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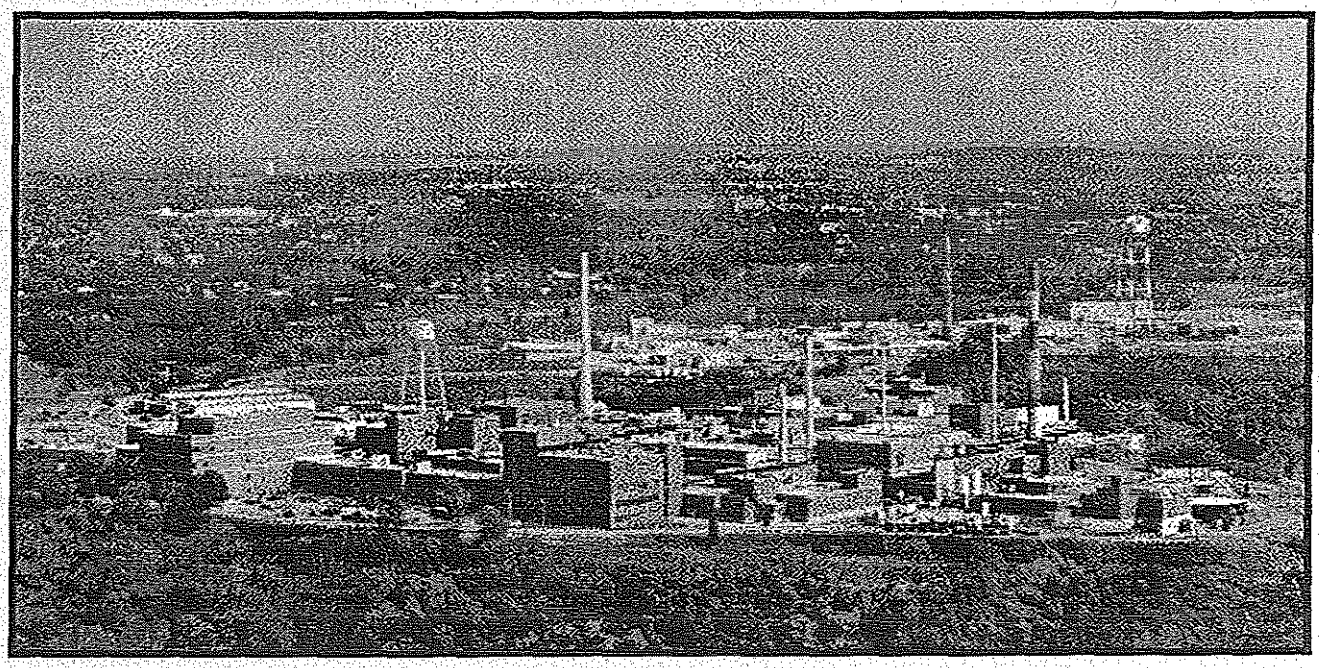
MOUND

Environmental
Restoration
Program

Miamisburg Closure Project
Potential Release Site Package
PRS 41

Final
June 2003



CH2M HILL
Mound, Inc.
1 Mound Road
P.O. Box 3030
Miamisburg, OH
45343-3030

ER-086/03
June 26, 2003

Mr. Richard B. Provencher, Director
Miamisburg Closure Project
U. S. Department of Energy
P. O. Box 66
Miamisburg, OH 45343-0066

SUBJECT: Contract No. DE-AC24-03OH20152
Contract Deliverable 039 – PRS Documents
PRS 41 and 154/238 PACKAGES, FINAL

Dear Mr. Provencher:

Paul Lucas from your office has approved the release of the following documents:

- PRS 41 Package, Final
- PRS 154/238 Package, Final

The responses to public comments on these packages have been approved by the Core Team and are included in the final packages. These packages are therefore submitted as documentation of the decision process leading to RA binning for these PRSs. Final documentation of the effectiveness of the RA will be accomplished through the issuance of a Core Team approved OSC Report. If you have any questions regarding the documents, please contact Dave Rakel at Extension 4203.

Sincerely,

Monte A. Williams
Deputy Project Manager, Environmental Restoration

MAW/KMA/jdg

Enclosure

Approved: Paul Lucas 6/25/03
Paul Lucas Date
CERCLA Program Manager

cc: David Seely, USEPA, (1) w/attachments
Brian Nickel, OEPA, (1) w/attachments
Ruth Vandegrift, ODH, (1) w/attachments
Danny Punch, DOE/MCP, (1) w/attachments
Lisa Rawls, DOE/MCP, w/o attachments
Randy Tormey, DOE/OH, (1) attachments
Terrance Tracy, DOE/HQ, (1) w/attachments
Dann Bird, MMCIC, (3) w/attachment
J. D. Bonfiglio, MESH, (1) w/attachment
Monte Williams, CH2M HILL, (1) w/attachments
John Fulton, CH2M HILL, w/o attachments
Gene Valett, CH2M HILL, w/o attachments
Dave Rakel, CH2M HILL, w/o attachments
Public Reading Room, (4) w/attachments
Admin Records, (2) w/attachments
DCC, (1) w/attachments

The Mound Core Team
P.O. Box 66
Miamisburg, Ohio 45343-0066

June 2003

Mr. Daniel Bird, AICP
Planning Manager
Miamisburg Mound Community Improvement Corporation
720 Mound Road
COS Bldg. 4221
Miamisburg, Ohio 45342-6714

Dear Mr. Bird:

The Core Team, consisting of the U.S. Department of Energy Closure Project (DOE-MCP), U.S. Environmental Protection Agency (USEPA), and the Ohio Environmental Protection Agency (OEPA), appreciates your comments on the PRS 41 Public Review Draft Package. Attached are our responses.

Should the response to comments require additional detail, please contact Paul Lucas at (937) 847-8350 extension 314 and we will gladly arrange a meeting or telephone conference.

Sincerely,

DOE/MCP:	Paul Lucas	6/18/03
	Paul Lucas, Remedial Project Manager	date
USEPA:	David P. Seely	6/24/03
	David P. Seely, Remedial Project Manager	date
OEPA:	[illegible]	6/23/03
	Brian K. Nickel, Project Manager	date

Response to Public Comments

from MMCIC
on PRS 41 Public Review Draft Package
February 2003

Comment 1. From our review of the PRS 41 Draft Package, MMCIC is in agreement with the decision for Removal Action for PRS 41 and 41 Ditch. Once the removal action is complete, MMCIC would like to request a copy of the verification sampling to confirm that the contamination removal is complete. MMCIC would also appreciate a copy of the On-Scene Coordinator Report when it becomes available.

Response 1. Thank you for your interest and support of the Removal Action decision. It is our understanding that MMCIC has access to Mound's Geographic Information System and therefore has access electronically to the verification results at the same time they are available to the site. Multiple copies of the OSC Report will be available in the Public Reading Room. The Document distribution List in the FFA Monthly was changed to indicate that MMCIC will receive a copy of Final OSC Reports.

Comment 2. The Draft Data Package includes a map of the sampling locations (Figure 2, page 4 of 5) and a table summarizing the sampling results (Table 1, page 1 of 5). The table indicates that 2 of the samples of Thorium-232 in PRS 41 exceeded the Cleanup Objective and 3 of the samples of Plutonium-238 in the PRS 41 Ditch exceed Cleanup Objectives. However, the locations of the sampling points with exceedances are not shown on Figure 1. Therefore, the extent of the contamination is not known to MMCIC. It is MMCIC's opinion that the Removal Action for PRS 41 and the 41 Ditch may be fairly large, and therefore not appropriate to be implemented under the Contingent Removal Action. Without additional information, MMCIC would request that this removal occur under a specific Action Memorandum.

Response 2. You are correct that the sample locations are shown on Figure 2. Table 1 identifies results above cleanup objective but also identifies the location of each (i.e., B044). Please refer to Figure 2 for their location within the PRS and in relation to other recent sample locations that were below screening levels (as they were not listed in Table 1).

The RA is expected to be limited in extent based on the few number of exceedances to cleanup objectives compared to the large number of characterization data points and their coverage of the PRS. Several historic characterizations/investigations occurred within PRS 41 yielding a large amount of data. Areas within PRS 41 that were not previously characterized were characterized during the recent further assessment. This is the reason that sample locations (Figure 2) are not over the entire PRS. Both historic and recent data are used to evaluate extent of contamination.

PRS Data Packages are detailed sufficient for binning purposes and are not intended to provide extent of contamination. For PRS 41, RA is based on the presence of contaminants above cleanup objective. The Action Memo follows removal action binning. The Core Team evaluated PRS 41 and determined that it meets the criteria (simple RA, easily verified, limited number of COCs) for a Removal Action under the Action Memorandum for Contingent Removal Actions.

The extent of contamination and plan for removal of the exceedances to cleanup objective are evaluated and detailed in the VSAP and Work Plan.

Comment 3. MMCIC understands that the PRS 41 Ditch is part of the overall site drainage system. It is also MMCIC's understanding that the site drainage system will be one of the final cleanup activities, as removal actions across the site continue to have a potential impact on the drainage system. MMCIC requests clarification as to why this portion of the drainage ditch is undergoing a removal action independent of the rest of the drainage system.

Response 3. The segments of the site drainage system planned for assessment and/or Removal Actions near the end of the closure project are designated as PRSs 67-70. PRS 41 Ditch is not a part of any of these segments. CH2MHill has evaluated the potential for other site Removal Actions to impact PRS 41 Ditch and has determined that there will be no impact.

Comment 4. It is MMCIC's understanding that after the Removal Action process is completed, the area will be restored to a natural state in accordance with the *Mound Reuse Plan.* The location of PRS 41 is the future location of an extension of Vanguard Boulevard, which is intended to be a major roadway in the redevelopment of the site. It is therefore, important that the regrading of the area be in concert with the intended use as a roadway.

Response 4. The Core Team understands MMCIC's request and encourages MMCIC to meet with DOE to obtain an agreeable end state.

Environmental
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MIAMISBURG CLOSURE PROJECT
POTENTIAL RELEASE SITE PACKAGE
Notice of Public Review Period

The following Potential Release Site (PRS) packages are available for public review in the CERCLA Public Reading Room, 305 E. Central Ave., Miamisburg, Ohio. Public comment on these documents will be accepted 26 February 2003 through 27 March 2003.

PRS 41: Area 3 Thorium Drum Storage/Redrum
PRS 64: Building 19 Historic Gasoline Tank
PRS 397: Soil Contamination

Questions can be referred to Paul Lucas at (937) 865-4578

PRS 41 Package Tracking Sheet

REVISION	DESCRIPTION	DATE
Working Draft (to DOE)	Binned FA on 2 October 1996.	
Draft (to Core Team)		
Draft Proposed Final	Addendum 1 submitted to CT to summarize FA results. No USEPA comments. OEPA comments included explanation of Co-60 SL<MDA and Th-230 MDA of 10, not SL of 10. PRS binned RA on 19 February 2003. Added Addendum 1 to original package and submitted it as the public review draft.	**January 2003**
Public Review Draft	Public review period: 26 Feb to 27 Mar 03	**February 2003**
Final	There were no public comments that required changes to the document.	**June 2003**

Addendum I

ADDENDUM 1

SUPPORTING RA RECOMMENDATION

MOUND

Environmental
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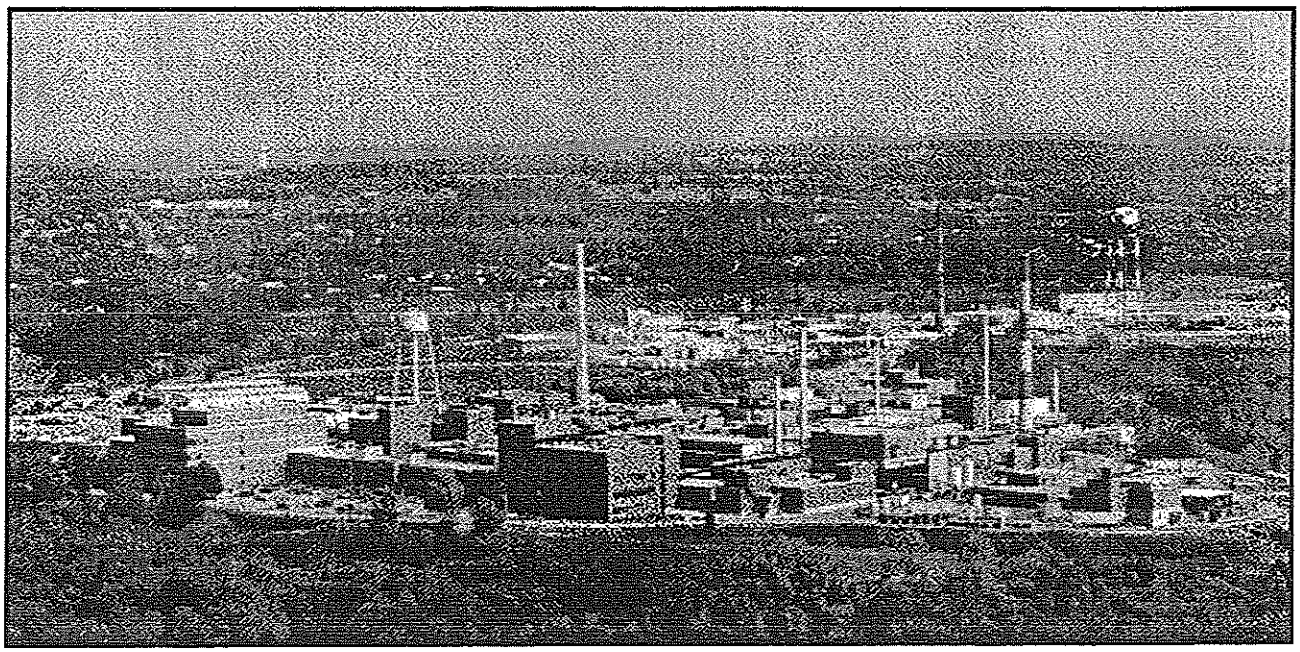
Miamisburg Closure Project
Potential Release Site Package
PRS 41
Addendum 1

Final
June 2003



PRS HISTORY:

Potential Release Site (PRS) 41 is located on the western portion of the site (Figure 1) and was binned Further Assessment (FA) by the Core Team on 2 October 1996. PRS 41 was identified based on potential impacts from historic thorium staging and re-drumming operations. Based on elevated historic soil sample results for plutonium-238, a portion of a small drainage feature within PRS 41 (41 Ditch) was also assessed.

FURTHER ASSESSMENT ACTIVITY:

PRS 41 sampling was grouped with PRSs 64 and 417 due to their proximity to each other. This addendum applies to PRS 41 only. The potential contaminants of concern (COCs) were thorium-232 and plutonium-238.

Further Assessment sampling was performed in November 2002 per the Sampling and Analysis Plan (**SAP**)[1] approved by the Core Team.

A total of 92 soil samples and nine duplicate samples were analyzed for the COCs as prescribed in the SAP. The FA sample locations are presented in Figure 2. The FA **Data Report**[2] presents a full account of soil sampling activities and sample results.

Maximum sample detections above screening levels (10^{-6} Risk-Based Guideline Value (RBGV) plus background or as approved by the Core Team) are presented in Table 1.

Table 1: FA Results above Screening Levels (pCi/g)

Radionuclide	No. >SL	No.>CO	Max. Result	Location & depth(1)	Screening Level	CO
PRS 41						
Actinium-227+D	1 of 92	0	0.57U	B002, 0-4'	0.56	4.6
Thorium-232+D	3 of 92	2 of 92	13.04	B044, 12-16'	1.47	2.1
Cobalt-60	20 of 92(3)	0	0.14U	B068, 0-1'	0.07	0.7
Thorium-230+D	1 of 92	0	10.64U	B015, 0-4'	MDA of 10(2)	NA
41 Ditch						
Actinium-227+D	1 of 10	0	1.14U	S003, 0-0'	0.56	4.6
Lead-210+D	1 of 10	0	1.95	S006, 0-0'	1.8	7.4
Plutonium-238	3 of 10	3 of 10	614	S003, 0-0'	55	55
Thorium-230+D	1 of 10	0	10.74U	S003, 0-0'	MDA of 10(2)	NA

MDA: minimum detectable activity
CO: cleanup objective (10^{-5} RGBV plus background)
U: not detected at the associated detection limit
RBGV: Risk-Based Guideline Value
NA: not applicable
(1): depth below ground surface
(2): If Th-230 is a contaminant of concern (COC), then the Screening Level is 1.99 pCi/g (10^{-6} RBGV (0.09 pCi/g) plus background (1.9 pCi/g)). If Th-230 is not a COC MCP will use our normal sample analysis process through gamma spectroscopy unless specified differently in a sampling and analysis plan. MCP will assure that the Th-230 MDA is less than 10 pCi/g (This implies a minimum laboratory counting time.). If Th-230 is detected greater than the MDA but below 10 pCi/g, MCP may re-analyze (gamma or alpha spectroscopy) the soil sample to confirm the absence or presence of Th-230. The MDA must be less than 10 pCi/g for the Th-230 result to be of value. 10 pCi/g is not a screening level for Th-230, rather an MDA for Th-230, at which gamma spec analysis can cease and results can be reported. It is more a reporting limit and defines the count time for the analysis suite because it is the limiting isotope (requires longest count to "see").
(3): The contract-required detection limit (CRDL) for cobalt-60 is 0.12 pCi/g and is based on maximum instrument capabilities.

FIGURES:

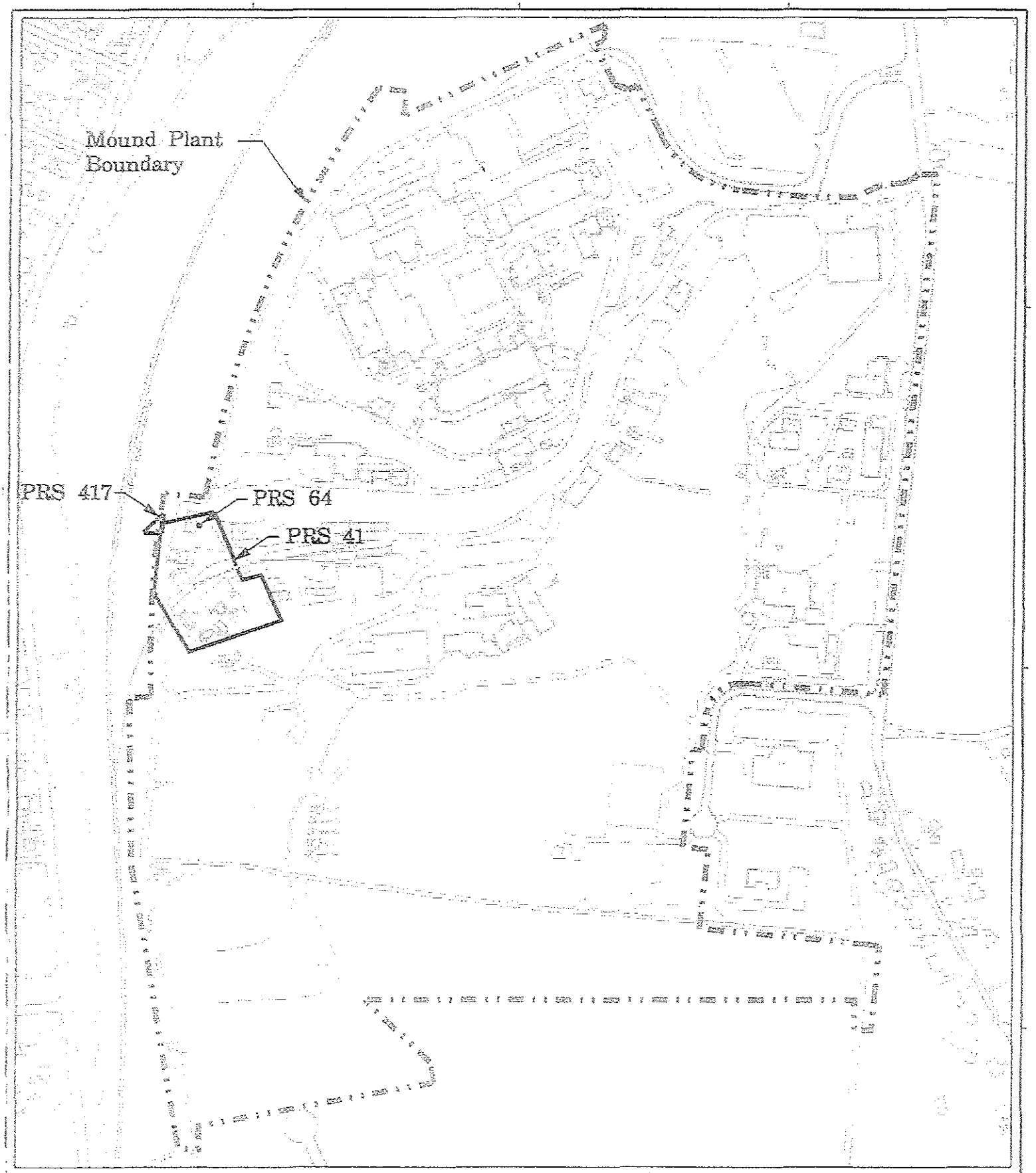
Figure 1: Location of PRS 41/64/417
Figure 2: PRS 41 and 41 Ditch Sample Locations

REFERENCES:

1) PRS 41/64/417 Sampling and Analysis Plan, Final, November 2002
2) PRS 41/64/417 Data Report, Rev. 0, December 2002

PREPARED BY:

Karen M. Arthur, CH2MHill, ER QA
Gary Miller, CH2MHill, ER Technical Staff



Legend

Structures
Paved roadway
Unpaved roadway
Mound Plant boundary
Railroads

0 100 200 400 600 800 1000
Scale in Feet

MOUND
Environmental Restoration Geographic Information System

SHEET	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
ISSUE																					

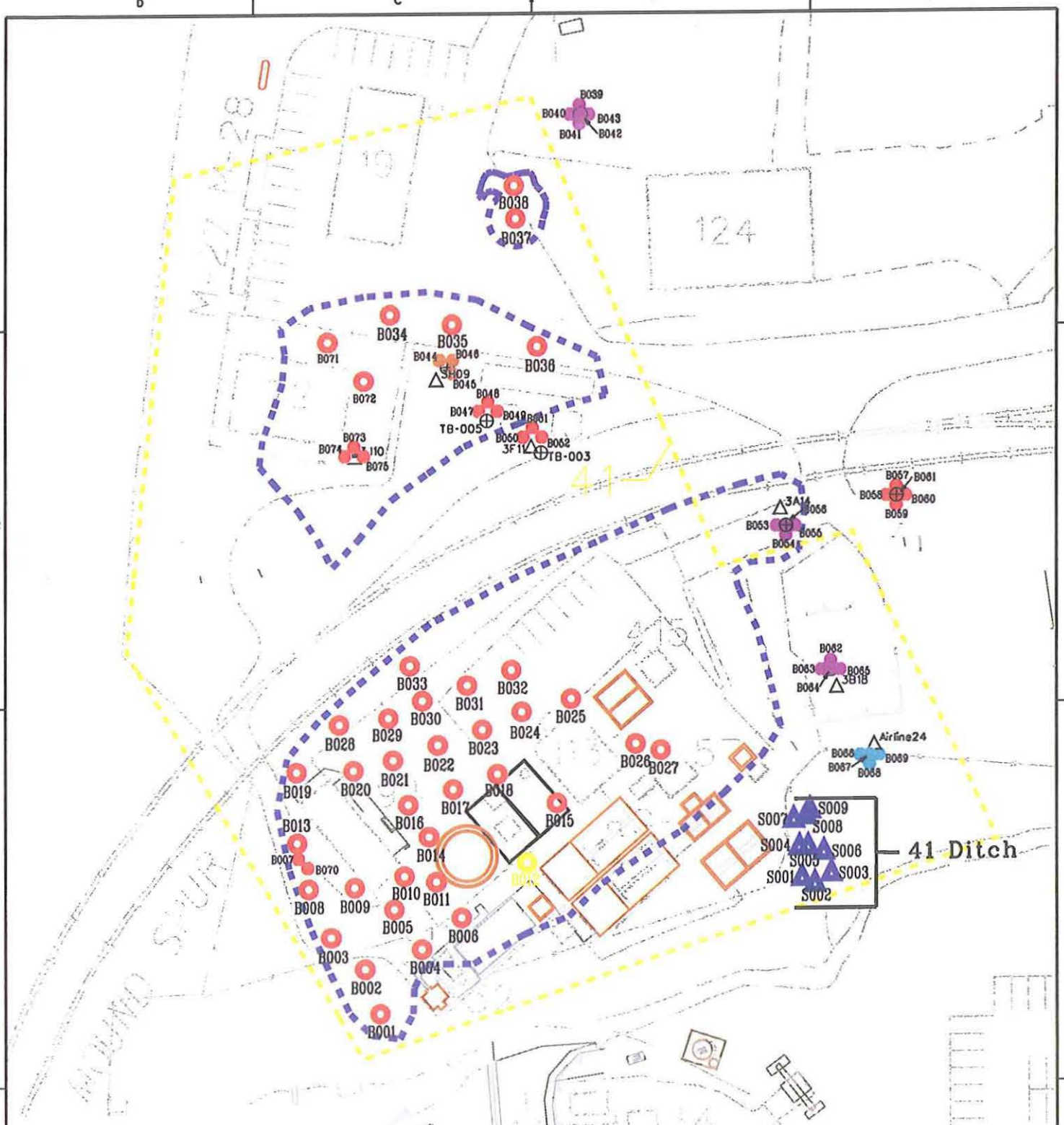
SHEET	1	2	3	4	5	6
ISSUE						

PART CLASSIFICATION

Figure 1: Location of PRS 41/64/417

DRAWING CLASSIFICATION: UNCLASSIFIED
SIZE
DRAWING NUMBER: gen_site_plan.dgn
JOB NUMBER
DWG TYPE: STE PROJ: ER-GIS DATE SCALE SHEET 1 OF
STATUS: WD-REL
OPERN: MSTATION / .1

REV	DATE	REVISION	BY	CHKD	DWG	UPDG	APVD	#
	06/24/02	*	SSB					



LEGEND

- Possible Drum Areas
- 16- 100% Gamma, 10% Off Iso Th
- 12- 100% Gamma, 10% Off Iso Th, @ 3x4 intervals
- 13- 100% Gamma, 10% Off Iso Th, 10% Off Iso Pu
- 04- 100% Gamma, 10% Off Iso Pu
- 38- PRS 41 (100% Gamma, 10% Off Iso Th)
- 09- Ditch (Sediment 100% Gamma, 10% Off Iso Pu)

92 - TOTAL SAMPLES

0 40
Scale in Ft.

MOUND
Environmental Restoration Geographic Information System

Figure 2
PRS 41 & 41 Ditch
Sample Locations

ISS	DATE	REVISION	BY	CHKR	ENG	LPEC	APVD	M
	01/16/02		SSF					

DRAWING CLASSIFICATION: UNCLASSIFIED
SIZE
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JOB NUMBER
DWG TYPE: STE
PRJG: ER-GIS
CADD
SCALE GRAPHIC
SHEET 1 OF 1
STATUS: MD-REL-08/02/02
ORIGIN: MSTATION / J

4 of 5

MIAMISBURG CLOSURE PROJECT
PRS 41

RECOMMENDATION:

Potential Release Site (PRS) 41 is located on the western portion of the site (Figure 1) and was binned Further Assessment by the Core Team on 2 October 1996. PRS 41 was identified based on potential impacts from historic thorium staging and re-drumming operations. Based on elevated historic soil sample results for plutonium-238, a portion of a small drainage feature within PRS 41 (41 Ditch) was also assessed. Further Assessment was performed and confirmed that thorium-232 (at PRS 41) and plutonium-238 (at 41 Ditch) exceed the cleanup objectives of 2.1 pCi/g and 55 pCi/g respectively. The cleanup objective is the 10^{-5} RBGV plus background.

Therefore, the Core Team recommends a **Removal Action** for PRS 41 and 41 Ditch.

This Removal Action will be performed under a specific Action Memorandum or under the Action Memorandum for Contingent Removal Actions. Successful completion of the Removal Action will be documented via an On-Scene Coordinator (OSC) Report signed by the Core Team, which will be placed in the Public Reading Room.

CONCURRENCE:

DOE/MCP: _____ 2/19/03
Robert S. Rothman, Remedial Project Manager (date)

USEPA: _____ 2/19/03
David P. Seely, Remedial Project Manager (date)

OEPA: _____ 2/19/03
Brian K. Nickel, Project Manager (date)

Original Document

ORIGINAL DOCUMENT & OTHER DATA

SUPPORTING FA RECOMMENDATION

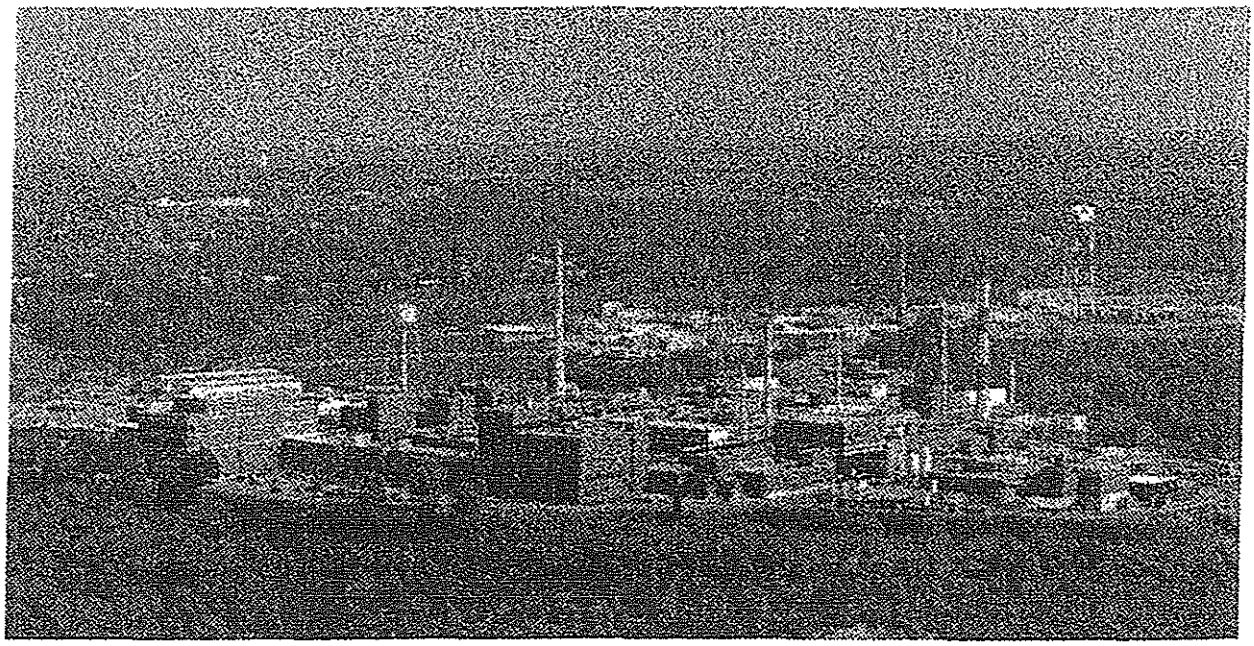
MOUND

Environmental
Restoration
Program

MOUND PLANT

Potential Release Site Package

PRS # 41 Group Supplementary Data

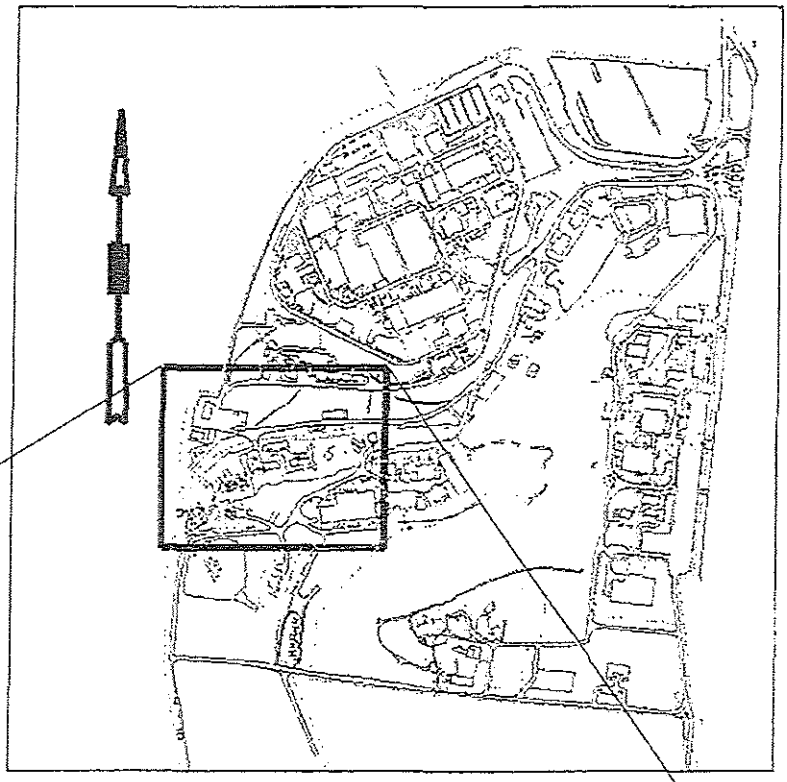


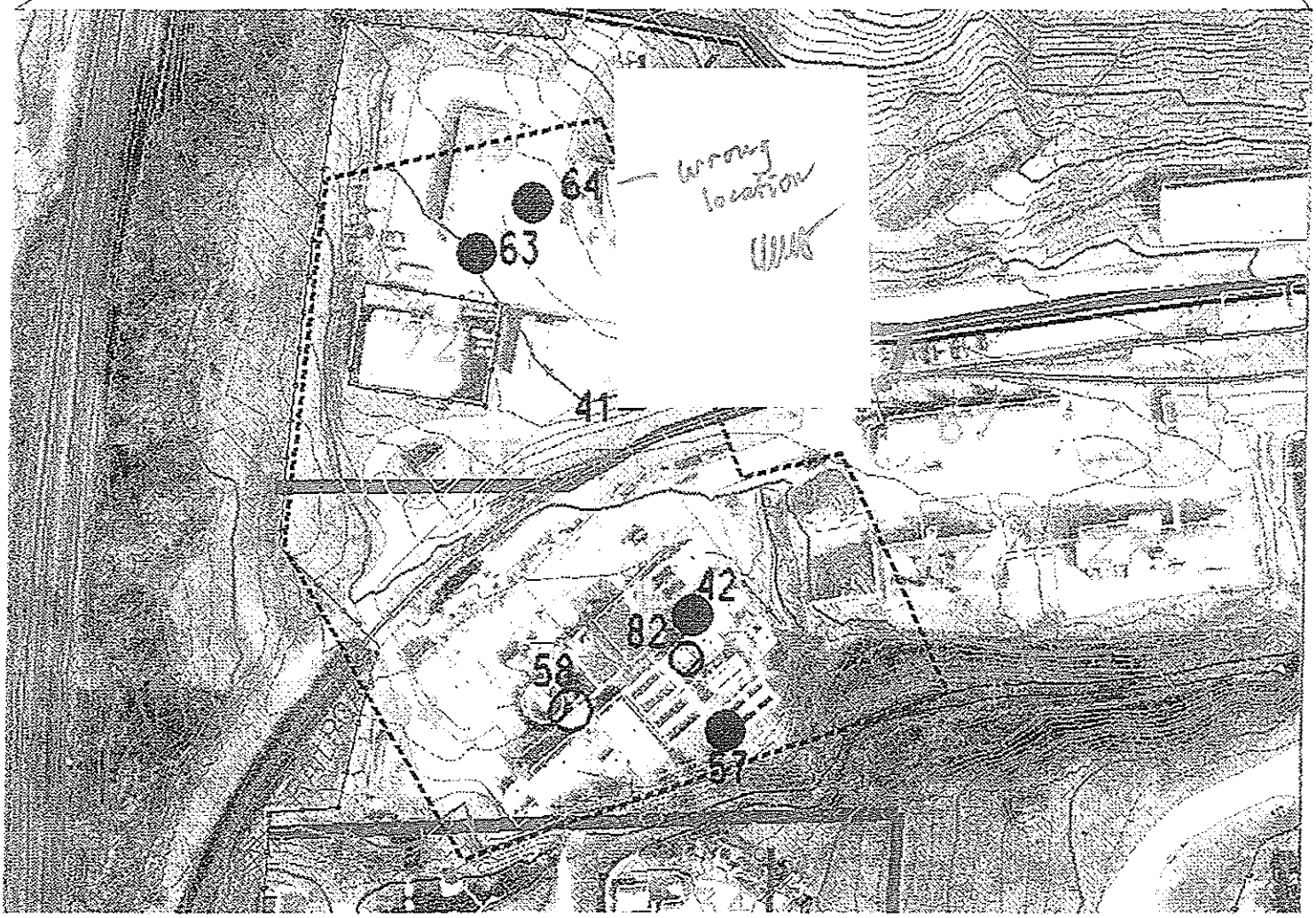
Mound Plant

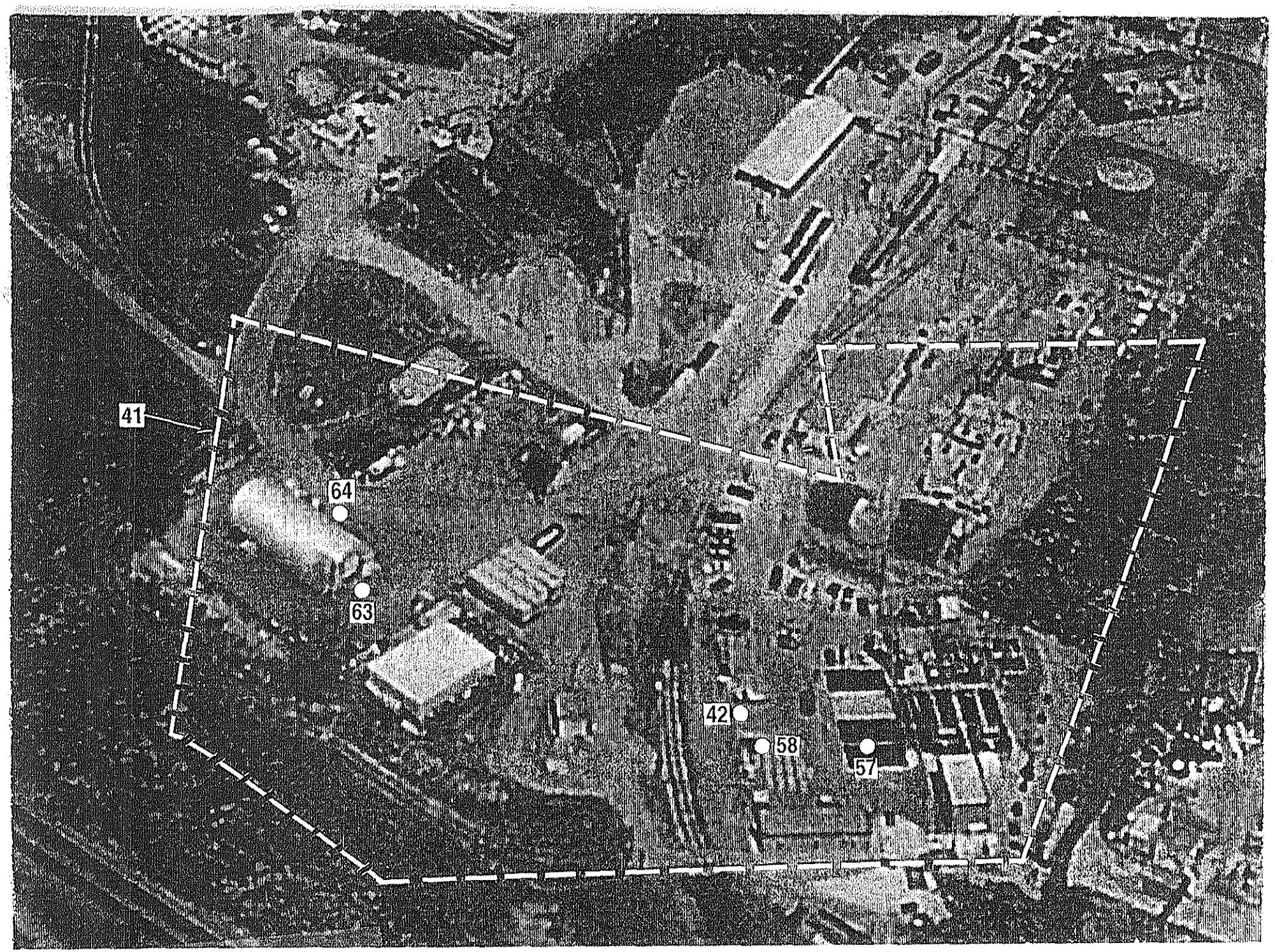
Release Block C/K/J

Potential Release Site

PRS 41, 42, 57, 58, 63, 64, 82






41
64
63
42
58
57

INTRODUCTION
to the PRS 41 Group
(PRSs 41, 42, 57, 58, 63, 64 and 82)

In an effort to better understand Potential Release Sites (PRSs) 41, 42, 57, 58, 63, 64 and 82, it is desired to introduce these PRSs as a group prior to addressing them as individual PRSs. These PRSs lend themselves to group study because each PRS represents a potential release located in a single large area, known as PRS 41, that has a history of diverse usage.

AREA HISTORY (chronological order)

T Building was one of the first buildings constructed on the Mound site. The construction of T-Building required the removal of a great deal of bedrock (shale and limestone) from the "Main Hill". Most of the ***T-Building excavation was deposited in the lower valley (PRS 42).*** The excavated material was compacted and graded and became a solid fill. Subsequently, roads, rails, paved parking, and Mound's wastewater treatment plant have been built on tope of the PRS 42 fill.

1947 Mound drawings show an ***underground fuel storage tank (PRS 64)***, a maintenance garage and two gasoline pumps located next to Building 19. The garage and fuel pumps no longer exist. It is not known if the tank has been removed.

In early 1955, fifty-five gallon drums containing a raw "ore" of thorium arrived by rail at the Mound site. Mound planned to use the thorium ore to develop a process of thorium extraction. However, the program was short lived and was canceled in May 1955 leaving behind some 6,000 fifty-five gallon drums of highly corrosive thorium sludge. The thorium drums were stored and repackaged outdoors on top of and beyond the boundaries of both the PRS 42 (T-Building fill) and the underground fuel storage tank location (PRS 64). This area, approximately 150,000 ft^2, encompassing the ***thorium operations is PRS 41.*** In 1965, PRS 41 thorium contaminated soil was reportedly scraped and the area graded.

In 1974, ***four sludge drying beds (PRS 57)*** were installed next to Mound's wastewater treatment plant. The beds were located on top of the historic thorium drumming area (PRS 41) and the T-Building excavation deposits (PRS 42). The beds were used to air dry biological sludges generated in the wastewater treatment plant's operations. Later, ***three portable drying beds were temporarily used in the treatment plant's sludge drying operations (PRS 58).*** The beds had been moved from Mound's asphalt lined pond where they were being used to drain and dry dredged spoils materials from the pond (PRS 68). Some of the pond's spoils materials contained low level radiological contamination. By 1991, Mound had discontinued the use of all air drying beds in favor of a filter press. All of the beds have been removed from the Mound site.

In 1974, ***an 850 gallon underground diesel fuel storage tank (PRS 82)*** was installed, near Building 57, within the PRS 41 boundary. The tank supplied diesel fuel to power an emergency generator. The tank was removed in 1995.

On May 31, 1984, a drain pipe, contaminated with cobalt-60 and cesium-137, was removed from T Building. The pipe spread contamination to ***a two square foot area of pavement outside of Building 19 (PRS 63).*** The pavement was decontaminated the following day.

CONTAMINATION SUMMARY

All available evidence of existing contamination in excess of regulatory, ALARA or 10^{-6} Risk Based Guideline Values is listed in the table below:

PRS	Contaminant	Maximum Concentration Detected	Guideline Criteria
41	Plutonium-238	125 pCi/g (in soil)	25 pCi/g (Mound ALARA in soil)
41	Thorium-232	13 pCi/g (in soil)	5 pCi/g (Regulatory limit in soil)
41	Benzo(a)pyrene	4 mg/kg (in soil)	0.41 mg/kg (10^{-6} Risk Based limit in soil)
41	Dibenz anthracene	1.2 mg/kg (in soil)	0.41 mg/kg (10^{-6} Risk Based limit in soil)
41	Lead	23.8 mg/l (in water)	15 mg/l (Regulatory limit in water)
41	Cadmium	7.0 mg/l (in water)	5 mg/l (Regulatory limit in water)
41	Nickel	11,600 mg/l (in water)	100 mg/l (Regulatory limit in water)
41	Trichloroethene	10 mg/l (in water)	5 mg/l (Regulatory limit in water)
41	Chromium	13,300 mg/l (in water)	100 mg/l (Regulatory limit in water)
63	Plutonium-238	32 pCi/g (in soil)	25 pCi/g (Mound ALARA in soil)

NOTE: No evidence is available of any contamination in excess of guideline criteria for PRSs 42, 57, 58, 64 or 82.
mg = milligrams, l = liters, pCi = picocuries, g = grams, ALARA = As Low As Reasonably Achievable, kg = kilograms

NOTES:

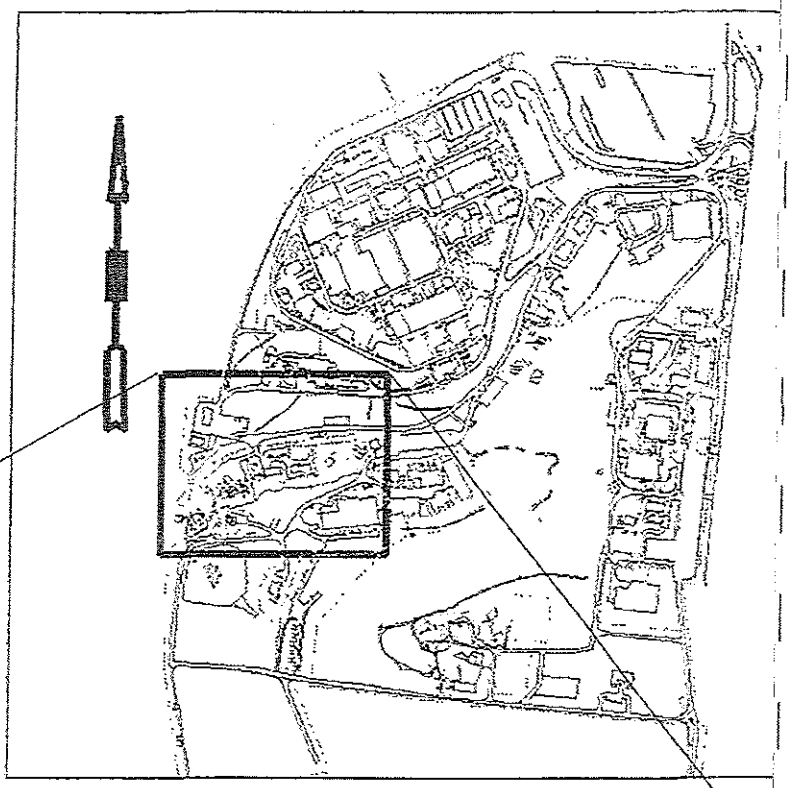
1) PRSs 31, 35, 43-56 and 60-62 are also located in or around the thorium storage and drumming area (PRS 41). However, these PRSs are not addressed in this grouping because they pertain to existing buildings (as opposed to soils associated with thorium drums) and will be evaluated as part of the Decontamination and Decommissioning building evaluation process.
2) PRS 356 is a soils location in the historical thorium drum area. However, this PRS was created due solely to elevated PETREX Soil Gas readings and has no historical process information. Hence, this PRS will be evaluated as a stand alone PRS.

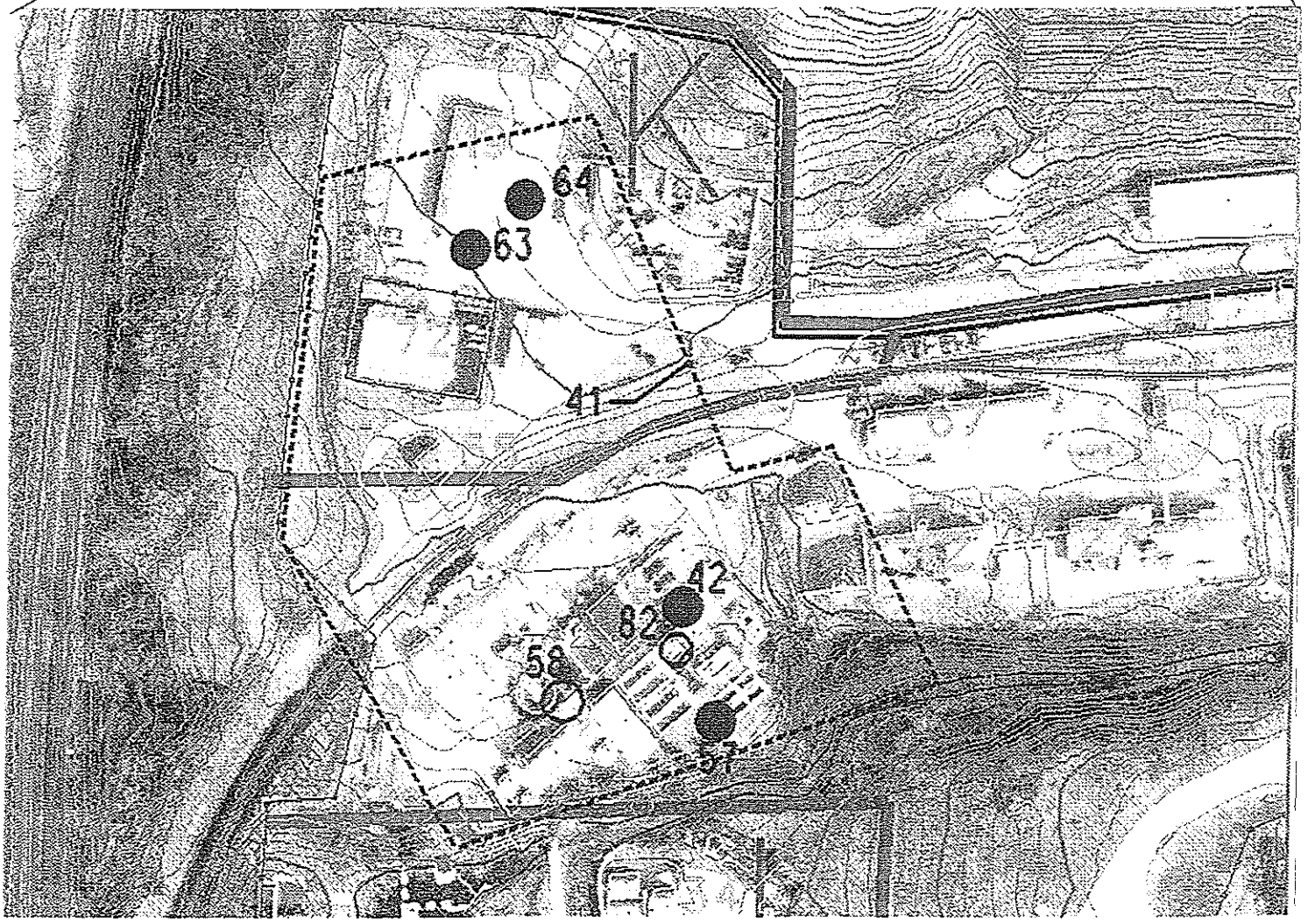
Mound Plant

Release Block C/K/J

Potential Release Site

PRS 41



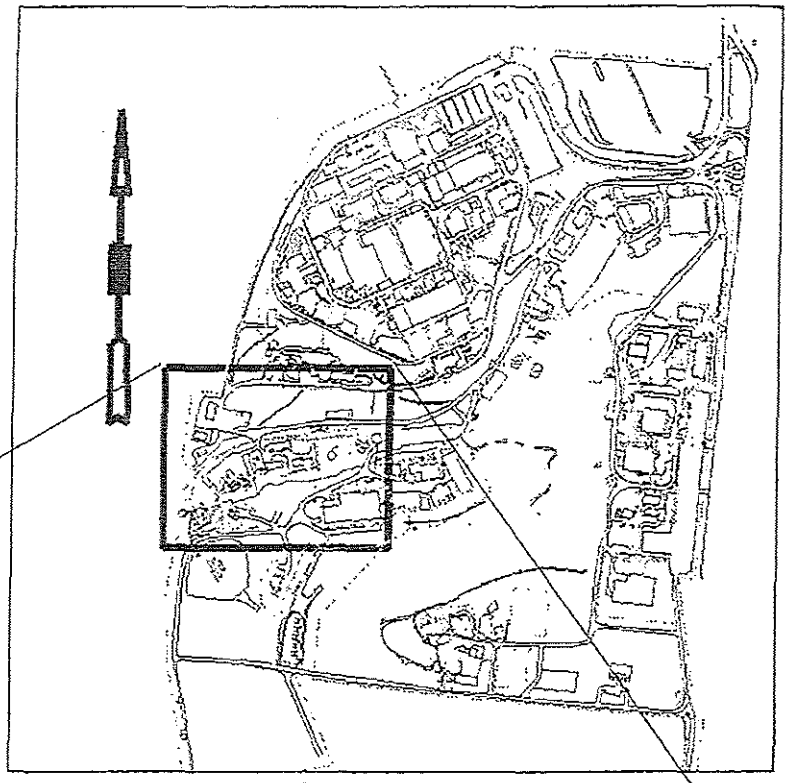


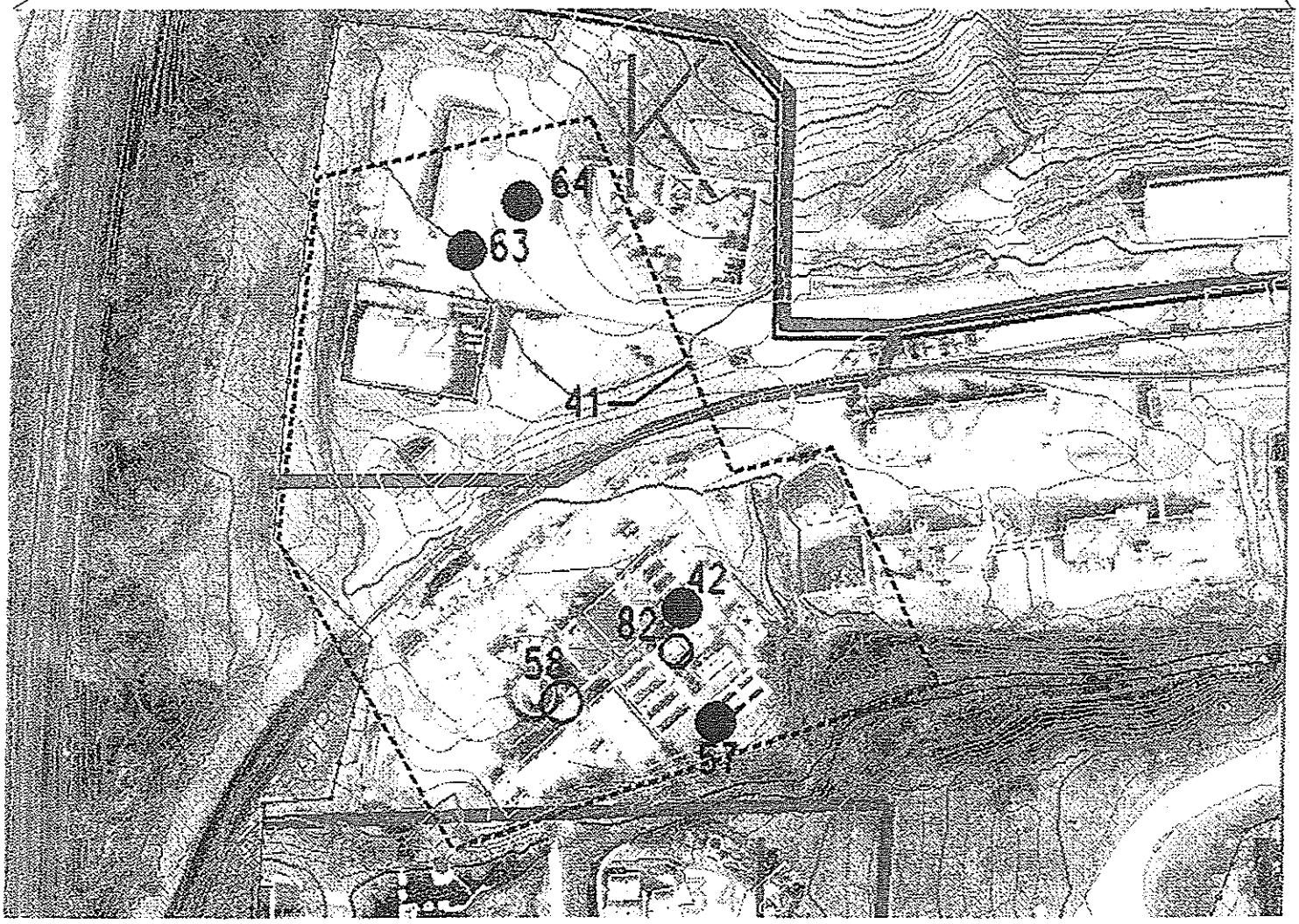
Mound Plant

Release Block C

Potential Release Site

PRS 42



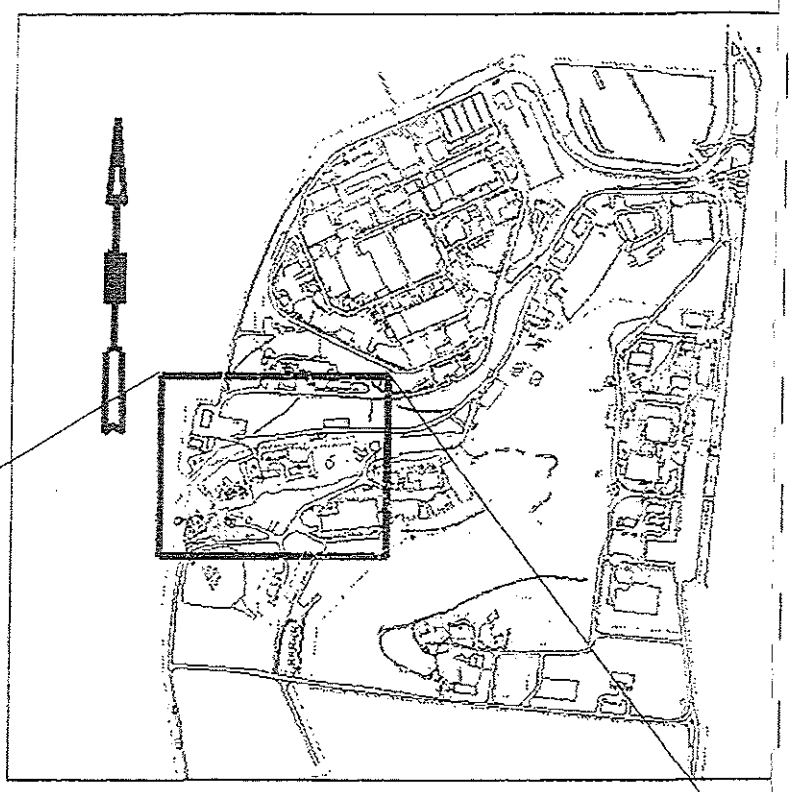


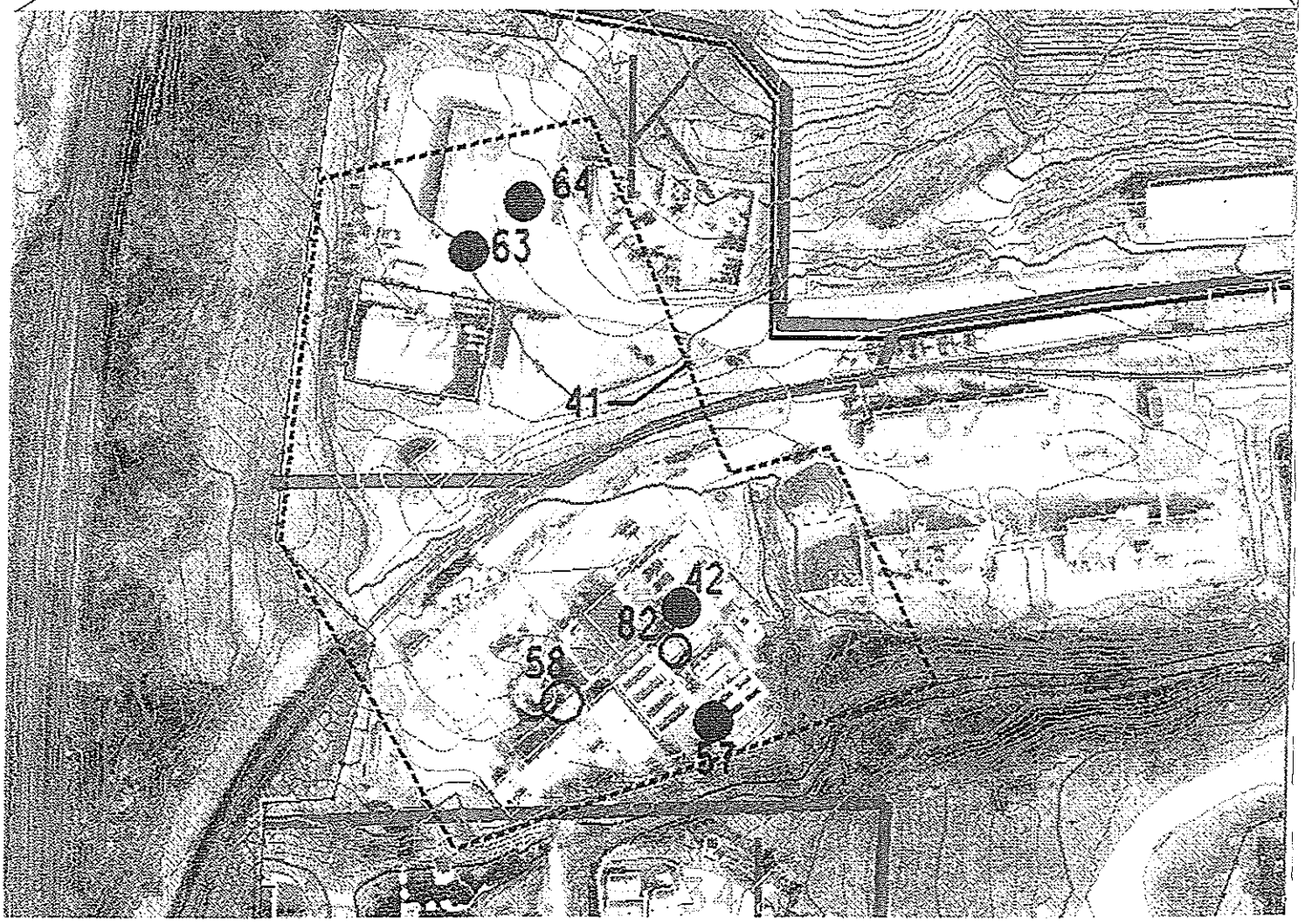
Mound Plant

Release Block C

Potential Release Site

PRS 57



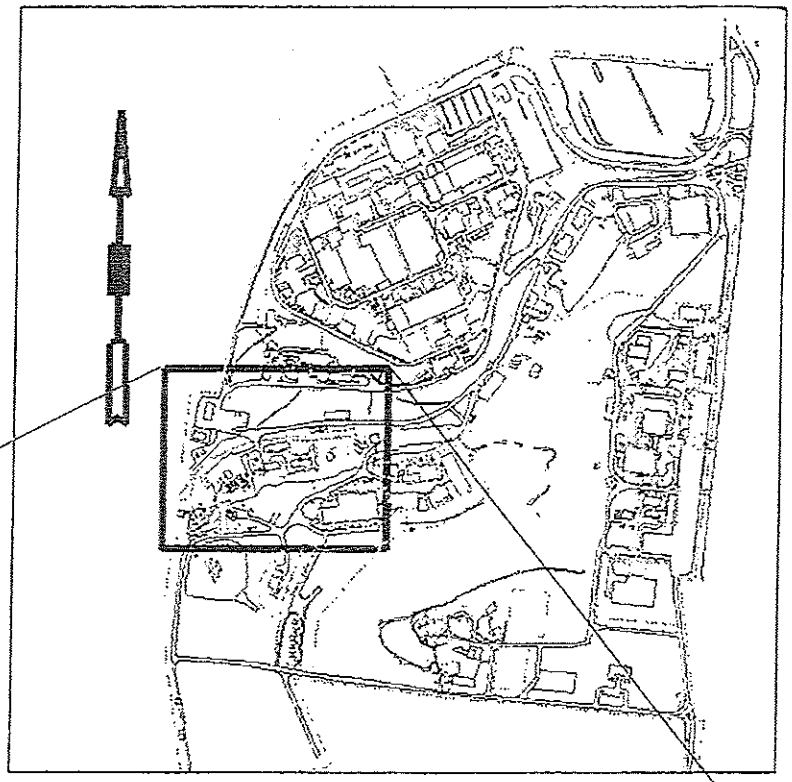


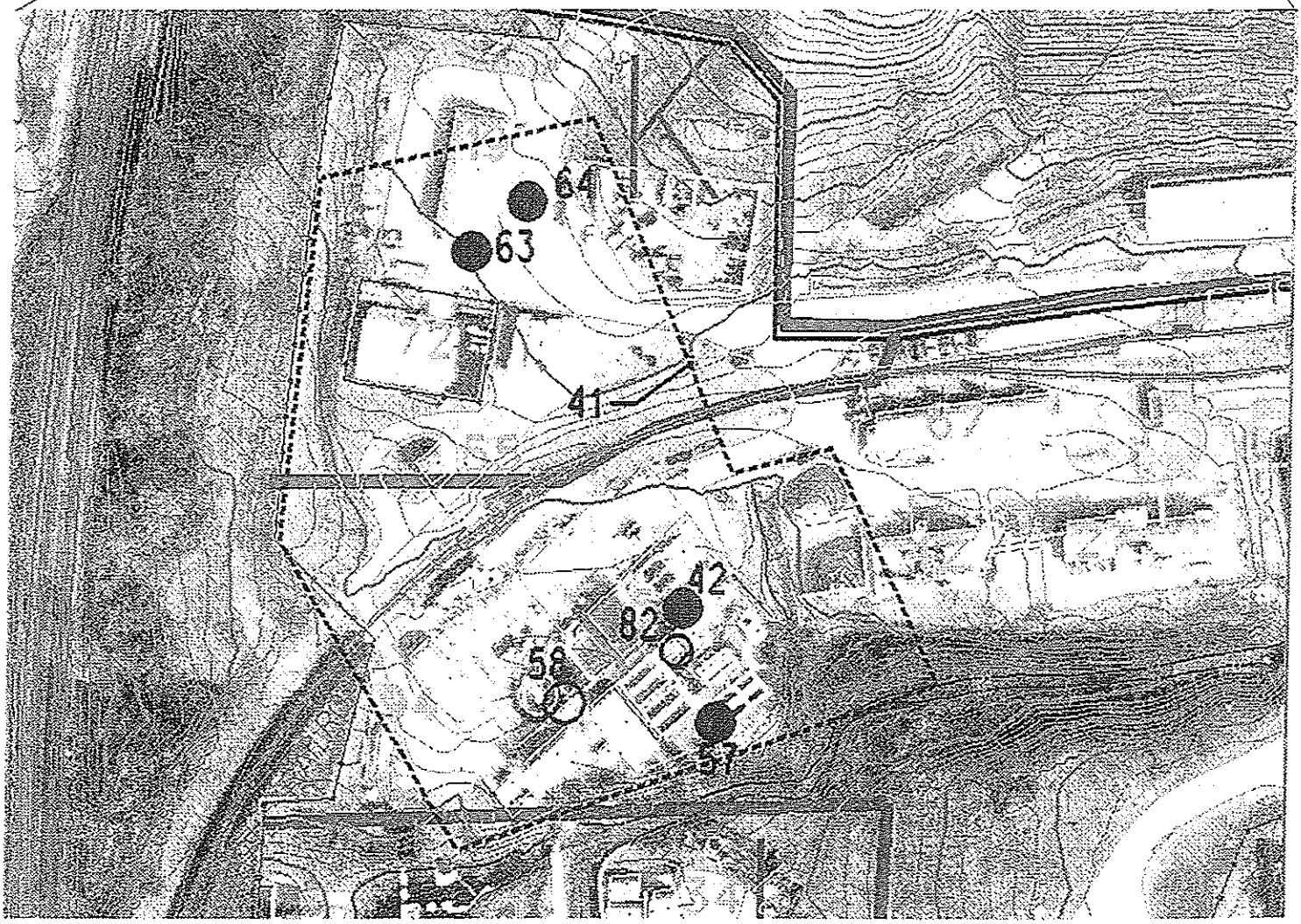
Mound Plant

Release Block C

Potential Release Site

PRS 58



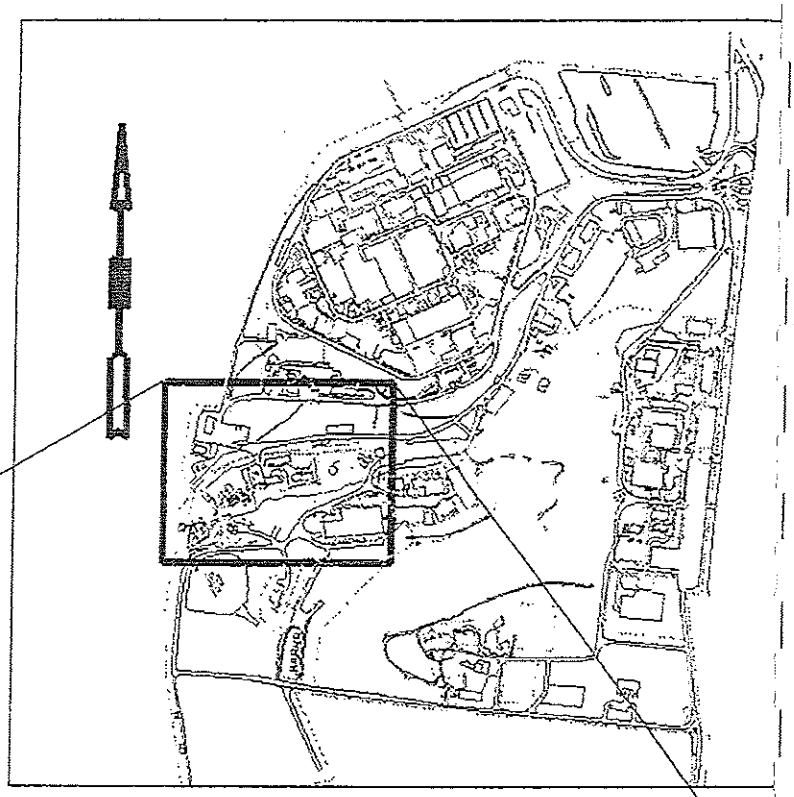


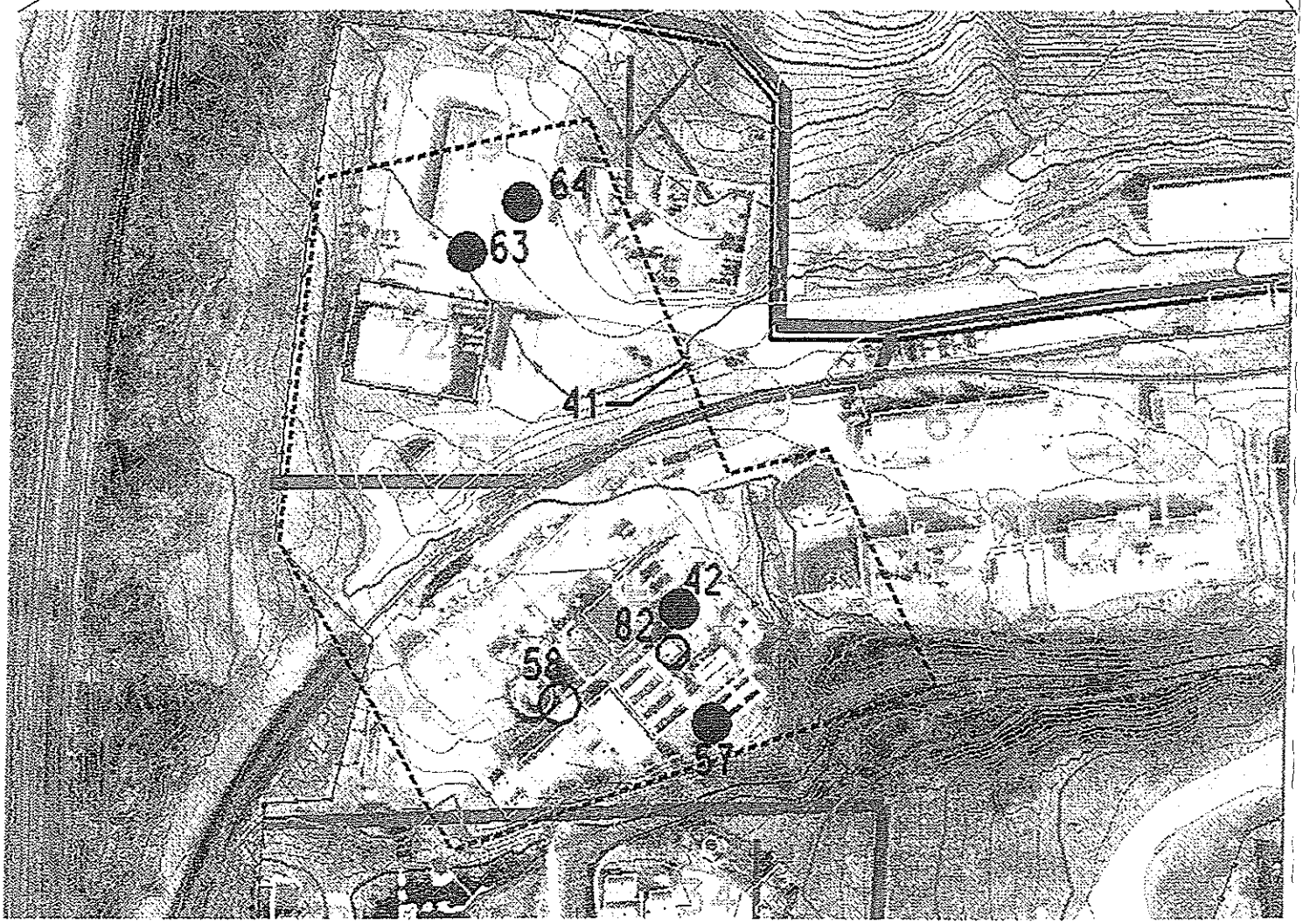
Mound Plant

Release Block K

Potential Release Site

PRS 63



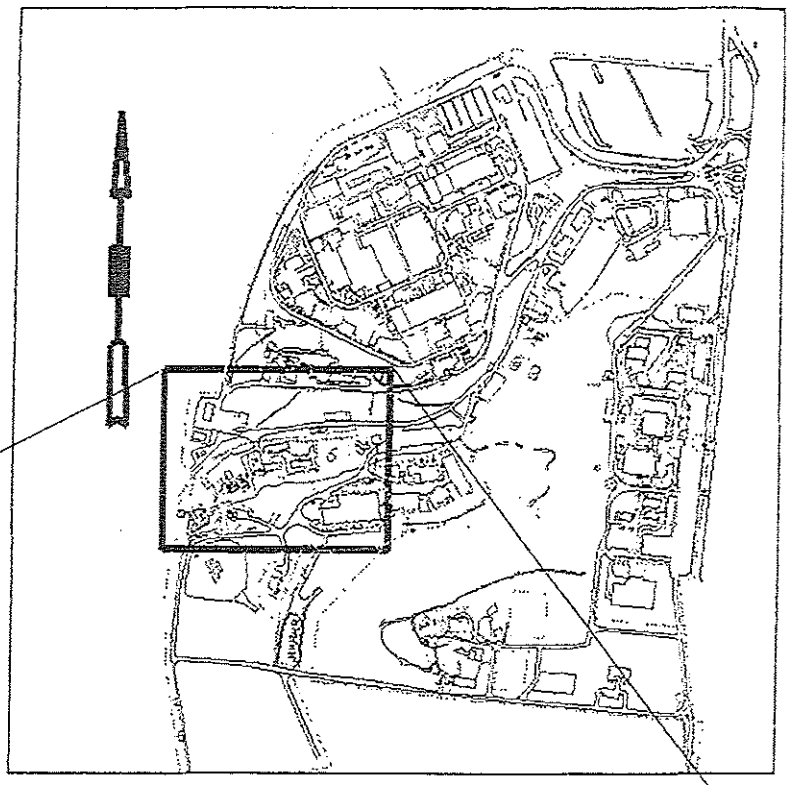


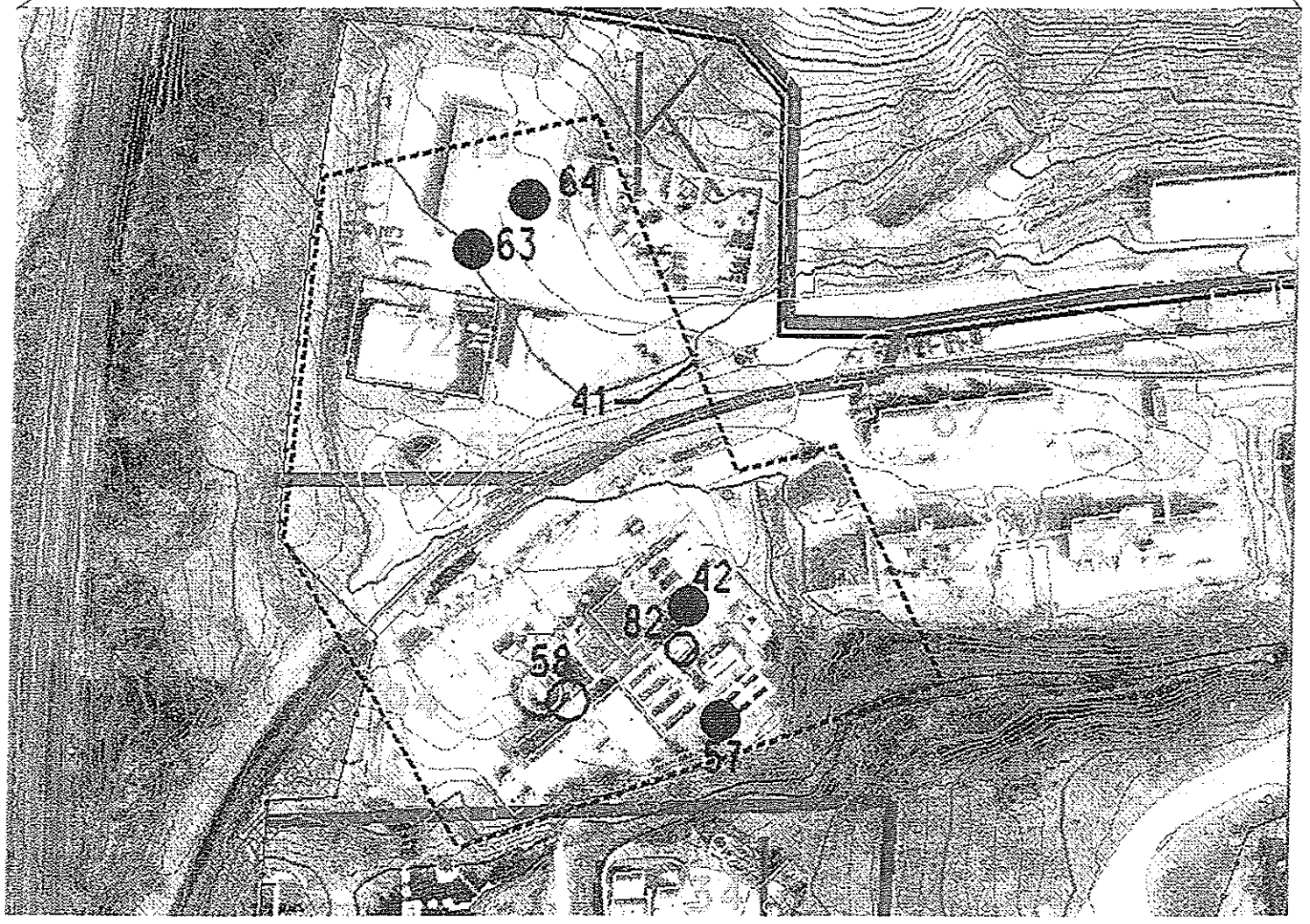
Mound Plant

Release Block K

Potential Release Site

PRS 64



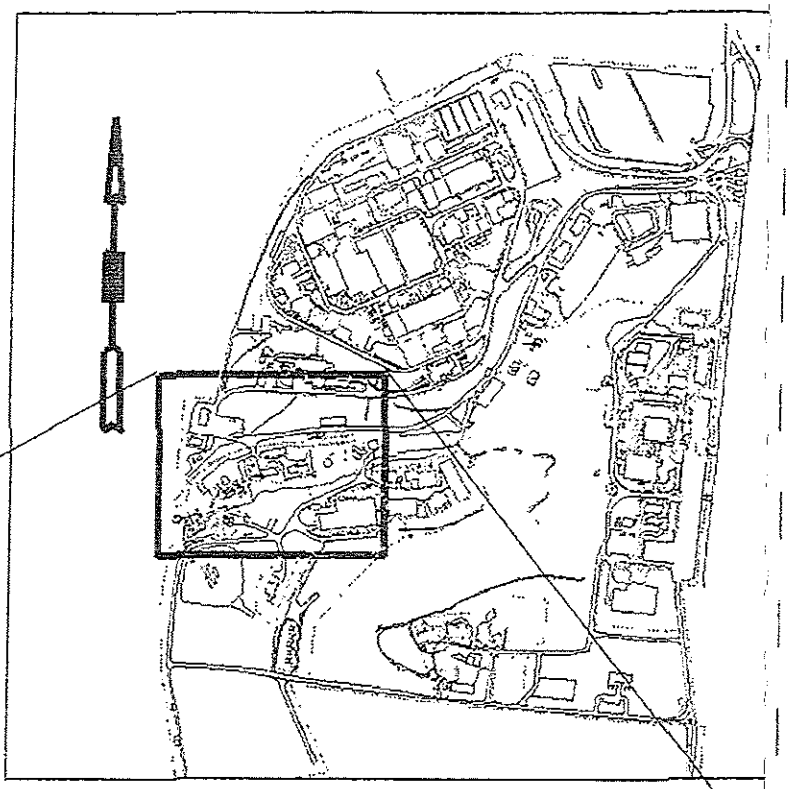


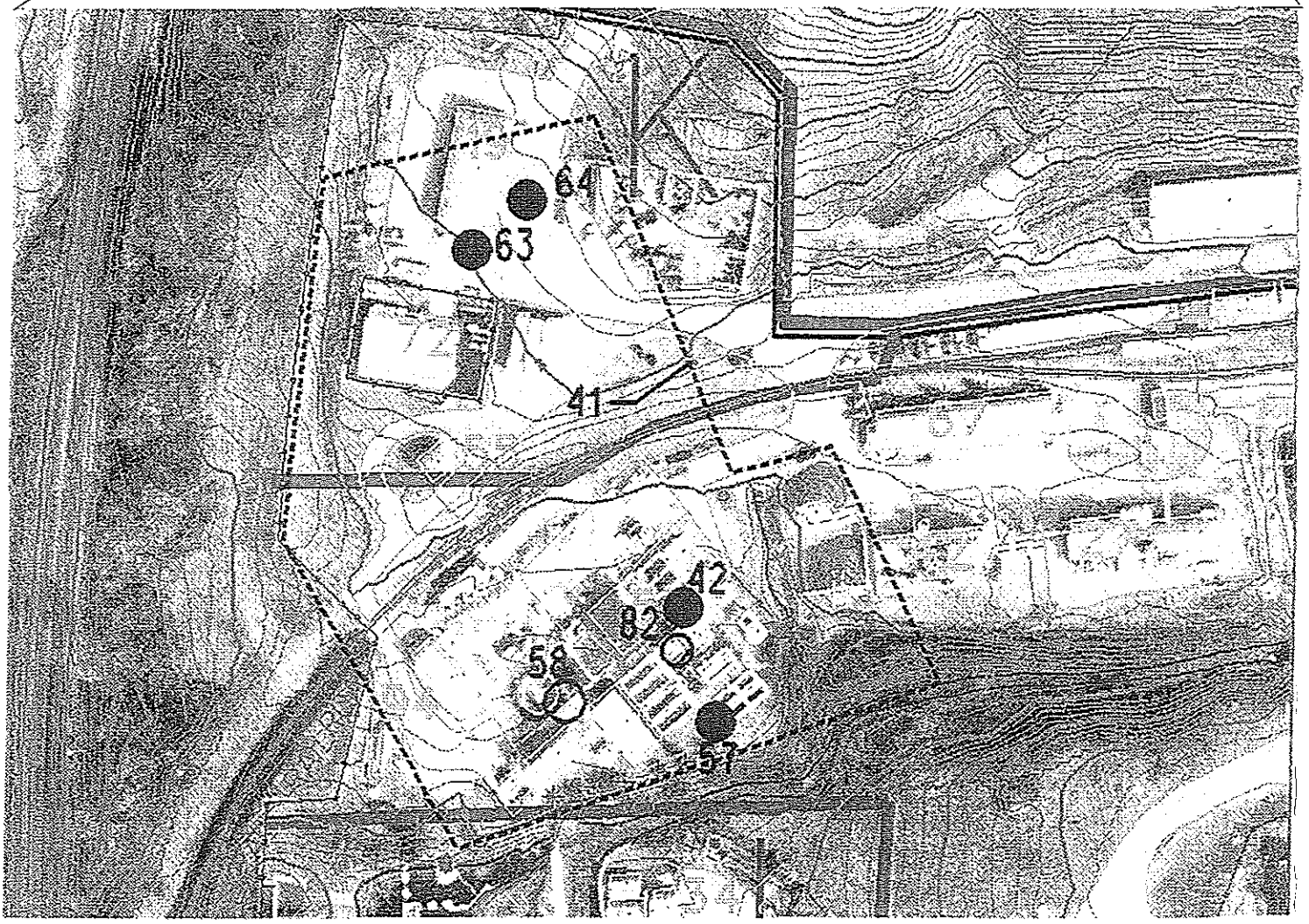
Mound Plant

Release Block C

Potential Release Site

PRS 82





MOUND

Environmental
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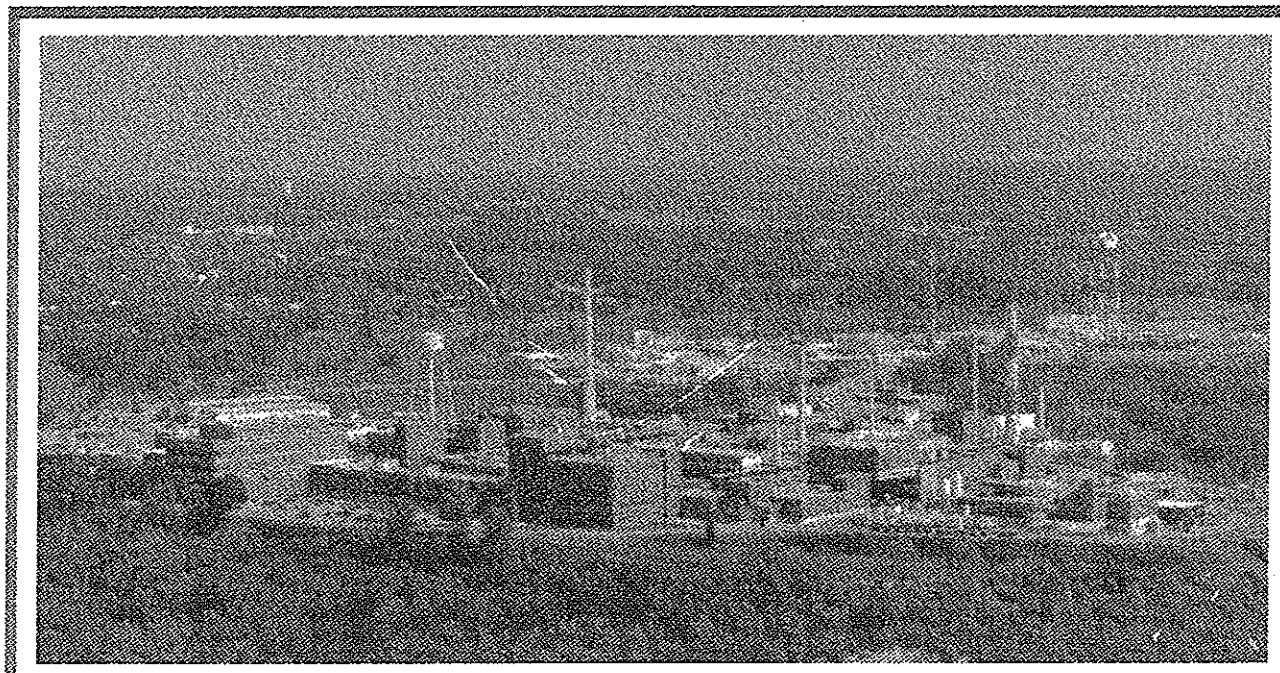
Program

MOUND PLANT

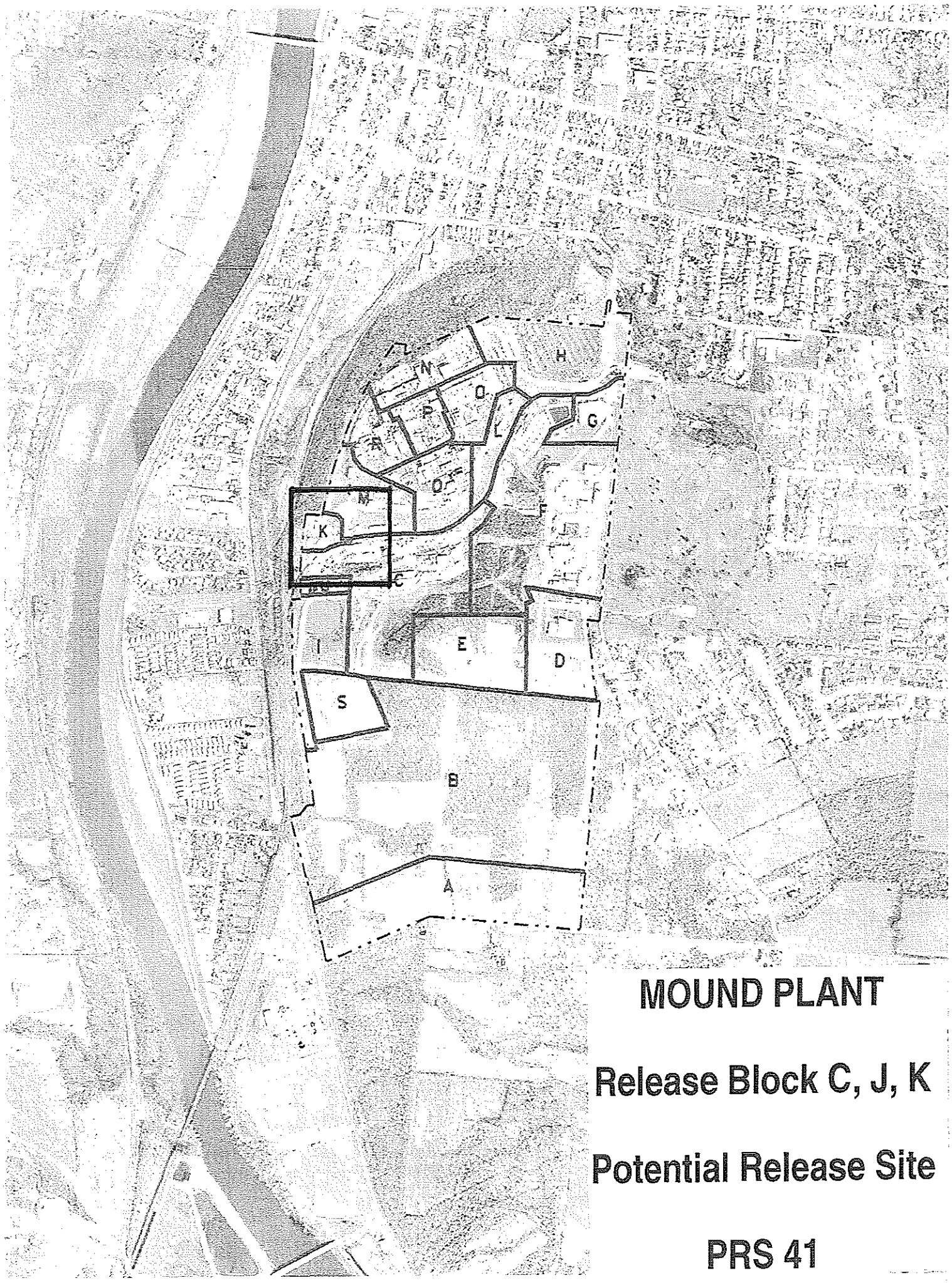
Potential Release Site Package

PRS # 41



PRS 41 (FILE)

REV	DESCRIPTION	DATE
DRAFT		**Mar. 5, 1996**
REGULATOR RELEASE **A**	CHANGED: - Wording in contamination section. - Guideline criteria for thorium-228 and trichloroethene (in tables). ADDED: - Definition of TT (total at tap).	**Apr. 9, 1996**
BINNING REVISION (MADE POST BINNING) **A1**	ADDED: - Soil Gas Confirmation Results - Additional clarification to narrative	**Dec. 04, 1996**
PUBLIC RELEASE **0**		

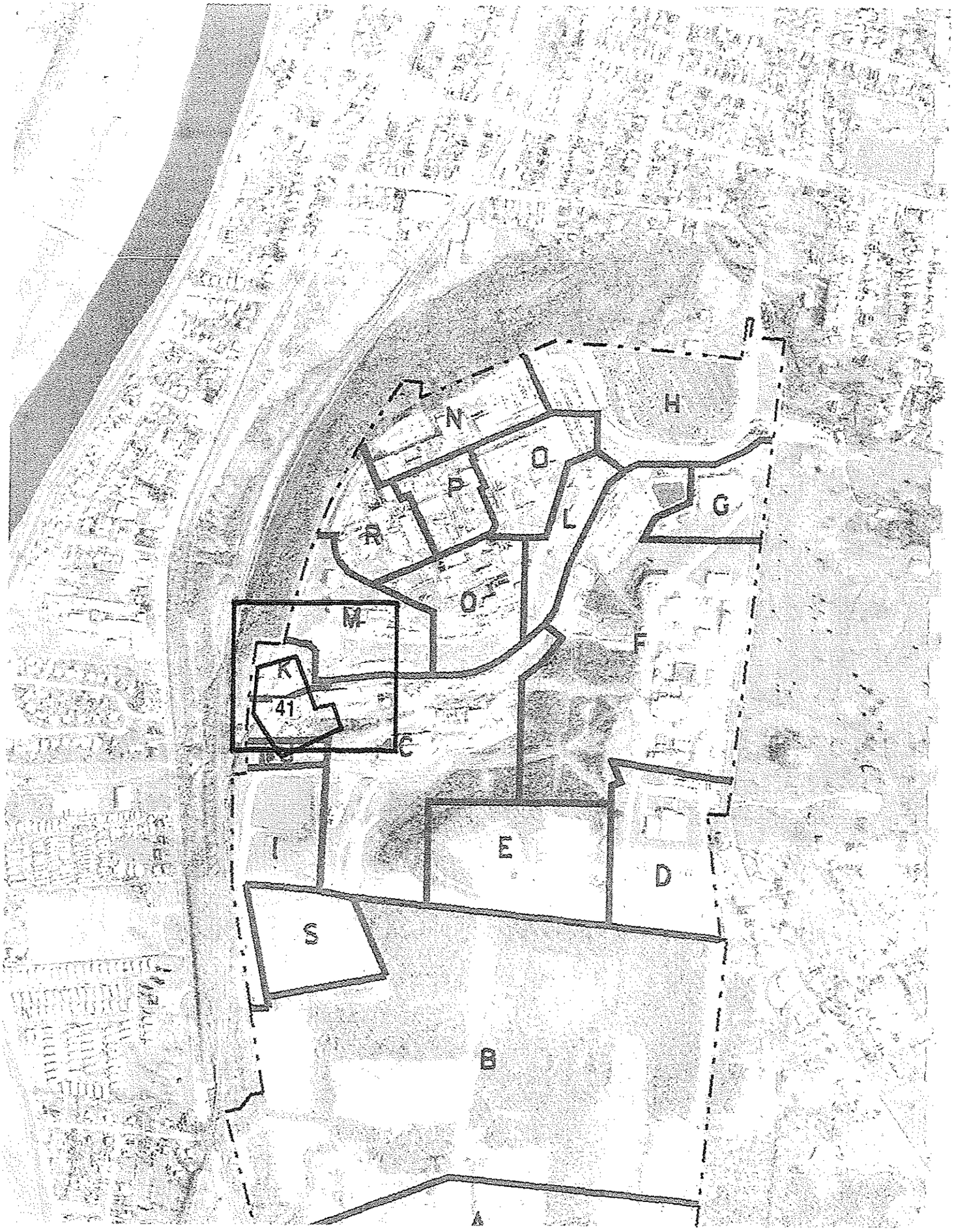


MOUND PLANT

Release Block C, J, K

Potential Release Site

PRS 41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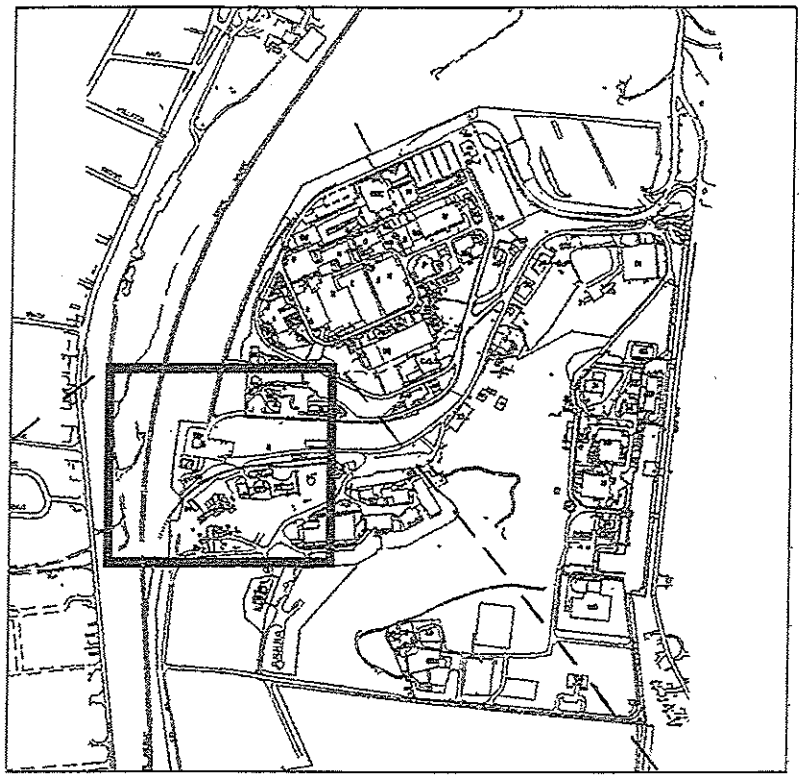
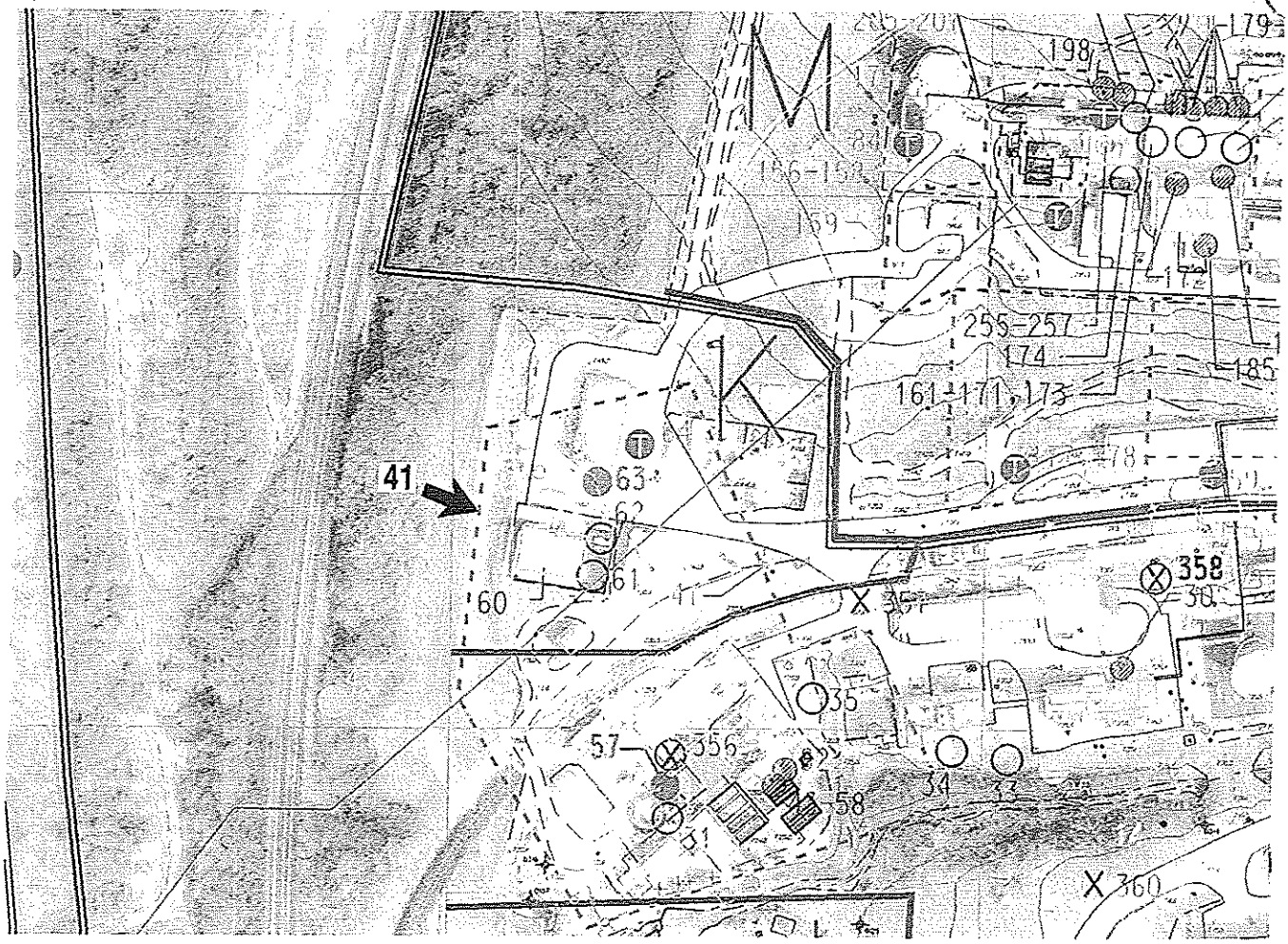
MOUND PLANT

Release Block C, J, K

Potential Release Site

PRS 41





41

PRS 41

PRS HISTORY:

In the mid-1950s, the Atomic Energy Commission directed Mound Plant to develop a process for the extraction of thorium from Brazilian monazite sludge and other thorium-bearing materials. The goal was to construct a refinery that would recover thorium from the sludge and other ores and provide a thorium salt suitable for preparing high purity thorium metal.[2,8] The thorium ore processing program was very short lived. Mound Plant began to receive sludge materials in early 1955 and the program was canceled in May 1955. [4] However, before the Commission canceled the program, the Mound Plant had received 5,900 55-gallon drums of thorium containing sludge and ore.[8]

From 1955 to 1965, the thorium ore and sludges were repackaged almost annually and the drums were stored in large groups throughout the plant grounds. As many as 20,000 empty, but corroded drums were buried. In 1966, the thorium was moved to a bulk-type storage silo (Building 21) and then was removed from the silo in 1974.

Interviews with current and former employees and a search of historical Mound Plant records identified that the thorium ores were stored in Area 3 which is Potential Release Site 41. In 1988, the Mound Site Survey Project[5] confirmed the presence of thorium in Area 3. Historical aerial photos of the plant show evidence of drum storage in this area.[6] Area 3 is located in the area surrounding Buildings 19 and 72 on the western border of Mound Plant. In 1965, thorium-contaminated soil was reportedly scraped, and the area was graded.

In a small section of Area 3, near Building 19, plutonium was detected during the site survey project. This area may have been contaminated by the 1969 plutonium-238 waste line break which contaminated the Miami-Erie Canal and the runoff hollow, west of the fenceline at the western edge of Area 3.

CONTAMINATION:

The major isotope in the Brazilian sludge was thorium-232 with the major daughter products being radium-228, radium-224, and other daughters. Minor amounts of thorium-230 may have also been present in the naturally occurring ores, and thorium-228 would be present due to the decay of radium-228. No analytical data quantifying these isotopes in the original thorium sludges was found. The ores were also found to contain small amounts of a variety of rare earth elements.

Both Scoping Report Volume 3 [2] and the Mound Site Survey report[5] show most of the elevated plutonium-238 activity as being present near Building 19 (core locations 0099, 0100, 0101, 0102, and 0104 on Plate 1; C099, C0100, C0101, C0102, and C0104 on Table V.2) and in the southwest corner of the area (surface locations 0547, 0548, 0550, 0552 on Plate 1; S0547, S0548, S0550, and S0552 on Table V.2). The maximum plutonium-238 concentration reported for

samples collected from Area 3, 50.60 pCi/g, was detected in the sample collected from core location C0104 at a depth of 18 inches. Only five samples contained plutonium-238 concentrations greater than 25 pCi/g.

Only four of the 63 samples collected in Area 3 contained levels of total thorium in excess of 2 pCi/g. The maximum concentration, 5.30 pCi/g, was detected in a surface sample collected from location 0547 (S0547 on Table V.2).

The depth of the core samples collected in Area 3 during the Site Survey Project ranged from 18 inches to a maximum of 180 inches. Most core locations were sampled to a depth of approximately 36 inches.

The Uranium Mill Tailings Reduction Act specifies clean-up guidelines for thorium as 5 pCi/g at the surface and 15 pCi/g in sub-surface soils. For plutonium-238, the Mound Plant attempts to attain an ALARA (As Low As Reasonably Achievable) criteria of 25 pCi/g for soils on the plant site.

As part of the 1974 investigations of plutonium-238 in the Miami-Erie Canal, Mound collected surface and core samples around the plant perimeter and fence line. Some samples were collected at the western border of Area 3. Samples were analyzed only for plutonium-238. Sample results indicate concentrations up to 125 pCi/g in the area where Area 3 borders the run-off hollow and 1 to 2 pCi/g elsewhere.

Mound Plant records[14] show that in 1987 two samples were collected in Area 3. One near building 55 and the other along the railroad near trailer 15. The sample near building 55 contained 13 pCi/g of thorium-232 and the other contained 107 pCi/g of thorium-232.

Elevated levels of plutonium-238 have also been discovered in Area 3 during surveys conducted for construction activities. Since 1985, Mound Plant has routinely conducted gamma ray screening of soils dug during construction activities. In August 1988, during survey of the dismantling of a portion of the sludge drying beds adjacent to the wastewater treatment facility, elevated levels of thorium and plutonium were indicated. An internal memorandum[7] indicates that analysis of 15 samples from bed #3 shows thorium concentrations that range from less than 1 to 63 pCi/g and plutonium-238 concentrations that range from less than 20 to 1,235 pCi/g. Notes on the memo indicate that the samples were collected at the surface, but during interviews with the personnel that collected the samples, it was indicated that the samples were collected below the drying bed at the surface of the underlying soil. As part of the construction, the contaminated soil was removed and boxed for off-site disposal. According to Collins[7] considerable doubt exists that any of the identified contamination actually contained plutonium-238. All of the radioactivity was assumed to be thorium-232, as it is apparent with as much thorium activity as was present in the drying beds, considerable interference occurs on the plutonium-238 channel of the analytical equipment. The 1,235 pCi/g of plutonium-238 were considered to have occurred by this interference. Soil was removed to a level approximating 15 pCi/g thorium according to field screening with a FIDLER (Field Instrument for Detection of Low Energy Radiation). No additional soil samples were taken before the area was backfilled.[2]

No processes, other than perhaps runoff from Area 14 (soils resulting from the 1969 pipeline break, PRS 176), could account for plutonium-238 under the sludge drying beds. The drying beds themselves were constructed in 1974 as part of the wastewater treatment plant. During that era, routine surveys did not accompany construction activities and the beds may have been built over soils contaminated with thorium.[2]

In August 1993, prior to construction of new sewage treatment facilities and a proposed waste storage building, Mound conducted sampling at the construction sites.[8] A variety of polycyclic aromatic hydrocarbons were detected. Benzo(a)pyrene and dibenz anthracene were detected above guideline values. All radionuclides detected were below guideline criteria or background values except for thorium-228. Metals were reported at concentrations below respective guideline criteria or background values. The results above guideline criteria are tabulated below.

Chemical	Maximum concentration	Guideline Criteria	Background Value
benzo(a)pyrene	4.0 mg/kg	0.41 mg/kg	Not available
dibenz anthracene	1.2 mg/kg	0.41 mg/kg	Not available

In 1994, Mound's Environmental Restoration Program conducted a screening investigation at Area 3.[3] The soil samples were analyzed at the Mound Soil Screening Facility for Plutonium and Thorium. Soil Screening detected plutonium above 25 pCi/g in 21 of the 72 samples, and the maximum concentration was 81 pCi/g. The maximum concentration of thorium-232 found was 3.1 pCi/g which is less than the UMTRA guideline of 5 pCi/g surface/ 15 pCi/g sub-surface. FIDLER surveys within Area 3 found several locations where elevated levels of radionuclides are suspected.

PETREX soil gas screening was also performed during the 1994 ER Program investigation[3]. The data obtained from this study is not quantitative but show that petroleum-based, aromatic, halogenated, and semi-volatile organic compounds exist within the area.

In February 1996 nine samples were collected and analyzed to quantify the elevated PETREX soil gas measurements in Area 3.[16] The samples were analyzed for a full suite of chemicals including volatile organic compounds, semi volatile organic compounds, pesticides and PCB's, explosives, metals and radionuclides. The following table lists chemicals that were detected above guideline criteria, background, or where there was no available criteria.

Chemical	Maximum concentration	Guideline Criteria	Background Value
benzo(a)pyrene	850 mg/kg	410 mg/kg	Not available
endosulfan II	4.4 mg/kg	Not available	Not available
magnesium	86,000 mg/kg	Not available	40,000 mg/kg
sodium	464 mg/kg	Not available	240 mg/kg
radium-226	0.88 pCi/g	0.14 pCi/g	2.0 pCi/g
thorium-228	1.18 pCi/g	0.85 pCi/g	1.5 pCi/g
plutonium-238	3.11 pCi/g	5.5 pCi/g	0.13 pCi/g

Reconnaissance sampling conducted in the Soil Gas Survey and Geophysical Investigation [10] collected soil gas samples at two locations in Area 3. Near building 19, elevated levels of Freon 11, Freon 113, trichloroethene, toluene were detected. Comparison of toluene and TCE soil gas values with calculated acceptable soil gas values show the detections are below levels of concern.[15]

Contaminant	Maximum Soil Gas Value	Acceptable Soil Gas Value
Trichloroethene	66 ppb	2400
Toluene	16 ppb	414600

During installation of monitoring wells soil samples were collected at several depths and analyzed for a suite of chemicals.[11] A number of metals were detected in samples collected during installation of well 0347 located within Area 3. All detections were below background or guideline criteria except the following:

Chemical	Maximum concentration	Guideline Criteria	Background Value
bismuth	11.4 mg/kg	Not available	Not available
lithium	36.1 mg/kg	Not available	26 mg/kg
magnesium	57,100 mg/kg	Not available	40,000 mg/kg
potassium	3340 mg/kg	Not available	1900 mg/kg
sodium	272 mg/kg	Not available	240 mg/kg

The samples were also analyzed for volatile organic compound and semi-volatile organic compounds. No organics were detected above guideline values although diethyl phthalate was detected once with a concentration of 47 mg/kg. No comparison values exist for diethyl phthalate. No radionuclides were detected above their respective background or guideline values. Thorium concentrations were below background values.

Monitoring wells 137, 312, 315, 347, 386, and 389 are in or downgradient from Area 3 and were sampled twice during the Operable Unit 9 Groundwater Sweeps Investigation.[13] Subsequent to the Groundwater Sweeps sampling, these wells and peizometer P023 were sampled in June

1995.[12] The following chemicals were detected above Maximum Contaminant Levels (MCL) specified in EPA's drinking water standards.

Chemical	Maximum concentration	MCL	Monitoring wells
lead	23.8 mg/l	15 mg/l (TT)	137, P023
cadmium	7.0 mg/l	5 mg/l	137
nickel	11600 mg/l	100 mg/l	312, 386
trichloroethene	10 mg/l	5 µg/l	312, 315, 347, 386, 389
chromium	13300 mg/l	100 mg/l	312, 315, 386

TT = total at tap

READING ROOM REFERENCES:

1) OU9, Site Scoping Report: Vol. 12 - Site Summary Report, December 1994. (pages 9-12)
2) OU9, Site Scoping Report: Vol. 3 - Radiological Site Survey, June 1993. (pages 13-26)
3) OU5, Operational Area Phase I Investigation Area 3 Field Report. (pages 27-53)
4) OU9, Site Scoping Report: Vol. 7 - Waste Management Report. (pages 54-56)
5) The Mound Site Survey Project for the Characterization of Radioactive Materials in Site Soils, May 1988. (pages 57-61)
6) Site Scoping Report: Volume 6 - Photo History. (pages 62-79)
10) Soil Gas Survey and Geophysical Investigations, February 1993. (pages 122-130)
11) Operable Unit 9 Hydrogeologic Investigation: Soil Chemistry Report, September 1994. (pages 131-140)
13) Operable Unit 9 Hydrogeologic Investigation: Groundwater Sweeps Report, April 1995. (pages 147-157)
16) Further Assessment: Soil Gas Confirmation Sampling, November 1996. (pages 162-173)

OTHER REFERENCES:

7) Collins 1988. (pages 80-81)
8) Options for Disposal of Thorium Ore Residues, April 1973. (pages 82-88)
9) Sampling and Analysis Report, Mound Operable Unit 5, Area 3, August 1993. (pages 89-121)
12) Groundwater Monitoring and Mapping for June 1995, Operable Unit 9, October 1995. (pages 141-146)
14) Pearson, T.J. Mound Plant Internal Memo, Soil Screening Facility. (page 158)
15) Comparison of Actual Soil Gas Values with Calculated Acceptable Soil Gas Values, A. Bray, March 19, 1996. (pages 159-161)

PREPARED BY:

James N. Rigano, Member of EG&G Technical Staff

PRS 41

RECOMMENDATION:

CONCURRENCE:

DOE: _____

USEPA: _____

OEPA: _____

REFERENCE MATERIAL
PRS 41

ENVIRONMENTAL RESTORATION PROGRAM

OPERABLE UNIT 9
SITE SCOPING REPORT:
VOLUME 12 - SITE SUMMARY REPORT

MOUND PLANT
MIAMISBURG, OHIO

December 1994

U.S. DEPARTMENT OF ENERGY
OHIO FIELD OFFICE

ENVIRONMENTAL RESTORATION PROGRAM
EG&G MOUND APPLIED TECHNOLOGIES

FINAL

Description of History and Nature of Waste Handling						Hazardous Conditions and Incidents			Environmental Data		
No.	Site Name	Location	Status	Potential Hazardous Substances	Ref	Releases	Media	Ref	Analytes[a]	Results	Ref
41	Area 3, Thorium Drum Storage and Redrumming Area	G-5 H-5	Grounds	Thorium-232 and daughters	1, 4, 5, 6, 18	Thorium dust	S	4, 6	14, 16 1	Table B.1 (Table V.2 in Ref. 6) SGS[b], Table B.5 Locations 5221 and 5222	6 12
42	Area A, Construction Soils from T Building	H-5	Grounds	Construction soil from T Bldg.	1	None Suspected			No Data		
43	Wastewater Treatment plant Building 57 Grit Chamber (Tank 101)	H-5	In service	Sanitary wastewaters	3, 4, 5	None Suspected	S	4	No Data on soils		
44	Building 57 Grit Conveyor										
45	Building 57 Comminuter (Tank 102)			Water softener backwashes discharged to storm sewer							
46	Building 57 Equalization Basin (Tank 103)			Plutonium-238 and other radionuclides		Treated effluent	SW	4	Water analyses submitted		
47	Building 57 Equalization Basin (Tank 104)					released to Great			monthly to OEPA in		
48	Building 57 Equalization Basin (Tank 105)					Miami River via			accordance with permit		
49	Building 57 Equalization Basin (Tank 106)					closed pipeline					
	ilding 57 Aeration Basin (Tank 107)					NPDES permitted					
	ilding 57 Aeration Basin (Tank 108)					outfall 001					
	Building 57 Clarifier (Tank 109)										
	Building 57 Clarifier (Tank 110)										

1 - Soil Gas Survey - Freon 11, Freon 113, Trans-1,2-Dichloroethylene, Cis-1,2-Dichloroethylene, 1,1,1-Trichloroethane, Perchloroethylene, Trichloroethylene, Toluene
2 - Gamma Spectroscopy - Thorium-228, -230, Cobalt-60, Cesium-137, Radium-224, -226, -228, Americium-241, Actinium-227, Bismuth-207, Bismuth-210m, Potassium-40
3 - Target Analyte List
4 - Target Compound List (VOC)
5 - Target Compound List (SVOC)
6 - Target Compound List (Pesticides/Polychlorinated Biphenyl)
7 - Dioxins/Furans
8 - Extractable Petroleum Hydrocarbons (EPH)/Total Petroleum Hydrocarbons (TPH)
9 - Lithium
10 - Nitrate/Nitrite
11 - Chloride
12 - Explosives
13 - Plutonium-238
14 - Plutonium-238, Thorium-232
15 - Cobalt-60, Cesium-137, Radium-226, Americium-241
16 - Tritium

Reference List

1. DOE 1986 "Phase I Installation Assessment Mound (DRAFT)."
2. DOE 1992a "Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide Work Plan (Final)."
3. DOE 1992c "Mound Plant Underground Storage Tank Program Plan & Regulatory Status Review (Final)."
4. DOE 1993a "Site Scoping Report: Volume 7 - Waste Management (Final)."
5. EPA 1988a "Preliminary Review/Visual Site Inspection for RCRA Facility Assessment of Mound Plant."
6. DOE 1993d "Operable Unit 9, Site Scoping Report: Volume 3 - Radiological Site Survey (Final)."
7. DOE 1993c "Operable Unit 3, Miscellaneous Sites Limited Field Investigation Report."
8. DOE 1992d "Reconnaissance Sampling Report Decontamination & Decommissioning Areas, OU6, (Final)."
9. Fentiman 1990 "Characterization of Mound's Hazardous, Radioactive and Mixed Wastes."
10. DOE 1992f "Operable Unit 9, Site Scoping Report: Volume 11 - Spills and Response Actions (Final)."
11. Styron and Meyer 1981 "Potable Water Standards Project: Final Report."
12. DOE 1993b "Reconnaissance Sampling Report - Soil Gas Survey & Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill (Final)."
13. DOE 1993d "Operable Unit 9, Site Scoping Report: Volume 3 - Radiological Site Survey (Final)."
14. DOE 1991b "Main Hill Seeps, Operable Unit 2, On-Scene Coordinator Report for CERCLA Section 104 Remedial Action, West Powerhouse PCB Site."
15. Halford 1990 "Results of South Pond Sampling."
16. DOE 1993e "Operable Unit 4, Special Canal Sampling Report, Miami Erie Canal."
17. DOE 1990 "Preliminary Results of Reconnaissance Magnetic Survey of Mound Plant Areas 2, 6, 7, and C."
18. DOE 1992a "Remedial Investigation/Feasibility Study, Operable Unit 9, Site-Wide Work Plan (Final)."
19. Rogers 1975 "Mound Laboratory Environmental Plutonium Study, 1974."
20. DOE 1992h "Ground Water and Seep Water Quality Data Report Through First Quarter, FY92."
21. Dames and Moore 1976 a, b "Potable Water Standards Project Mound Laboratory" and "Evaluation of the Buried Valley Aquifer Adjacent to Mound Laboratory."
22. DOE 1992i "Closure Report, Building 34 - Aviation Fuel Storage Tank."
23. DOE 1992j "Closure Report, Building 51 - Waste Storage Tank."
24. DOE 1994 "Operable Unit 1, Remedial Investigation Report."
25. EG&G 1994 "Active Underground Storage Tank Plan."

Table XI.1. Maximum Radioactivity Concentrations in Soil Samples from Major Areas

Site	Plutonium-238 (pCi/g)	Thorium (pCi/g)	Tritium (pCi/mL)	Cobalt-60 (pCi/g)	Cesium-137 (pCi/g)	Radium-226 (pCi/g)	Americium-241 (pCi/g)	Actinium-227 (pCi/g)	Bismuth-207 (pCi/g)	Bismuth-210m (pCi/g)
Area 1	34,000	924.2	1.67	LDL	0.6	1.1	LDL	--	--	--
Area 2	17.10	3.31	--	--	--	--	--	--	--	--
Area 3	1,235	63	--	--	--	--	--	--	--	--
Area 4/4a	355.00	<2	--	LDL	LDL	1.2	1.0	--	--	--
Area 5	0.35[b]	<2[b]	--	250	1.6	0.8	LDL	--	--	--
Area 6	--	--	--	LDL	LDL	0.9	LDL	--	--	--
Area 7	7.40[l]	20.52	5.23	LDL	1.2	2.0	LDL	1,400	--	--
Area 8	24.40	254.30	1.12	LDL	LDL	3.3	LDL	--	--	--
Area 9	6.15	150	--	--	--	--	--	--	--	--
Area 10	89	<2	--	--	--	--	--	--	--	--
Area 11	100,000	69	--	--	--	--	--	--	--	--
Area 12	313.00	169.90	--	LDL	LDL	1.1	LDL	--	--	--
Area 13	5.74	<2	--	--	--	--	--	--	--	--
Area 14	29[l]	2.24	--	LDL	LDL	1.2	LDL	--	--	--
Area 15[e]	--	--	--	--	--	--	--	--	--	--
Area 16	6,000	3.46	0.35	LDL	LDL	1.2	LDL	--	--	--
Area 17	3,300	1,000	--	LDL	LDL	0.9	LDL	--	--	--
Area 18	3.71	<2	--	--	--	--	--	--	--	--
Area 19[d]	185[m]	1.2	--	--	--	--	--	--	--	--
Area 20	1.90[b]	4.02[b]		600	200	0.9	LDL	--	70	400
Area 21	1.12	<2	0.77	LDL	31	1.2	LDL	--	--	--
Area 22	1.67	<2	0.99	143	7.0	0.7	LDL	--	--	--
Area 23	--	6,000[k]	--	--	--	--	--	--	--	--
Area D	0.86	<2	--	--	--	--	--	--	--	--
Area J	147	30.42	6.84	3.0	LDL	1.0	LDL	--	--	--
Spoils Disposal	8.30	<2	1.90	LDL	LDL	0.94	LDL	--	--	--

Table B.1.

TABLE II.12. SUMMARY OF POSITIVE DETECTIONS–MAIN PARKING LOT AND SOUTHWEST OF MAIN HILL
(ppb)

SAMPLE ID	SAMPLE DATE	FREON 11	FREON 113	TRAN–12DCE	CIS–12DCE	111TCA	PCE	TCE	TOLUENE
MND–01–2216–0005	28 SEP 92	---	---	---	---	---	---	---	104
MND–01–2219–0005	28 SEP 92	---	---	---	---	---	---	---	11
MND–01–5221–0005	27 SEP 92	21	131	---	---	---	---	68	16 *
MND–01–5222–0005	27 SEP 92	---	---	---	---	---	---	---	11 *
MND–01–5222–1005	27 SEP 92	---	---	---	---	---	---	---	16 *
MND–01–5225–0005	27 SEP 92	---	---	---	---	---	---	---	13 *
MND–01–5228–0005	27 SEP 92	---	---	---	---	---	---	---	82 *

Notes:

Only sample locations having positive detections are shown.

*: Associated trip, ambient, equipment or field blank contained specified compound.

B: Indicates blank sample.

Table B.5.

Document Control No: DGC

Environmental Restoration Program

OPERABLE UNIT 9, SITE SCOPING REPORT
VOLUME 3 - RADIOLOGICAL SITE SURVEY

MOUND PLANT
MIAMISBURG, OHIO

June 1993

FINAL

Department of Energy
Albuquerque Field Office

Environmental Restoration Program
EG&G Mound Applied Technologies

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4.1.6. Area 18 4-30
4.1.7. Area 19 4-31
4.1.8. Area D 4-34
4.1.9. Building 48 Hillside 4-44
4.1.10. Building 66 Lot Site 4-46
4.1.11. Locations With Elevated Plutonium-238 4-46

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5.3. AREA 2 5-7
5.4. AREA 3 5-8
5.5. AREA 7 5-11
5.6. AREA 8 5-12
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3 GENERAL REPRESENTATION OF SITE SURVEY RESULTS - THORIUM GAMMA SURVEY

4 SITE SURVEY PROJECT PLUTONIUM CONCENTRATIONS

5 SITE SURVEY PROJECT THORIUM CONCENTRATIONS

Area 2 do not provide any information concerning the historic disposal trenches. The elevated thorium concentration detected in a sample collected from core location 0191 at a depth of 108 inches may be indicative of some subsurface elevated thorium activity. It is not clear that C0190 was not deep enough to sample the buried thorium drums directly. Corehole 0190 was positioned in the right place to sample the area of drum burial, but it was only 36 inches deep.

5.4. AREA 3

Area 3, located in the area surrounding Buildings 19 and 72 on the western border of Mound Plant, was used for storage and redrumming of thorium in the late 1950s and early 1960s (MRC, 1973). As with Area 1, Area 3 has a varied and complex history. A photo interpretive history of the historic landfill and Area 2 is provided in the Site Scoping Report: Volume 6 - Photo History (DOE 1992b). In 1965, thorium-contaminated soil was reportedly scraped, and the area was graded (MRC, 1985; Stought et al., 1988). The excavated area was then backfilled with clean soil. No documentation of this activity was found during the research for the scoping reports. A small section of Area 3, near Building 19, may have been contaminated by either the 1969 plutonium-238 waste line break that created Area 14, or by the cleanup operations that followed the break. This event also resulted in the contamination of an offsite area, known as the runoff hollow, west of the fenceline at the western edge of Area 3 (Rogers 1975). Because the runoff hollow is outside the boundary of Mound Plant and was sampled as part of the Miami-Erie Canal investigation (Rogers 1975), it was not addressed by the Site Survey Project. The Miami-Erie Canal is not addressed in this report.

The extent of Area 3 shown on Plate 1 was determined by an evaluation of the site survey data conducted in preparation for this report, and appears to be in agreement with the Area 3 shown in the original Site Survey Project Report. Similarly, both this report and the original report show most of the elevated plutonium-238 activity as being present near Building 19 (core locations 0099, 0100, 0101, 0102, and 0104 on Plate 1; C099, C0100, C0101, C0102, and C0104 on Table V.2) and in the southwest corner of the area (surface locations 0547, 0548, 0550, 0552 on Plate 1; S0547, S0548, S0550, and S0552 on Table V.2). The maximum plutonium-238 concentration reported for samples collected from Area 3, 50.60 pCi/g, was detected in the sample collected from core location C0104 at a depth of 18 inches. Only five samples contained plutonium-238 concentrations greater than 25 pCi/g. These plutonium-238 concentrations were used to develop the isoconcentration lines shown on Plate 4.

Only four of the samples collected in Area 3 contained levels of total thorium in excess of 2 pCi/g. The maximum concentration, 5.30 pCi/g, was detected in a surface sample collected from location 0547 (S0547 on Table V.2). Review of the data for this report indicates that the summary provided

Table V.2. Mound Site Survey Project - Area 3

Plate 1 Location[a]	Coordinates South	Coordinates West	MRC ID No.	Mo-Yr	Depth (Inch)	Plutonium-238 (pCi/g)	Thorium[b] (pCi/g)
C0099	1965	4265	10419	08-85	18	31.4	b
			10420	08-85	36	14.7	b
C0100	1975	4275	10421	08-85	18	32.4	b
			10422	08-85	36	17.7	b
			10423	08-85	54	12.4	b
			10424	08-85	72	10.1	b
C0101	1985	4285	10425	08-85	18	22.0	b
			10426	08-85	36	0.90	b
			10427	08-85	54	0.34	b
			10428	08-85	72	0.71	b
C0102	1995	4295	10429	08-85	18	10.4	b
			10430	08-85	36	6.44	b
			10431	08-85	54	2.16	b
			10432	08-85	72	0.93	b
C0103	2060	4300	1624	04-83	18	0.26	3.95
			1625	04-83	36	0.50	b
C0104	2085	4365	1622	04-83	18	50.60	b
			1623	04-83	36	5.28	b
C0105[c]	2100	4140	7804	10-84	90	0.47	b
			7805	10-84	180	0.01	b
C0106	2105	4315	1626	10-84	18	0.41	b
			1626	10-84	36	0.13	b
C0107	2170	4375	1620	04-83	18	0.69	b
			1621	04-83	36	0.07	2.56
C0108	2200	4250	1632	04-83	18	0.25	b
			1633	04-83	36	0.14	b
C0109	2225	4325	1658	04-83	18	2.30	b
			1659	04-83	36	0.66	b
			1660	04-83	54	0.47	b
C0110	2230	4390	1628	04-83	18	0.48	b
			1629	04-83	36	0.14	b
C0111	2250	4165	1636	04-83	18	0.82	b
			1637	04-83	36	0.21	b
C0112	2250	4300	1640	04-83	18	0.02	b
			1641	04-83	36	0.03	b
C0113[c]	2275	4140	7759	09-84	90	2.83	b
			7760	09-84	180	0.03	b
C0114	2275	4200	1638	04-83	18	0.16	b
			1639	04-83	36	0.01	b

Table V.2. (page 2 of 2)

Plate 1 Location[a]	Coordinates South	Coordinates West	MRC ID No.	Mo-Yr	Depth (inch)	Plutonium-238 (pCi/g)	Thorium[b] (pCi/g)
C0115	2275	4395	1644	04-83	18	1.46	3.56
			1646	04-83	36	0.31	b
C0116	2305	4315	1642	04-83	18	0.05	b
			1643	04-83	36	0.24	b
S0490	2175	4135	2918	10-83	0	0.71	b
S0494	2275	4135	6974	08-74[d]	0	1.48	b
S0496	2300	4135	6873	08-84	0	0.02	b
S0499	2350	4135	2919	10-83	0	0.04	b
S0536	1950	4290	7167	09-84	0	2.20	b
S0537	1950	4315	2683	10-83	0	0.17	b
S0538	1975	4165	7165	09-84	0	5.94	b
S0539	2000	4340	7168	09-84	0	10.20	b
S0540	2050	4165	2685	10-83	0	36.94	b
S0541	2075	4265	2688	10-83	0	0.64	b
S0542	2075	4390	2684	10-83	0	0.83	b
S0543	2200	4265	6881	08-84	0	18.60	b
S0545	2350	4415	6876	08-84	0	4.16	b
S0547	2365	4375	10485	08-85	0	11.0	5.30
S0548	2370	4380	10488	08-85	0	5.77	b
S0549	2375	4165	6880	08-84	0	0.23	b
S0550	2375	4290	6879	08-84	0	12.10	b
S0551	2375	4390	6878	08-84	0	27.10	b
S0552	2380	4370	10486	08-85	0	41.70	b
S0553	2385	4375	10487	08-85	0	8.42	b

[a]Map locations are given using a "C" to designate core locations and an "S" to designate surface locations.
[b]A "b" indicates that the total thorium concentration was less than the background level of 2.0 pCi/g, using FIDLER screening. Therefore, radiochemical analysis was not performed.
[c]Boring logs indicate that these locations were not sampled to bedrock (Appendix B)
[d]Date of 08-74 given in the data is suspect. The correct date is probably 08-84 or 07-84.
FIDLER - field instrument for the detection of low-energy radiation
MRC ID - Monsanto Research Corporation Identification
pCi/g - picocuries per gram

in the project report (Stought et al. 1988) is accurate. However, a more recent survey of the sanitary sewage drying beds in Area 3 indicate higher levels than reported by the Site Survey Project. Of 15 samples collected in the beds in 1988, the highest had a thorium-232 concentration of 63 pCi/g and a plutonium-238 concentration of 1235 pCi/g (Collins 1988). Additional discussion is provided in subsection 4.1.11.

The depth of the core samples collected in Area 3 during the Site Survey Project ranged from 18 inches to a maximum of 180 inches. Most core locations were only sampled to a depth of approximately 36 inches. The depth to bedrock in this area appears to range from 300 to 900 inches or about 25 to 75 ft (DOE 1992b). Boring logs are available for two Area 3 core locations, 0105 and 0113, and indicate that these locations were not sampled to bedrock (Appendix B).

5.5. AREA 7

Area 7 is a large area located in the upper valley at Mound Plant, behind or below Buildings 29, 51, 66, and 98 (Plate 1). This area was once a steep ravine that formed the upper reach of the plant drainage ditch. This area has a long history of debris disposal and infilling, including the disposal of approximately 10,000 empty thorium drums in the late 1950s to early 1960s, a polonium-contaminated washing machine (date unknown); a thorium-contaminated flat bed truck, and other equipment used in repackaging the thorium sludges. In the mid 1960s, materials contaminated with polonium-210 were also buried on the side of the ravine. An exhaust system from the remodeling of T Building and a large stainless steel washing machine were among the items. Smaller items contaminated with polonium-210, may also have been buried. The Site Scoping Report: Volume 6 - Photo History (DOE 1992b) documents several episodes of filling and construction. Plate 4 - Estimation of Fill Materials in Site Scoping Report: Volume 5 - Topographic Maps (DOE 1992a) indicates that over 30 feet of fill materials may exist in Area 7.

The current extent of Area 7 shown on Plate 1 is based on an interpretation of the site survey data made in the preparation of this report, and is similar to the area depicted in the original Site Survey Project Report (Stought et al. 1988). The area shown is actually larger than the estimate of the area used in the historic disposals. On the north end of Area 7 is an old buried septic tank that was first used during plant construction, and was the site of disposal of actinium- and radium-bearing soils excavated from the SW Building in 1955 (DOE 1992g), which is described in section 7 of this report.

The samples from the locations in Area 7 were analyzed mainly for plutonium-238 and thorium. The maximum plutonium-238 concentration detected was 7.40 pCi/g in the surface sample from location 0286 (S0286 on Table III.5). The maximum total thorium concentration detected, 20.52 pCi/g, was found in the surface sample collected from location S0298. Other radionuclides detected in Area 7

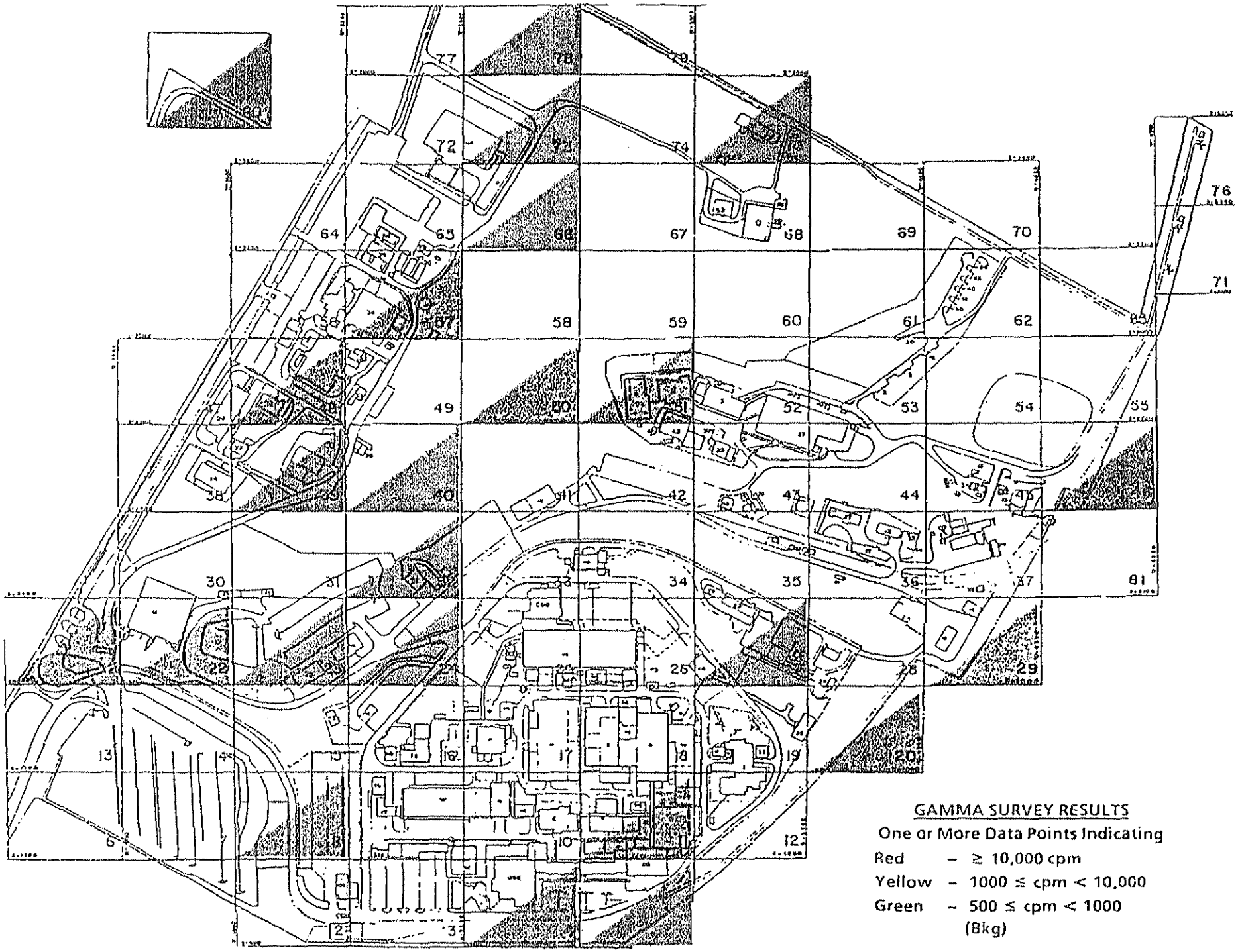


Plate 2. General representation of site survey results - plutonium-238 gamma survey.

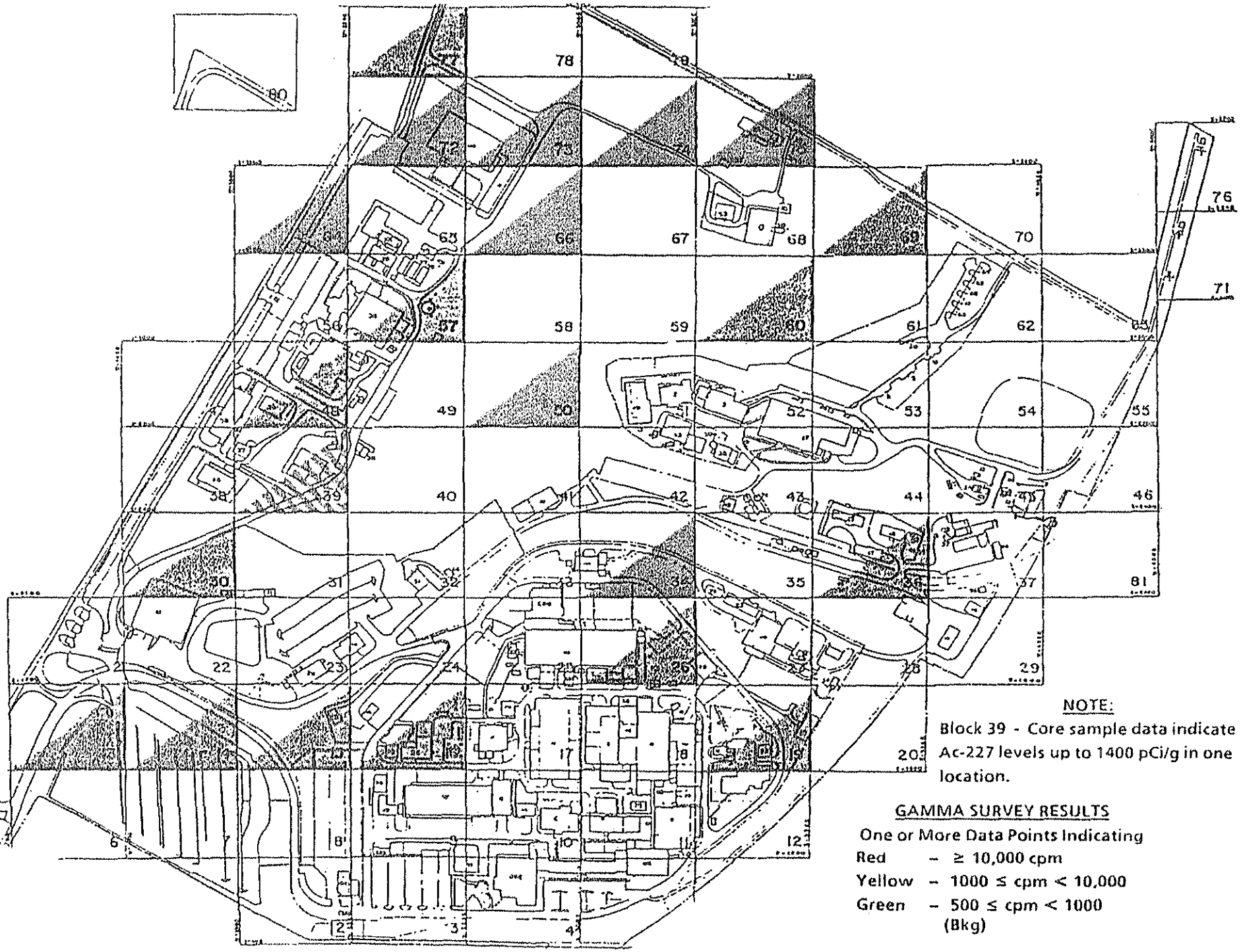


Plate 3. General representation of site survey results - thorium gamma survey.

WESTON
MANAGERS DESIGNERS/CONSULTANTS
6501 Americas Parkway N.E.
SUITE 800
ALBUQUERQUE, NM 87110
PHONE: (505) 884-5050

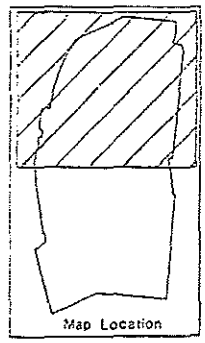
ER PROGRAM
MOUND PLANT

Miamisburg, Ohio

PLATE 1
(1 of 2)

Site Survey Project Sampling Locations

Prepared for
Site Scoping Report: Volume 3,
Radiological Site Survey



Legend

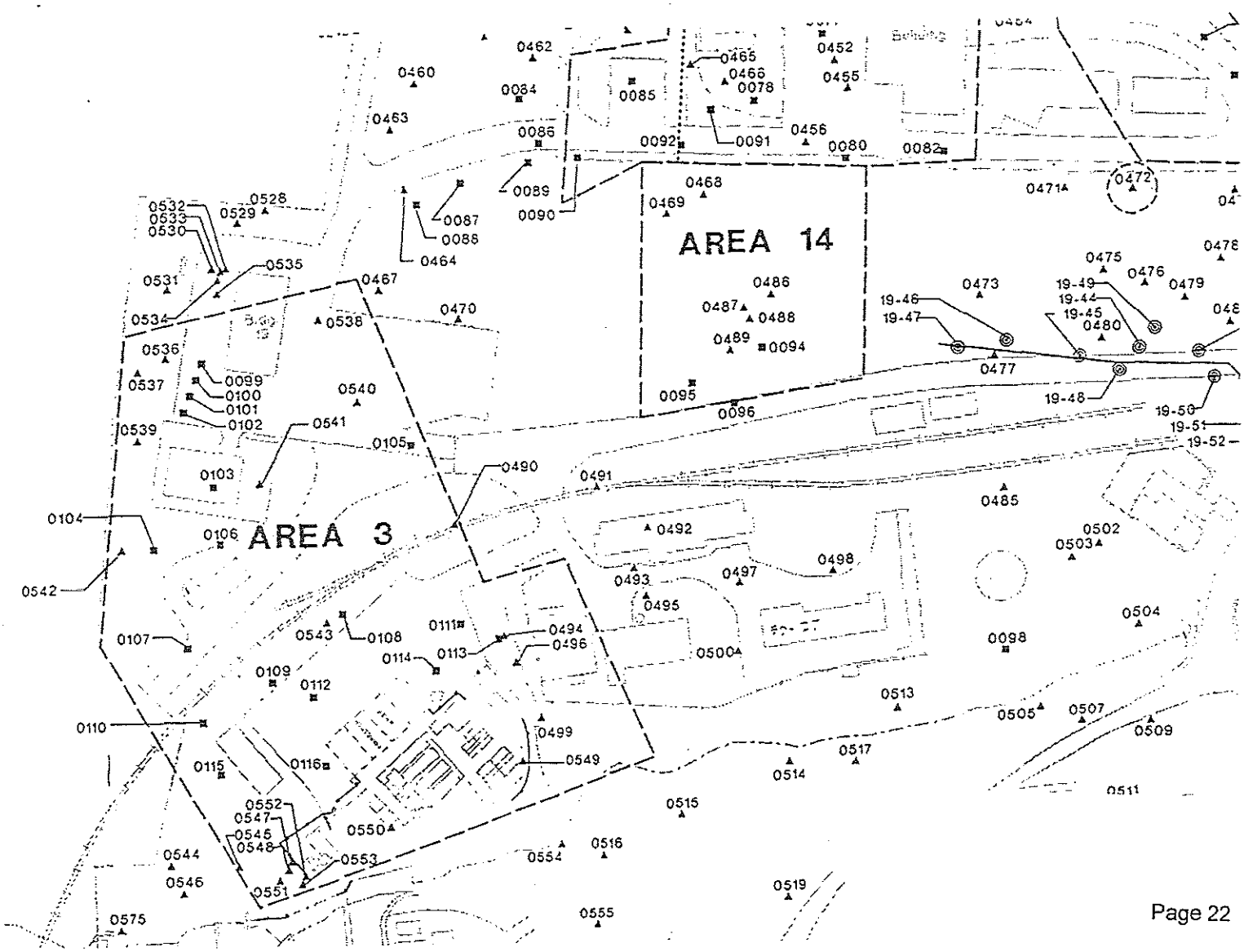
- Structure
- Paved road
- Dirt road
- Water
- Mound Plant Boundary
- 0015 Surface Location
- 0002 Core Location
- Potential Release Site
- Elevated Activity
- 19-17 Sampling Location for Verificat Survey of Former WTS Pipelin

0 50 100 150 200
Scale in Feet
1 inch = 100 feet

NOTE: Accuracy of surface locations is +/- 25 feet.

TN
GN
MN

1981 MAGNETIC NORTH DECLINATION AT CENTER OF PLANT. MAGNETIC NORTH IS 3 DEGREES WEST OF TRUE NORTH. DECLINATION BETWEEN STATE PLANE (GRID) NORTH IS 1 13 DEGREES WEST OF TRUE NORTH.



The maximum sample depth during the 1974 study at the plant drainage ditch was 5 to 6 ft. Although the depth of the ditch sediments is not known, the depth to bedrock ranges from 30 to 40 ft near Building 51, at the beginning of the ditch, to approximately 70 ft at the western end, where the ditch exits the plant boundary. This depth to bedrock includes the ditch sediments, the older stream sediments, glacial outwash, and glacial till (DOE 1992f).

Radioactively contaminated sediments are also present in the asphalt-lined pond in the northeastern portion of the plant and in the storm water retention (overflow) pond and retention basins near Area 2 in the southwestern portion of Mound Plant (Plate 1). Both of these are used to settle the sediments in storm water runoff. No characterization was done during the Site Survey Project because of their operational status. The ponds and other basins are described in detail in the Site Scoping Report: Volume 7 - Waste Management (DOE 1992g) and the Operable Unit 9 Site-Wide RI/FS Work Plan (DOE 1992c).

10.5. FENCE LINE SAMPLING CONDUCTED IN 1974

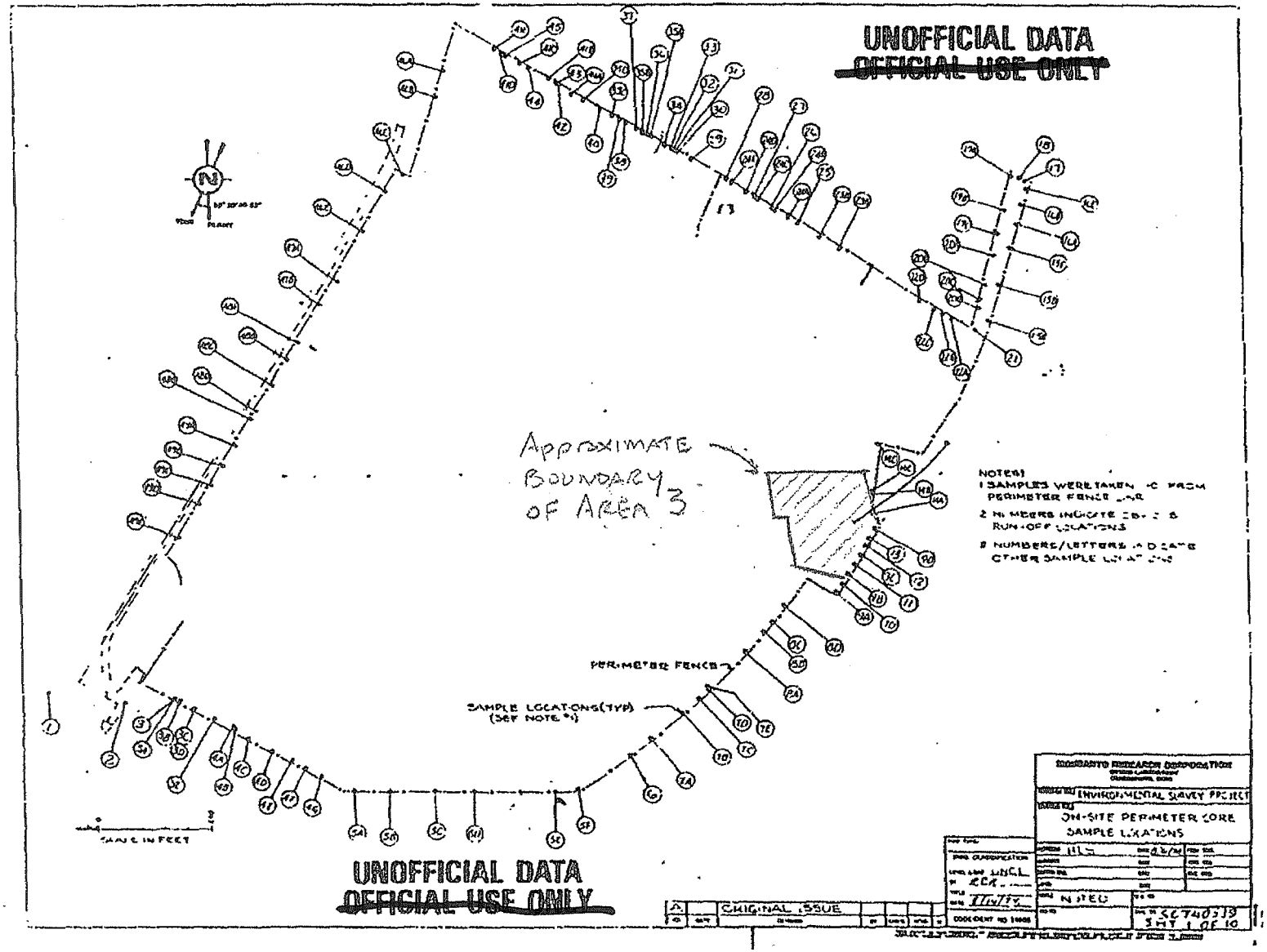
As part of the 1974 investigations of plutonium-238 in the Miami-Erie Canal, surface and core samples were collected around the Mound Plant perimeter and fence line. Samples were analyzed only for plutonium-238. Sample results indicate concentrations up to 125 pCi/g in the area of the canal and 1 to 2 pCi/g elsewhere. The data sheets are included in Appendix E.

10.6. DEPLETED URANIUM CLEANUP AT FIRE FIGHTER TRAINING PITS

A cleanup of uranium contamination in the fire fighter training pit area occurred in the early spring of 1989. The pits are located south of Building 34 (Figure 10.2). The uranium contamination was detected during routine surveys being conducted as part of the repair of a water line adjacent to Building 34 in January 1988. The uranium was found to occur as metallic scraps about 1-inch square and 1/4-inch thick. Analysis of a metallic sample indicated concentrations of uranium-238 and uranium-235 at 500,000 and 3,000 pCi/g, respectively (Jarvis 1988), thus indicating a much greater uranium-238 content than occurs naturally. The metallic scraps were thus determined to consist of depleted uranium, a metal used for its very high density. The origin of the metallic scraps in the pit area is unknown. The actual concentration of depleted uranium in soil was measured to be about 6,340 pCi/g (Jarvis 1989).

On March 16, 1989, the cleanup of the depleted uranium was accomplished by excavation and placement of soil into low-specific activity (LSA) boxes for shipment offsite. The cleanup goal was 5

FROM SCOPING REPORT - VOL 3 APPENDIX E 1 OF 3



Reviewed for Classification/UCNI/OUO
BY: J.A. Neskeen Derivative Classifier
DOE, EMCBC
Date: 06-22-10
Confirmed Unclassified, Not UCNI/Not OUO

UNOFFICIAL DATA

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CORE SAMPLE RESULTS

8D-1	0.000079 ± 0.000153
8D-2	0.000151 ± 0.000242
8D-3	0.000095 ± 0.000174
8D-4	
8D-5	

8E-1	0.000027 ± 0.000070
8E-2	0.000019 ± 0.000056
8E-3	0.000088 ± 0.000165
8E-4	
8E-5	

9A-1	YES
9A-2	0.000762 ± 0.000772
9A-3	0.000169 ± 0.000256
9A-4	
9A-5	

9B-1	0.000038 ± 0.000091
9B-2	0.000016 ± 0.000048
9B-3	0.000030 ± 0.000076
9B-4	
9B-5	

9C-1	0.0360 ± 0.0124
9C-2	0.0153 ± 0.0066
9C-3	0.000706 ± 0.000731
9C-4	
9C-5	

9D-1	0.000132 ± 0.000220
9D-2	0.000045 ± 0.000101
9D-3	0.000641 ± 0.000828
9D-4	0.000691 ± 0.000720
9D-5	YES

10-1	0.000155 ± 0.000246
10-2	0.000085 ± 0.000161
10-3	
10-4	
10-5	

11-1	0.000583 ± 0.000637
11-2	0.000466 ± 0.000543
11-3	YES
11-4	YES
11-5	0.000145 ± 0.000235

12-1	0.00510 ± 0.00301
12-2	0.00208 ± 0.00158
12-3	0.00130 ± 0.00113
12-4	NO
12-5	

13-1	0.000526 ± 0.000591
13-2	0.00137 ± 0.00117
13-3	0.000478 ± 0.000709
13-4	
13-5	

← 36 pCi/g

14A-1	0.000333 ± 0.000427
14A-2	0.00101 ± 0.00095
14A-3	0.000093 ± 0.000171
14A-4	
14A-5	

14B-1	0.000349 ± 0.000441
14B-2	0.000353 ± 0.000445
14B-3	
14B-4	
14B-5	

NOTES:

1. FIRST NUMBER OR NUMBER/LETTER INDICATES THE SAMPLE LOCATION. REFER TO MRC DRG NO SC740539.
2. THE NUMBER FOLLOWING THE DASH REPRESENTS A ONE (1) FOOT SECTION OF THE CORE AT THE INDICATED DEPTH
3. ALL VALUES ARE IN NANOCURIES/GRAM (nCi/g) NANOCURIES = 10^{-9} CURIES = 2220 DISINTEGRATION/MIN

UNOFFICIAL DATA

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

PROGRAM TITLE ENVIRONMENTAL SURVEY PROJECT

DRAWING TITLE ON SITE PERIMETER CORE SAMPLE LOCATIONS

DWG. TYPE

DWG. CLASSIFICATION

LEVEL & CAT. UNCL.

BY K.R.R.

TITLE

DATE 7/19/74

DESIGNER 111S DATE 8/14/74 PROJ. ENGR.

CHECKER DATE ASSOC. ENGR.

DESIGN ENG. DATE ENGR. MGR.

APVD DATE

SCALE NONE W.O. NO.

JOB NO 740533 DWG. NO SC 740539 SH 4 OF 10

CODE IDENT NO 14065

ISS	DATE	REVISION	BY	CHK'D	APVD	W
A		ORIGINAL ISSUE				

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Reviewed for Classification/UCNI/OUO
BY: J A Kohem Derivative Classifier
DOE, EMCBC
Date: 05-25-10
Confirmed Unclassified, Not UCNI/Not OUO

SC740539
SH 5 OF 10

3 of 3

UNOFFICIAL DATA

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CORE SAMPLE RESULTS

125 pCi/g?

? X

14C-1	0.125 ± 0.030
14C-2	0.000740 ± 0.000756
14C-3	0.000085 ± 0.000161
14C-4	"
14C-5	"

14D-1	0.000699 ± 0.000725
14D-2	0.000090 ± 0.000168
14D-3	0.000085 ± 0.000161
14D-4	"
14D-5	"

15A-1	0.000862 ± 0.000843
15A-2	0.000046 ± 0.000104
15A-3	0.00126 ± 0.00110
15A-4	0.00108 ± 0.00099
15A-5	0.000139 ± 0.000229

15B-1	0.000562 ± 0.000620
15B-2	0.000162 ± 0.000255
15B-3	0.000976 ± 0.000921
15B-4	0.000471 ± 0.000546
15B-5	0.000129 ± 0.000216

15C-1	0.000083 ± 0.000158
15C-2	NOT DETECTED
15C-3	0.000077 ± 0.000051
15C-4	"
15C-5	"

16A-1	0.000099 ± 0.000179
16A-2	0.000020 ± 0.000057
16A-3	0.000067 ± 0.000136
16A-4	"
16A-5	"

16B-1	0.000134 ± 0.000222
16B-2	0.000035 ± 0.000085
16B-3	0.00281 ± 0.00196
16B-4	0.000069 ± 0.000138
16B-5	0.000040 ± 0.000094

16C-1	0.000145 ± 0.000235
16C-2	0.000146 ± 0.000237
16C-3	0.000079 ± 0.000100
16C-4	"
16C-5	"

17-1	0.000312 ± 0.000407
17-2	0.000085 ± 0.000160
17-3	0.000064 ± 0.000129
17-4	"
17-5	"

18-1	0.000250 ± 0.000347
18-2	0.000126 ± 0.000212
18-3	0.000059 ± 0.000123
18-4	"
18-5	"

19A-1	0.000048 ± 0.000107
19A-2	0.000049 ± 0.000109
19A-3	0.000139 ± 0.000228
19A-4	"
19A-5	"

19B-1	0.000389 ± 0.000477
19B-2	0.000147 ± 0.000238
19B-3	0.000139 ± 0.000229
19B-4	"
19B-5	"

NOTES:

1. FIRST NUMBER OR NUMBER/LETTER INDICATES THE SAMPLE LOCATION REFER TO NRC DWG NO SC740539.
2. THE NUMBER FOLLOWING THE DASH REPRESENTS A ONE (1) FOOT SECTION OF THE CORE AT THE INDICATED DEPTH.
3. ALL VALUES ARE IN NANOCURIES/GRAM (nCi/g). NANOCURIES = 10^{-9} CURIES = 2220 DISINTEGRATION/MIN.

Reviewed for Classification/UCNI/OUO
BY: J.A. Neshem Derivative Classifier
DOE, EMCBC
Date: 05-25-10
Confirmed Unclassified, Not UCNI/Not OUO

UNOFFICIAL DATA

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

PROGRAM TITLE: ENVIRONMENTAL SURVEY PROJECT

DRAWING TITLE: ON-SITE PERIMETER CORE SAMPLE LOCATIONS

DRAWN: HIS DATE: 8/24/76
CHECKED DATE
DESIGN ENG DATE
APVD DATE
SCALE: NONE
DWG NO: SC740539 SH 5 OF 10

DWG TYPE
DWG CLASSIFICATION
LEVEL & CAT. Unclass
By RCA
TITLE
DATE 5/17/24

CONFIDENT NO. 4085

A		CB SIMPLIFY & SCALE			
	DATE	REMARKS	BY	CHK'D	APVD

~~OFFICIAL USE ONLY~~

Environmental Restoration Program

OPERABLE UNIT 5
OPERATIONAL AREA PHASE I INVESTIGATION
AREA 3 FIELD REPORT

MOUND PLANT
MIAMISBURG, OHIO

VOLUME I - TEXT

June 1995

Final (Revision 1)

U.S. Department of Energy
Ohio Field Office

EG&G Mound Applied Technologies

2. FIELD ACTIVITIES AND DATA SUMMARY

The Area 3 Phase 1 field activities were conducted to screen this area of concern (AOC) for potential areas of contamination. Reconnaissance activities in Area 3 consisted of:

- a field instrument for the detection of low-energy radiation (FIDLER) survey and surface soil sample analyses at the Mound Plant Soil Screening Facility to detect possible surface radiological contamination; and
- a soil gas survey to detect subsurface volatile and semi-volatile organic chemical contamination.

As specified in the FSP (DOE 1993d), the radiological screening was conducted to detect the presence of plutonium-238 (Pu-238) and thorium-232 (Th-232) in Area 3. These two radionuclides are the most prevalent radiological contaminants at Mound Plant. The soil gas survey was conducted to detect total aromatic hydrocarbons, total semi-volatile compounds, total C_5 to C_{11} petroleum hydrocarbons, and total halogenated compounds.

The data collection points for the FIDLER survey, the soil screening activities, and the soil gas survey were established over a 25 foot grid system within the estimated Area 3 boundary (see Figure 2.1 or Plate 1, Appendix A). The survey map of Area 3 (Appendix B) shows those points on the grid system located by a registered land surveyor. Before sampling, all transverses of the grid system were cleared of small trees and underbrush and the remaining sample locations were marked with wooden stakes or paint.

Portions of the "estimated" Area 3 location were not included in this Phase 1 program. These included the immediate areas surrounding and under Buildings 72 and 19 due to both being RCRA facilities. Also, the asphalt parking lot (in the northwest region of Area 3) was not surveyed due to the extent of the paving material. Should Phase II activities be required, cores in this area will be assessed for those sample requirements.

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

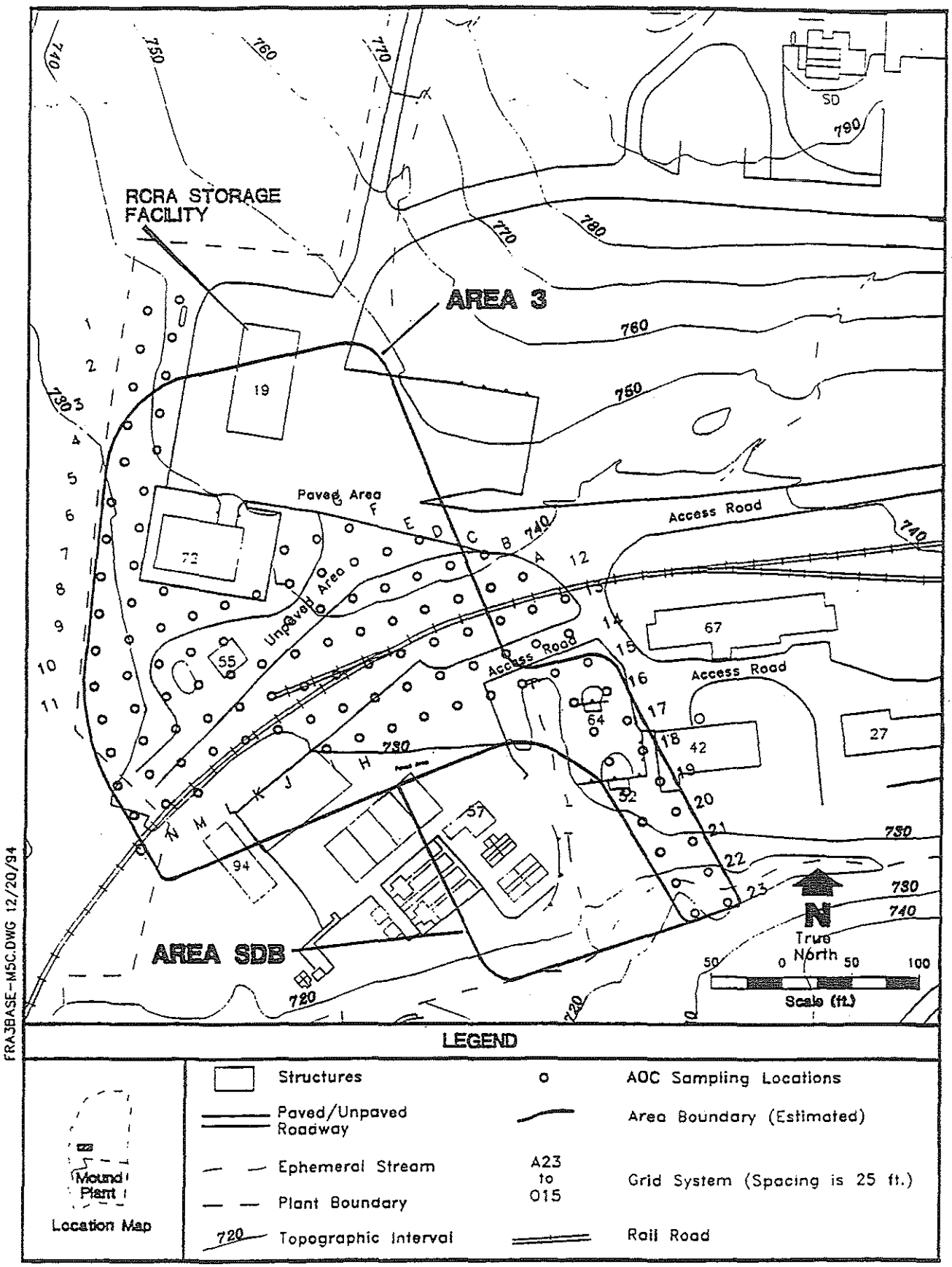


Figure 2.1. The Estimated Boundary and Established Grid System of Area 3

2.1. RADIOLOGICAL (FIDLER) SURVEY

A FIDLER survey was performed at Area 3 on July 20, 26, 27, and 28, and on August 1 and 2, 1994, per the Mound Standard Operating Procedure (SOP) 6.7, Near Surface and Soil Screening for Low-Energy Gamma Radiation Using the FIDLER.

2.1.1. Field Work Performed and Procedures

Prior to beginning the survey, a Bicron FIDLER was calibrated and a background station was established each day as listed in Table II.1.

Table II.1. FIDLER and Background Station Information for Area 3

Date	FIDLER #	Instrument #	Probe #	Background Station
7/20/94	#1	#3712	#3713	Stake A22
7/26/94	#1	#3712	#3713	Stake N01
7/27/94	#1	#3712	#3713	Stake A12
7/28/94	#3	#3228	#3432	Stake I12
8/01/94	#3	#3228	#3432	Stake C16
8/02/94	#3	#3228	#3432	Area A15

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

Due to its ability to detect a wide range of isotopes, the Out Channel was selected for screening surface radiological contamination within Area 3. The Out Channel responds to low-energy gamma rays and x-rays, while Channel 1 primarily responds to Pu-238 and Channel 2 primarily responds to Th-232.

In cleared areas, each 25 foot by 25 foot grid block was subdivided into 25 five foot by five foot sections (see Appendix C, Generic Sampling Identification Scheme figure). These sections were surveyed in a

serpentine fashion at a rate of 20 feet per minute. An Out Channel reading was taken in each section and recorded in the FIDLER logbook. If the readings exceeded the CC for the Out Channel, the section was divided into quadrants (northwest, northeast, southwest, and southeast). The FIDLER crew then located the point of highest activity in the area of elevated activity by identifying where the highest readings were detected in one of these quadrants. After one minute stabilization periods, 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 around 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 by distance and direction from the highest activity in the FIDLER logbook (Appendix A.2).

Where grid blocks could not be surveyed in a serpentine fashion due to thick vegetation, Out Channel readings were taken at each stake after a one minute stabilization period. The FIDLER operator then walked between stakes perpendicular to Row A, (i.e. A13 to A23, B12 to B23, etc. as depicted in Figure 2.2) at a rate of 20 feet per minute with the FIDLER in the Out Channel mode. In these particular grid blocks of Area 3, no Out Channel readings exceeded the CC between stakes.

2.1.2. Quality Assurance Summary Report

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

2.1.2.1. Field Variance Report

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

The first minor variance was the use of Pu-238 and Th-232 sources for the daily source check as opposed to the americium-241 source specified in SOP 6.7. Plutonium and thorium sources were provided by the Mound plant for the required daily check. The second variance from SOP 6.7, the inability to screen the entire area in a serpentine fashion, occurred due to portions of Area 3 being thickly wooded and very steep. In grid blocks where it was not possible to screen in a serpentine fashion, screening was conducted at and between grid points as described in Section 2.1.1. For Area 3, 64 percent was screened in a

serpentine fashion, 11 percent was partially screened in a serpentine fashion, and 25 percent was screened at grid points only.

2.1.2.2. Data Analysis Variance Report

FIDLER survey data were not formally validated. However, all logbook entries were checked for accuracy, completeness, and format. An error was found in the calculations used to determine the FIDLER contamination criteria (CC). These values were recalculated and compared to the FIDLER survey data. After reviewing the data, several additional locations in Area 3 were identified as having elevated radiological activity when compared to the recalculated Out Channel CC. Because the corrections were made following the completion of the survey, no Channel 1 or Channel 2 readings were taken at these locations identified as having elevated Out Channel readings.

2.1.3. Health and Safety Summary Report

The FIDLER survey was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993e), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area - Area 3 and Sewage Disposal Building Area. Health and safety issues were discussed and resolved during daily tailgate safety briefings conducted by the Site Health and Safety Officer and documented in the Site Manager Logbook (Appendix A.1).

On July 27, 1994 a minor accident occurred when a member of the FIDLER field team slipped on a steep gravel incline and fell into a thistle bush. Thistles were imbedded in her hand, arm, leg, and back. First aid was administered at the site. Serpentining was discontinued in this steep portion of Area 3 to prevent a recurrence of this type of accident.

No safety violations occurred during the FIDLER survey at Area 3. On August 23, a health and safety surveillance was conducted; no deviations were found.

2.1.4. Presentation of Radiological Data

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

The FIDLER survey of Area 3 located several areas of elevated surface activity shown in Figure 2.2 and summarized in Table II.2. A majority of these locations were found near Building 55 and Building 72. The activity was found near of on the surface of a gravel road constructed on fill dirt and a grassy area to the west of Building 72. Two other locations of elevated activity (3B15-15 and 3B15-25) were found on the edge of a drainage ditch that runs between Building 42 and Building 57, through the woods, and empties into the plant drainage ditch running through Area SDB.

Surface soil samples, collected as part of the soil gas survey (see Section 2.2.1.1), were analyzed for Pu-238 and Th-232 at the Mound Plant Soil Screening Facility. Concentrations of Th-232 at or exceeding the Mound Plant Soil Screening Facility detection limit of 2.0 pCi/g were detected at four of the 102 sample locations (G10, I13, J10, and N15) (see Table II.3). Concentrations of Pu-238 at or exceeding the Mound Plant Soil Screening Facility detection limit of 25 pCi/g were detected at 22 of the 102 sample locations. Figure 2.3 shows (1) the locations where concentrations of Pu-238 equal or exceed 25 pCi/g; (2) the concentration contours where Pu-238 exists at concentrations from 25-50 pCi/g; and 3) the concentration contours where Pu-238 exists at concentrations greater than 50 pCi/g. This information is summarized in Table II.3. The concentration of Pu-238 at the soil surface does not appear to exceed 100 pCi/g within the estimated boundary of Area 3. Additionally, surface soil sample results indicate that Pu-238 might be present outside the estimated Area 3 boundary on the northwest "arm" and the southeast "arm" of the area at concentrations above 25 pCi/g.

2.1.5. Comparison with Historical Radiological Data

Surface and subsurface soil samples were collected within the boundary of Area 3 from 1983 to 1985 during the Site Survey Project (Stought et al. 1988). Eighteen core locations (drilled to a maximum depth of 15 feet) and 20 surface soil sample locations were analyzed for Pu-238 and isotopic thorium. A summary of the results of the soil sampling conducted under the Site Survey Project is presented in Table II.4 of this report (DOE 1992b). The corresponding core and surface soil sampling locations are shown in Figure 2.4.

During the Site Survey Project, Pu-238 was detected in six samples at concentrations greater than 25 pCi/g. Elevated Pu-238 activity was found near Building 19 (C0099, C0100, and S0540), near Building 72 (C0103 and C0104), and in surface samples S0547, S0557, and S0540. The maximum concentration

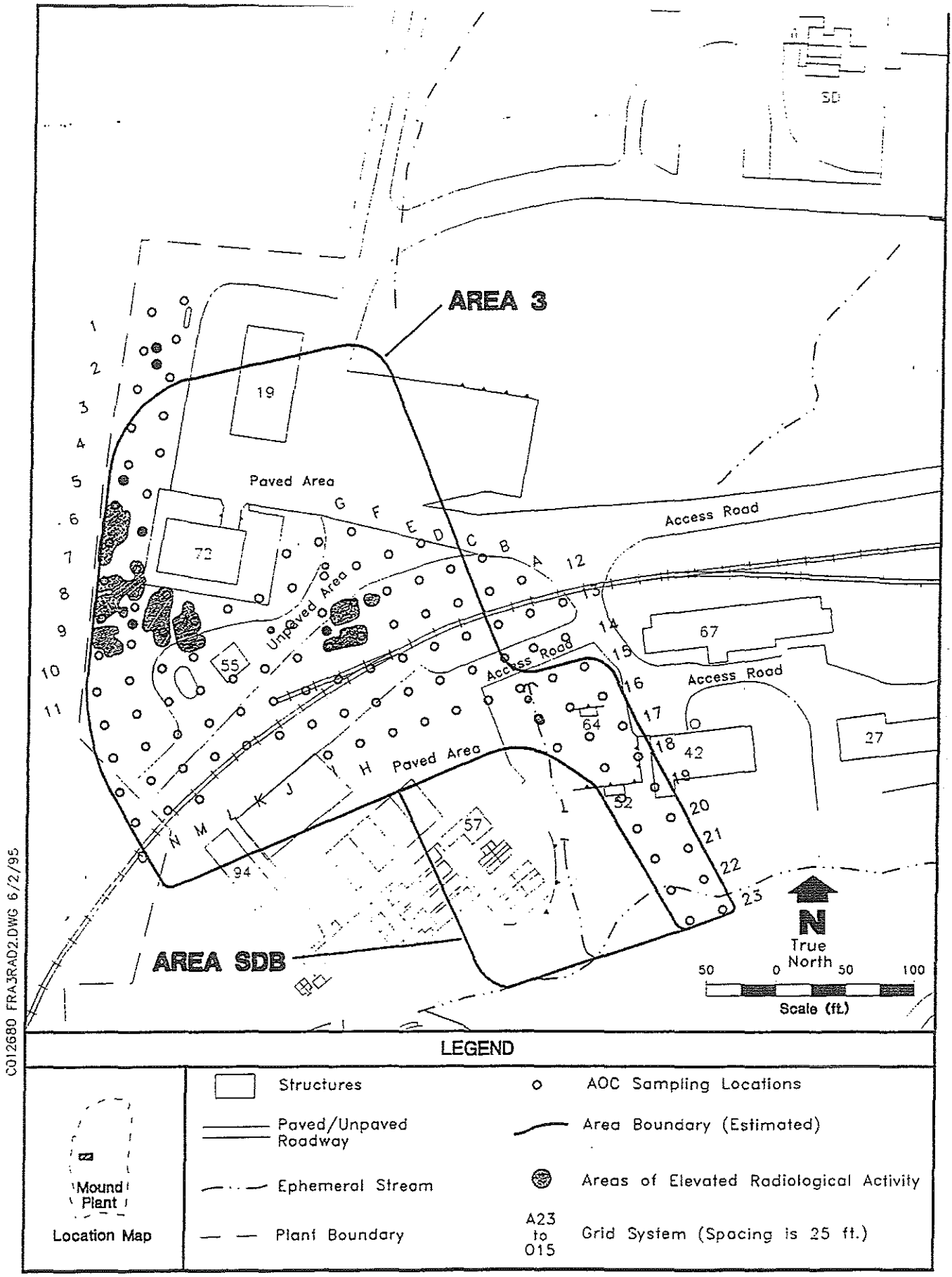


Figure 2.2. Areas of Elevated Surface Radiological Activity (FIDLER Survey)

Table II.2. Summary of Elevated Surface Radiological Activity in Area 3
(FIDLER Survey)
Page 1 of 2

Grid Location	Out Channel Reading (kcpm)	Out Channel CC (kcpm)
3N01-24	8.0	7.5
3N02-07	8.0	
3N05-06	8.0	
3N06-05 to 3N06-07, 3N06-14 to 3N06-17, 3N06-21, 3N06-22, 3N06-24, 3N06-25	8.0 - 8.5	
3N07-05, 3N07-06	8.0	
3N08, 3N08-04, 3N08-05, 3N08-08 to 3N08-10, 3N08-14 to 3N08-17, 3N08-20, 3N08-24, 3N08-25	8.0 - 9.5	
3L09-19	12.5	11.5
3M09-01 to 3M09-03, 3M09-08 to 3M09-12, 3M09-19 to 3M09-21	8.0 - 9.5	7.5
3N09-02, 3N09-11, 3N09-14 to 3N09-16, 3N09-23, 3N09-24	8.0 - 8.5	
3F10-02, 3F10-03, 3F10-05	12.0 - 19.0	11.5
3G10-01 to 3G10-03, 3G10-08 to 3G10-10, 3G10-15, 3G10-18 to 3G10-25	8.0 - 9.5	7.5
3I10-23	22.0	11.5
3L10-01 to 3L10-03, 3L10-05, 3L10-08, 3L10-09, 3L10-11, 3L10-12	12.0 - 27.0	11.5
3M10-02, 3M10-09, 3M10-10, 3M10-14 to 3M10-18, 3M10-23 TO 3M10-25	8.0 - 13.5	7.5
3N10-08, 3N10-09, 3N10-11 to 3N10-25	8.0 - 13.0	7.5
3K11-04	19.0	11.5
3M11-03 to 3M11-07, 3M11-12 to 3M11-18, 3M11-21 to 3M11-25	8.0 - 8.5	7.5
3N11-01 to 3N11-25	8.0 - 10.0	7.5
3E12-03	13.0	11.5
3F12-04, 3F12-05, 3F12-08, 3F12-11, 3F12-12	12.0 - 12.5	11.5

Table II.2. Summary of Elevated Surface Radiological Activity in Area 3
(FIDLER Survey)
Page 2 of 2

Grid Location	Out Channel Reading (kcpm)	Out Channel CC (kcpm)
3G12-06 to 3G12-12, 3G12-20	12.5 - 13.0	11.5
3H12-01, 3H12-03, 3H12-07 to 3H12-10, 3H12-12 to 3H12-14	12.0 - 14.0	11.5
3I13	15.0	12.1
3K13-22	13.0	12.1
3L13-20	13.0	12.1
3A15-01 to 3A15-03	9.5 - 10.0	9.3
3B15-13, 3B15-15, 3B15-25	11.0 - 29.0	9.9
3A16-24	9.5	9.3
3B16-05	21.0	9.9
3A17-07	9.5	9.3
3A18-24, 3A18-25	10.0	9.3

CC contamination criteria
kcpm counts per minute x 1000

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

Grid Location[a]	Mound Soil Screening Facility Data	
	Plutonium-238 (pCi/g)	Thorium-232 (pCi/g)
A20	31	ND
A21	37	ND
A22	84	ND
B15	39	ND
B16	25	ND
B17	29	ND
B18	25	ND
B22	35	ND
B23	25	ND
E12	25	ND
G10	ND	3.6
I13	38	2.3
J10	ND	2.1
M12	25	ND
N6	48	ND
N7	31	ND
N10	32	ND
N11	26	ND
N15	ND	2.2
O2	25	ND
O5	27	ND
O6	53	ND
O7	40	ND
O8	32	ND
O9	52	ND
O12	27	ND

a - See Figure 2.3 for grid location
ND - Radiological activity not detected above detection limit

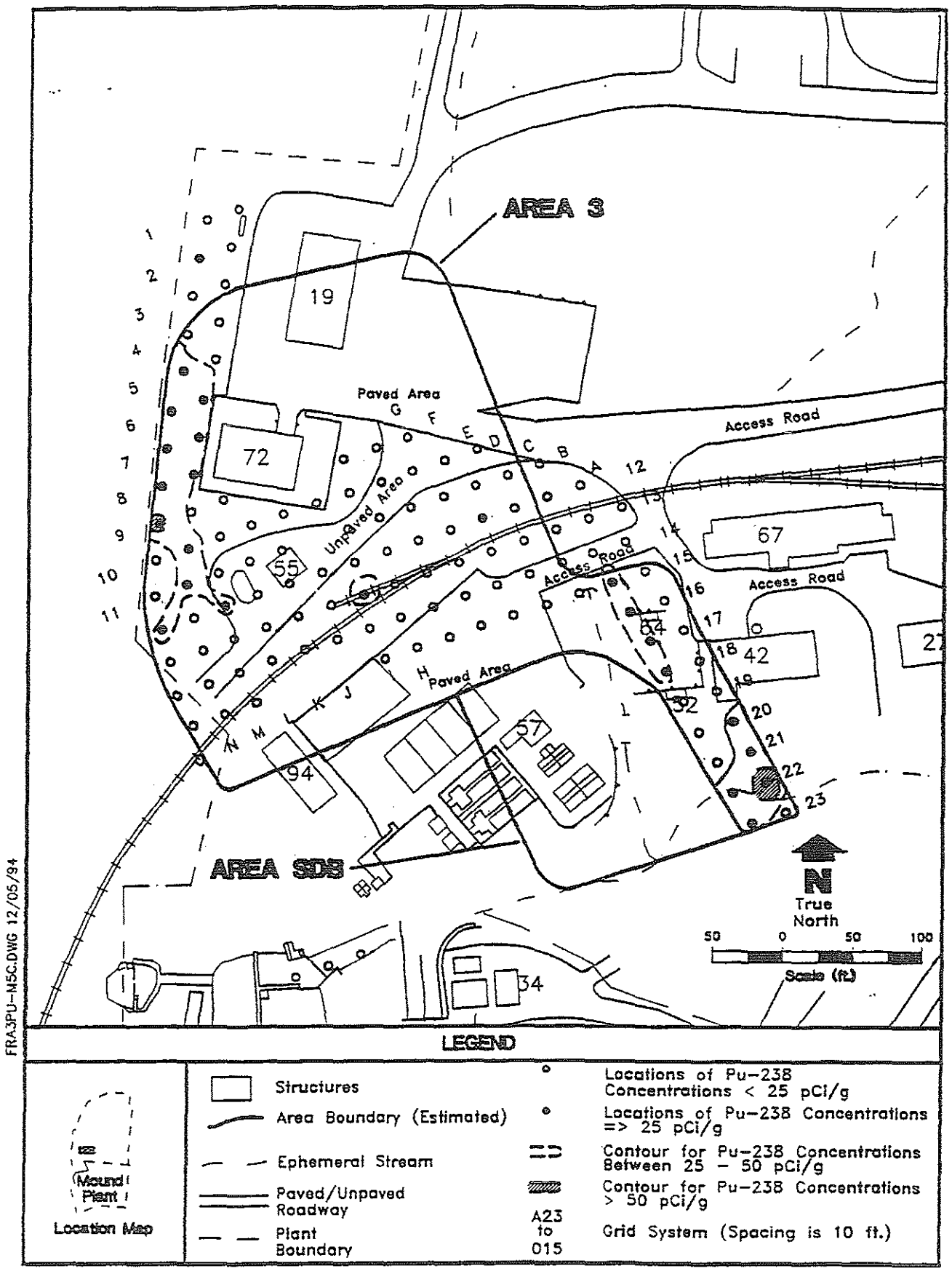


Figure 2.3. Locations of Elevated Surface Soil Radiological Activity (Pu-238)

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

Location[a]	Coordinates South	Coordinates West	MRC ID No.	Mo.Yr.	Depth (inch)	Plutonium-238 (pCi/g)	Thorium[b] (pCi/g)
C0099	1965	4265	10419	08-85	18	31.4	b
C0100	1975	4275	10421	08-85	18	32.4	b
C0103	2060	4300	1624	04-83	18	0.26	3.95
			1625	04-83	36	0.50	b
C0104	2085	4365	1622	04-83	18	50.60	b
			1623	04-83	36	5.28	b
C0107	2170	4375	1620	04-83	18	0.69	b
			1621	04-83	36	0.07	2.56
C0115	2275	4395	1644	04-83	18	1.46	3.56
			1646	04-83	36	0.31	b
S0540	2050	4165	2685	10-83	0	36.94	b
S0547	2365	4375	10485	08-85	0	11.0	5.30
S0551	2375	4390	6878	08-84	0	27.10	b
S0552	2380	4370	10486	08-85	0	41.70	b

[a]Map locations are given using a "C" to designate core locations and an "S" to designate surface locations.
[b]A "b" indicates that the total thorium concentration was less than the Mound Plant Soil Screening Facility level of 2.0 pCi/g. Therefore, radiochemical analysis was not performed.
MRC ID - Monsanto Research Corporation identification.
pCi/g - picocuries per gram.

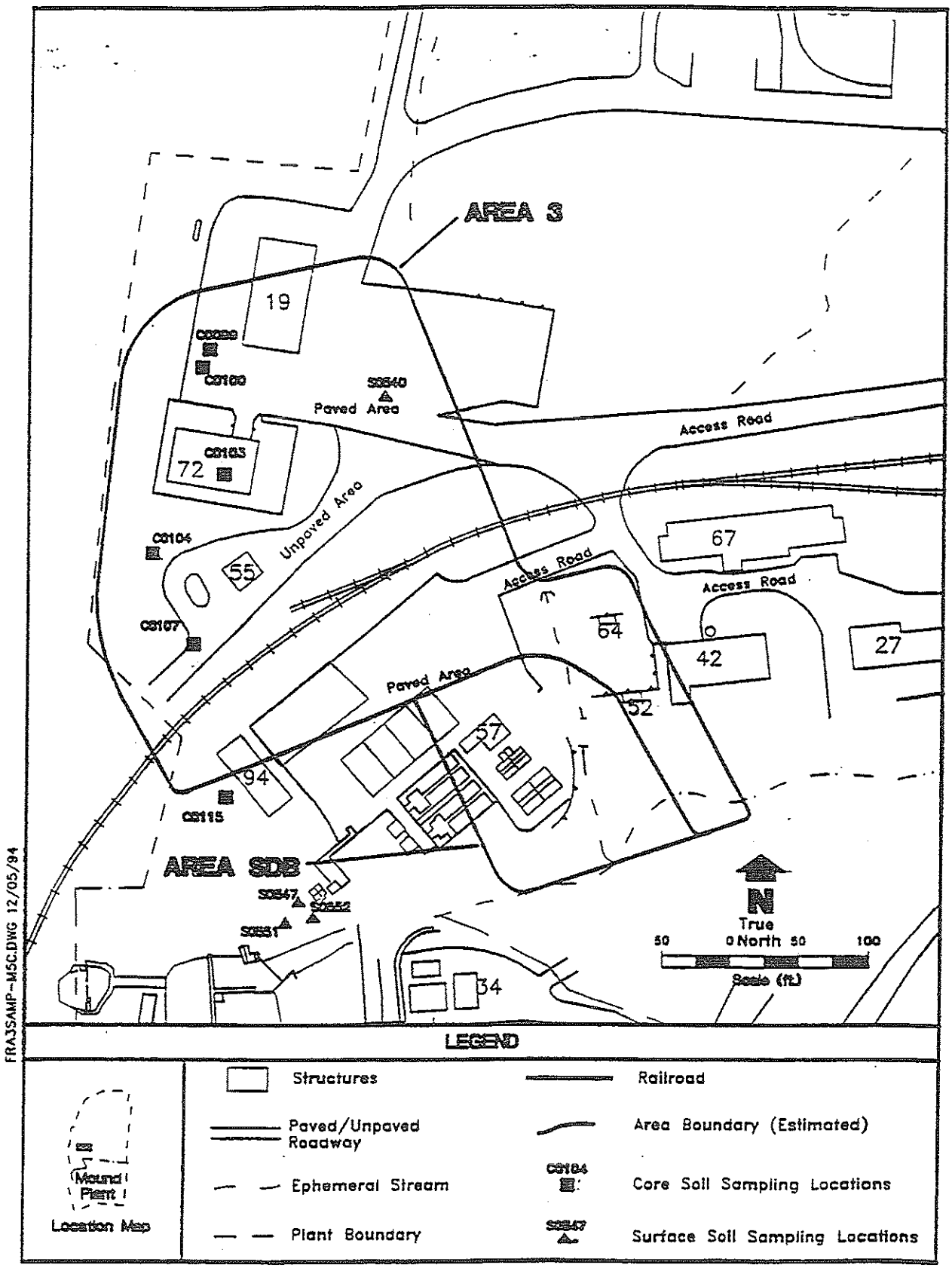


Figure 2.4. Sampling Locations for Historical Radiological Data Collected in Area 3 (Mound Site Survey Project, 1983-1985)

of 50.6 pCi/g was measured in the sample taken at a depth of 18 inches at core location 0104. Thorium was detected in four samples at concentrations greater than 2.0 pCi/g, with a maximum concentration of 5.30 pCi/g at surface location 0547 in the southern portion of Area 3.

The results from the soil sample screening of Area 3 during the 1994 Phase I investigation clearly indicate the presence of Pu-238 in the surface soil around buildings 19 and 72. Pu-238 was also found in this area during the Mound Site Survey Project. In both investigations, four isolated locations of elevated thorium activity were detected. However, the locations of elevated activity for thorium are not consistent between the two investigations (see Figures 2.3 and 2.4).

2.2. SOIL GAS SURVEY

2.2.1. Field Work Performed and Procedures

A soil gas survey was performed in Area 3 from July 18 to September 1, 1994, per the OU5 QAPjP, SOP for Petrex Environmental Surveys [Attachment 1] (DOE 1993d). The survey was completed over the grid system established for Area 3 (see Figure 2.1 or Plate 1, Appendix A).

2.2.1.1. Soil Gas Sampler Installation

Two sets of time calibration samplers (timers) and 114 data samplers were installed on six days between July 18 and August 18, 1994. Locations of the timers and data samplers are shown in Appendix D, Plate 1. The samplers and timers were installed at depths between 7-18 inches using an electric hammer drill and a 18 x 1.5 inch steel/tungsten carbide-tipped drill bit.

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

A FIDLER was used to monitor placement of all 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 and presented in their entirety in Appendix C.

2.2.1.2. Soil Gas Sampler Retrieval

On July 25, 1994, one timer from each of the two timer sets was retrieved, wiped (checked for radiological contamination), and sent to Northeast Research Institute LLC (NERI) for analysis. The analysis of timers at grid coordinates B12 and N12 indicated low to moderate relative response to C_4 to C_9 petroleum hydrocarbons and very low relative response to the chlorinated organic compound tetrachloroethene. Based on these low relative responses and slow loading rates, NERI requested that the second set of timers be retrieved on July 28, 1994. After analyses of the second set of timers, NERI recommended an exposure time of approximately 21 days per sampler.

Samplers were extracted on four days between August 10 and September 1, 1994. Six of the samplers O10, I11, C13, G14, J14, and H15 could not be retrieved due to broken tubes and the placement of construction materials and debris over the emplacement site. The remaining samplers were wiped and prepared for shipment. On September 1, 1994, the samplers were sent to NERI for analysis.

Upon receipt of the samplers, NERI noted that the collector wires in samplers B13 and H09 had been scraped and that the cap liner in sampler G11 was missing. As these conditions compromise sample integrity, these three samplers were withheld from analysis. Thus, 105 samplers were analyzed by NERI (108 samplers retrieved less three samplers withheld from analyses).

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 1993d). These variances included decontamination procedures, the number of samplers installed, timers, 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.

Three minor variances from the FSP affected the total number of samplers and timers installed, and the use of travel blanks. The first variance was a decrease of nine samplers installed in Area 3 (123 proposed, 114 installed). Eight of these sampling points were located under freshly laid asphalt. These points were deleted from the survey area because of the uncertain effect of the new asphalt on the integrity of the soil gas samples. The remaining sample point (grid coordinate J11) was located under a building.

The second variance was a decrease in the number of timers installed in Area 3. The FSP requires five timers for an area this size, whereas NERI suggested that three timers were sufficient.

A third variance from the FSP was the use of the 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 Area 3 was received from NERI on October 20, 1994. Sample locations shown on Plate 1 of the NERI report (Appendix D) were checked against the field map to confirm that all sampling locations were correctly plotted; no errors were found. A ten percent quality assurance check of ion count values (Table 1, Appendix D) versus plot accuracy (Plates 2 through 5, Appendix D) yielded no errors.

2.2.3. Health and Safety Summary Report

The soil gas survey was conducted according to the OU5 South Property RI/FS Health and Safety Plan (DOE 1993e), and the Environmental Restoration Program Site-Specific Health and Safety Plan for OU5 Operational Area - Area 3 and Sewage Disposal Building Area.

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.1).

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 D. The report discusses the Petrex method, the scope of work, quality assurance/quality control methods, and results. Appendix D, Plates 1 through 5, show sample locations and significant ion counts of targeted compounds. Ion count values are the unit of measure assigned by the mass spectrometer to the relative intensities associated with each compound. These intensity levels do not represent actual concentrations. Soil gas data are considered qualitative in that multiple sources in soil and/or groundwater cannot be differentiated. Based on a review of historical information for Area 3 and the immediate vicinity, NERI provided analytical data for the following four general classes of compounds in order to assess the potential for the presence of these compounds below the surface:

- total aromatic hydrocarbons;
- total semi-volatile hydrocarbons;
- total C_5 to C_{11} petroleum hydrocarbons; and
- total halogenated hydrocarbons.

The following subsections describe the distribution of these compounds.

2.2.4.1. Distribution of Total Aromatic Hydrocarbons

Total aromatic hydrocarbons are reported as the combined levels of C_6 to C_{15} aromatic (benzene based) hydrocarbon compounds detected in the soil gas samples. The majority of the samples contained only the smaller (C_6 through C_9) aromatics. Very few samples were observed to contain C_{10} and larger aromatic hydrocarbons. This combination of compounds is typical of vapor derived from the weathered residue of medium and heavy weight fuels.

Elevated relative levels of total aromatic hydrocarbons are present along the periphery of Area 3 in several zones to the east, west, and north and in one larger zone centered in the middle of the area (see Appendix D, Plate 2). This larger zone surrounds the railroad spur and Building 55 and extends south toward the

border of Area SDB. The highest relative level of aromatics detected occurs at sample G13, located near the bed of the railroad spur.

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 heating oils. Soil gas data indicate that very few semi-volatile compounds over C_{12} molecular weight may be present in the soil gas, and that the majority of the relative responses derive from the presence of naphthalene compounds.

Elevated relative responses of semi-volatile hydrocarbons are found in scattered zones along the northern edge of Area 3, in a zone bordering Building 55, and in a central zone which extends to the south toward Area SDB (see Appendix D, Plate 3). These relative responses are principally naphthalene and alkyl naphthalenes and generally coincide with elevated relative levels of a broad assortment of other petroleum hydrocarbons which are typical of the vapor of various weathered fuels. Only the soil gas at sample locations B23, F14, and G15 showed relative levels of napthalene compounds atypical of fuels.

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.

The areal distribution of total C_5 to C_{11} petroleum hydrocarbons is shown in Appendix D, Plate 4. The distribution of these petroleum hydrocarbons is similar to that of total aromatics, except that several zones in which heavier aliphatic compounds are more abundant appear better defined. Several small zones of elevated relative responses of total petroleum hydrocarbons are scattered throughout the central portion of Area 3. The highest relative levels were found near Building 55 and at a point near the northeast border at grid coordinate F10. The soil gas from locations in these areas contained elevated relative levels

of aliphatic compounds and alkyl styrenes which is typical of vapor from weathered, heavy fuel, oil-like products.

Also, there is a larger zone in the central portion of the site which trends along the railroad spur and extends to the south. The composition of the soil gas in this zone and in most of the other zones scattered along the northern and eastern border is more characteristic of weathered, medium weight fuels.

2.2.4.4. Distribution of Total Halogenated Hydrocarbons

Total halogenated hydrocarbons are reported as the combined levels of tetrachloroethene (PCE), trichloroethene (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 for 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). DCB, as a solid, is used as a fumigant (1,2- isomer).

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

Elevated relative levels of halogenated hydrocarbons occur in several zones throughout the western half of the site. The two largest zones are found near Buildings 19 and 72. A smaller zone borders Building 42 to the east (see Appendix D, Plate 5).

2.2.5. Comparison with Historical Chemical Data

Previous sampling investigations indicate the presence of subsurface organic chemical contamination in and around Area 3. The following subsections describe the sampling events, present the data from these events, and compare this data with data from the Phase 1 soil gas survey.

2.2.5.1. Historical Groundwater Data

Laboratory analyses of groundwater samples from five monitoring wells in or around Area 3 have indicated chemical contamination. The locations of Wells 0122, 0125, 0137, 0312, and 0315 are shown in Figure 2.5; Well 0122 is the only well located in Area 3. These wells were sampled from February 1984 to December 1991 (DOE 1992c), and in March 1993 (DOE 1993f).

Though no comprehensive interpretive report has been produced, certain organic contaminants were found (DOE 1992d). These contaminants included 1,2-*trans*-dichloroethene (DCE), TCA, PCE, and TCE. In addition, dichloromethane (DCM), 2-butanone, carbon tetrachloride (CTC), 1,2-dichloroethane (DCA), and styrene were also found. Table II.5 shows the sampled wells and the contaminants found.

Table II.5. Chemical Contaminants Detected in Monitoring Wells in the Vicinity of Area 3

CONTAMINANT	WELL ID #
DCM	0122
2-butanone	0122, 0137
TCE	0122, 0137, 0312, 0315
TCA	0125, 0137, 0312, 0315
DCE	0137, 0312, 0315
PCE	0137, 0315
CTC	0137
DCA	0137
Styrene	0137

As Table II.5 shows, TCE, TCA, and DCE were the most commonly occurring organic contaminants. Well 0137, located south of Area 3 shows the most contaminants. Well 0122, the only well within the boundary of Area 3, shows contamination by DCM, 2-butanone, and TCE.

Data from the soil gas survey as reported in the NERI report (Appendix D) is somewhat consistent with the groundwater sample analyses, shown in Table II.5. PCE and TCE are common parameters to both the groundwater samples and the NERI soil gas survey. TCA was found in groundwater samples from

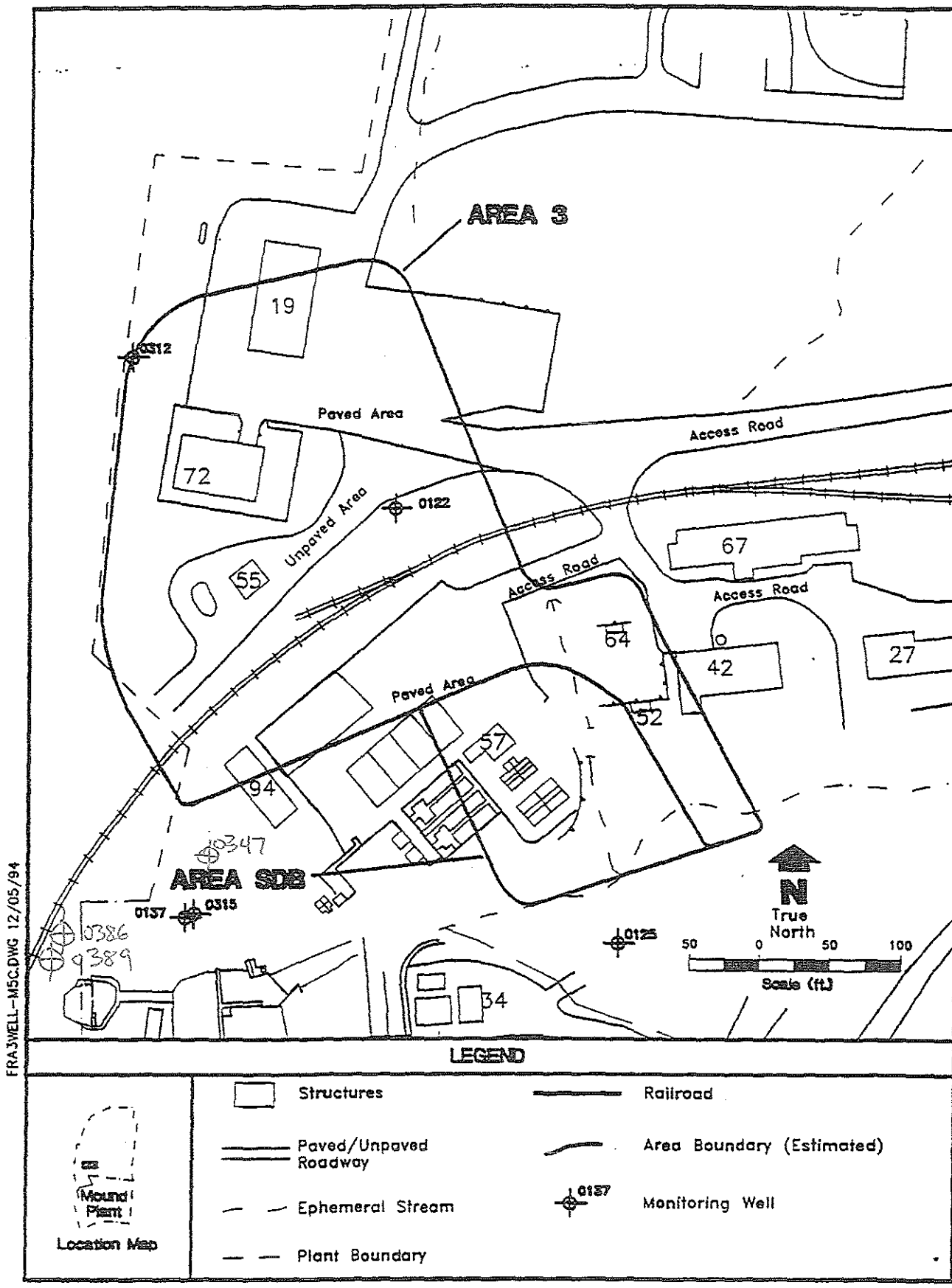


Figure 2.5. Monitoring Wells Located in the Vicinity of Area 3

four of the wells but was only found sporadically by NERI. DCA and styrene were found in Well 0137 but was not detected by NERI. DCE, DCM, and CTC were not reported as constituents of total halogenated hydrocarbons by NERI so no comparison is possible. The compound, 2-butanone, was found in two of the wells (0122 and 0137), however, due to it's solubility in water, it does not disperse as a gas and was not detected by NERI.

2.2.5.2. Historical Soil Gas Data

During the 1992 reconnaissance soil gas survey, four soil gas samples were collected in or around Area 3 (1992e). Sample 5221, collected at the edge of Building 19, indicated the presence of Freon-11, Freon-113, TCE, and possibly toluene. Sample 5222, collected a few feet northwest of Building 72, indicated the possible presence of toluene.

These data are fairly consistent with data from the NERI report, especially with respect to Freon-11, Freon-113, and TCE. These compounds were found consistently by both NERI and the 1992 soil gas survey around Buildings 19 and 72. Toluene was possibly detected during the 1992 soil gas survey in this same area, but was not reported by NERI.

Prepared by: Northwest Research Institute LLC, 605 Parfet Street, Suite 100, Lakewood, Colorado 80215, (303) 238-0060	Drawn By: JCS Checked By: Project Manager:	Project #: 2114E Date: October 8, 1994 File Name: 2114-8_2.dwg	AOC-3/Operable Unit-5 USDOE Mound Facility Miamisburg, Ohio	LEGEND Relative Response Values: ≥ 10,000,000 1,000,000 – 9,999,999 Features: PEIREX Sample Location

Relative Response
Total Aromatic Hydrocarbons

Plate 2

Prepared by: Northeast Research Institute LLC, 805 Portet Street, Suite 100, Lakewood (303)	Drawn By: JCS; Checked By:	Project #: 2114E; Date: October 6, 1994; File 2114-6_3.dwg	AOC-3/Operable Unit-5; USDOE Mound Facility, Miamisburg, Ohio	LEGEND: Relative Response Values: ≥ 1,000,000; 100,000 – 999,999; Features: + PETREX Sample Location; ND Not Detected	Relative Response; Total Semivolatile Hydrocarbons; Plate 3

Prepared by: Northeast Research Institute LLC, 405 Parfet Street, Suite 100, Lakewood, Colorado 80215, (303) 235-0099	Drawn By: JCS	Project #: 2114E	AOC-3/Operable Unit-5
	Checked By:	Date: October 6, 1994	USDOE Mound Facility, Miamisburg, Ohio
	Project Manager:	File Name: 2114-5_4.dgn	

LEGEND

Relative Response Values:
- ≥ 35,000,000
- 6,000,000 – 34,999,999

Features:
- + PETREX Sample Location

Relative Response
Total C5-C11 Petroleum Hydrocarbons

Plate 4

Prepared by: Northeast Research Institute LLC, 405 Parfet Street, Suite 100, Lakewood, Colorado 80215 (303)	Drawn By: JCS Checked By:	Project #: 2114E Date: October 6, 1994 File 2114-6_b.dwg	AOC-3/Operable Unit-5 USDOE Mound Facility Miamisburg, Ohio	LEGEND Relative Response Values: ≥ 1,000,000 100,000 – 999,999 Features: + PETREX Sample Location ND Not Detected H Pi[illegible]drocarbo[illegible] in [illegible] see to.	Relative Response Total Halogenated Hydrocarbons Figure 5

ENVIRONMENTAL RESTORATION PROGRAM

OPERABLE UNIT 9
SITE SCOPING REPORT:
VOLUME 7 - WASTE MANAGEMENT

MOUND PLANT
MIAMISBURG, OHIO

February 1993

DEPARTMENT OF ENERGY
ALBUQUERQUE FIELD OFFICE

ENVIRONMENTAL RESTORATION PROGRAM
EG&G MOUND APPLIED TECHNOLOGIES

FINAL

Closed containers of mixed waste are transported from the laboratory generating the material to Building 23, using a box-type or flatbed truck with rails. The truck is marked "Dangerous." Mixed waste is not transported off-plant; such waste is stored pending completion of waste characterization and identification of an acceptable waste treatment/disposal option. One hundred 55-gallon drums were stacked three-high during the 1988 site inspection (EPA 1988). Building 23 is one-story, 30 ft by 117 ft, and constructed of concrete block walls. The storage area is 30 ft by 40 ft with a concrete floor sloping to a 3-ft diameter, 6-ft deep concrete sump. The sump is not double contained. The sump has a sump pump with a flex-hose that can route the liquids to the storm sewer if clean or to WD Building or drums if contaminated (Hopkins, D 1991). An automatic sprinkler system is in the interior of the building, and two loading docks are on the front side of the building. The site inspection (EPA 1988) reported a release of tar-like substance near the radioactive waste drums in the northeast corner of Building 23, but the source of the leak was unidentified. The tar-like substance was later identified as a non-hazardous/non-radioactive material and was disposed of accordingly (Hopkins, D 1991). Approximately 85 gallons of scintillation vial wastes (and associated packaging materials) are generated annually.

5.1.3. Building 31, Contaminated Material Storage Building

The Building 31 Contaminated Material Storage Building (Figure 5.1) was built in 1966 and is located on the SM/PP Hill, (MRC 1978c). The building was originally used to store recoverable plutonium wastes that had been moved from the SM storage field east of Building 21 (McMannon 1963-1967). It is now used for interim storage of packaged radioactive waste waiting final disposition. The building is a one-story, sheet-metal building occupying 6,100 ft^2. The radioactive waste storage room was originally divided into three bays, but has been converted to a single large bay. The floor is a concrete slab with no drains or sumps or curbing. The waste is normally noncombustible equipment or soil contaminated with plutonium-238 or tritium. Waste stored in Building 31 is packaged in either drums or boxes that meet LSA or TRU criteria (Davis 1991).

5.1.4. Area 3, Thorium Storage and Redrumming Area (Historical)

Area 3 is in the lower valley area southwest of the Main Hill (Stought et al. 1988) and includes Buildings 19, 42, 55, 57, and 72 (Figure 5.1). These buildings serve various purposes, including salvage operations, effluent monitoring, sewage treatment, and hazardous waste storage. In 1954 and 1955, about 6,000 55-gallon drums of thorium sludge were delivered by rail to Mound (MRC 1973a; Meyer 1979a). Some thorium drums were stored in Area 3 for prolonged periods during which time exposure to the elements and internal exposure to corrosive solutions necessitated frequent redrumming (MRC 1973a). Leakage and redrumming operations resulted the release of thorium into

the soil. In 1965, the thorium-contaminated soil was reportedly excavated and the area backfilled with clean soil (MRC 1985a; Stought et al. 1988). This claim could not be verified through research for this report. The Mound Site Survey Project (1982-1985) (DOE 1991c) analyzed soil samples from Area 3 and found elevated concentrations of plutonium and thorium (maximum plutonium-238 concentration of 50.60 pCi/g and maximum thorium concentration of 5.30 pCi/g). The plutonium contamination may have resulted from runoff from the rupture of the WTS line between the WD Building and the SM/PP area complex in 1969 (DOE 1991c). Building 72 is currently used to store drums of hazardous waste prior to shipment for off-plant disposal. Wastes stored in this area may include organic solvents (e.g., acetone, isopropanol, methanol, trichloroethene); waste oils; paints and thinners; spent plating solutions containing chrome, cadmium, nickel, and copper; photoprocessing wastes; and polymer wastes (EPA 1988).

5.1.5. Area 9, Thorium Storage and Redrumming Area (Historical)

Area 9, the former Thorium Storage and Redrumming Area, is located under and around Building 31 (Figure 5.1). Building 31 was constructed in 1966 (MRC 1985a) and is on the eastern border of the site on the SM/PP Hill. It is currently used to stage both alpha and beta solidified and packaged wastes prior to shipment to off-plant disposal locations. In 1954 and 1955, 6,000 55-gallon drums of thorium sludge were delivered to Mound (MRC 1973a; Meyer 1979a). Some of these drums were stored at Area 9, and prolonged outside storage and internal exposure to corrosive solutions necessitated their frequent repackaging to ensure containment of the ore residue. Redrumming was initiated in April 1966 (Meyer 1956d). It became routine to repackage 20 to 45% of the drums annually. Drums were eventually moved to Area 1 where the thorium sludge was removed and placed in Building 21 (Thorium Sludge Storage Facility) beginning in July 1964. In 1965, an area of approximately 40,000 ft^2 was excavated from Area 9 and backfilled with clean soil to remove thorium-contaminated soils, which were subsequently deposited in Area 8 (MRC 1985a; DOE 1991c). The area is currently covered with asphalt. Low levels of plutonium and thorium contamination were detected in soils in this area (maximum plutonium-238 concentration of 8.15 pCi/g and maximum thorium concentration of 12 pCi/g) during the 1982 to 1985 Radiological Site Survey (DOE 1991c).

5.1.6. Building 21, Thorium Sludge Storage Facility (Historical)

Building 21 is southeast of the Building 90 blockhouse in the southern portion of Mound (Figure 5.1). Building 21 became operational in July 1964 (MRC 1973a), but is currently empty and is to be decommissioned. The building is 112 ft by 36 ft by 14 ft high and is completely enclosed with the walls and roof constructed of iron and steel (MRC 1973a). It was constructed on concrete with a 10-inch-thick floor and 14- to-16-inch-thick walls, which were intended to act as cantilevered retaining

#5

MLM-3517
UC-702

The Mound Site Survey Project for the Characterization of Radioactive Materials in Site Soils

Robert L. Stought, Don A. Edling, and
Douglas G. Draper

Issued: May 16, 1988

MOUND
Miamisburg, Ohio 45342

operated by
MONSANTO RESEARCH CORPORATION
a subsidiary of Monsanto Company

for the
U.S. DEPARTMENT OF ENERGY
Contract No. DE-AC04-76DP00053

Table 2.1 - AREAS OF KNOWN AND SUSPECTED SOIL CONTAMINATION

Area	Isotopes	Description
1	Thorium	1966 - Building 21 constructed and filled with thorium from aged drums. Contaminated soils were removed and the area backfilled with clean soil.
	^{238}Pu	1967 - Pu-238 waste packages staged in this area. Subsequent degradation lead to the release of small amounts of plutonium. Pu-238 soil sample of 226 nCi/g detected and removed in 1984.
		1975 - Thorium removed from Building 21; building cleaned and drums of Cotter concentrate staged in the building.
2	^{210}Po Residuals ^{238}Pu	1965 - Polonium-contaminated sand. Sand resulted from cleaning metal framework of WD-Building sand filters. (Polonium contamination has decayed out.) Crushed empty thorium storage drums.
3	Thorium	1965 - Storage and redrumming area cleaned and area backfilled with clean soil. Little indication in current survey data of thorium contamination.
	^{238}Pu	1969 - Sources include the 1969 WD hillside cleanup operation.
4	^{210}Po Residuals	1965 - Waste Disposal Building influent tanks overflowed. Sewage sludge drying beds also became contaminated. (Polonium contamination has decayed out.)
	^{210}Po Residuals	1965 - Sewage sludge drying beds were contaminated when radioactive waste line broke in Area 5. (Polonium contamination has decayed out.)

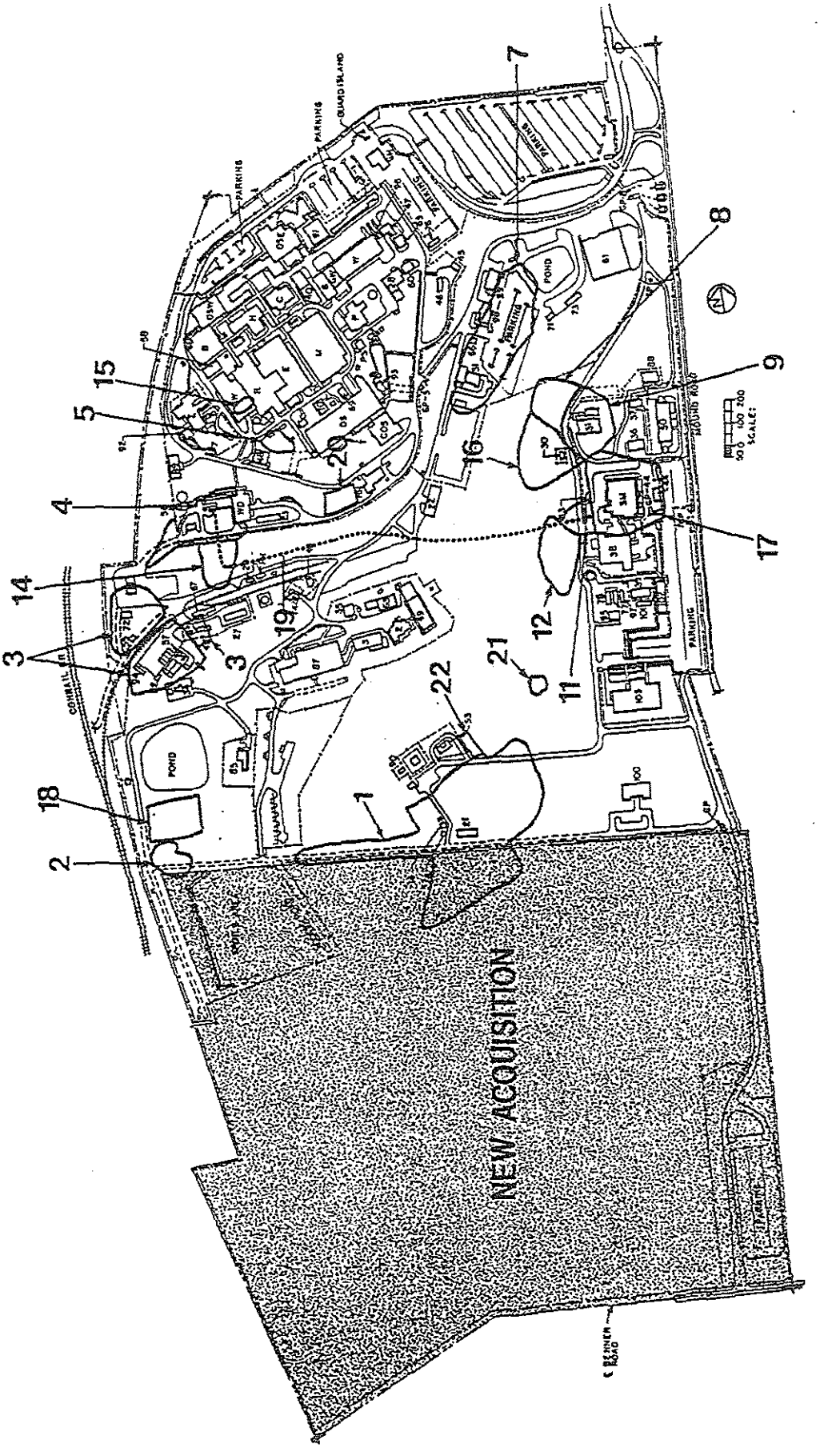
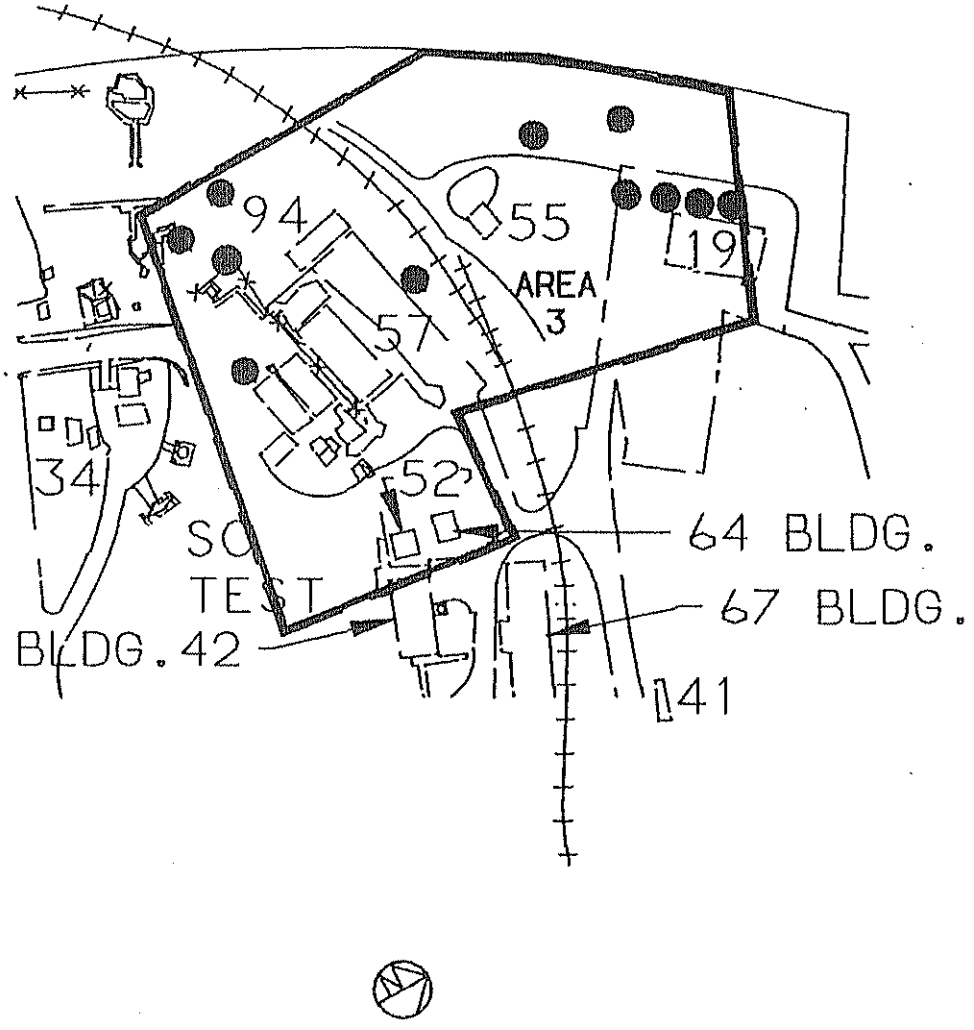


Figure 3.1 - Site map showing the 19 areas now identified as having known contamination.

Table 3.1. SUMMARY OF RADIONUCLIDE CONCENTRATION FOR THE 22 IDENTIFIED AREAS

Area Number	Radio-nuclide	Bkg	≥0.01 pCi/g	≥0.1 pCi/g	≥1.0 pCi/g	≥2.0 pCi/g	≥10.0 pCi/g	≥100 pCi/g	≥1000 pCi/g
1	Pu-238	-	9	41	57	--	40	12	2
	Th	130	--	--	--	14	10	--	--
	H-3	-	--	6	2	--	--	--	--
2	Pu-238	-	5	16	4	--	1	--	--
	Th	26	--	--	--	--	--	--	--
3	Pu-238	-	9	25	11	--	17	--	--
	Th	51	--	--	--	4	--	--	--
4	Pu-238	-	3	16	27	8	15	8	--
	Th	-	--	--	--	2	--	--	--
	Cs	-	--	1	--	--	--	--	--
	Ra	-	--	2	1	--	--	--	--
5	Pu-238	-	1	--	--	--	--	--	--
	Th	1	--	--	--	--	--	--	--
	Co	16	--	1	13	--	11	--	--
	Cs	-	--	42	--	--	--	--	--
6	None Detected								
7	Pu-238	2	56	101	15	--	--	--	--
	Th	128	--	--	--	34	9	--	--
	H-3	-	--	3	1	--	--	--	--
	Ra	-	--	36	12	--	--	--	--
	Ac	-	--	--	--	--	4	2	1



AREA No. 3

SUSPECTED ISOTOPES: Plutonium-238

VERIFIED ISOTOPES: Plutonium-238

AREA 3 Pu-238 : (red)

● 6 core samples 10 - 99 pCi/g

● 5 surface samples 10 - 99 pCi/g

Figure 4.3 - Area No. 3 - An expanded view.

ENVIRONMENTAL RESTORATION PROGRAM

OPERABLE UNIT 9,
SITE SCOPING REPORT
VOLUME 6 - PHOTO HISTORY REPORT

MOUND PLANT
MIAMISBURG, OHIO

February 1992

DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE

ENVIRONMENTAL RESTORATION PROGRAM
TECHNICAL SUPPORT OFFICE
LOS ALAMOS NATIONAL LABORATORY

FINAL

Note: Although this document is an approved Final document, some text may be marked as "Draft" in the footer. This indicates that no changes have been necessary between submission of the Draft, revision, and regulatory agency approval.

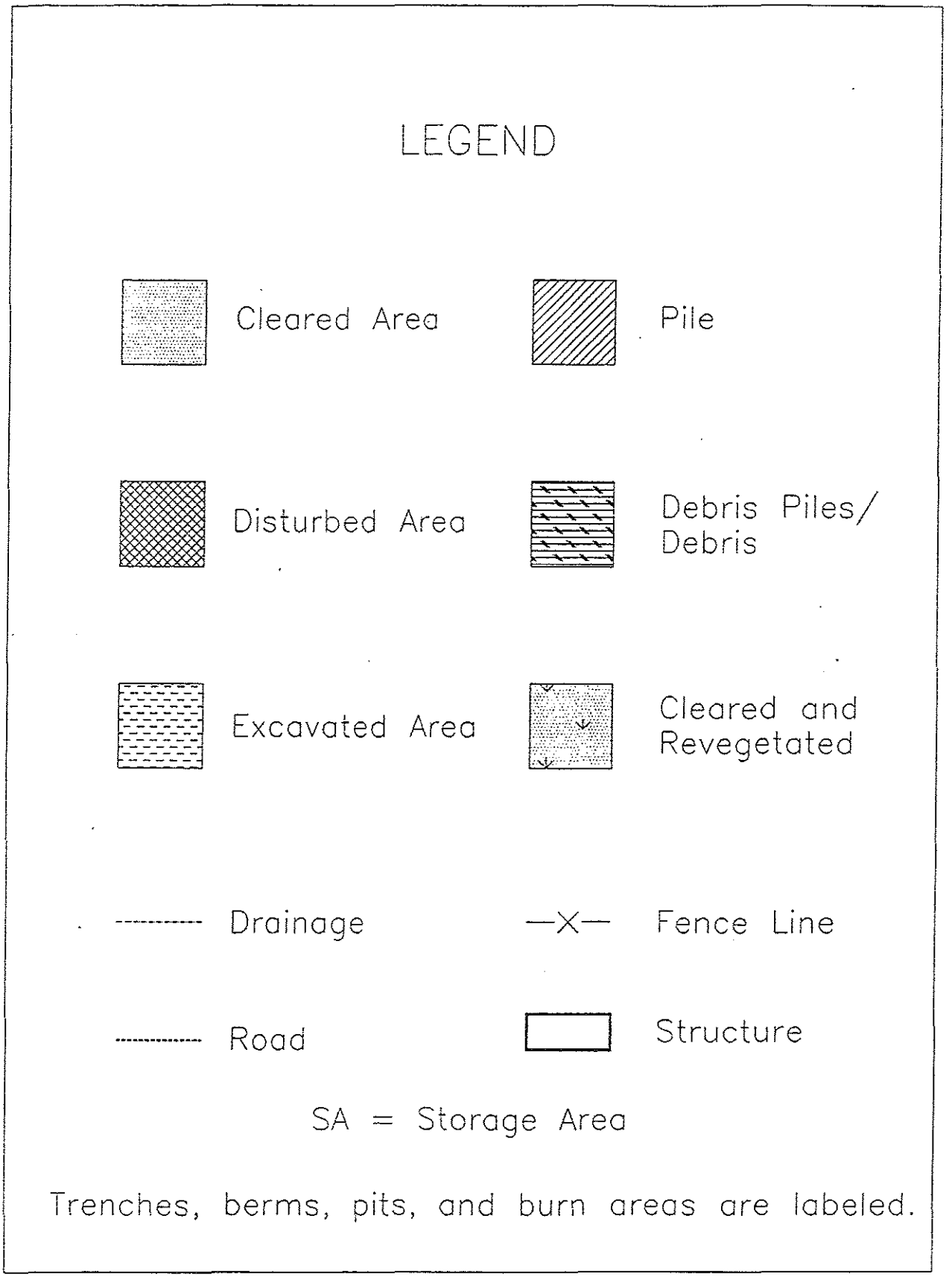


Figure 3.1. Legend of map units for aerial photograph interpretive mapping.

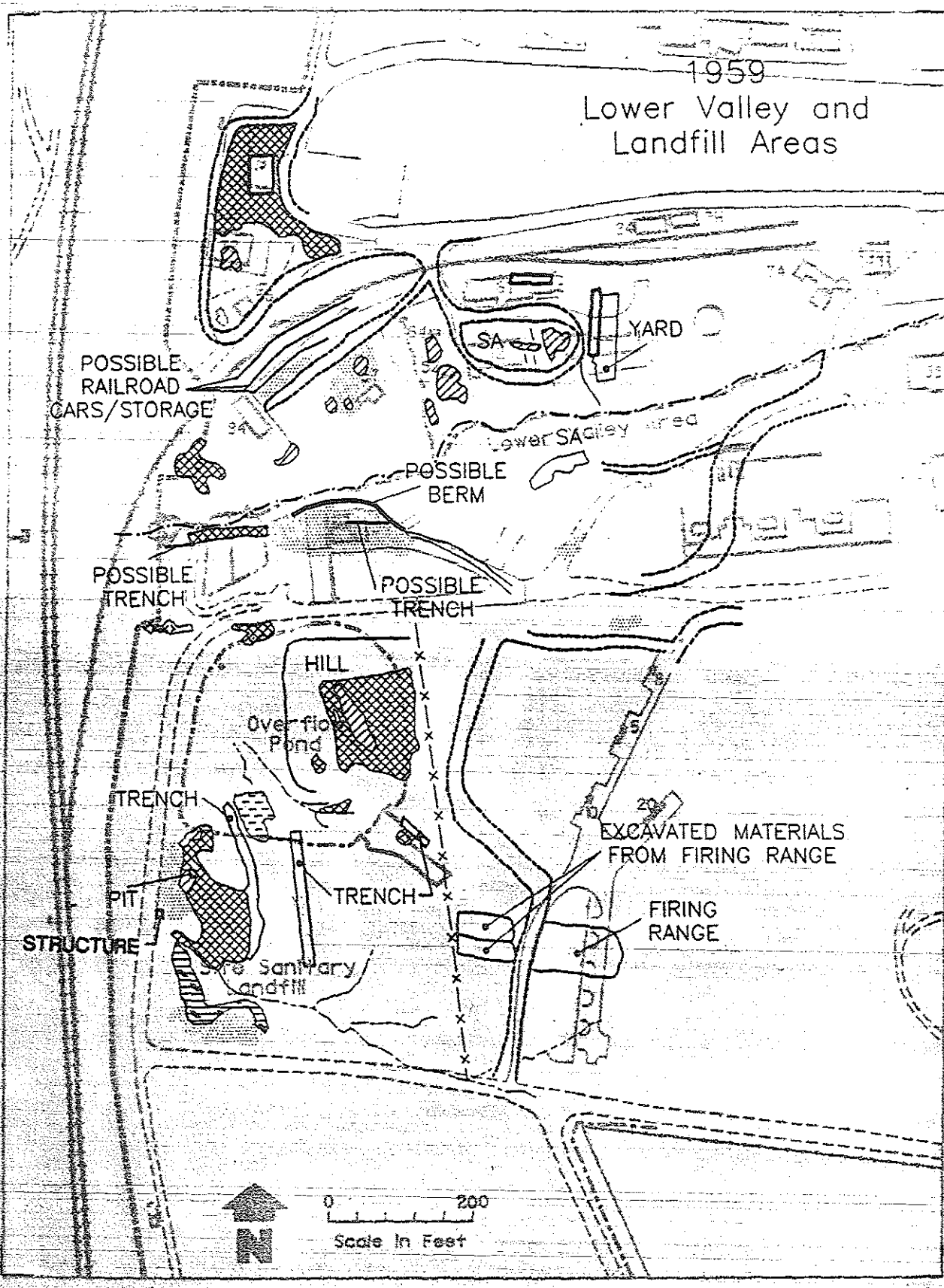


Figure 4.9. Interpretive map of Southern Study Area - 1959.

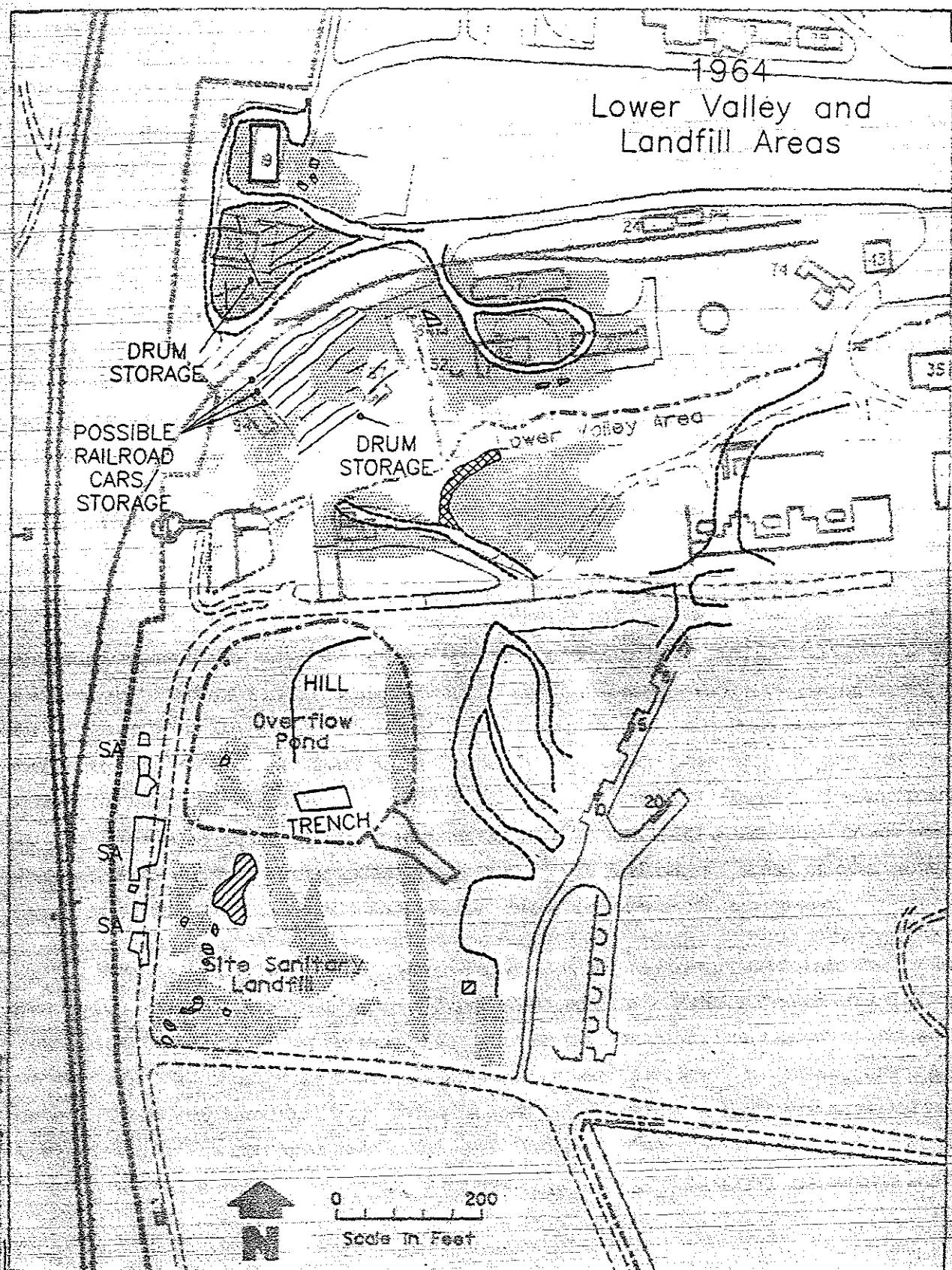


Figure 4.10. Interpretive map of Southern Study Area - 1964.

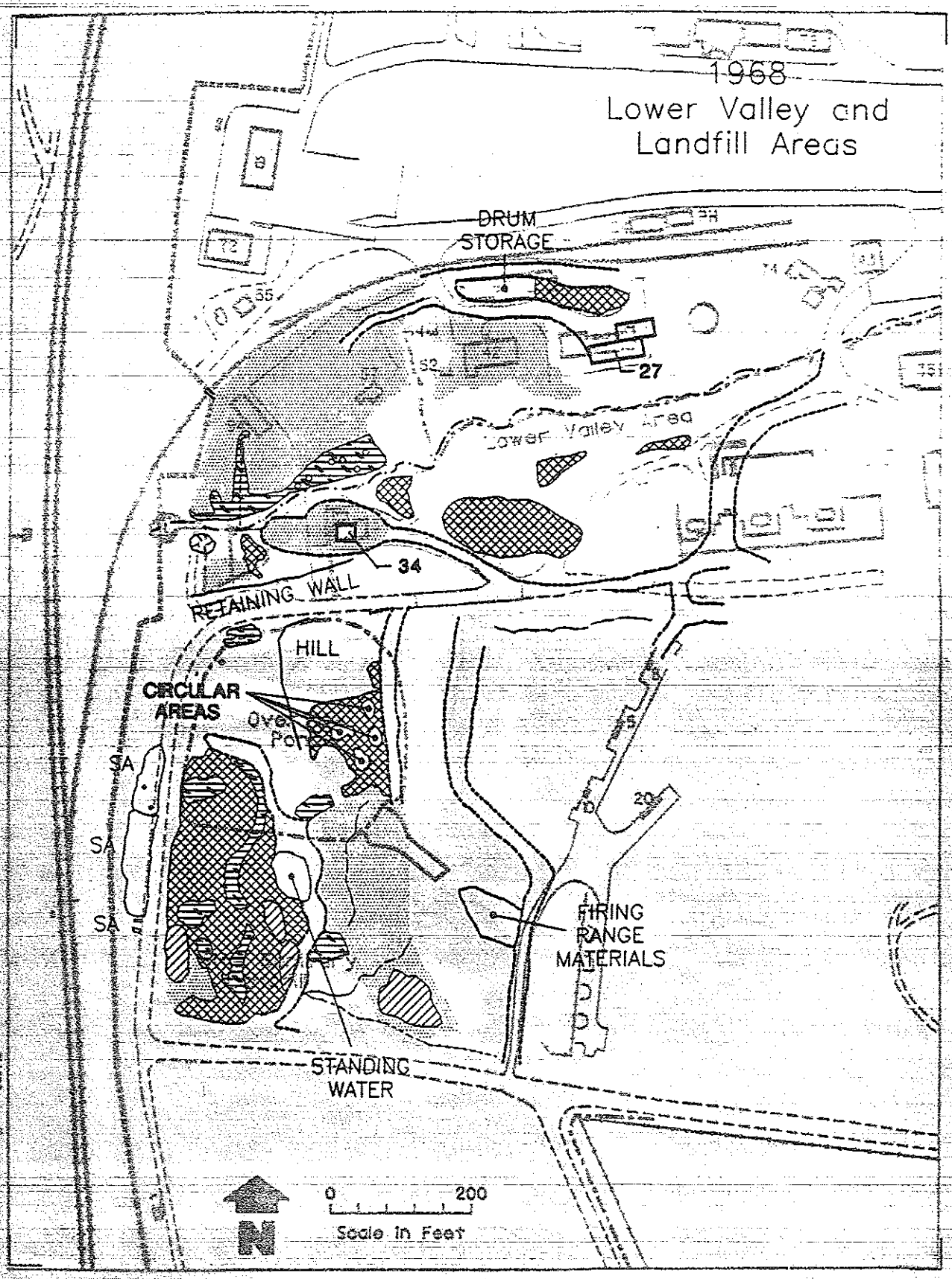


Figure 4.11. Interpretive map of Southern Study Area - 1968.

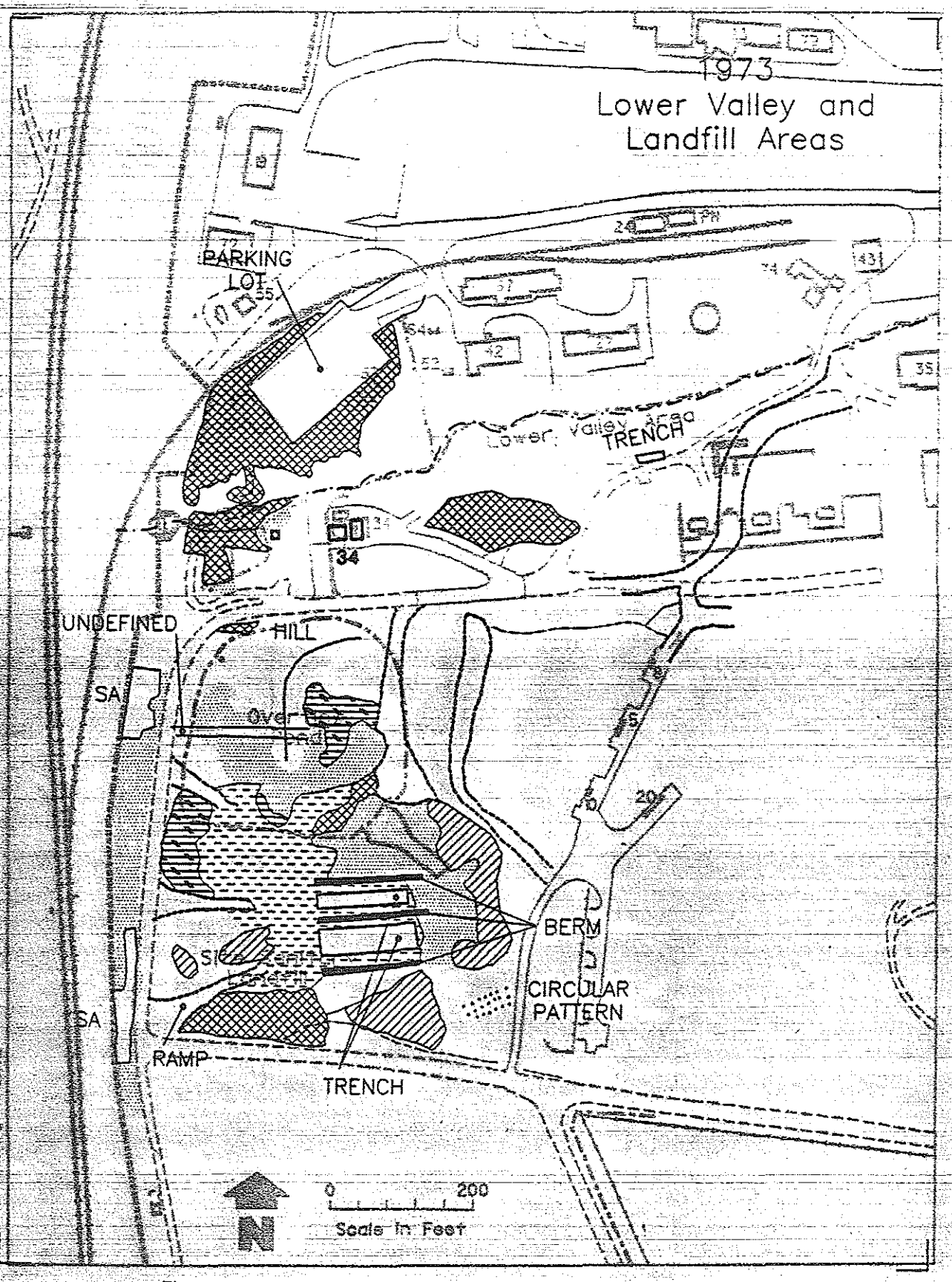


Figure 4.12. Interpretive map of Southern Study Area - 1973.

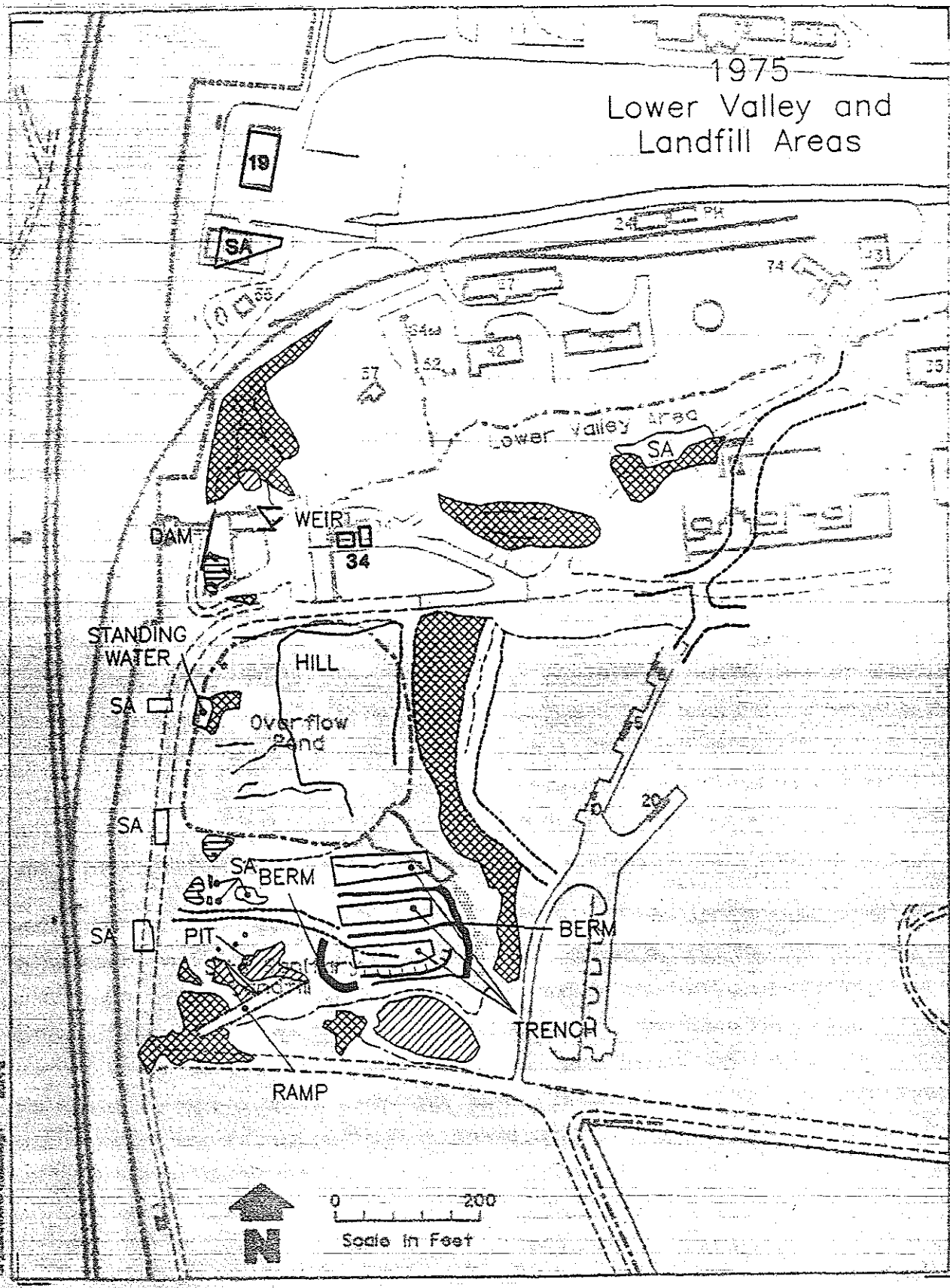


Figure 4.13. Interpretive map of Southern Study Area - 1975.

evident on the western side of the main road east of the fence line. Ponding occurs, possibly in a small excavation that borders the main road in the northeast.

By 1979, the construction of the overflow pond and site sanitary landfill are complete (Figure 4.14). The overflow pond receives excess storm water flow from the plant drainage ditch via an overflow channel from the north. Surface water runoff from the hillslope to the east flows directly into the overflow by a drainage channel east of the site sanitary landfill. The landfill area assumed its present configuration by 1979, with the exception of a lined flume later installed at the southeast corner at the overflow pond to control erosion.

4.4. LOWER VALLEY AREA

The lower valley area is located in the northern half of the Southern Study Area in the west-central portion of Mound Plant (Figure 2.1). The Lower Valley Area is comprised of the lower reach of the plant drainage ditch and the adjacent land surfaces. Off-plant discharge from the plant drainage ditch occurs to the west of the plant fence line.

A clearing is situated north of the main road and south of the main plant drainage ditch in 1959 (Figure 4.9). This clearing consists of a leveled surface which may be bermed along its northern perimeter and includes a drainage channel or a trench along its center. A smaller clearing exhibiting a disturbed surface extends from the western end of the large clearing, its southern half obscured in shadow. The westernmost edge of the small clearing may be intersected by a short, narrow trench. Little or no evidence remains of the cultural features that predated Mound Plant in this area (DOE 1991f). To the north of the drainage is an area encircled by a road with visible stored materials. Multiple piles of material lie to the southwest of this storage area. To the west of the storage area and south of the railroad tracks, a road leads to a small cleared surface, north of which are three strings of very large containers, possibly railroad cars.

In 1964, the large clearing south of the drainage ditch is still visible (Figure 4.10) with a road or trail leading across it to the west. The small clearing is no longer sharply defined, but there are three small disturbed areas in its former location. Lying to the east and upslope from the large clearing is another large cleared surface. Disturbed soil borders it on a northwest-facing slope. To the north of the drainage, the 1959 storage area has been cleared of materials and the area around the encircling road has been cleared. Some debris is present to the south of this road. South of the railroad, to the west of the former storage area, are multiple lines of storage containers on a cleared surface. Storage containers are also evident in a storage area north of the railroad.

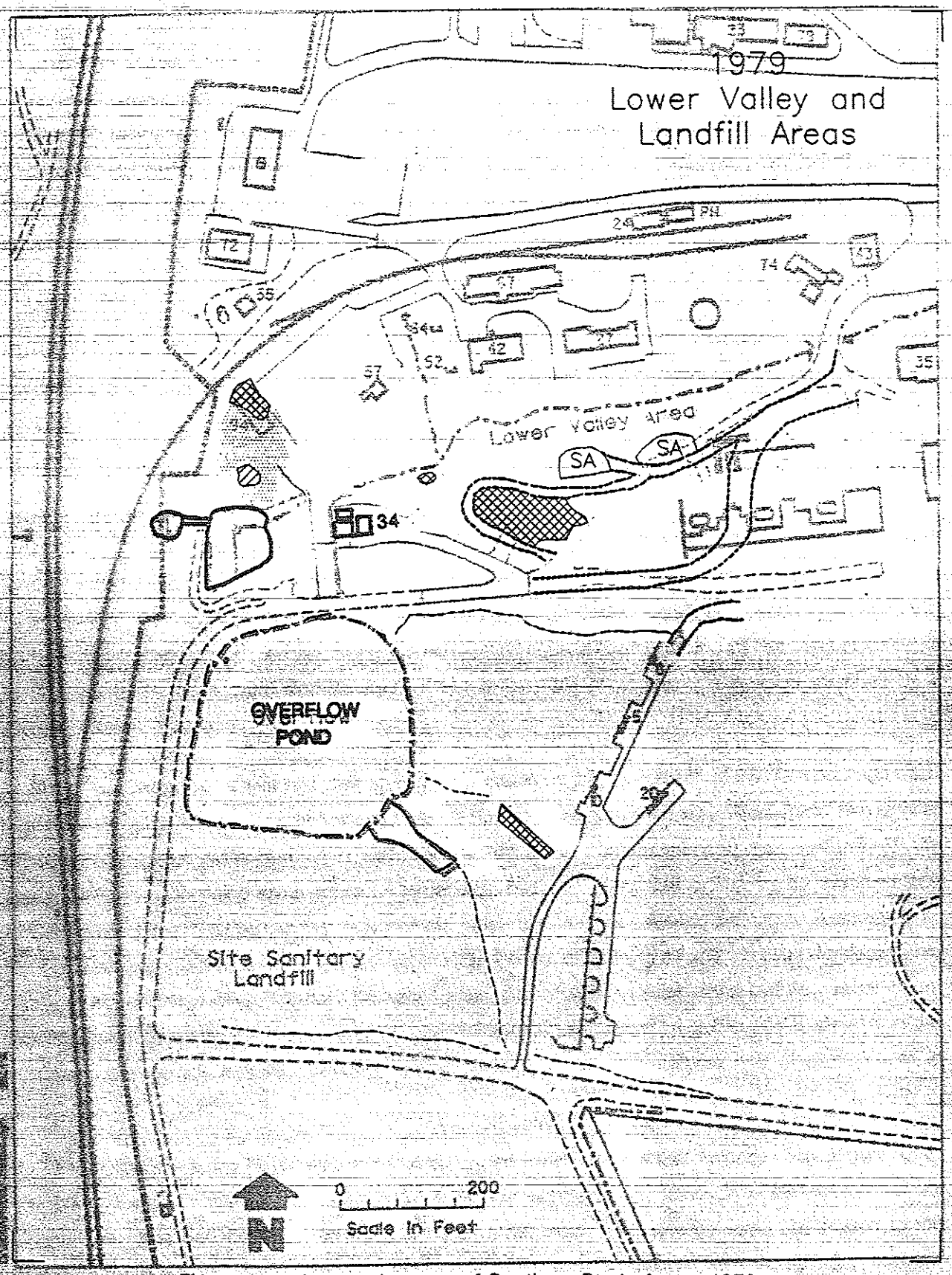


Figure 4.14. Interpretive map of Southern Study Area - 1979

Building 34 is established in the clearing south of the drainage in the 1968 photograph (Figure 4.11). The large cleared surface to the east in the 1964 photograph now appears smaller in areal extent and includes areas of disturbance or vegetation near the center. Farther to the west of the cleared surface holding Building 34 is an area of disturbed soil, possibly on a slope, bordering a small, semi-circular, flat, cleared surface. The straight, upslope edge of the semicircle is backed by a linear east-west excavation, possibly in the form of a retaining wall. A small circular depression is visible on the northwestern edge of this cleared surface. Three areas of disturbed soil lie to the north of the main road (Figure 4.11). Former storage areas to the north of the drainage ditch appear to be cleared. Building 27 is established by 1968. A new drum storage area is located to the northwest of Building 27 at a road intersection. The large drum storage area evident in the 1964 aerial photograph south of the railroad, is cleared and its surface expanded. No containers are evident. It is bordered on the south by a disturbed surface and slope and is cut on the west by a short drainage channel.

In 1973, a second building is present to the east of Building 34 (Figure 4.12). The western end of the surface has been cleared and contains some stored material or possibly a small structure. Farther to the west, the area that appeared as a small, flat, cleared surface in the 1968 photograph is heavily vegetated and may have been sloped to meet the retaining wall, which is no longer visible. The clearing on the slope to the east of Building 34 shows major disturbance and possible debris. To the northwest of this feature is a short trench lying just off the road. North of the drainage ditch, a formal parking lot has been established on the site of the large drum storage area evident in the 1964 photograph. This lot is bordered by a cleared, disturbed surface.

In the 1975 photograph, a weir and dam or outfall structures on the lower reach of the plant drainage ditch are evident (Figure 4.13). The clearing that includes Building 34 appears formally established. Two smaller clearings to the west of the Building 34 complex and east of the dam, contain disturbed surfaces with the lower of the two containing some debris. A larger disturbed area to the east of Building 34 shows surface discoloration and a linear pattern that may indicate initial incision of west-flowing drainages. A storage area bordered on the south by a disturbed surface is evident south of Building 27 and the plant drainage ditch. North of the drainage ditch, tributary drainages appear to have been established that flow south of the disturbed surface bordering the parking lot south of the railroad tracks. A debris pile is situated at the southern edge of this surface. Building 18 was constructed by 1975. Some type of storage area is apparent south of Building 19.

By 1979, retention basins have been constructed on the lower reach of the drainage ditch (Figure 4.14). The cleared area to the east of Building 34 is heavily vegetated but does show evidence of former disturbance. It is now bordered on three sides by a dirt road. Two storage areas are located to the northeast of this cleared area (south of the Building 27 and the drainage ditch). Drums and other materials

are evident. North of the drainage ditch, the cleared surface southwest of the parking lot in the 1975 photograph is still present, as is the pile of materials visible in the 1975 photograph on its southern edge. Short drainages flow south from this surface. Disturbed soils are evident near the present location of Building 94, possibly in preparation for construction. Considerable construction that is not mapped has taken place north of the drainage ditch (Figure 4.14).

In 1981 photographs, the area of the hillslope east of Building 34 has been graded and planted, or naturally re-vegetated (Figure 4.15). A small area of former disturbance is still evident here. Storage areas (south of Building 27 and the drainage ditch) are still in active use. The cleared surface and pile north of the drainage ditch remain evident.

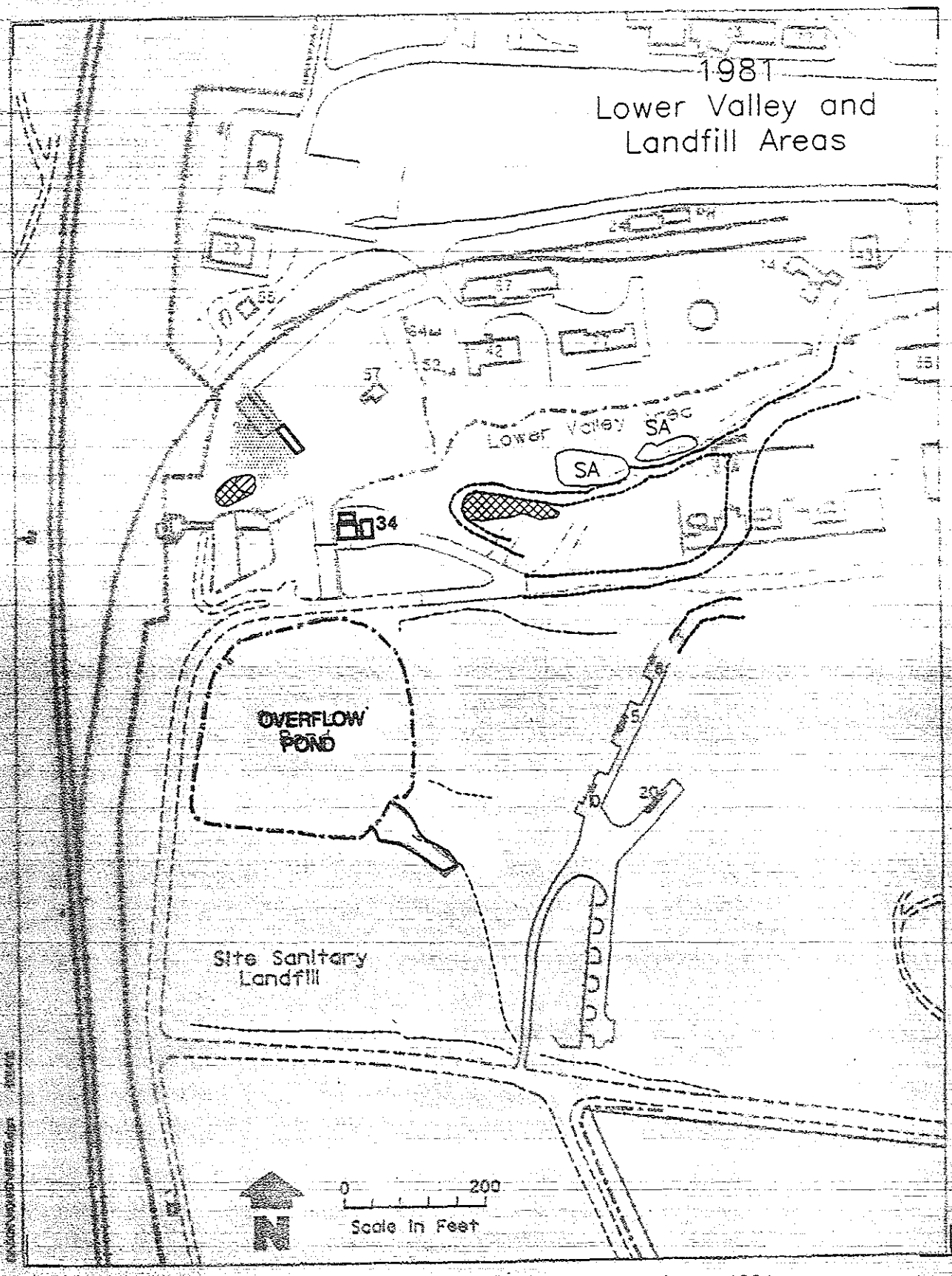


Figure 4.15. Interpretive map of Southern Study Area - 1981

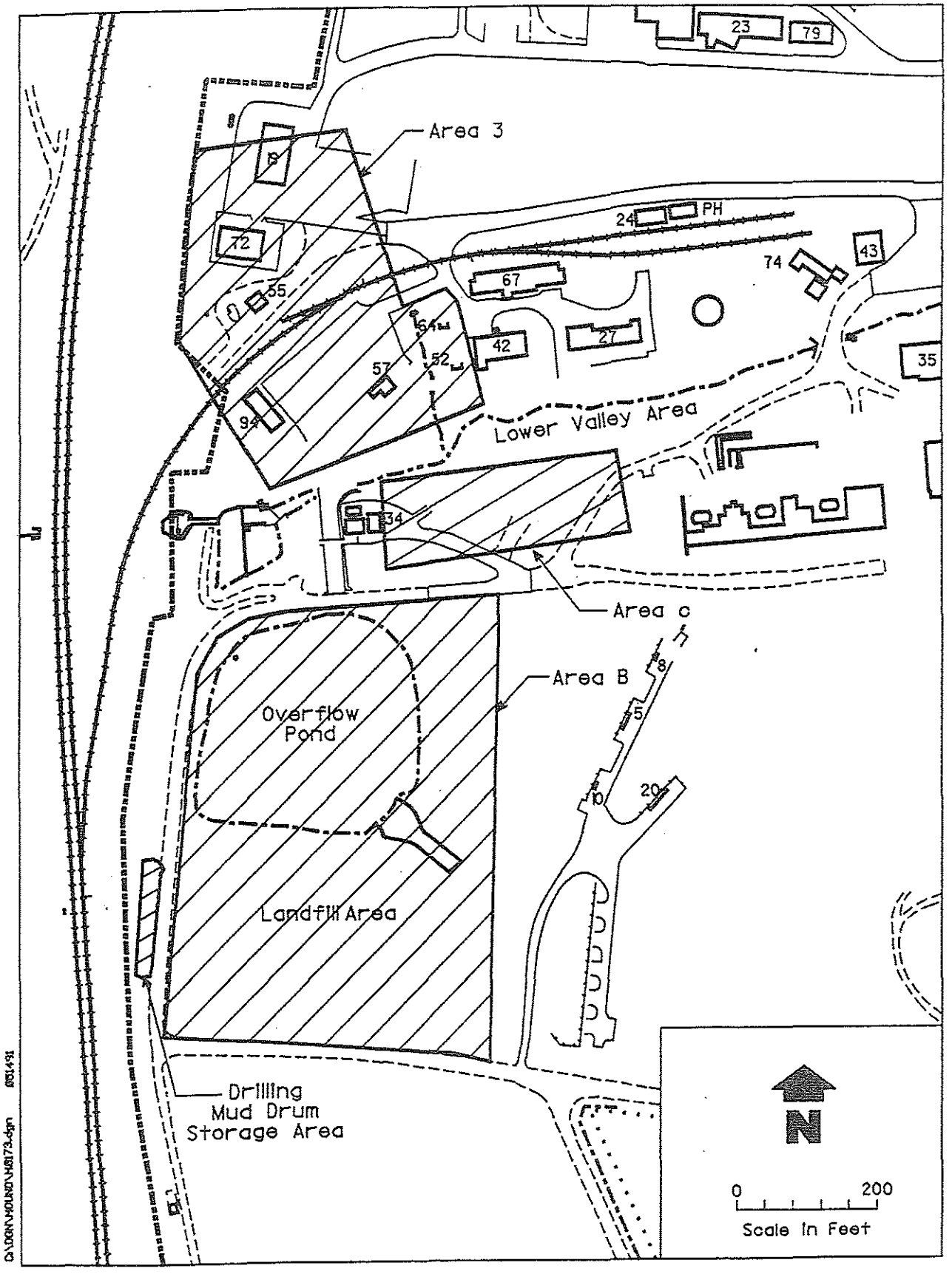


Figure 5.2. Areas of interest to the ER Program in the Southern Study Area.

portion of the landfill area, north and east of the existing roads. In fact, the 1959 photographs indicate that excavation activities extended into the present road intersection. By 1964 the roadway was backfilled enough to permit through traffic, but was subjected to periodic flooding from the east. The burial of many thousands of crushed, empty, thorium ore drums probably extended under the current road intersection (DOE 1991b, 1991c). This investigation indicates that the activities of open burning and general waste and burned trash burial during the period prior to 1968 were limited to central and southwestern portions of Area B. Figure 5.3 presents an updated interpretation of the geometry at Area B from evidence presented in this report.

The north-trending trench (1959) in the middle of the historic landfill may have been filled with trash when it was covered over by 1968. No other indications of this trench appear to exist other than the photo record. The east-west trending landfill cells (trenches) that appear in 1973 are described in the History of Area B (DOE 1991b) and resulted from a ban on open burning imposed by the State of Ohio in 1969. This investigation indicates that the landfill cells installed in 1973 were placed in an area that had not been previously used for trash disposal. Some of the disturbed areas near the southernmost cell were, in previous years, possibly gravel pit extractions, as the area provided some gravel resources.

The area west of the landfill area and west of the north-south access road to the landfill appears to have a long history of drum and other container storage. More recently this area was used for storage of drums containing drilling mud in 1987 and is referred to as the Drilling Mud Drum Storage Area (DOE 1991a). This investigation indicates that at least from 1964 to 1975 the stretch of area west of the access road to the landfill was used for staging or storage of drums and containers of currently unknown type or contents.

In 1976 the site sanitary landfill and overflow pond were constructed on the site of the historic landfill. The overflow pond was constructed to complement the low-flow retention basins on the lower reach of the plant drainage ditch. During excavation for the pond, the materials that had been buried in the landfill cells were removed to the site sanitary landfill, built concurrently to the south of the pond. During construction of the sanitary landfill, most of the burned material that had been disposed of or buried in the historic landfill was not excavated. Details of the overflow pond and site sanitary landfill construction are contained in the History of Area B (DOE 1991b).

5.4. LOWER VALLEY AREA

The lower valley area (Table V.4) includes numerous sites that are known to have been used for storage or staging radioactive and hazardous materials. Disposal activities have been suspected in Area C (Figure 5.2), but the exact location of Area C has not been corroborated by this investigation. The lower reach of the plant drainage ditch has undergone extensive local engineering since the plant was built to control

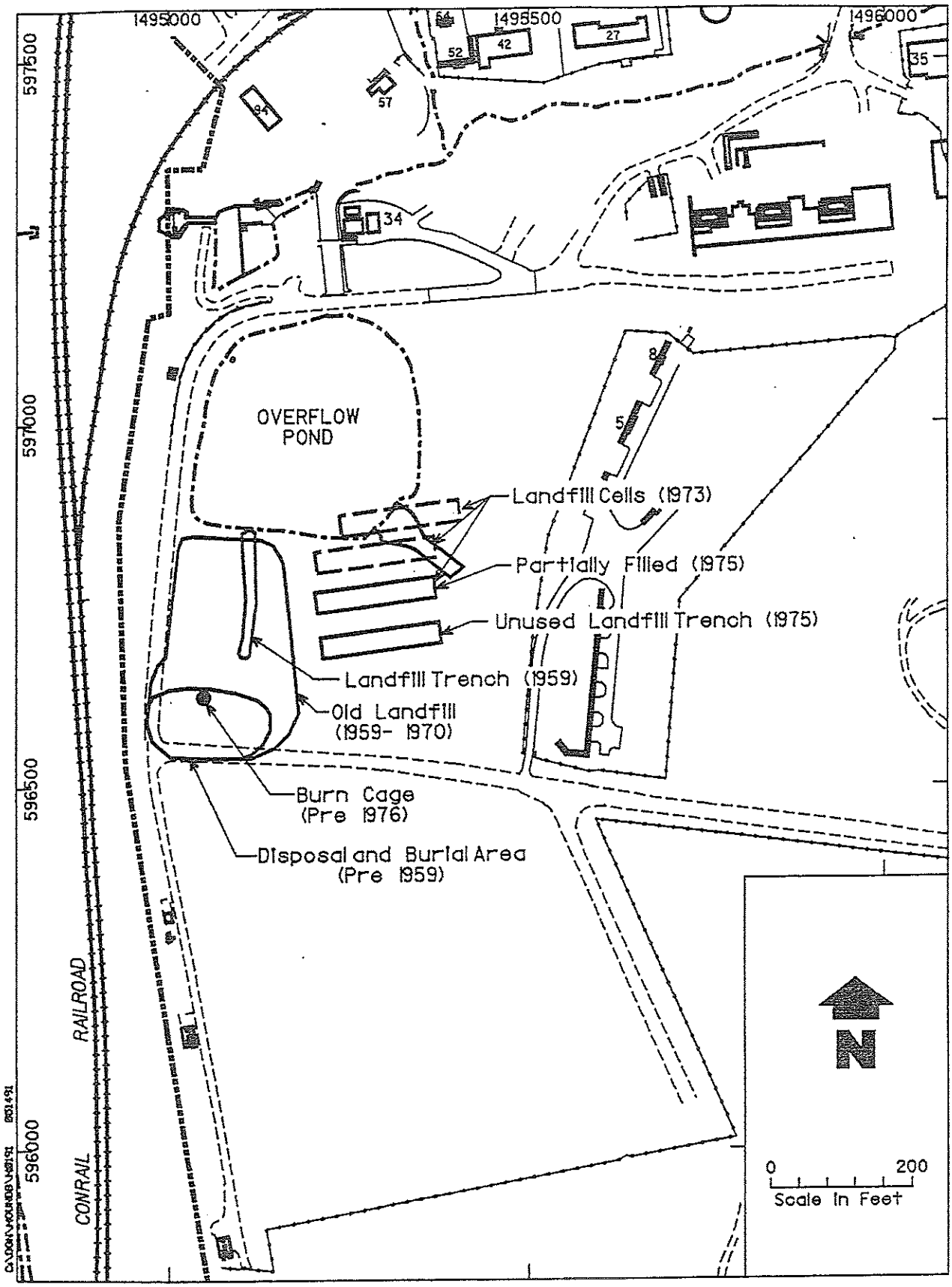


Figure 5.3. Photo interpretation of geometry and extent of historical site sanitary landfill areas.

Table V.4. Features in Lower Valley Area

Date	Major Photointerpreted Feature	Historical Interest to ER Program
1959	– Clearing with berm along drainage ditch.	– Unknown.
	– Possible trench near center of drainage.	– Unknown, perhaps drainage control.
	– Possible trench to west of berm.	– Unknown.
	– Storage area north of railroad tracks; possible railroad cars, south and parallel to tracks.	– Thorium drum storage and re–drumming area, now known as Area 3.
1964	– Drum storage to NW.	– Possible thorium drum storage and re–drumming area. Now known as Area 3.
	– Possible railroad cars and drum storage south and parallel to railroad tracks.	– Possible thorium drum storage and re–drumming area. Now known as Area 3.
1968	– Building 34 constructed in clearing.	– Unknown.
	– Level clearing evident west of Building 34 with E–W trending retaining wall or berm.	– Unknown.
	– Drum storage south of railroad tracks.	– Unknown drum storage area.
	– Building 27 constructed.	– Unknown.
1973	– Parking lot established south of railroad tracks.	– Unknown.

Table V.4. (Concluded)

Date	Major Photointerpreted Feature	Historical Interest to ER Program
	– Disturbed soils around parking lot.	– Re–grading of area of previous railroad storage.
	– Small trench south of drainage ditch in east part of lower valley area.	– Unknown.
	– Disturbed soils east of Building 34.	– Unknown.
1975	– Weir and dam in place.	– Parsall flume that preceded retention basin construction.
	– Smaller disturbed area west of Building 34.	– Unknown activity.
	– Disturbed area east of Building 34.	– Unknown.
	– Storage area south of drainage ditch in the area of older trench.	– Unknown storage activity.
1979	– Retention basin completed.	– Completion of weir and retention basin.
	– Smaller disturbed area near present location of Building 94.	– Unknown; perhaps related to the building of Building 94.
	– Storage areas added to the south of the drainage ditch; possibly drum storage.	– Unknown storage areas.
1981	– Storage areas still active.	– Unknown.
	– Area east of Building 34 re–graded and re–vegetated.	– Unknown activities.

surface water discharge from the plant. A Parshall flume was installed in 1973 and was later replaced by the low-flow retention basins in 1976. The trenches and berms near the 1959 ditch observed by this study may have been related to sediment or water control at that time, or may be related to the cultural features that pre-dated Mound Plant. Most of the cultural structures that pre-dated Mound Plant were located along the lower reaches of the drainage ditch (DOE 1991f).

The large area of drum storage around the curve of the railroad tracks is known to be related to the thorium drum repackaging project. During the period December 10 through 27, 1954, Mound Plant received about 5,900 55-gallon drums of thorium ore and sludge that had been shipped in box cars. The thorium in the drums consisted of hydroxide and oxalate sludges, a few drums of thorium oxide and a small quantity of mixed sludges. From 1954 to 1966, the thorium sludges were stored and redrummed in various locations of the plant. The location in the lower valley area near the curve of the tracks is now known as Area 3 (DOE 1991c). The box cars observed in this investigation may be related to the thorium project. The area near the tracks is reported to have been scraped of thorium contamination and backfilled with clean soil in 1965 (DOE 1991c).

Building 34 was constructed in 1965 to serve as a center for training emergency personnel. The area around it contains fuel tanks and pits for fire fighter training. The pits would typically be flushed with aviation fuel and ignited. An additional oil burn structure was added in the early 1970s and was used for testing drums for fire susceptibility by ignition. These sites are currently scheduled for investigation by the ER Program (DOE 1991e). The aviation fuel tank was removed in November 1990 (DOE 1991e).

The exact location of Area C is not known, but has been described as a stagnant water area about 150 feet in diameter. Metal containers containing lithium residues were reported to have been disposed of in the area and some fill added (DOE 1986). The disturbed area east of Building 34 (Figures 4.13 and 4.14) has been referred to as Area C by the ER Program and has undergone several episodes of investigation (DOE 1990a). It appears unlikely that the disturbed area immediately east of Building 34 is actually the location where the treatment and disposal activities described as Area C (DOE 1986) actually took place. This investigation indicates that this area has been an area of relatively high topography since at least 1959 and was unlikely to have ever been an area of standing water.

This investigation does indicate, however, that the drum storage areas south of Building 27 and the drainage channel were active from at least 1975 to 1981. These drum storage areas are currently addressed by the ER Program (DOE 1991e), but the lateral extent of the storage areas may be somewhat greater than that investigation allows. The storage areas are known to have been used for hazardous chemical wastes prior to offsite disposal (DOE 1991e).

August 25,1988
Page # 1

SOIL SCREENIG FACILITY
Data Management System

CONT Sample's, taken by COLLINS [redacted]
DAILY REPORT FOR August 25,1988

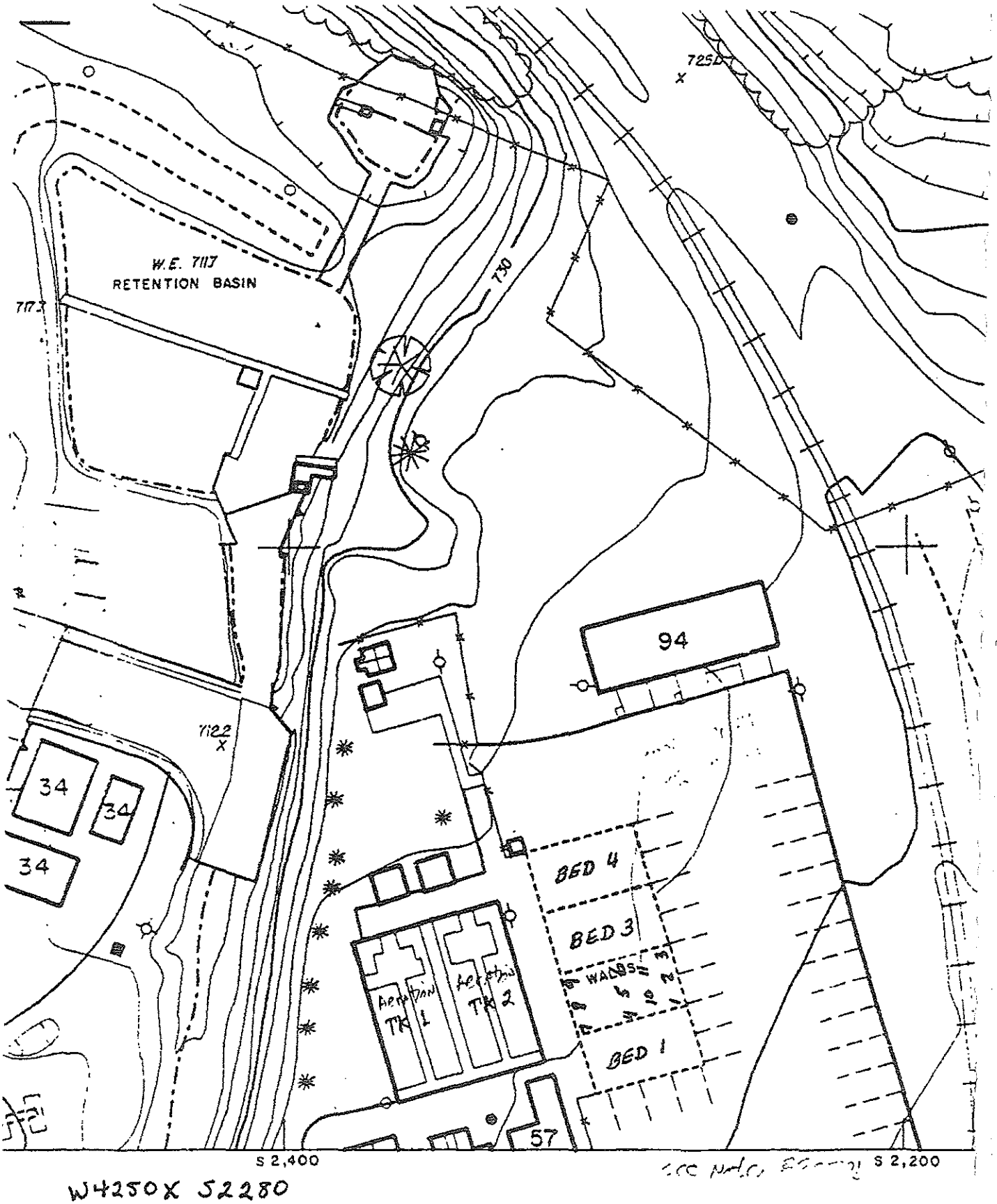
SAMPLE NUMBER	DATE SCREEN	SAMPLER	SAMPLE TYPE	TH 232 pCi/g	PU 238 pCi/g	GRID & SAMPLE LOCATION	WELL ID
1 8808251	08/25/88	COLLINS [redacted]	CONT	22.1	172	#1 @ SURFACE W4275 X S2300 (BED	A
2 8808252	08/25/88	COLLINS [redacted]	CONT	13.2	344	#2 @ SURFACE W4275 X S2300 (BED	B
3 8808253	08/25/88	COLLINS [redacted]	CONT	8.6	30	#3 @ SURFACE W4275 X S2300 (BED	C
4 8808254	08/25/88	COLLINS [redacted]	CONT	17.8	243	#4 @ SURFACE W4275 X S2300 (BED	A
5 8808255	08/25/88	COLLINS [redacted]	CONT	2.1	67	#5 @ SURFACE W4275 X S2300 (BED	B
6 8808256	08/25/88	COLLINS [redacted]	CONT	0.8	16	#6 @ SURFACE W4275 X S2300 (BED	C
7 8808257	08/25/88	COLLINS [redacted]	CONT	63.0	1235	#7 @ SURFACE W4275 X S2300 (BED	A
8 8808258	08/25/88	COLLINS [redacted]	CONT	1.9	78	#8 @ SURFACE W4275 X S2300 (BED	B
9 8808259	08/25/88	COLLINS [redacted]	CONT	24.9	111	#9 @ SURFACE W4275 X S2300 (BED	C
10 88082510	08/25/88	COLLINS [redacted]	CONT	35.9	992	#10 @ SURFACE W4275 X S2300 (BED	A
11 88082511	08/25/88	COLLINS [redacted]	CONT	0.8	45	#11 @ SURFACE W4275 X S2300 (BED	B
12 88082512	08/25/88	COLLINS [redacted]	CONT	2.4	20	#12 @ SURFACE W4275 X S2300 (BED	C
13 88082513	08/25/88	COLLINS [redacted]	CONT	0.9	0	#13 @ SURFACE W4275 X S2300 (BED	A
14 88082514	08/25/88	COLLINS [redacted]	CONT	0.8	39	#14 @ SURFACE W4275 X S2300 (BED	B
15 88082515	08/25/88	COLLINS [redacted]	CONT	3.4	23	#15 @ SURFACE W4275 X S2300 (BED	C

15 samples taken from SD Bed #3, all samples were on surface, as indicated, and are marked accordingly on Map. In General, stronger readings seem to Be located in the Southwest corner, Additional samples may be necessary, to determine how deep. It is assumed to contain mostly Th 232, and that some of this th 232 Bled over into the Pu 238, causing higher reading from Pu 238

Eric M Collins

PREPARED BY : TROY J. PEARSON III

ALL SOIL SAMPLE ARE RAN FOR 400 SEC UNLESS SPECIFIED IN THIS REPORT



W4250X S2280

SAMPLES COLLECTED BY K. McMAHAN & J. DICKEY

NO DIALECT READINGS ON WALLS. FIDLER READINGS ON WALL - BACKGROUND

FIDLER READINGS ON SOIL - 50-100K c

OPTIONS FOR DISPOSAL OF THORIUM ORE RESIDUES STORED

AT

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

APRIL 9, 1973

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I. SUMMARY

This report examines the consequences of and possible alternatives to the continued storage of thorium ore residues at Mound Laboratory. The options that have been considered include: disposal as excess to some commercial metals processor, disposal as waste, continued storage elsewhere and continued storage at Mound. The current method of storage is evaluated for impact on the immediate surroundings. Alternatives for repackaging and shipping and the associated costs have been examined.

It has been determined that there are some companies currently interested in obtaining the thorium residues. The number of such organizations is expected to increase as the demand for thorium rises in the next five to ten years.

Since storage in the present manner does not appear to have caused any serious problems to date, the thorium sludge could continue to be stored as is until a purchaser is located. Until that time the material should be considered as a national resource and kept intact and in a retrievable form either at Mound or at some other location.

Efforts to further explore the possible interests of others in acquiring thorium ore residue should be pursued.

II. BACKGROUND

In December 1954, Mound Laboratory began receiving quantities of thorium sludge from Brazilian ore residues that had been held in the National Stockpile. This material was sent to Mound for the planned separation and recovery of the contained thorium by the Monex process.[1]

The material that accumulated in the six-month period during which receipts were accepted consisted of a variety of chemical forms: hydroxide, oxalate, sulfate and metal. Eventually, all these compounds were either converted to hydroxide and/or oxalate or disposed of as being too reactive. The amount and quality of resulting residue is shown in Table I. This material was contained in some six thousand 55-gallon drums. The original value of the 400 tons of Thorium-232 was listed as $1.8 million. The appreciable quantity of rare earths was initially considered to be only a bothersome contaminant.

As time passed, the concept of recovery was dropped, however the material continued to be stored in a field at Mound in 55-gallon drums. The prolonged outside storage and internal exposure to corrosive solutions necessitated the frequent repackaging of the drums to insure containment of the ore residue. It became routine that typically 20-45% of the drums were repackaged each year. Since this residue was considered to be accountable material, an inventory was taken at the time of repackaging.

In 1961, it was proposed that a storage facility be constructed to eliminate the need for continued periodic repackaging. The use of such a storage building would eliminate the expenditure of $17,000 to $30,000 per year that had been required for the redrumming operation. The building was designed in FY 1963; construction begun by Marion Construction Company in late 1963 being completed and finally accepted in July 1964.[3] The total cost for design and construction of this facility was $49,610. (Further details of construction may be found under Building Description.)

Table I

Original Quantity of Thorium Sludge Stored at Mound Laboratory[2]

	Sludge Weight (lb)	Thorium Content (kg)	Thorium Content (% dry wt)
Brazilian Hydroxide	2,700,000	270,013	>40
Brazilian Oxalate	286,000	36,876	~30
Domestic Oxalate	309,000	22,291	~20

Typical Analysis of Brazilian Sludge[1]

(Percentages on Dry Basis at 110°C)

Component	Percent	Component	Percent
ThO_2	45	ZrO_2	1.4
$(RE)_2O_3$	15	P_2O_5	5.3
SiO_2	4.4	U_3O_8	1.0
TiO_2	7.0	Cl^-	1.4
Fe_2O_3	4.3	Loss on Ignition	14

All of the ore residue was transferred into this facility in bulk form by dumping the drums. The material was segregated by a partition to keep the hydroxide and oxalate separate.

In September 1972, the AEC Division of Production and Materials Management declared the residue to be waste.[4] By this time the quantity had been reduced to 321,710 kg due to losses on repackaging and some sales. Mound was subsequently informed that as of December 31, 1972 the material should be considered as Waste Awaiting Burial - Solids and could be removed from the accountability records.[5]

An examination of the hydroxide residue in December 1972, when some material was removed, indicated that the moisture content of the residue had been greatly reduced. The material resembled a fairly dry sand, being mostly granular. Where lumps were found, these were easily crushed by striking with a shovel.

Duplicate

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Section 1

Appendix B

Appendix C

SAMPLING AND ANALYSIS REPORT

MOUND OPERABLE UNIT 5

AREA 3

Prepared For

EG&G Mound Applied Technologies, Inc.

August 10, 1993

1.0 INTRODUCTION

EG&G Mound Applied Technologies and the Department of Energy (DOE) are planning construction inside Operable Unit 5, Area 3. Because this construction activity will hinder the DOE in its RI/FS for a portion of Area 3, it was necessary to evaluate the construction sites prior to beginning construction. This sampling and analysis plan report was prepared to document the results of the prior investigative activity for the proposed sites for permanent structures planned in Area 3.

Area 3 is located in the valley between the SM/PP Hill and the Main Hill at the southwest foot of the Main Hill. The area is approximately 250 ft. by 300 ft. (75,000 sq. ft.). Area 3 was used for the storage and redrumming of drum contents containing thorium and plutonium-238. Thorium contaminated soil was removed from Area 3 in 1965 and the site was backfilled with an undetermined amount of clean soil. Drums containing chemical wastes from various processing facilities at Mound Plant are also stored in and near Building 72 in Area 3, which is a RCRA-permitted facility.

The first proposed structure is a 70 ft. x 72 ft. building which is needed to support waste management operations. This building has been sited adjacent to existing Building 72. Locating the building here is desirable since both buildings will support related waste management functions.

The second set of structures are additions to the Mound Sanitary Treatment Plant. A new 34 ft. diameter clarifier, a 10 ft. x 10 ft. pump station, and a 22 ft. x 22 ft. sludge holding tank are proposed. These structures are sited among other Treatment Plant facilities and are required to ensure compliance with NPDES permits. Figure 1.1 shows the location of the proposed structures.

1.1 PURPOSE AND SCOPE OF THE SAMPLING ACTIVITY

The purpose of the sampling activity was to acquire representative data in order to verify the concentration of radiological and hazardous chemical compounds potentially present in the soils at the site of the proposed construction.

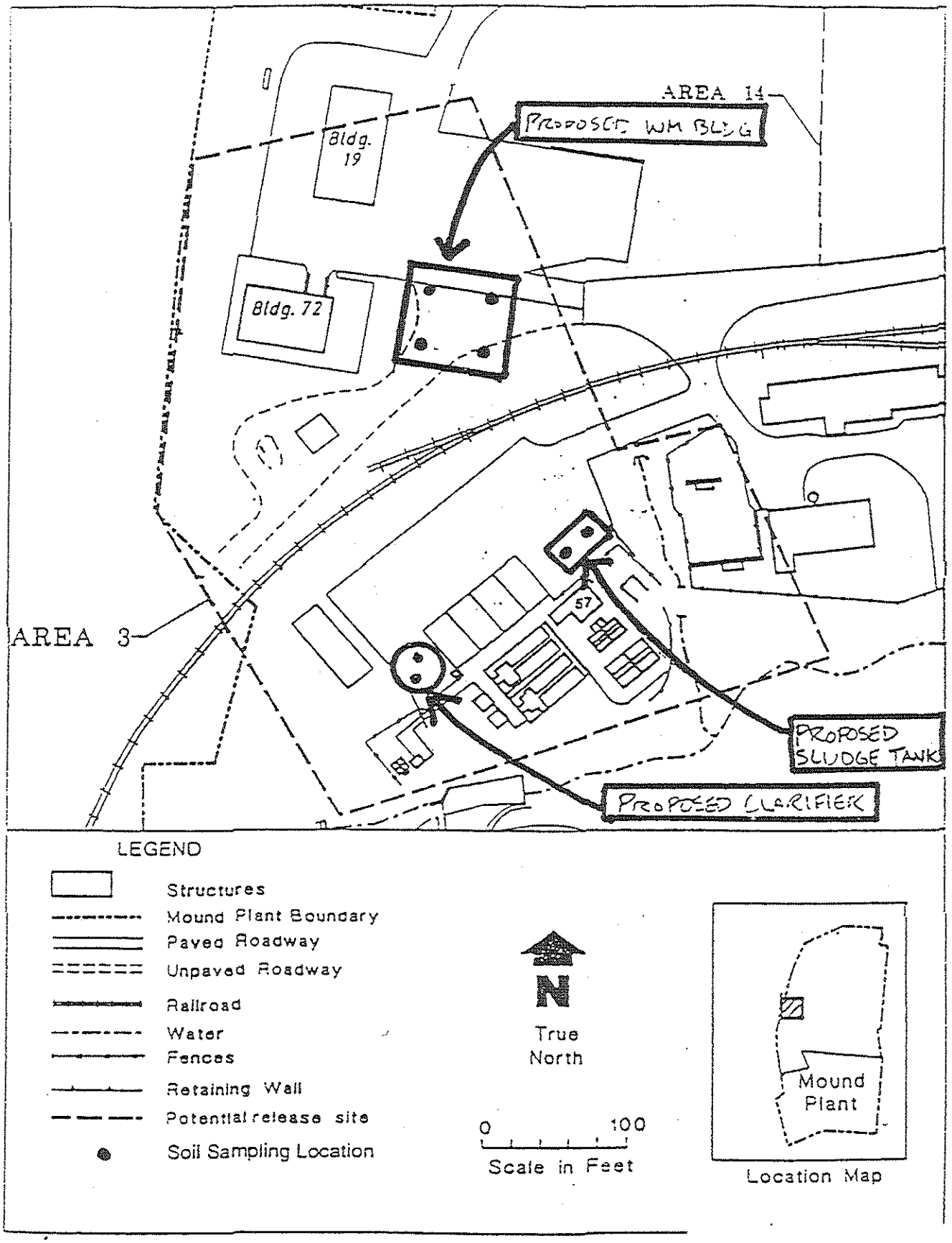
The scope of the sampling activity was to:

- Quantify the extent and magnitude of radiological contamination at the proposed construction site.
- Quantify the extent and magnitude of chemical contamination at the proposed construction sites.
- Provide data to assess the impacts to human health and the environment and to assess the impact to DOE's ability to conduct a thorough RI/FS in Area 3 if the structures are constructed.

1.2 SAMPLING ACTIVITY SUMMARY

Nine test borings were sampled for the characterization of the construction sites. Five sampling locations were situated below the future foundation of the Waste Management (WM) Building, two sampling locations were sited inside the foundation of the Clarifier and two sampling locations were

Figure 1.1 - Location of Construction Sites.



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sited inside the foundations of the sludge tanks. Figure 1.2 illustrates the sampling locations. Attachment 1 - Presents the surveyor's report of the sampling location.

At all locations, samples were taken at the surface and at 5 foot intervals. A six inch deep sample was obtained at the surface. The borehole was advanced to five feet deep and a two foot core sample was obtained. This scheme was followed until a 15 foot depth was reached. Attachment 2 presents this sampling rationale and boring log reports. All surface and subsurface soil samples were analyzed for the Mound Plant list of potential contaminants of concern which is presented in Table 1.

1.3 DATA SUMMARY

The following section describes the results of the sampling analysis and is presented by class of chemical constituent. The data tables are presented only for detected constituents and the tables are reflective of unvalidated data for radiologicals and volatiles.

Explosives

- Results for all samples in each area are reported as non-detect.

Radiologicals

- The results for the detected values are summarized in Table 2. Results for all samples in each area (Tables 3,4,5) are below the proposed Mound cleanup level for radiologicals. Therefore, concentrations are not expected to be of concern.

Semivolatiles

- The results for the detected values are summarized in Table 6. There are currently no ARAR's such as Maximum Contaminant Level (MCL) values or RCRA cleanup levels for data comparison. It is currently customary to compare detected results to a threshold value for polynuclear aromatic hydrocarbons (PAH's) of 330 ug/kg. Concentrations below 330 ug/kg are generally not of concern. As can be seen from Table 6, several PAH values exceed this level for surface soils. The boring logs (Attachment 1) indicate that surface soil samples were obtained through an asphalt boring. The Naphthalene, benzo(a)pyrene, and other PAHs have most likely leached from surface asphalt. A risk assessment would be necessary to confirm the levels of concern for these constituents.

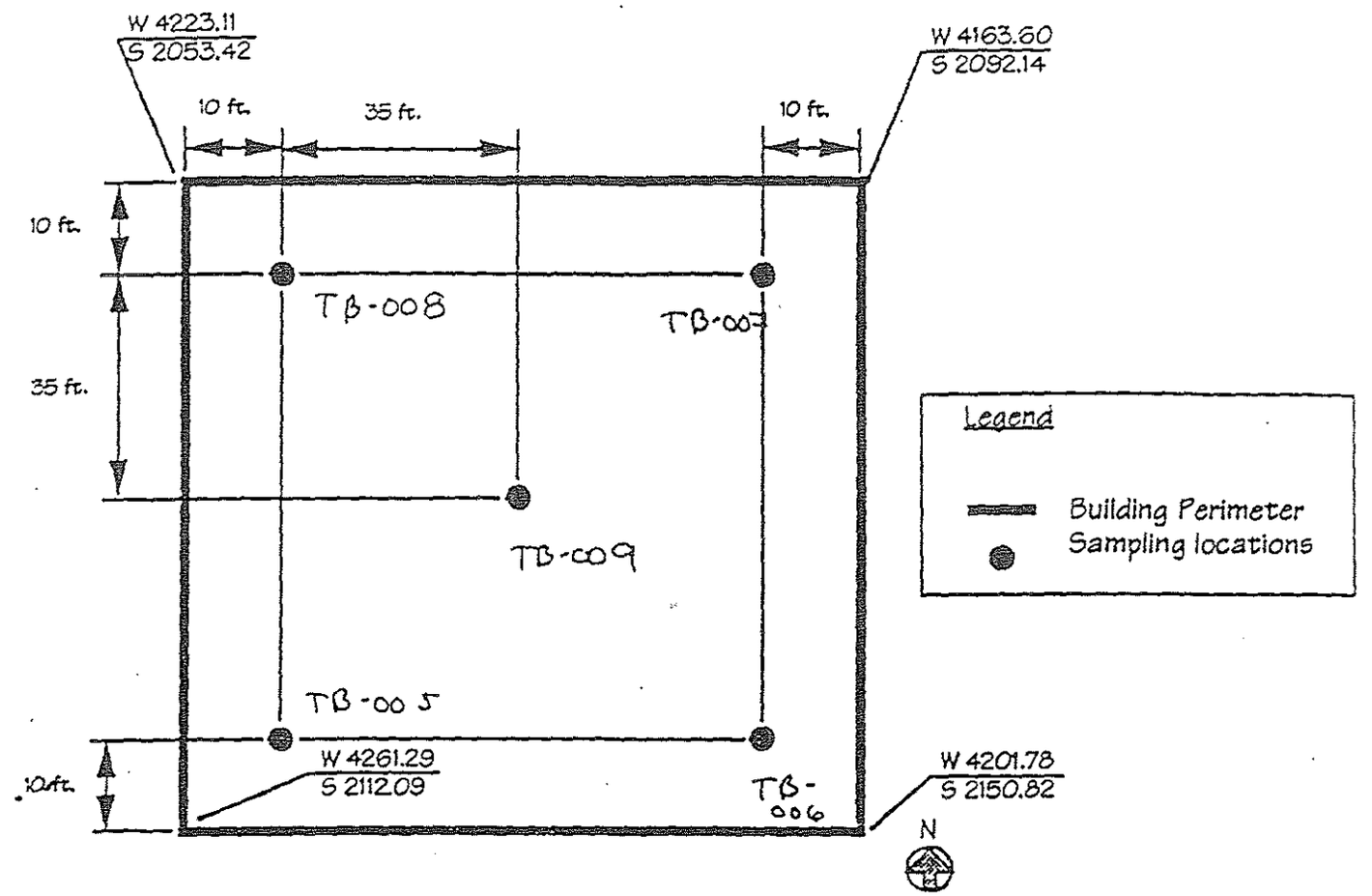
Inorganics

- The results for the detected values are summarized in Table 7. Results for all samples in each area (Tables 8, 9, 10) are below the RCRA cleanup levels (Table 12) and are within reasonable expectations of background conditions and do not appear to be of concern. Here again, a simple risk assessment would confirm the findings.

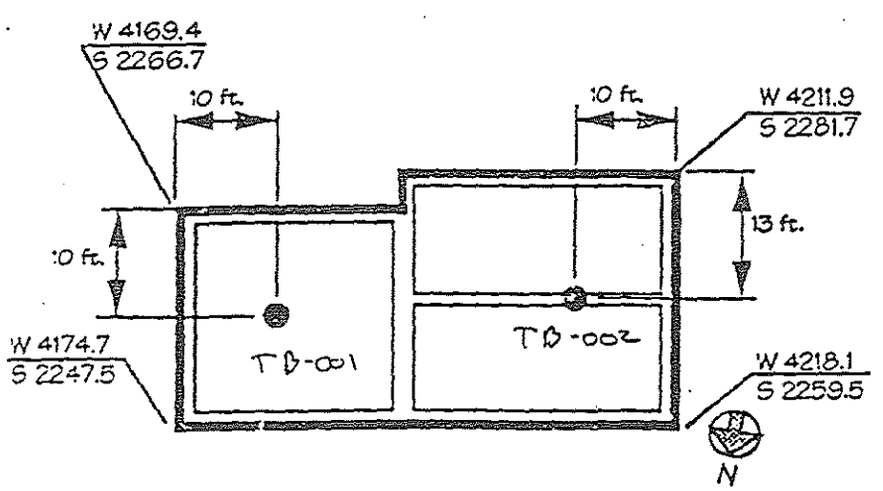
Volatile Organic Compounds

- The results for the detected values are summarized in Table 11. Detected concentrations are extremely low and are not expected to be of concern. Validated data will be used to confirm these findings. Results for all samples in each area are below the RCRA cleanup levels (Table 12).

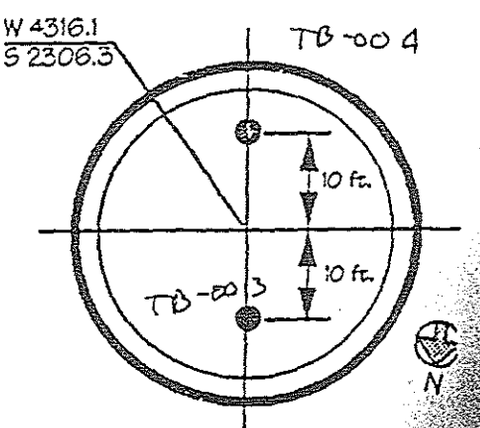
Figure 1.2 - Sampling Locations



Waste Management Building Sampling Locations



Sludge Tank Sampling Locations



Clarifier Sampling Locatic

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Table 1 - Mound Plant Potential Contaminants of Concern

Compound	Compound
Acetone	Antimony
Acetonitrile	Beryllium
Acrylonitrile	Bismuth
Ammonia	Cadmium
ANCO ALGAECIDE No. 1 (2-benzyl-4-chlorophenol) [a]	Chromium
ANCOOL 3310 (triazole) sodium molybdate[a,b]	Cobalt
Arsenic	Cyanide
Benzene	Copper
Calcium	Iron
Carbon disulfide	Lead
Carbon tetrachloride	Lithium
Chloroform	Magnesium
Cresols (methylphenol)	Manganese
Diethyl benzene	Mercury
Fluoride	Nickel
Freon-TF (Freon 113, trichlorotrifluoroethane)	Selenium
Hexane	Silver
High explosives	Vanadium
PETN	Zinc
RDX	Actinium-227
HMX	Americium-241
Iodomethane	Bismuth-207
Methylene chloride	Bismuth-210m
Methyl ethyl ketone (2-butanone)	Cesium-137
Methyl isobutyl ketone (4-methyl-2-pentanone)	Cobalt-60
NALCO 2532 bis(tributyltin) oxide[a]	Plutonium-238,239/240
PCBs	Radium-226
Phenol	Strontium-90
Potassium	Thorium-228, 230, 232
Sodium	Tritium
Tetrachloroethane	Uranium-234/235, 238
Toluene	Rare earths (lanthanides)
Tribromomethane (bromoform)	Nitrate-nitrite
Trichloroethane	Nitrite
Trichloroethene	Chloride
Xylene	Sulfate
Aluminum	

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TABLE 2

Radiologicals Summary - Detects Only
(results in pCi/gr)

	Sample Boring											
Isotope	001 (S)	001 (5)	001 (10)	001 (15)	002 (S)	002 (5)	002 (10)	002 (15)	003 (S)	003 (5)	003 (10)	003 (15)
K-40	1.61	1.80	1.92	1.22	8.19	2.23	1.89	1.24	5.95	3.08	2.28	2.02
Ra-226	.842	1.03	1.48	1.06	.733	1.45	1.39	.975	.611	.979	.878	1.22
Pu-238	.080	U	U	U	.0739	U	.0311	U	.0266	U	.430	.943J
Pu-239/240	U	U	U	U	U	U	.0311	U	U	U	U	UJ
Th-228	2.32	.878	1.51	.674	.475J	.784	.891	.690J	.211	1.05J	1.18J	.946J
Th-230	.961	1.71	1.72	.917	.664J	1.08	1.26	1.04J	.712	.807J	1.31J	1.39J
Th-232	2.54	.753	1.71	.505	.396J	.856	.938	UJ	.233	1.32J	.995J	.998J
U-234	1.03	.639	.955	.717	.600	1.02	.841	.828	.466	.687	.953	.757
U-235/236	U	U	.0429	U	U	U	U	U	.0482	.0425	U	U
U-238	.929	.600	.891	.649	.574	.781	1.04	.761	.506	.701	.891	.879
Sr-90	U	U	.876	1.14	U	.535	.507	U	U	U	1.38	U
H-3	.199	2.93	1.92	.613	.270	2.73	1.73	.911	.0680	5.62	2.88	2.41

U = Indicates that the analyte is not detected
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2 (Continued)

Radiologicals Summary - Detects Only
(results in pCi/gr)

	Sample Boring											
Isotope	004 (S)	004 (5)	004 (10)	004 (15)		005 (S)	005 (5)	005 (10)				
K-40	6.22	2.24	1.97	2.17		1.37	2.05	1.43				
Ra-226	.599	1.03	1.16	1.10		.906	1.33	.844				
Pu-238	.0143	.0219	.308	.050		.255	.0121	U				
Pu-239/240	.0716	U	.0203	U		-	.0162	U				
Th-228	.0957	.560J	.834	1.04		.452	.949	.561J				
Th-230	.447	.852J	1.04	1.02		.711	1.10	1.09J				
Th-232	.131	.757	.872	.96		.462	.597	.570				
U-234	.477	.745	.617	.87		.793	.939	.703				
U-235/236	U	U	.0372	.052		.0597	.0678	.0592				
U-238	.535	.724	.803	.890		.462	.998	.802				
Sr-90	U	U	U	U		U	U	U				
H-3	.068	1.39	1.53	1.61		.502	.820	1.13				

U = Indicates that the analyte is not detected
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2 (Continued)

Radiologicals Summary - Detects Only
(results in pCi/gr)

	Sample Boring											
Isotope	006 (S)	006 (5)	006 (10)		007 (S)	007 (5)	007 (10)					
K-40	1.76	1.40	1.46		3.96	1.66	1.27					
Ra-226	.953	1.02	1.06		.434	.901	.896					
Pu-238	.522	U	U		.141	U	U					
Pu-239/240	U	U	.0147		U	U	U					
Th-228	1.15	.721J	.496		.212J	.503J	.371J					
Th-230	.760	1.06J	.960		.265J	1.19J	2.99J					
Th-232	1.19	.323	.597		.211J	.394J	.419J					
U-234	.756	.717	.691		.351	.566	.582					
U-235/236	.0301	.0552	.0547		.0166	.0363	.0436					
U-238	.703	.800	.650		.365	.694	.656					
Sr-90	U	U	U		U	U	U					
H-3	.302	.656	2.14		.112	.551	.910					

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 2 (Continued)

Radiologicals Summary - Detects Only
(results in pCi/gr)

	Sample Boring											
Isotope		008 (5)			009 (S)	009 (5)	009 (10)					
K-40		1.24			5.98	1.69	1.62					
Ra-226		.847			.670	.812	.845					
Pu-238		.0762			.0780	U	.0121					
Th-239/240		UJ			U	U	.0121					
Th-228		.539J			.319	.551	.760					
Th-230		.885J			.444	.799	.689					
Th-232		.749J			.317	.385	.506					
U-234		.678			.366	.029	.692					
U-235/236		U			U	.0532	.0194					
U-238		.678			.415	.795	.805					
Sr-90		.423			.539	1.08	U					
H-3		.124			.194	.310	.306					

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 3

Radiologicals Summary by Area - Sludge Tank
(results in piCi/gr)

Isotope	$\bar{x}$ (001)	$\bar{x}$ (002)	$\bar{x}$ (Area)	#detects/ #Total	Det. Min.	Det. Max.
K-40	1.64	3.39	2.52	8/8	1.22	8.19
Ra-226	1.10	1.14	1.12	8/8	.733	1.48
Pu-238	.080	.053	.066	3/8	.0311	.080
Pu-239/240	U	.0311	.031	1/8	U	.0311
Th-228	1.35	.710	1.03	8/8	.475	2.32 *
Th-230	1.33	1.01	1.17	8/8	.664	1.72
Th-232	1.38	.730	1.06	7/8	.396	2.54
U-234	.835	.822	.830	8/8	.600	1.03
U-235/236	.0429	U	.043	1/8	U	.0429
U-238	.802	.789	.800	8/8	.574	1.04
Sr-90	1.01	.521	.766	4/8	.507	1.14
H-3	1.42	1.41	1.42	8/8	.199	2.93

U = Indicates that the analyte is not detected.

* ABOVE GUIDELINE VALUE OF 0.85 pCi/g AND BACKGROUND VALUE OF 2.13 pCi/g

TABLE 4

Radiologicals Summary by Area - Clarifier
(results in pCi/gr)

Isotope	$\bar{x}$ (003)	$\bar{x}$ (004)	$\bar{x}$ (Area)	#detects/ #Total	Det. Min.	Det. Max.
K-40	3.33	3.15	3.24	8/8	1.97	6.22
Ra-226	.922	.972	.947	8/8	.599	1.22
Pu-238	.467	.099	.283	7/8	.0143	.943
Pu-239/240	U	.046	.046	2/8	.0203	.0716
Th-228	.847	.632	.740	8/8	.0957	1.18
Th-230	1.05	.840	.945	8/8	.447	1.39
Th-232	.887	.680	.784	8/8	.131	1.32
U-234	.716	.670	.693	8/8	.447	.953
U-235/236	.045	.045	.045	4/8	.0372	.052
U-238	.744	.738	.741	8/8	.506	.891
Sr-90	1.38	U	1.38	1/8	U	1.38
H-3	2.75	1.15	1.95	8/8	.168	5.62

U = Indicates that the analyte is not detected.

TABLE 5

Radiological Summary by Area - WM Unit
(results in PCi/gr)

Isotope	$\bar{x}$ (005)	$\bar{x}$ (006)	$\bar{x}$ (007)	$\bar{x}$ (008)	$\bar{x}$ (009)	$\bar{x}$ (area)	#detects/ #total	Det. Max	Det. Min.
K-40	1.62	1.53	2.30	1.24	1.30	1.60	13/13	5.98	1.24
Ra-226	1.03	1.01	.744	.847	.776	.881	13/13	1.33	.434
Pu-238	.134	.522	.141	.0762	.045	.184	7/13	5.22	.0121
Pu-239/240	0.0162	.0147	U	U	.0121	.0143	3/13	.949	.0121
Th-228	.654	.789	.362	.539	.543	.577	13/13	1.15	.212
Th-230	.967	.927	.585	.885	.644	.796	13/13	1.19	.265
Th-232	.543	.703	.341	.749	.403	.548	13/13	1.19	.211
U-234	.812	.721	.500	.678	.629	.668	13/13	.939	.293
U-235/236	.062	.047	.032	U	.0363	.044	11/13	.0678	.0166
U-238	.754	.718	.572	.678	.672	.679	13/13	.998	.365
Sr-90	U	U	U	.423	.810	.617	3/13	1.08	.423
H-3	.817	.391	.524	.124	.270	.425	13/13	1.94	.112

U = Indicates that the analyte is not detected.

TABLE 6

SEMIVOLATILE DATA SUMMARY (detects only)
(results in ug/kg)

	001 (S)	001 (5)	001 (10)	001 (15)	002 (S)	002 (5)	002 (10)	002 (15)
Benzoic acid	51 J	U	U	U	38 J	50 J	U	U
Acenaphthylene	760	45	U	U	610	U	U	U
Dibenzofuran	58	U	U	U	U	U	U	U
Fluorene	140	U	U	U	U	U	U	U
Phenanthrene	780	210	U	160	120	U	U	U
Anthracene	420	46	U	U	240	U	U	U
Carbazole	63	U	U	U	U	U	U	U
Fluoranthene	2100	570	U	150	980	120	U	U
Pyrene	2000	510	U	120	1200	120	46	U
Benzo(a)anthracene	1500	330	U	58	770	87	U	U
Chrysene	1400	350	U	65	760	93	U	U
Bis(2-Ethylhexyl)Phthalate	48	U	U	43	49	66	65	47
Benzo(b)fluoranthene	U	270	U	U	1200	98	U	U
Benzo(k)fluoranthene	1800	310	U	51	1100	98	45	U
Benzo(a)pyrene	2100 *	320	U	U	1300 *	95	45	U
Ideno(1,2,3-cd)pyrene	1400	210	U	U	900	81	U	U
Dibenz Anthracene	480 *	94	U	U	300	U	U	U
Benzo Perylene	1300	210	U	U	910	92	U	U
Naphthalene	U	U	U	U	U	U	U	U
Di-n-octyl Phthalate	45	66	U	U	U	U	U	U
Di-n-butyl Phthalate	U	U	42	U	39	50	U	41

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.
* = DETECTED ABOVE RISK-BASED GUIDELINE VALUE

TABLE 6 (Continued)

SEMIVOLATILE DATA SUMMARY (detects only)
(results in ug/kg)

	003 (S)	003 (5)	003 (10)	003 (15)	004 (S)	004 (5)	004 (10)	004 (15)
Benzoic acid	U	U	U	U	42 J	U	U	U
Acenaphthylene	540	U	62	U	U	120	72	U
Dibenzofuran	65	U	U	U	140	U	U	U
Fluorene	79	U	U	U	120	U	U	U
Phenanthrene	570	U	85	U	1200	63	U	U
Anthracene	280	U	99	U	820	51	U	U
Carbazole	36	U	U	U	110	U	U	U
Fluoranthene	1500	U	260	U	2600	280	160	U
Pyrene	1500	U	260	U	2700	320	170	U
Benzo(a)anthracene	1100	U	170	U	2700	220	120	U
Chrysene	1000	U	220	U	2500	220	120	U
Bis(2-Ethylhexyl)Phthalate	U	U	54	U	U	48	65	U
Benzo(b)fluoranthene	1200	U	160	U	U	330	190	U
Benzo(k)fluoranthene	1200	U	190	U	3900	340	200	U
Benzo(a)pyrene	1300 K	U	190	U	4000 K	400	210	U
Ideno(1,2,3-cd)pyrene	820	U	110	U	2700	270	160	U
Dibenz Anthracene	280	U	U	U	1200 K	85	51	U
Benzo Perylene	810	U	100	U	2800	280	170	U
Naphthalene	71	U	67	U	180	U	U	U
Di-n-octyl Phthalate	U	U	U	U	U	U	U	U
Di-n-butyl Phthalate	U	U	U	U	U	U	U	U

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.
K - Detected above guideline value

TABLE 6 (Continued)

SEMIVOLATILE DATA SUMMARY (detects only)
(results in ug/kg)

	005 (S)	005 (5)	005 (10)	006 (S)	006 (5)	006 (10)	007 (S)	007 (5)	007 (10)
Benzoic acid	-	U	U	U	U	U	U,J	U	U
Acenaphthylene	U	U	U	U	U	U	U,J	U	U
Dibenzofuran	U	U	U	U	U	U	U,J	U	U
Fluorene	U	U	U	U	U	U	U,J	U	U
Phenanthrene	800	U	46	U	U	U	U,J	U	U
Anthracene	160	U	U	U	U	U	U,J	U	U
Carbazole	91	U	U	U	U	U	U,J	U	U
Fluoranthene	1300	U	47	U	U	U	U,J	U	U
Pyrene	1100	U	U	U	U	U	U,J	U	U
Benzo(a)anthracene	620	U	U	U	U	U	U,J	U	U
Chrysene	660	U	57	U	U	U	U,J	U	U
Bis(2-Ethylhexyl)Phthalate	U	U	U	U	U	U	40 J	50 J	U
Benzo(b)fluoranthene	570	U	U	U	U	U	U,J	U	U
Benzo(k)fluoranthene	610	U	U	U	U	U	U,J	U	U
Benzo(a)pyrene	590 *	U	U	U	U	U	U,J	U	U
Ideno(1,2,3-cd)pyrene	410	U	U	U	U	U	U,J	U	U
Dibenz Anthracene	160	U	U	U	U	U	U,J	U	U
Benzo Perylene	420	U	U	U	U	U	U,J	U	U
Naphthalene	U	U	U	U	U	U	U,J	U	U
Di-n-octyl Phthalate	U	U	U	U	U	U	U,J	U	U
Di-n-butyl Phthalate	U	U	U	U	U	U	51 J	U	U

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.
* = Detected above guideline value

TABLE 6 (Continued)

SEMIVOLATILE DATA SUMMARY (detects only)
(results in ug/kg)

	008 (S)	008 (5)	008 (10)		009 (S)	009 (5)	009 (10)		
Benzoic acid	U	U	U		U	U	U		
Acenaphthylene	U	U	U		U	U	U		
Dibenzofuran	U	U	U		U	U	U		
Fluorene	U	U	U		U	U	U		
Phenanthrene	–	U	U		U	U	U		
Anthracene	U	U	U		U	U	U		
Carbazole	U	U	U		U	U	U		
Fluoranthene	68 J	U	U		U	U	U		
Pyrene	58 J	U	U		U	U	U		
Benzo(a)anthracene	U	U	U		U	U	U		
Chrysene	U	U	U		U	U	U		
Bis(2UEthylhexyl)Phthalate	70 J	51 J	U		U	U	U		
Benzo(b)fluoranthene	U	U	U		U	U	U		
Benzo(k)fluoranthene	U	U	U		U	U	U		
Benzo(a)pyrene	U	U	U		U	U	U		
Ideno(1,2,3-cd)pyrene	U	U	U		U	U	U		
Dibenz Anthracene	U	U	U		U	U	U		
Benzo Perylene	U	U	U		U	U	U		
Naphthalene	U	U	U		U	U	U		
Di-n-octyl Phthalate	U	54 J	U		U	U	U		
Di-n-butyl Phthalate	U	U	U		U	U	U		

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 7

INORGANIC DATA SUMMARY (detects only)
(results in mg/kg)

	001 (S)	001 (5)	001 (10)	001 (15)	002 (S)	002 (5)	002 (10)	002 (15)
Arsenic	1.3 L	6.6	4.5	2.3	3.1	4.7	6.2	5.0
Chromium	U	R	R	R	U	R	R	R
Lead	7.7 J	214 J	17.6 J	3.9 J	11.6	11.6 J	14.3 J	5.1 J
Nickel	U	15	25	16.5 L	20.2	20.2	U	11.8
Silver	U	4.8 J	8.7 J	U	6.8J	6.8 J	8.1 J	3.5 J

U = Indicates that the analyte is not detected.
L = Indicates results which fall between the instrument detection limit or the method detection limit and the practical quanititation limit. Results are considered estimates and are usable for limited purposes.
J = Results are considered estimates and are usable for limited purposes.
R = Results are rejected and data are unusable for all purposes.

TABLE 7 (Continued)

INORGANIC DATA SUMMARY (detects only)
(results in mg/kg)

	003 (S)	003 (5)	003 (10)	003 (15)	004 (S)	004 (5)	004 (10)	004 (15)
Arsenic	3.0	4.1	2.9	5.9	2.6	4.3	5.0	7.7
Chromium	U	R	R	R	U	R	R	R
Lead	9.2 J	7.2 J	6.7 J	13.4	3.3	9.2	11.3	10.7
Nickel	U	19.5	14.8	15.1	U	14.8	15.8	15.7
Silver	U	5.8 J	4.5 J	5.3 J	U	4.4 J	5.8 J	5.7 J

U = Indicates that the analyte is not detected.
L = Indicates results which fall between the instrument detection limit or the method detection limit and the practical quanititation limit. Results are considered estimates and are usable for limited purposes.
J = Results are considered estimates and are usable for limited purposes.
R = Results are rejected and data are unusable for all purposes.

TABLE 7 (Continued)

INORGANIC DATA SUMMARY (detects only)
(results in mg/kg)

	005 (S)	005 (5)	005 (10)	006 (S)	006 (5)	006 (10)	007 (S)	007 (5)	007 (10)
Arsenic	3.0	6.9	4.0	2.6	3.7	4.5	2.9 J	5.6 J	4.4 J
Chromium	U	R	R	U	R	R	U	12.5	6.6
Lead	6.2	8.4	6.5	4.6	6.1	6.3	9.7 J	6.3 J	5.4 J
Nickel	U	16.7	14.7 L	U	17	11.0 L	U	U	U
Silver	U	5.9 J	U	U	5.1 J	U	U	U	U

U = Indicates that the analyte is not detected.
L = Indicates results which fall between the instrument detection limit or the method detection limit and the practical quanititation limit. Results are considered estimates and are usable for limited purposes.
J = Results are considered estimates and are usable for limited purposes.
R = Results are rejected and data are unusable for all purposes.

TABLE 7 (Continued)

INORGANIC DATA SUMMARY (detects only)
(results in mg/kg)

	008 (S)	008 (5)	008 (10)		009 (S)	009 (5)	009 (10)		
Arsenic	6.0 J	2.4 J	5.9 J		3.9 J	6.2 J	6.7 J		
Chromium	9.7	8.2	6.3		U	6.5	7.0		
Lead	22.1 J	9.4 J	6.2 J		11.1 J	8.4 J	9.5 J		
Nickel	U	12.2	U		U	13.7	13.0		
Silver	U	4.5 J	U		U	3.6 J	3.8 J		

U = Indicates that the analyte is not detected.
L = Indicates results which fall between the instrument detection limit or the method detection limit and the practical quanititation limit. Results are considered estimates and are usable for limited purposes.
J = Results are considered estimates and are usable for limited purposes.
R = Results are rejected and data are unusable for all purposes.

TABLE 8

Inorganic Data Summary by Area - Sludge Tank*
(results in mg/kg)

	$\bar{x}$ (001)	$\bar{x}$ (002)	$\bar{x}$ (Area)	#detects/ #Total	Det. Min.	Det. Max.
Arsenic	3.68	4.75	4.22	8/8	1.3	6.6
Lead	60.80	10.33	35.57	8/8	3.5	214 *
Nickel	18.83	16.00	17.42	5/8	11.8	20.2
Silver	6.75	6.13	6.44	5/8	3.5	8.7

* Results for chromium are rejected based on data validation process.

* BELOW VALUE OF 400 mg/kg

TABLE 9

Inorganic Data Summary by Area - Clarifier*
(results in mg/kg)

	$\bar{x}$ (003)	$\bar{x}$ (004)	$\bar{x}$ (Area)	#detects/ #Total	Det. Min.	Det. Max.
Arsenic	3.98	4.90	4.44	8/8	2.6	7.7
Lead	9.13	8.63	8.88	8/8	3.3	13.4
Nickel	16.47	15.43	15.95	6/8	14.8	19.5
Silver	5.20	5.30	5.25	6/8	4.4	5.8

* Results for chromium are rejected based on data validation process.

TABLE 10

Inorganic Data Summary by Area - WM Unit
(results in mg/kg)

min. max.

	$\bar{x}$ (005)	$\bar{x}$ (006)	$\bar{x}$ (007)	$\bar{x}$ (008)	$\bar{x}$ (009)	$\bar{x}$ (area)	#detects/ #total	Det. Max	Det. Min.
Arsenic	4.63	3.60	4.30	4.77	5.60	4.58	15/15	2.4	6.9
Chromium	-*	-*	9.40	8.07	6.75	8.07	11/15	6.3	12.5
Lead	7.03	5.67	7.13	12.57	9.67	8.41	15/15	4.6	22.1
Nickel	15.70	14.00	U	12.20	13.35	11.05	7/15	11.0	16.7
Silver	5.90	5.10	U	4.50	3.70	3.84	5/15	3.6	5.9

* = Detected values rejected by validation process.
U = Indicates that the analyte was not detected.

TABLE 11

VOLATILE ORGANICS SUMMARY (detects only)
(results in ug/kg)

	001 (S)	001 (5)	001 (10)	001 (15)	002 (S)	002 (5)	002 (10)	002 (15)
Methylene Chloride	U	U	U	U	U	U	U	U
Acetone	UJ	U	UJ	UJ	U	UJ	UJ	UJ
2-Hexanone	UJ	U	U	U	U	U	U	U
Toluene	U	3J	2J	3J	U	4J	2J	2J
Xylenes	U	U	U	U	U	U	U	U
Hexane	U	U	U	U	U	U	U	U
2-Butanone	U	UJ	UJ	U	U	U	U	U

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 11 (Continued)

VOLATILE ORGANICS SUMMARY (detects only)
(results in ug/kg)

	003 (S)	003 (5)	003 (10)	003 (15)	004 (S)	004 (5)	004 (10)	004 (15)
Methylene Chloride	U	U	U	U	U	U	U	U
Acetone	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
2-Hexanone	U	U	U	UJ	U	U	U	U
Toluene	1J	3J	3J	3J	U	U	5J	3J
Xylenes	U	U	U	U	U	U	U	U
Hexane	U	U	U	U	U	U	U	U
2-Butanone	U	U	U	UJ	UJ	U	UJ	UJ

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 11 (Continued)

VOLATILE ORGANICS SUMMARY (detects only)
(results in ug/kg)

	005 (S)	005 (5)	005 (10)	006 (S)	006 (5)	006 (10)	007 (S)	007 (5)	007 (10)
Methylene Chloride	U	U	U	U	U	U	U	U	U
Acetone	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ	UJ
2-Hexanone	U	U	U	U	U	U	U	U	U
Toluene	140	5J	1J	150	U	U	U	U	U
Xylenes	440	9	U	360	U	U	U	U	U
Hexane	34	U	U	U	U	U	U	U	U
2-Butanone	U	U	U	U	U	U	U	U	U
Ethylbenzene	22	U	U	54	U	U	U	U	U

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 11 (Continued)

VOLATILE ORGANICS SUMMARY (detects only)
(results in ug/kg)

	008 (S)	008 (10)		009 (S)	009 (5)	009 (10)		
Methylene Chloride	U	U		U	U	U		
Acetone	UJ	UJ		UJ	UJ	UJ		
2-Hexanone	U	U		U	U	U		
Toluene	U	U		U	U	U		
Xylenes	U	U		U	U	U		
Hexane	U	U		U	U	U		
2-Butanone	U	U		U	U	U		

U = Indicates that the analyte is not detected.
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 13

PCB and Pesticide Data Summary - Detects Only
(results in ug/kg; ppb)

	002 (S)	003 (S)	004 (S)	005 (S)
Endrin	4.6J	8.7J*	4.4J	U
Aroclor 1254	U	U	U	76

* = Average of duplicates
U = Nondetect
J = Results are estimated and the data are valid for limited purposes. The results are qualitatively acceptable.

TABLE 15

Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Total Organic Carbon and Explosives - Detects Only
(results in mg/kg)

	001(S)	001(5)	001(10)	001(15)	002(S)	002(5)	002(10)	002(15)
Chloride	2009	1534	162	103	1837	65	143	59
Fluoride	1.49	0.64	4.21	2.97	2.28	0.89	3.44	2.03
Nitrate	2.9J	1.26J	3.98J	1.1J	3.25J	2.12J	2.96J	1.13J
Sulfate	80.02	33	77	24	93	43	64	22.52
Total Organic Carbon	7520J	20164J	14068J	13238J	13924J	34825J	13174J	6060J

U = Indicates that the analyte is not detected.
J = Results are estimated and the data is valid for limited purposes. The results are qualitatively acceptable.

TABLE 15 (Continued)

Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Total Organic Carbon and Explosives - Detects Only
(results in mg/kg)

	003(S)	003(5)	003(10)	003(15)	004(S)	004(5)	004(10)	004(15)
Chloride	44	57	58	151	49	86	106	105
Fluoride	0.55	3.9	3.72	1.99	1.01	2.38	2.83	2.86
Nitrate	1.77J	2.35J	2.08J	2.16J	1.07J	2.35J	1.92J	2.16J
Sulfate	21.03	556	619	40	21.41	703	257	177
Total Organic Carbon	12332J	9612J	15225J	23244J	14789J	21448J	20302J	12880J

U = Indicates that the analyte is not detected.
J = Results are estimated and the data is valid for limited purposes. The results are qualitatively acceptable.

TABLE 15 (Continued)

Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Total Organic Carbon and Explosives - Detects Only
(results in mg/kg)

	005(S)	005(5)	005(10)	006(S)	006(5)	006(10)	007(S)	007(5)
Chloride	112	46	70	104	16	11	247	83
Fluoride	1.57	4.16	5.54	0.89	2.11	1.97	0.7	3
Nitrate	1.12J	4.92J	5.64J	2.34J	4.31J	2.34J	2.33J	4J
Sulfate	26	23.78	92	21.81	38	30	39	43
Total Organic Carbon	19721J	13683J	10149J	25782J	12548J	4661J	14579.8J	6877.8J

U = Indicates that the analyte is not detected.
J = Results are estimated and the data is valid for limited purposes. The results are qualitatively acceptable.

TABLE 15 (Continued)

Chloride, Fluoride, Nitrate/Nitrite, Sulfate, Total Organic Carbon and Explosives - Detects Only
(results in mg/kg)

	007(10)	008(S)	008(5)	008(10)	009(S)	009(5)	009(10)
Chloride	113	437	770	125	57	23	42
Fluoride	2	3.29	2.83	2.25	0.96	1.85	3.9
Nitrate	2.31J	3.35J	2.72J	3.42J	1.27J	4.3J	4.02J
Sulfate	36.47	97	44	38	30	32	74
Total Organic Carbon	10235.3J	15423J	13248.6J	6463.2J	6237.2J	7525.5J	4457J

U = Indicates that the analyte is not detected.
J = Results are estimated and the data is valid for limited purposes. The results are qualitatively acceptable.

ENVIRONMENTAL RESTORATION PROGRAM

SOIL GAS SURVEY AND GEOPHYSICAL INVESTIGATIONS MAIN HILL AND SM/PP HILL AREAS RECONNAISSANCE SAMPLING

MOUND PLANT
MIAMISBURG, OHIO

February 1993

DEPARTMENT OF ENERGY
ALBUQUERQUE OFFICE

ENVIRONMENTAL RESTORATION PROGRAM
EG&G MOUND APPLIED TECHNOLOGIES

Table II.2. SUMMARY OF DATA IDENTIFCATIONS, LOCATIONS, AND DEPTHS

SAMPLE	DATE	LOCATION	SAMPLE DEPTH (FEET)	QA/QC
MND-01-1201-0007	9/25/92	Main Hill	7	
MND-01-1201-1007	9/25/92	Main Hill		Duplicate
MND-01-1202-0002	9/25/92	Main Hill	2	
MND-01-1202-1002	9/25/92	Main Hill		Duplicate
MND-01-1203-0002	9/25/92	Main Hill	2	
MND-01-1204-0005	9/25/92	Main Hill	5	
MND-01-1205-0005	9/25/92	Main Hill	5	
MND-01-1206-0005	9/26/92	Main Hill	5	
MND-01-1207-0005	9/25/92	Main Hill	5	
MND-01-1208-0005	9/26/92	Main Hill	5	
MND-01-1208-2000	9/26/92	Main Hill		Trip Blank
MND-01-3209-5000	9/26/92	Area J		Field Blank
MND-01-3209-3000	9/26/92	Area J		Ambient Blank
MND-01-3209-0017	9/26/92	Area J	17	
MND-01-3209-1017	9/26/92	Area J		MS/MDS
MND-01-3210-0020	9/26/92	Area J	20	
MND-01-3210-1020	9/26/92	Area J		Duplicate
MND-01-2211-3000	9/26/92	Area 7		Ambient Blank
MND-01-2211-0015	9/26/92	Area 7	15	
MND-01-2212-0015	9/26/92	Area 7	15	
MND-01-2213-0005	9/26/92	Area 7	5	
MND-01-2214-0005	9/26/92	Area 7	5	
MND-01-2215-0005	9/26/92	Area 7	5	
MND-01-2216-0005	9/26/92	Main Parking Lot	5	
MND-01-2217-0005	9/26/92	Main Parking Lot	5	
MND-01-2218-0005	9/26/92	Main Parking Lot	5	
MND-01-2219-0005	9/26/92	Main Parking Lot	5	
MND-01-2220-0005	9/26/92	Main Parking Lot	5	
MND-01-2220-3002	9/27/92	Main Parking Lot		Ambient Blank
MND-01-2220-2000	9/27/92	Main Parking Lot		Trip Blank
MND-01-5221-5000	9/27/92	Southwest Main Hill		Field Blank
MND-01-5221-3000	9/27/92	Southwest Main Hill		Ambient Blank
MND-01-5221-0005	9/27/92	Southwest Main Hill	5	
MND-01-5221-1005	9/27/92	Southwest Main Hill		MS/MSD
MND-01-5222-0005	9/27/92	Southwest Main Hill	5	
MND-01-5222-1005	9/27/92	Southwest Main Hill		Duplicate
MND-01-5223-0005	9/27/92	Southwest Main Hill	5	
MND-01-5224-0005	9/27/92	Southwest Main Hill	5	
MND-01-5225-0005	9/27/92	Southwest Main Hill	5	
MND-01-5226-0005	9/27/92	Southwest Main Hill	5	
MND-01-5226-2000	9/27/92	Southwest Main Hill		Trip Blank
MND-01-1227-5000	9/28/92	Main Hill		Field Blank
MND-01-1227-3000	9/28/92	Main Hill		Ambient Blank
MND-01-1227-0005	9/28/92	Main Hill	5	
MND-01-1228-0005	9/28/92	Main Hill	5	
MND-01-1229-0005	9/28/92	Main Hill	5	
MND-01-1229-1005	9/28/92	Main Hill		MS/MSD
MND-01-1230-0005	9/28/92	Main Hill	5	
MND-01-1230-1005	9/28/92	Main Hill		Duplicate
MND-01-1231-0005	9/28/92	Main Hill	5	
MND-01-1232-0005	9/28/92	Main Hill	5	
MND-01-1232-2000	9/28/92	Main Hill		Trip Blank
MND-01-1233-5000	9/29/92	Main Hill		Field Blank
MND-01-1233-3001	9/29/92	Main Hill		Ambient Blank
MND-01-1233-0002	9/29/92	Main Hill	2	
MND-01-1233-1002	9/29/92	Main Hill		Duplicate

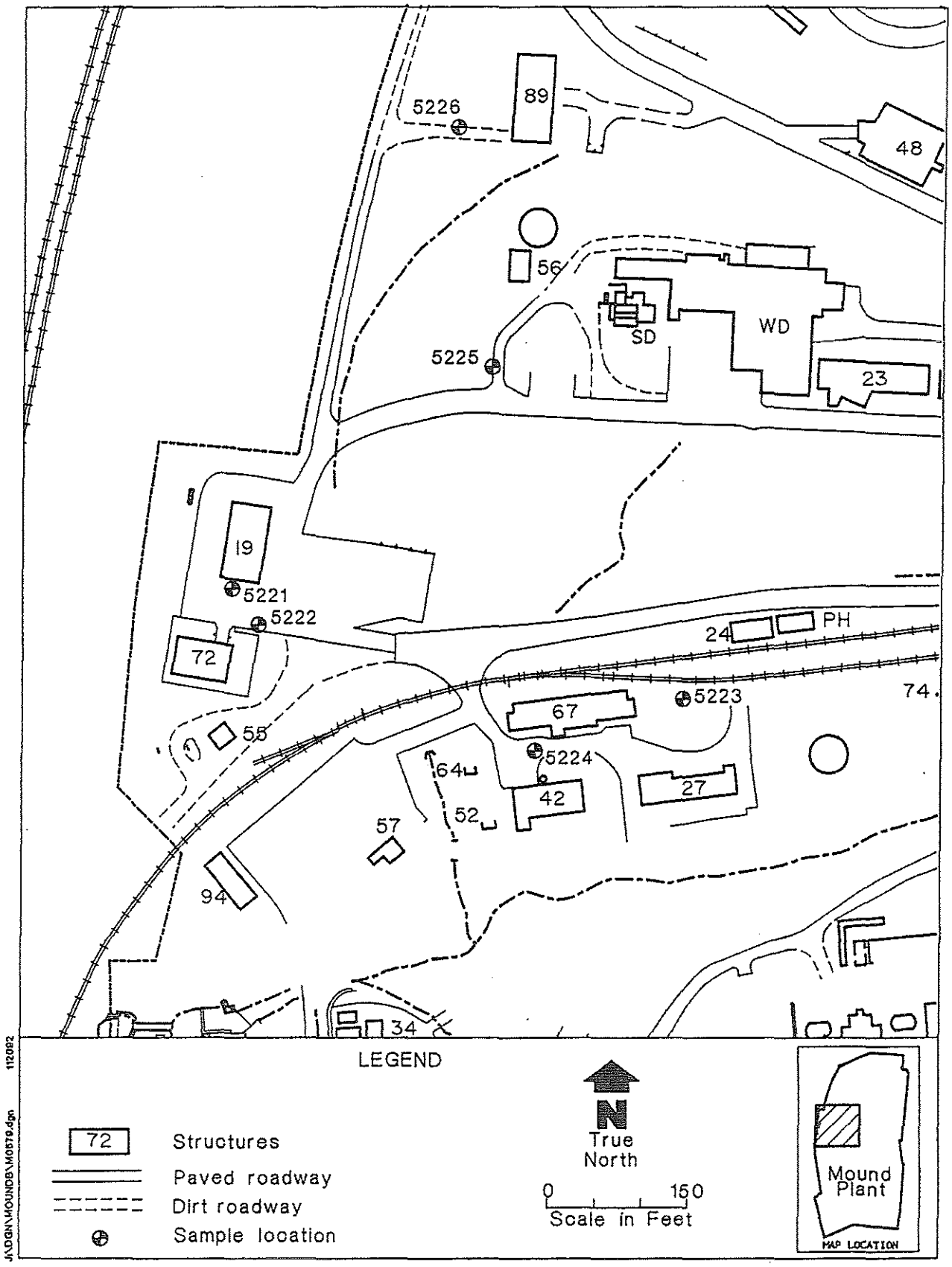


Figure 2.6. Southwest of Main Hill sample location map.

Table II.11 summarizes the Area 7 blank samples which contained VOC concentrations. Toluene was detected in various trip, ambient, and field blank samples associated with the Area 7 sampling effort at concentrations ranging from 3 to 186 ppb.

2.3.5. Main Parking Lot and Southwest of Main Hill

The contingency sampling effort conducted during the final week of the soil gas survey included the collection of five Main Parking Lot soil gas samples and six soil gas samples southwest of the Main Hill. All were collected from a depth of 5 feet. Table II.12 summarizes the detections from the Main Parking Lot and southwest of Main Hill sampling efforts.

At the Main Parking Lot only toluene was detected. Samples 2216 and 2219 contained toluene at 104 and 11 ppb, respectively (Figure 2.37). Toluene was detected in an ambient blank sample at location 2220 at a concentration of 8 ppb, but this sample was collected one day after the detections described above. No other blanks contained measurable concentrations of target compounds.

Southwest of the Main Hill four of the target compounds were detected. Most of these occurred in sample 5221, which was collected adjacent to Building 19. Freon 11, Freon 113, and TCE were detected in sample 5221 at concentrations of 21, 131, and 66 ppb, respectively. Figures 2.38 through 2.40 illustrate these detections. Toluene was detected at four locations southwest of the Main Hill, at concentrations ranging from 11 to 82 ppb (Figure 2.41); however, all of these samples had an associated ambient blank sample containing 8 ppb toluene (Table II.13). Figure 2.42 shows the sum of total VOCs detected at sample location 5221.

2.4. SUMMARY AND CONCLUSIONS

2.4.1. Summary of Results

Table II.14 summarizes the range of detections from each study area for the eight target compounds. As shown, peak Main Hill detections for the eight target compounds ranged from 247 to 131,000 ppb, with the highest being Freon 113. Peak Area J detections ranged from 11 to 46 ppb, with the highest being Freon 11. Peak Building 51 detections ranged from 18 to 89 ppb, with the highest being Freon 11. Peak Area 7 detections ranged from 7 to 825 ppb, with the highest being Toluene. Peak detections from the Main Parking Lot and southwest of Main Hill ranged from 21 to 131 ppb, with the highest being Freon 113.

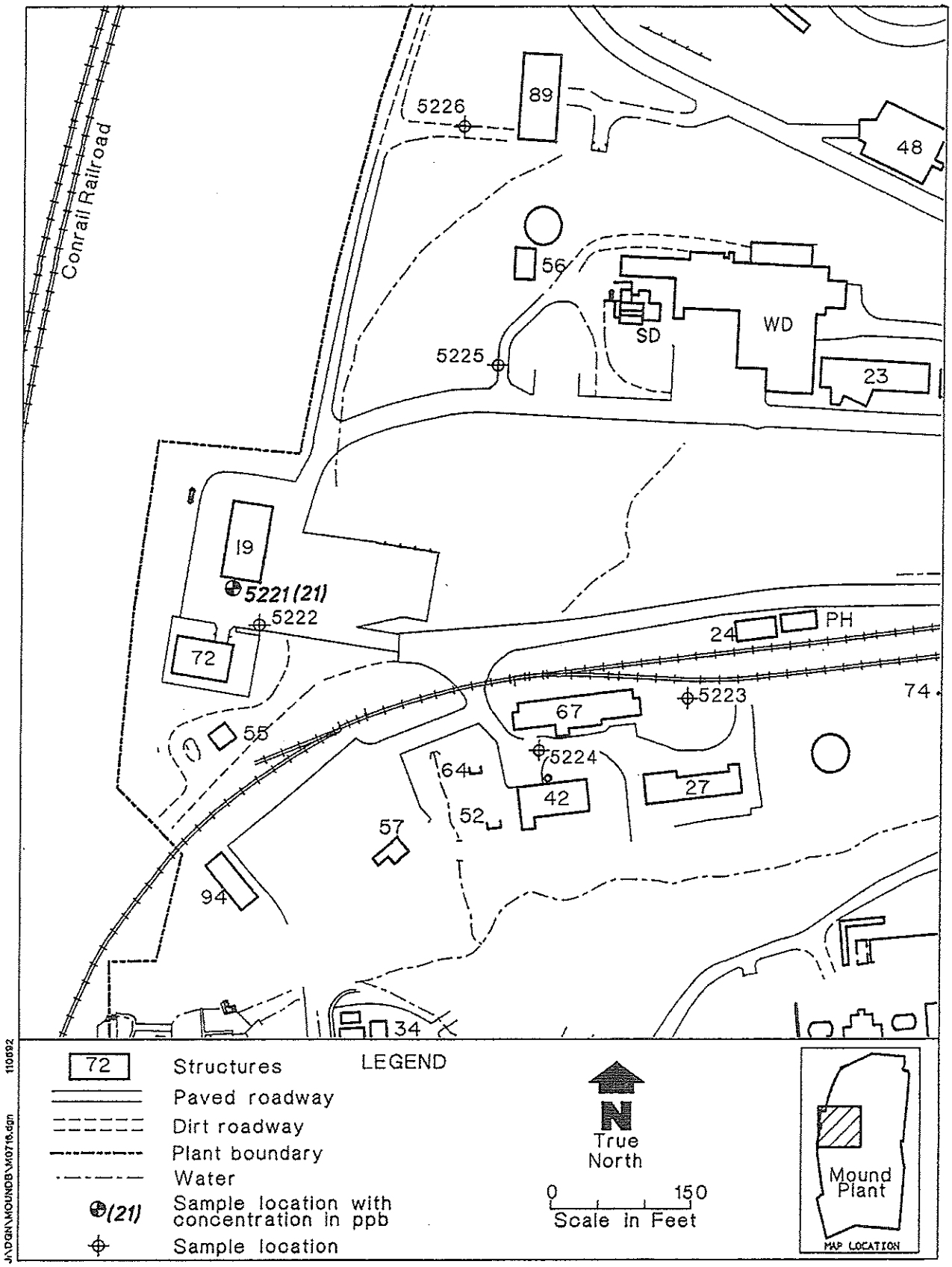


Figure 2.38. Freon II detection map for southwest of Main ''''

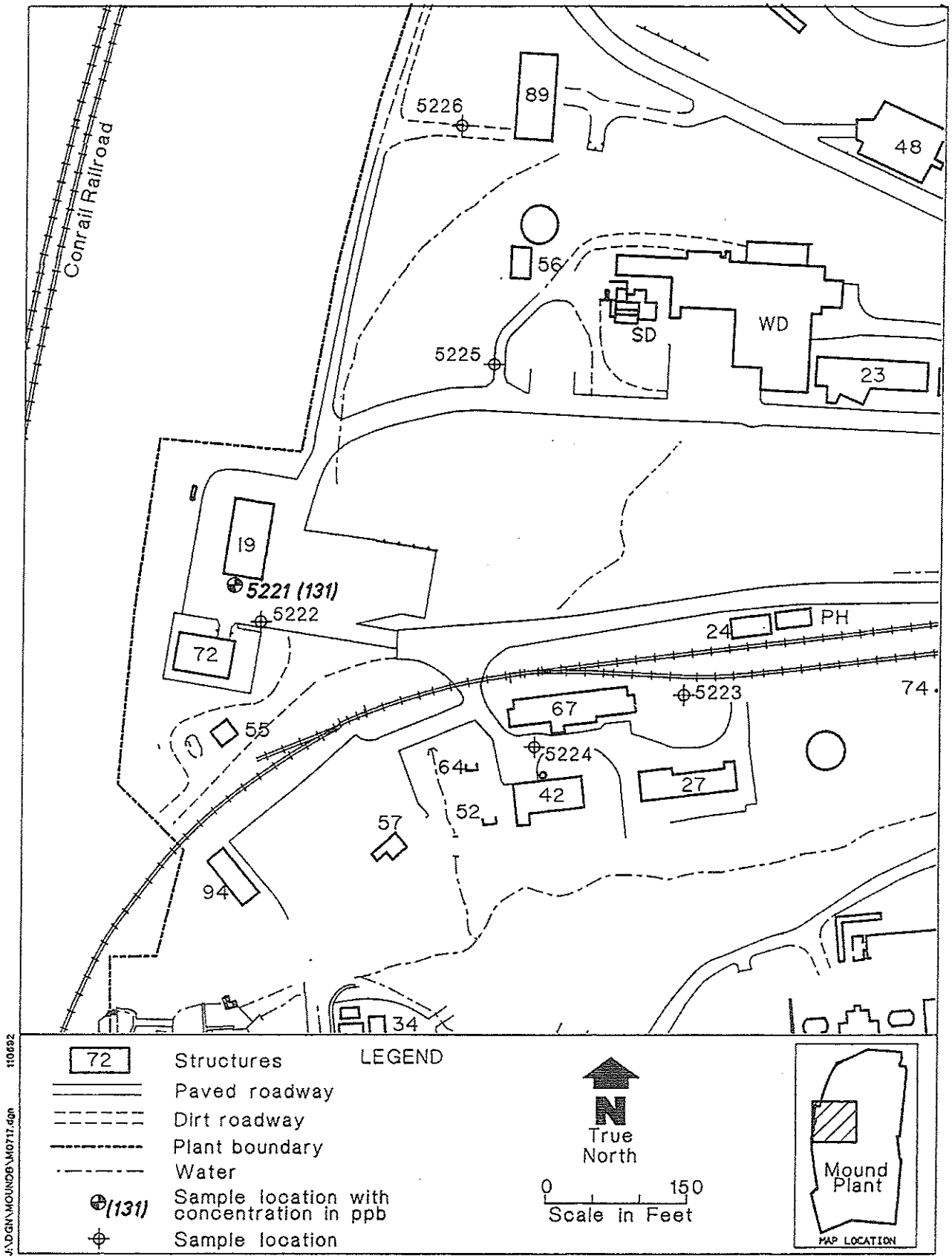


Figure 2.39. Freon 113 detection map for southwest of Main Hill.

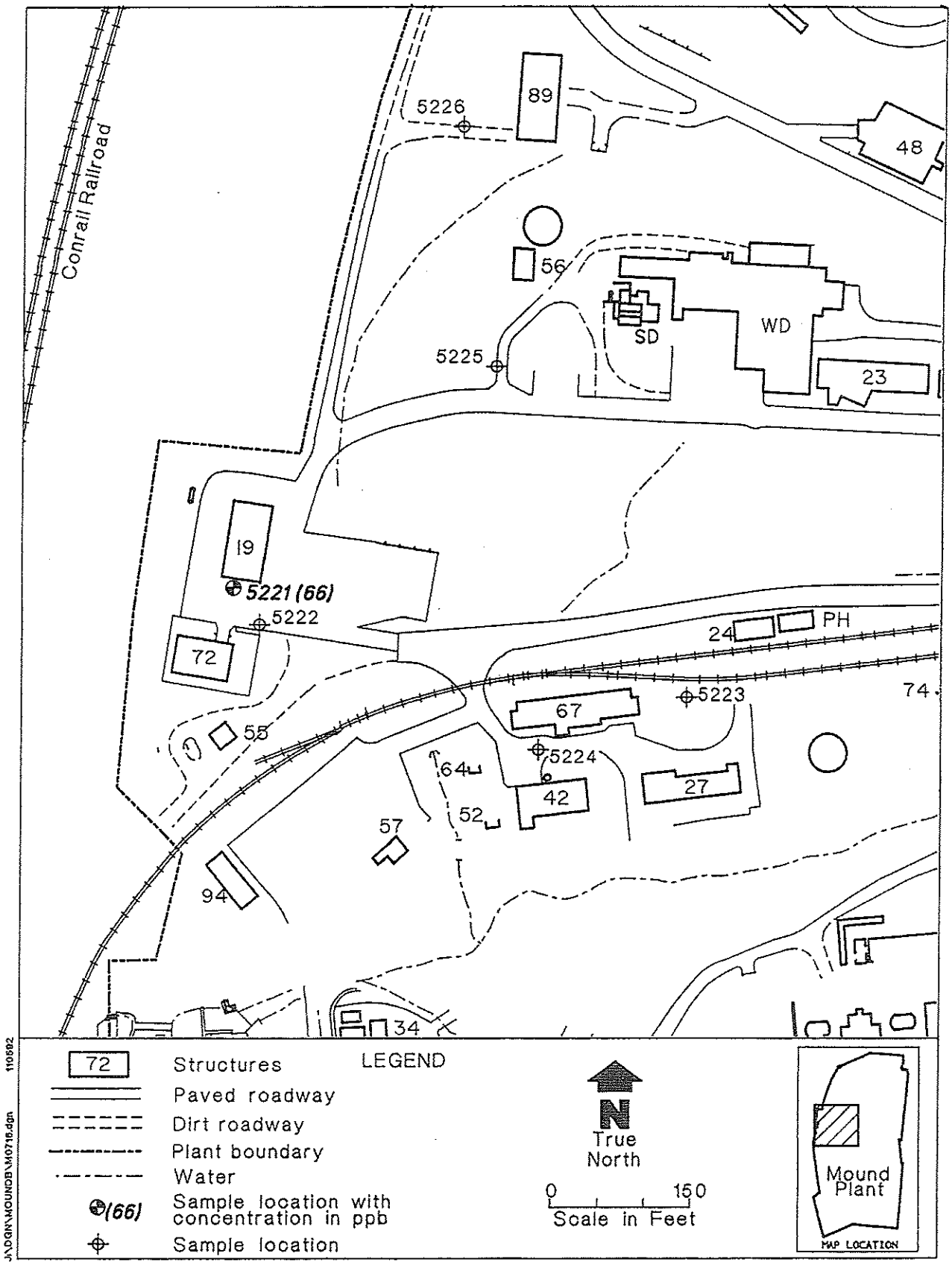


Figure 2.40. Trichloroethylene detection map for southwest of Main Hill.

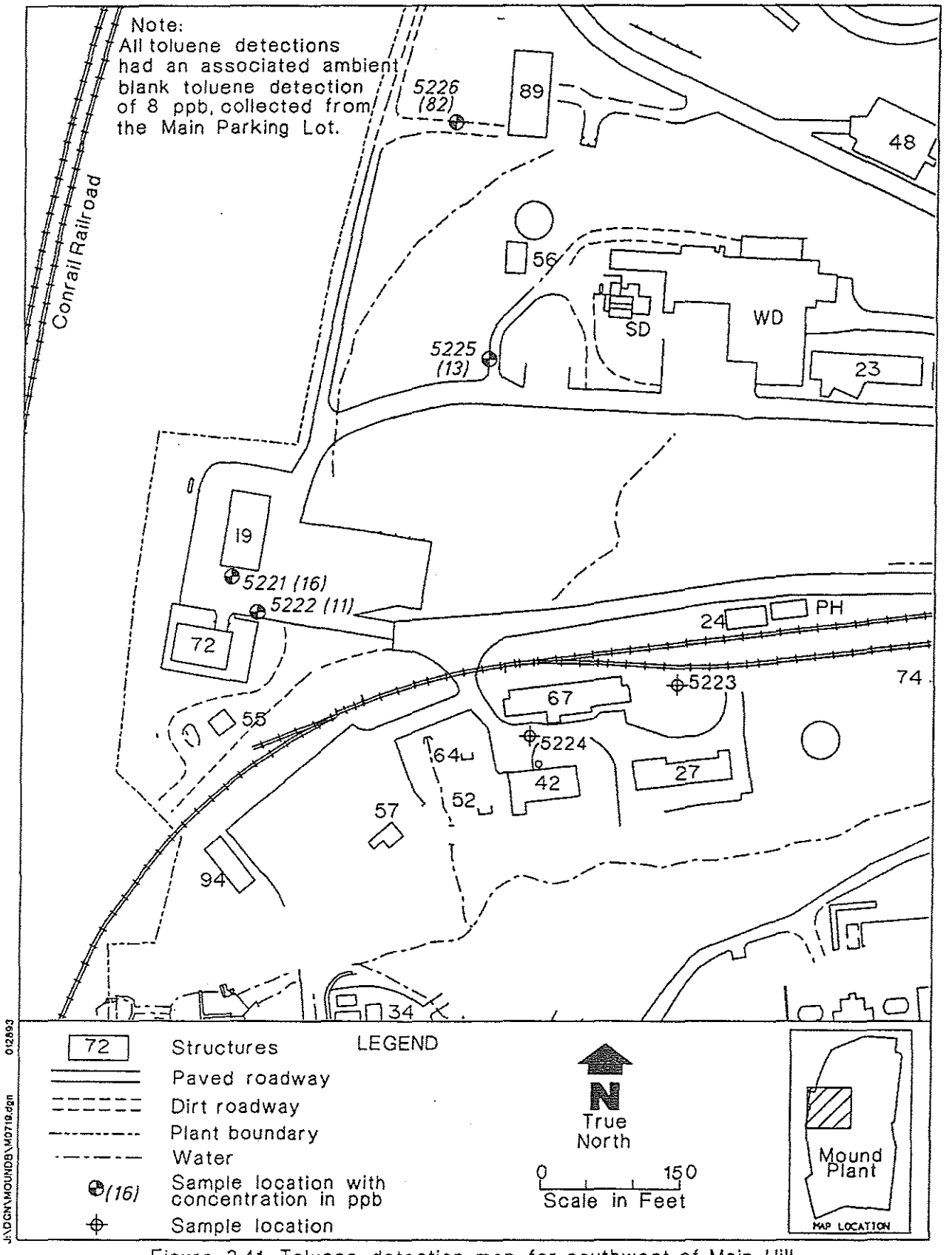


Figure 2.41. Toluene detection map for southwest of Main Hill.

TABLE II.14. RANGE OF DETECTIONS BY AREA

Area	Range of Detections (ppb)	Location of Highest Detection
Main Hill		
Freon 11	2–801	MND–01–1122–0005
Freon 113	4–131000	MND–01–1093–0005
Trans–12DCE	13–247	MND–01–1093–0005
cis–12DCE	120–40800	MND–01–1093–0005
111TCA	2–315	MND–01–1114–0005
PCE	3–1191	MND–01–1074–0005
TCE	2–34780	MND–01–1093–0005
Toluene	3–23142	MND–01–1206–0005
Area J		
Freon 11	2–46	MND–01–3154–1005
111TCA	7–37	MND–01–3175–0005
PCE	10–15	MND–01–3171–0005
TCE	13	MND–01–3154–0005
Toluene	5–11	MND–01–3153–0005
Building 51		
Freon 11	5–89	MND–01–4167–0015
Freon 113	9–18	MND–01–4166–0025
cis–12DCE	8–18	MND–01–4167–0015
111TCA	4–37	MND–01–4167–0015
PCE	7–44	MND–01–4166–0015
		MND–01–4166–0025
		MND–01–4167–0015
TCE	9–207	MND–01–4167–0015
Toluene	0.2–37	MND–01–4160–0015
Area 7		
Freon 11	11–32	MND–01–2139–0005
Freon 113	4–33	MND–01–2146–0005
cis–12DCE	3–10	MND–01–2141–0005
111TCA	2–22	MND–01–2148–0005
PCE	6–7	MND–01–2214–0005
Toluene	3–825	MND–01–2027–0005
Main Parking Lot and Southwest of Main Hill		
Freon 11	21	MND–01–5221–0005
Freon 113	131	MND–01–5221–0005
TCE	66	MND–01–5221–0005
Toluene	11–104	MND–01–2216–0005

ENVIRONMENTAL RESTORATION PROGRAM

OPERABLE UNIT 9
HYDROGEOLOGIC INVESTIGATION:
SOIL CHEMISTRY REPORT

MOUND PLANT
MIAMISBURG, OHIO

September 1994

U.S. DEPARTMENT OF ENERGY
ALBUQUERQUE OPERATIONS OFFICE

ENVIRONMENTAL RESTORATION PROGRAM
EG&G MOUND APPLIED TECHNOLOGIES

TECHNICAL MEMORANDUM

(REVISION 1)

Ni	6.6	2.6-3.0	NA	NA
K	602	2.6-3.0	NA	NA
Ag	2.7	2.6-3.0	NA	NA
Na	208	2.6-3.0	NA	NA
V	15.6	2.6-3.0	NA	NA
Zn	52.3	2.6-3.0	NA	NA

ER PROGRAM

MOUND PLANT

Miamisburg, Ohio

Plate 1

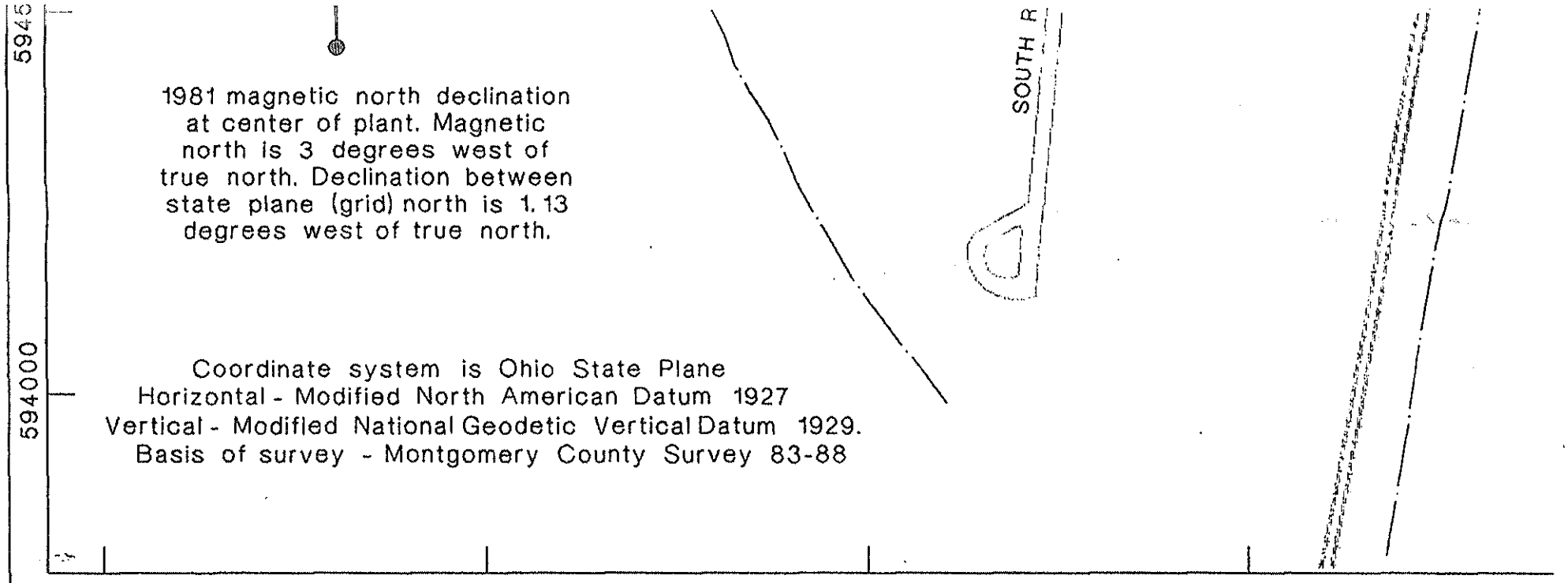
Subsurface Soil Concentrations for Metals

Prepared for

Soils Chemistry Report

January 1994

METALS
Al
As
Ba
Be
Ca
Cr
Co
Cu
Fe
Pb
Mg
Mn
Mo
Ni
K
Ag
Na
V
Zn



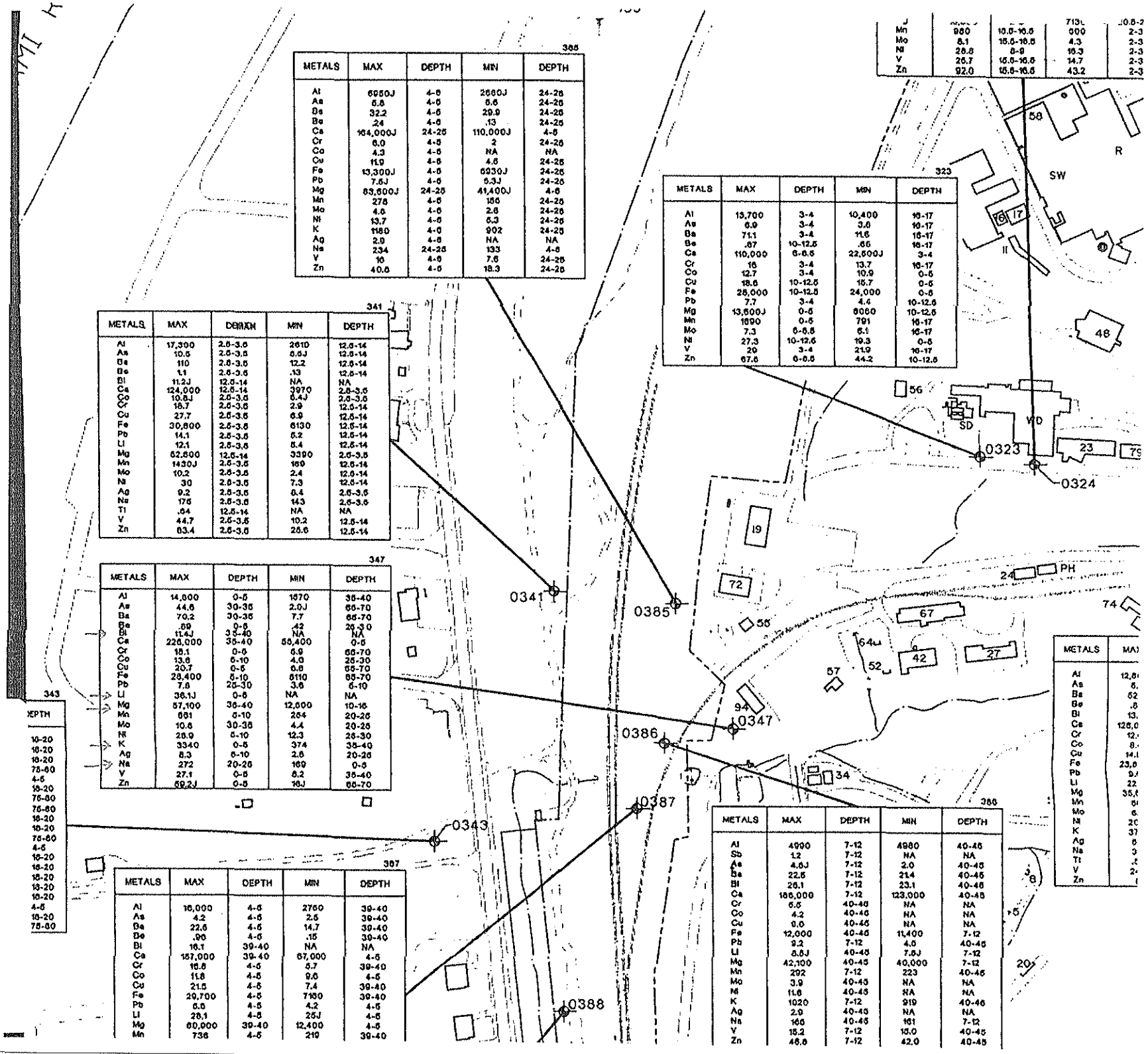
0997.dgn 011894

53 Structures
Paved roadway
Unpaved roadway
Railroad
Water course
Fence
Retaining wall
Mound Plant boundary
Property boundary
Contour line
Piezometer
Borehole
Monitoring well

Max = Maximum Concentration
Min = Minimum Concentration
Depth = feet
NA = Not Applicable
Concentration = (mg/kg)
= milligrams/kilogram
J = Estimated Quantity

Al = Aluminum
Sb = Antimony
As = Arsenic
Ba = Barium
Be = Beryllium
Bi = Bismuth
Ca = Calcium
Cr = Chromium
Co = Cobalt
Cu = Copper
Fe = Iron
Pb = Lead
Li = Lithium
Mg = Magnesium

Fe =
Pb =
Li = L
Mg =
Mn =
Hg =
Mo =
Ni = N
K = I
Ag =
Na =
Tl = T
Sn =
V =
Zn =



METALS	MAX	DEPTH	MIN	DEPTH
Al	6950J	4-6	2660J	24-26
As	6.6	4-6	6.6	24-26
Ba	32.2	4-6	29.9	24-26
Be	.24	4-6	.13	24-26
Ca	164,000J	24-26	110,000J	4-6
Cr	6.0	4-6	2	24-26
Co	4.3	4-6	NA	NA
Cu	11.9	4-6	4.6	24-26
Fe	13,300J	4-6	6930J	24-26
Pb	7.5J	4-6	5.3J	24-26
Mg	63,600J	24-26	41,400J	4-6
Mn	276	4-6	156	24-26
Mo	4.6	4-6	2.6	24-26
Ni	13.7	4-6	5.3	24-26
K	1160	4-6	902	24-26
Ag	2.9	4-6	NA	NA
Na	234	24-26	133	4-6
V	16	4-6	7.6	24-26
Zn	40.6	4-6	18.3	24-26

METALS	MAX	DEPTH	MIN	DEPTH
Al	17,300	2.6-3.6	2610	12.6-14
As	10.5	2.6-3.6	6.6J	12.6-14
Ba	110	2.6-3.6	12.2	12.6-14
Be	1.1	2.6-3.6	.13	12.6-14
Bi	11.2J	12.6-14	NA	NA
Ca	124,000	12.6-14	3970	2.6-3.6
Co	10.6J	2.6-3.6	6.4J	2.6-3.6
Cr	18.7	2.6-3.6	2.9	12.6-14
Cu	27.7	2.6-3.6	6.9	12.6-14
Fe	30,600	2.6-3.6	6130	12.6-14
Pb	14.1	2.6-3.6	6.2	12.6-14
Li	12.1	2.6-3.6	6.4	12.6-14
Mg	52,600	12.6-14	3390	2.6-3.6
Mn	1430J	2.6-3.6	169	12.6-14
Mo	10.2	2.6-3.6	2.4	12.6-14
Ni	30	2.6-3.6	7.3	12.6-14
Ag	9.2	2.6-3.6	6.4	2.6-3.6
Na	176	2.6-3.6	143	2.6-3.6
Tl	.64	12.6-14	NA	NA
V	44.7	2.6-3.6	10.2	12.6-14
Zn	63.4	2.6-3.6	26.6	12.6-14

METALS	MAX	DEPTH	MIN	DEPTH
Al	14,600	0-5	1570	35-40
As	44.6	30-35	2.0J	65-70
Ba	70.2	30-35	7.7	65-70
Be	.69	0-5	.42	25-30
Bi	11.4J	35-40	NA	NA
Ca	226,000	35-40	55,400	0-5
Cr	18.1	0-5	6.9	65-70
Co	13.6	5-10	4.0	25-30
Cu	20.7	0-5	6.6	65-70
Fe	28,400	5-10	6110	65-70
Pb	7.5	25-30	3.6	5-10
Li	36.1J	0-5	NA	NA
Mg	57,100	35-40	12,600	10-15
Mn	661	5-10	264	20-25
Mo	10.6	30-35	4.4	20-25
Ni	28.9	5-10	12.3	25-30
K	3340	0-5	374	35-40
Ag	8.3	5-10	2.6	20-25
Na	272	20-25	169	0-5
V	27.1	0-5	6.2	35-40
Zn	59.2J	0-5	16J	65-70

METALS	MAX	DEPTH	MIN	DEPTH
Al	16,000	4-5	2750	39-40
As	4.2	4-5	2.5	39-40
Ba	22.5	4-5	14.7	39-40
Be	.96	4-5	.15	39-40
Bi	16.1	39-40	NA	NA
Ca	157,000	39-40	67,000	4-5
Cr	16.6	4-5	5.7	39-40
Co	11.8	4-5	9.5	4-5
Cu	21.5	4-5	7.4	39-40
Fe	29,700	4-5	7130	39-40
Pb	5.5	4-5	4.2	4-5
Li	28.1	4-5	25J	4-5
Mg	60,000	39-40	12,400	4-5
Mn	736	4-5	219	39-40

METALS	MAX	DEPTH	MIN	DEPTH
Al	13,700	3-4	10,400	16-17
As	6.9	3-4	3.6	16-17
Ba	71.1	3-4	11.6	16-17
Be	.67	10-12.5	.66	16-17
Ca	110,000	6-6.5	22,600J	3-4
Cr	16	3-4	13.7	16-17
Co	12.7	3-4	10.9	0-5
Cu	18.6	10-12.5	15.7	0-5
Fe	26,000	10-12.5	24,000	0-5
Pb	7.7	3-4	4.4	10-12.5
Mg	13,600J	0-5	6060	10-12.5
Mn	1690	0-5	791	16-17
Mo	7.3	5-5.5	6.1	16-17
Ni	27.3	10-12.5	19.3	0-5
V	20	3-4	21.9	16-17
Zn	67.6	5-5.5	44.2	10-12.5

METALS	MAX	DEPTH	MIN	DEPTH
Al	4990	7-12	4980	40-45
Sb	1.2	7-12	NA	NA
As	4.6J	7-12	2.0	40-45
Ba	22.5	7-12	21.4	40-45
Bi	26.1	7-12	23.1	40-45
Ca	166,000	7-12	123,000	40-45
Cr	5.5	40-45	NA	NA
Co	4.2	40-45	NA	NA
Cu	9.0	40-45	NA	NA
Fe	12,000	40-45	11,400	7-12
Pb	9.2	7-12	4.5	40-45
Li	5.5J	40-45	7.5J	7-12
Mg	42,100	40-45	40,000	7-12
Mn	292	7-12	223	40-45
Mo	3.9	40-45	NA	NA
Ni	11.6	40-45	NA	NA
K	1020	7-12	919	40-45
Ag	2.9	40-45	NA	NA
Na	166	40-45	161	7-12
V	15.2	7-12	10.0	40-45
Zn	46.6	7-12	42.0	40-45

Mn	960	10.5-16.5	600	2-3
Mo	5.1	15.5-16.5	4.3	2-3
Ni	26.8	5-9	16.3	2-3
V	26.7	15.5-16.5	14.7	2-3
Zn	92.0	15.5-16.5	43.2	2-3

METALS	MAX
Al	12,6
As	6.
Ba	52
Be	.5
Bi	13.
Ca	126,0
Cr	12.
Co	8.
Cu	14.
Fe	23,0
Pb	9.
Li	22
Mg	35,
Mn	6
Mo	6.
Ni	20
K	37
Ag	5
Na	9
Tl	.2
V	2
Zn	

DEPTH
10-20
10-20
10-20
75-80
4-5
10-20
75-80
75-80
10-20
10-20
75-80
4-5
10-20
10-20
10-20
10-20
10-20
4-5
10-20
75-80

ER PROGRAM

MOUND PLANT

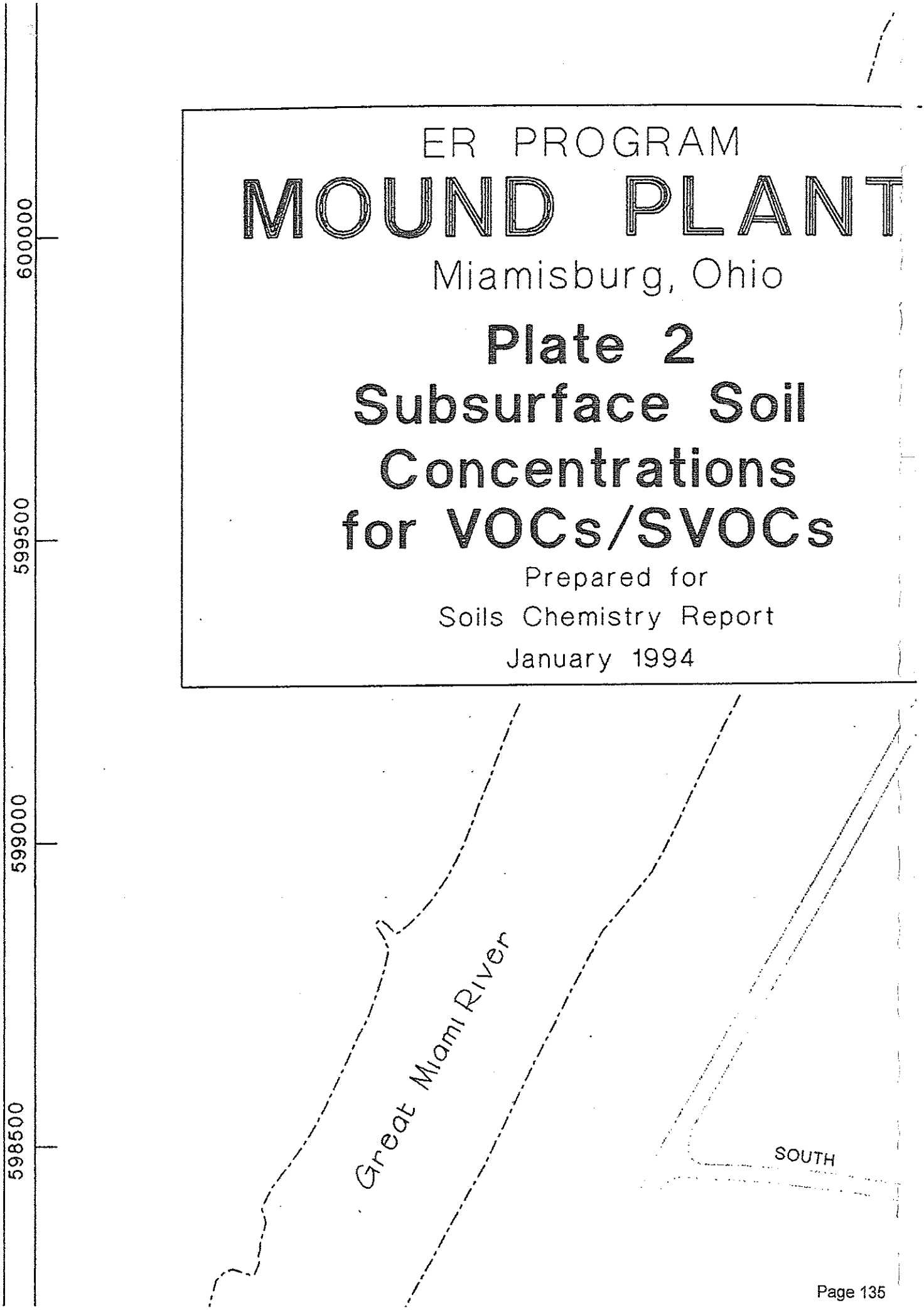
Miamisburg, Ohio

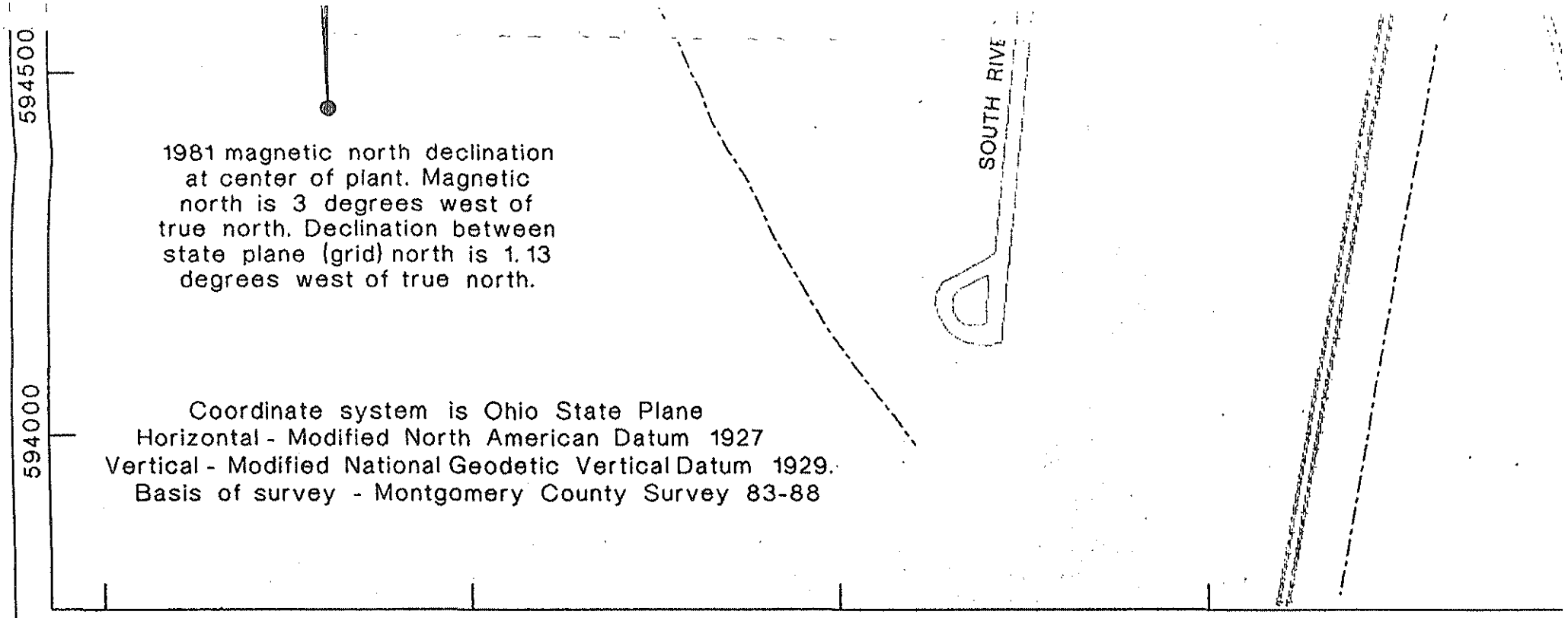
Plate 2
Subsurface Soil Concentrations for VOCs/SVOCs

Prepared for

Soils Chemistry Report

January 1994

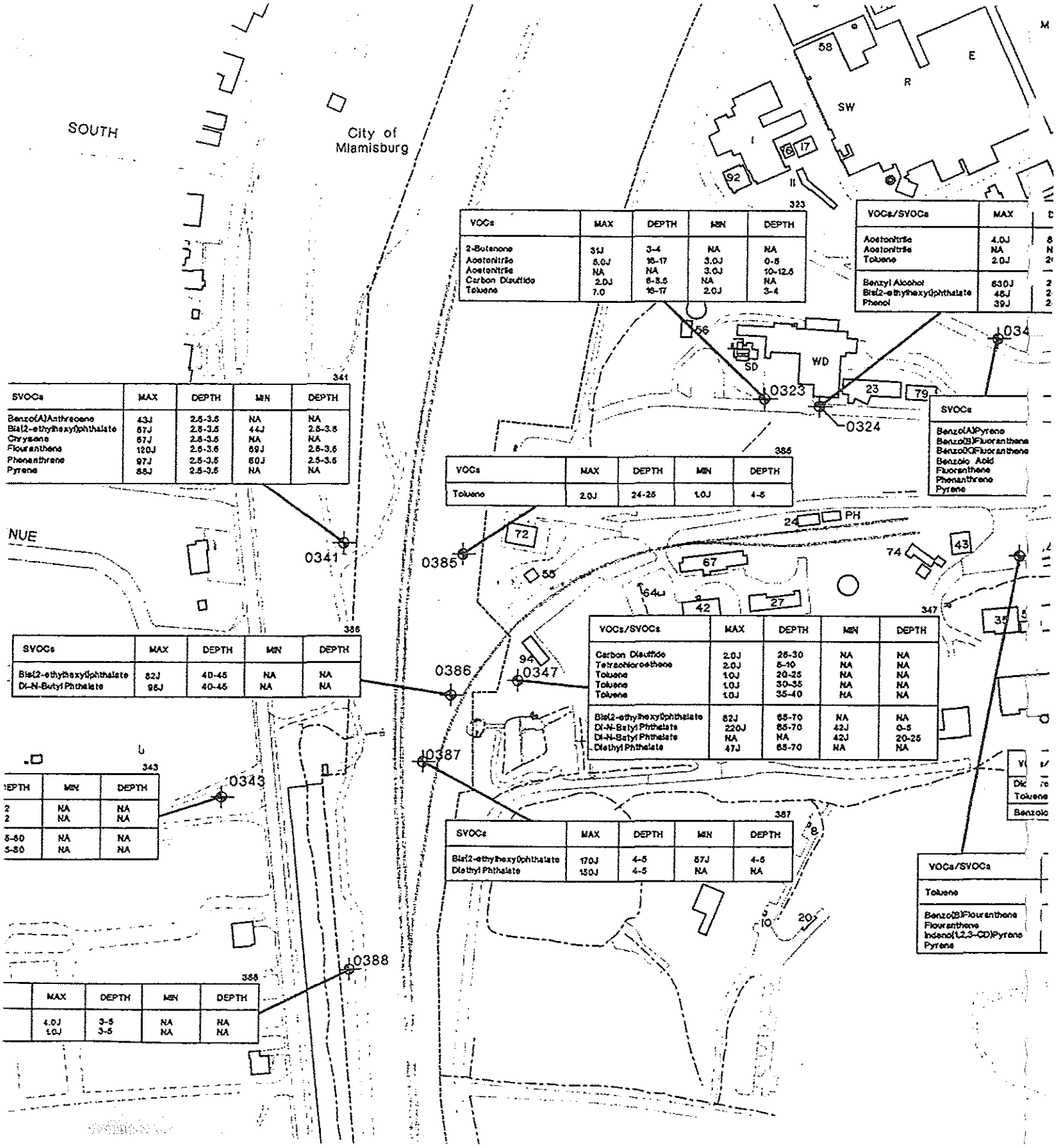




NOT

53 Structures
Paved roadway
Unpaved roadway
Railroad
Water course
Fence
Retaining wall
Mound Plant boundary
Property boundary
Contour line
Piezometers
Borehole
Monitoring well

Max = Maximum Concentration
Min = Minimum Concentration
Depth = feet
NA = Not Applicable
Concentration = (μg/kg)
= micrograms/kilogram
J = Estimated Quantity



VOCs	MAX	DEPTH	MIN	DEPTH
2-Butanone	31J	3-4	NA	NA
Acetonitrile	5.0J	16-17	3.0J	0-5
Acetonitrile	NA	NA	3.0J	10-12.5
Carbon Disulfide	2.0J	6-8.5	NA	NA
Toluene	7.0	16-17	2.0J	3-4

VOCs/SVOCs	MAX
Acetonitrile	4.0J
Acetonitrile	NA
Toluene	2.0J
Benzyl Alcohol	630J
Bis(2-ethylhexyl)phthalate	45J
Phenol	39J

SVOCs	MAX	DEPTH	MIN	DEPTH
Benzo(A)Anthracene	43J	2.5-3.5	NA	NA
Bis(2-ethylhexyl)phthalate	57J	2.5-3.5	44J	2.5-3.5
Chrysene	57J	2.5-3.5	NA	NA
Fluoranthene	120J	2.5-3.5	59J	2.5-3.5
Phenanthrene	97J	2.5-3.5	50J	2.5-3.5
Pyrene	88J	2.5-3.5	NA	NA

SVOCs
Benzo(A)Pyrene
Benzo(B)Fluoranthene
Benzo(K)Fluoranthene
Benzoic Acid
Fluoranthene
Phenanthrene
Pyrene

VOCs	MAX	DEPTH	MIN	DEPTH
Toluene	2.0J	24-25	1.0J	4-5

SVOCs	MAX	DEPTH	MIN	DEPTH
Bis(2-ethylhexyl)phthalate	82J	40-45	NA	NA
Di-N-Butyl Phthalate	96J	40-45	NA	NA

VOCs/SVOCs	MAX	DEPTH	MIN	DEPTH
Carbon Disulfide	2.0J	25-30	NA	NA
Tetrachloroethene	2.0J	5-10	NA	NA
Toluene	1.0J	20-25	NA	NA
Toluene	1.0J	30-35	NA	NA
Toluene	1.0J	35-40	NA	NA
Bis(2-ethylhexyl)phthalate	82J	65-70	NA	NA
Di-N-Butyl Phthalate	220J	65-70	42J	0-5
Di-N-Butyl Phthalate	NA	NA	42J	20-25
Diethyl Phthalate	47J	65-70	NA	NA

SVOCs	MAX	DEPTH	MIN	DEPTH
Bis(2-ethylhexyl)phthalate	170J	4-5	57J	4-5
Diethyl Phthalate	150J	4-5	NA	NA

VOCs/SVOCs
Toluene
Benzo(B)Fluoranthene
Fluoranthene
Indeno(1,2,3-CD)Pyrene
Pyrene

DEPTH	MIN	DEPTH
2	NA	NA
2	NA	NA
5-50	NA	NA
5-50	NA	NA

MAX	DEPTH	MIN	DEPTH
4.0J	3-5	NA	NA
1.0J	3-5	NA	NA

Th-230	.746	2.5-3.0	NA	NA
Th-232	.331	2.5-3.0	NA	NA
Tritium	.336	2.5-3.0	NA	NA
U-234	.43	2.5-3.0	NA	NA
U-235/236	.0233	2.5-3.0	NA	NA
U-238	.533	2.5-3.0	NA	NA

ER PROGRAM

MOUND PLANT

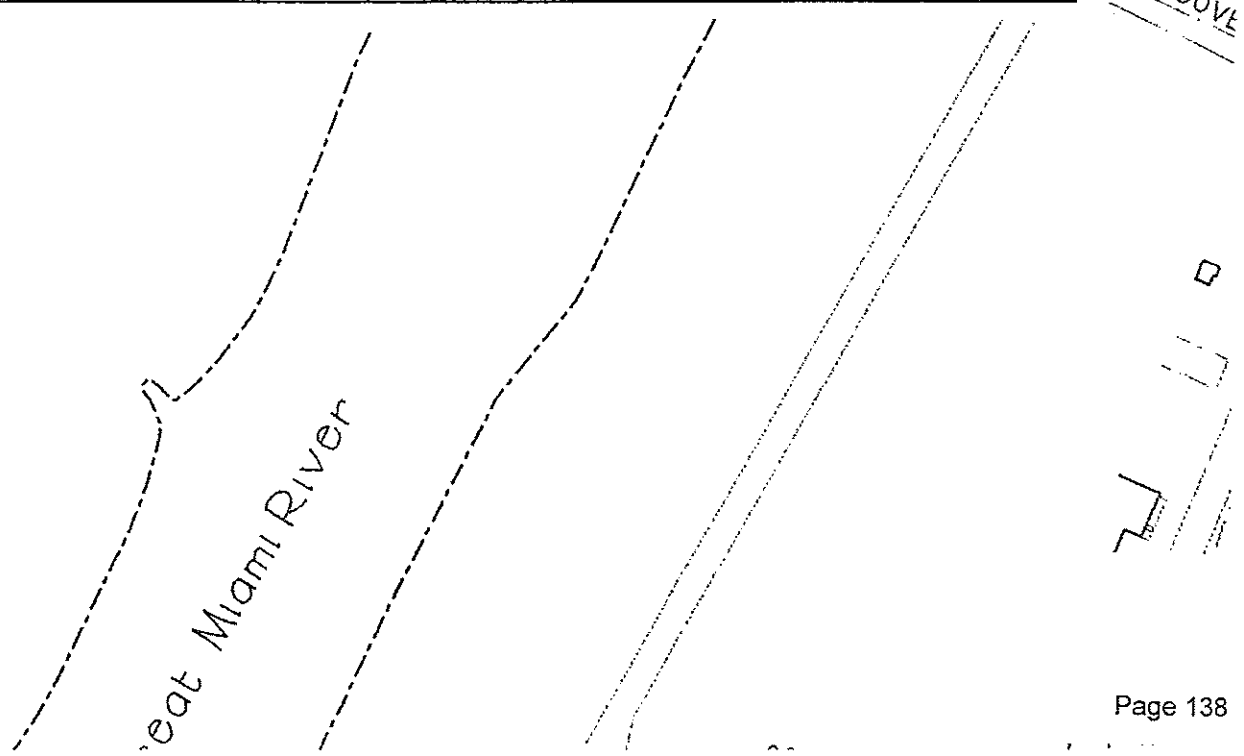
Miamisburg, Ohio

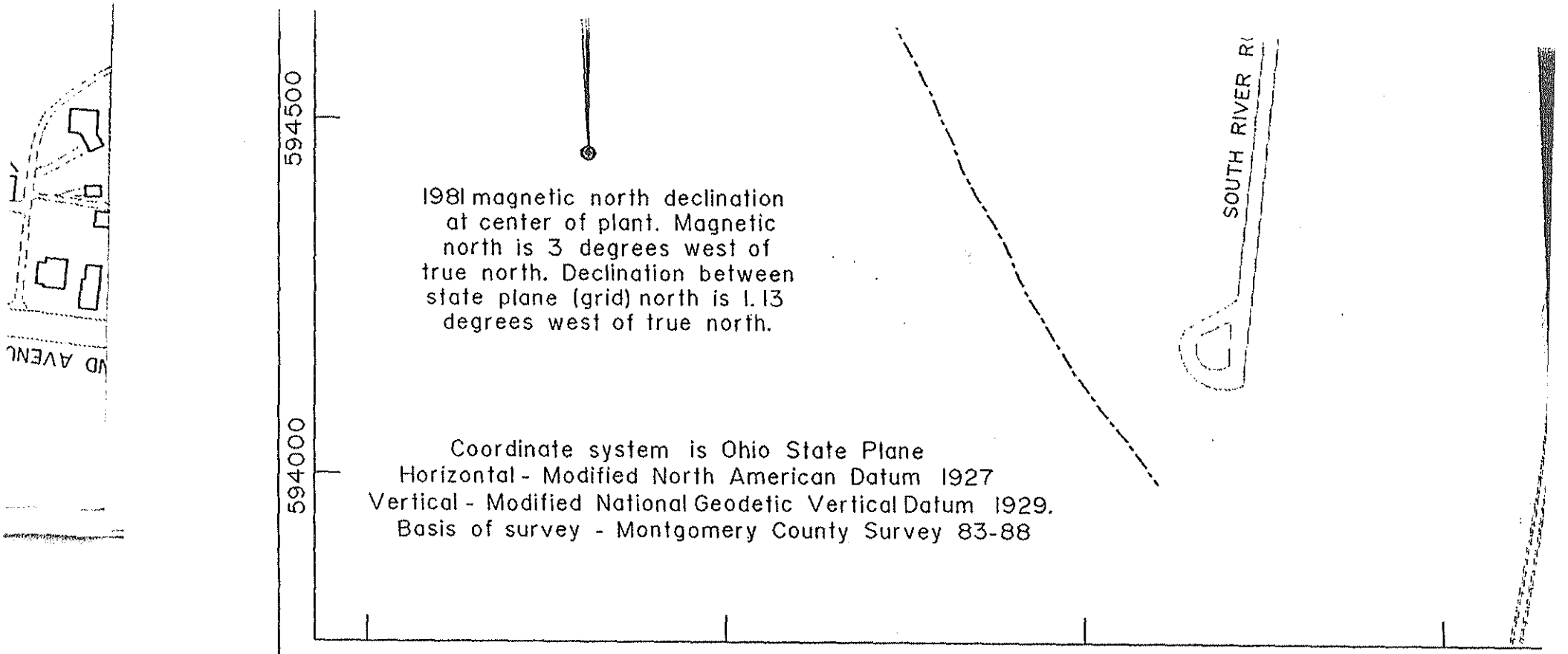
Plate 3
Subsurface Soil Concentrations for Radionuclides

Prepared for

Soils Chemistry Report

September 1994





53 Structures
Paved roadway
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Water course
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Retaining wall
Mound Plant boundary
Property boundary
Contour line
Piezometer
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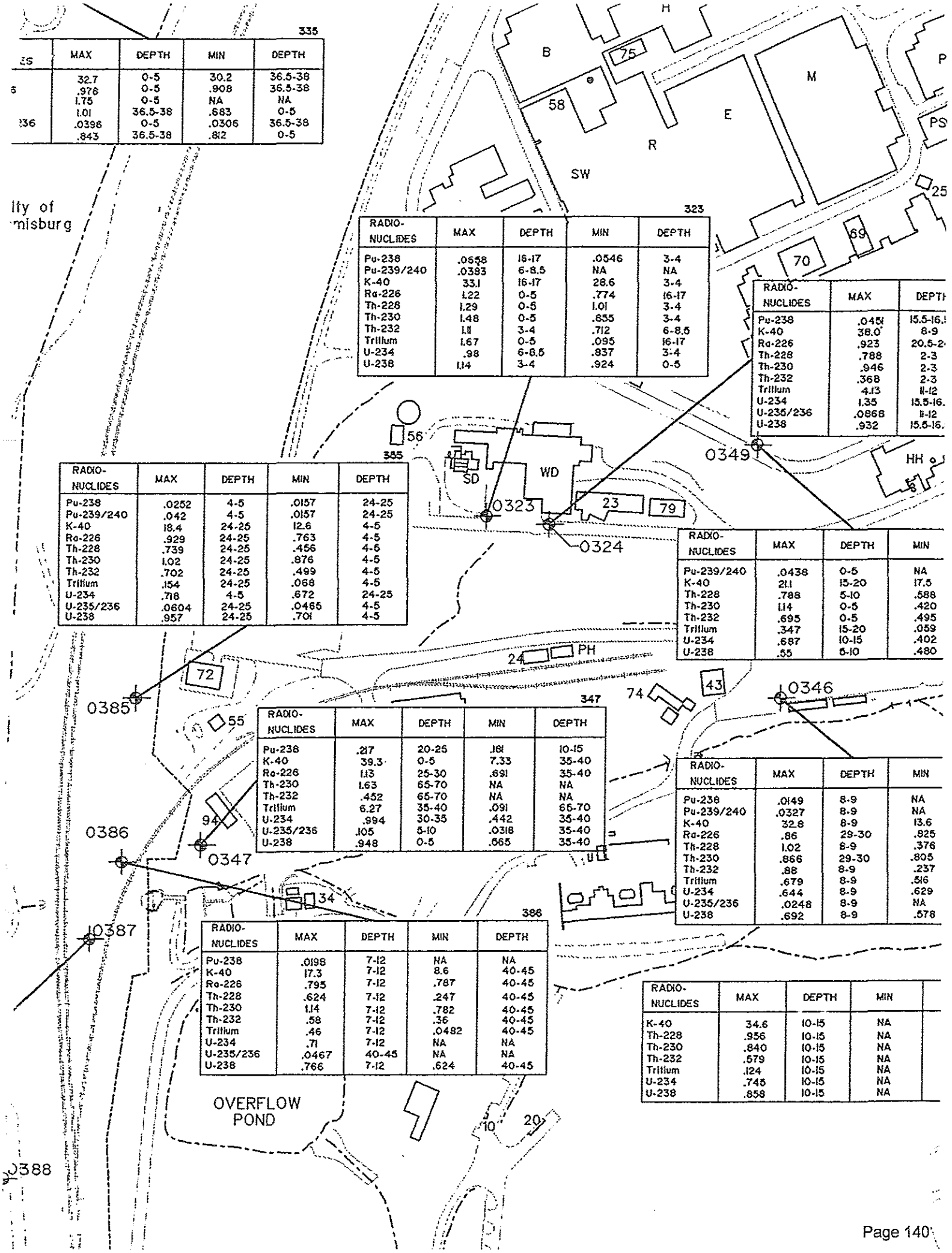
Monitoring Well

Max = Maximum Concentration
Min = Minimum Concentration
Depth = feet
NA = Not Applicable
Concentration = (pic/g)
= pico-curies/gram
J = Estimated Quantity

J:\DGN\MOUNDB\MI009.dgn 091494



335

ES	MAX	DEPTH	MIN	DEPTH
5	32.7	0-5	30.2	36.5-38
	.978	0-5	.908	36.5-38
	1.75	0-5	NA	NA
	1.01	36.5-38	.683	0-5
136	.0398	0-5	.0306	36.5-38
	.843	36.5-38	.812	0-5

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RADIO-NUCLIDES	MAX	DEPTH	MIN	DEPTH
Pu-238	.0658	16-17	.0546	3-4
Pu-239/240	.0383	6-8.5	NA	NA
K-40	33.1	16-17	28.6	3-4
Ra-226	1.22	0-5	.774	16-17
Th-228	1.29	0-5	1.01	3-4
Th-230	1.48	0-5	.855	3-4
Th-232	1.11	3-4	.712	6-8.5
Tritium	1.67	0-5	.095	16-17
U-234	.98	6-8.5	.837	3-4
U-238	1.14	3-4	.924	0-5

RADIO-NUCLIDES	MAX	DEPTH
Pu-238	.0451	15.5-16.
K-40	38.0	8-9
Ra-226	.923	20.5-2
Th-228	.788	2-3
Th-230	.946	2-3
Th-232	.368	2-3
Tritium	4.13	11-12
U-234	1.35	15.5-16.
U-235/236	.0868	11-12
U-238	.932	15.5-16.

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RADIO-NUCLIDES	MAX	DEPTH	MIN	DEPTH
Pu-238	.0252	4-5	.0157	24-25
Pu-239/240	.042	4-5	.0157	24-25
K-40	18.4	24-25	12.6	4-5
Ra-226	.929	24-25	.763	4-5
Th-228	.739	24-25	.456	4-5
Th-230	1.02	24-25	.876	4-5
Th-232	.702	24-25	.499	4-5
Tritium	.154	24-25	.068	4-5
U-234	.718	4-5	.672	24-25
U-235/236	.0604	24-25	.0465	4-5
U-238	.957	24-25	.701	4-5

RADIO-NUCLIDES	MAX	DEPTH	MIN
Pu-239/240	.0438	0-5	NA
K-40	21.1	15-20	17.5
Th-228	.788	5-10	.588
Th-230	1.14	0-5	.420
Th-232	.695	0-5	.495
Tritium	.347	15-20	.059
U-234	.687	10-15	.402
U-238	.55	5-10	.480

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RADIO-NUCLIDES	MAX	DEPTH	MIN	DEPTH
Pu-238	.217	20-25	.181	10-15
K-40	39.3	0-5	7.33	35-40
Ra-226	1.13	25-30	.691	35-40
Th-230	1.63	65-70	NA	NA
Th-232	.452	65-70	NA	NA
Tritium	6.27	35-40	.091	65-70
U-234	.994	30-35	.442	35-40
U-235/236	.105	5-10	.0318	35-40
U-238	.948	0-5	.665	35-40

RADIO-NUCLIDES	MAX	DEPTH	MIN
Pu-238	.0149	8-9	NA
Pu-239/240	.0327	8-9	NA
K-40	32.8	8-9	13.6
Ra-226	.86	29-30	.825
Th-228	1.02	8-9	.376
Th-230	.866	29-30	.805
Th-232	.88	8-9	.237
Tritium	.679	8-9	.516
U-234	.644	8-9	.629
U-235/236	.0248	8-9	NA
U-238	.692	8-9	.578

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RADIO-NUCLIDES	MAX	DEPTH	MIN	DEPTH
Pu-238	.0198	7-12	NA	NA
K-40	17.3	7-12	8.6	40-45
Ra-226	.795	7-12	.787	40-45
Th-228	.624	7-12	.247	40-45
Th-230	1.14	7-12	.782	40-45
Th-232	.58	7-12	.36	40-45
Tritium	.46	7-12	.0482	40-45
U-234	.71	7-12	NA	NA
U-235/236	.0467	40-45	NA	NA
U-238	.766	7-12	.624	40-45

RADIO-NUCLIDES	MAX	DEPTH	MIN
K-40	34.6	10-15	NA
Th-228	.956	10-15	NA
Th-230	.840	10-15	NA
Th-232	.579	10-15	NA
Tritium	.124	10-15	NA
U-234	.745	10-15	NA
U-238	.858	10-15	NA

GROUNDWATER MONITORING AND MAPPING FOR JUNE 1995 OPERABLE UNIT 9

MOUND PLANT
MIAMISBURG, OHIO

October 1995

WORKING DRAFT

Department Of Energy

EG&G Mound Applied Technologies

3.0 RESULTS OF GROUNDWATER ANALYSES

3.1. LABORATORY DATA VALIDATION

This section reviews the laboratory data packages, analytical results obtained, validated data and overall groundwater quality. The analytical results were reviewed for compliance with the OU-9 QAPP QA/QC requirements. At least 10% of all laboratory data packages were validated in accordance with Appendix H of the OU-9 QAPP (April 1995, Final). The remaining data packages were reviewed for completeness and QC compliance. No data were rejected as unusable. A summary of the validation report is presented in Appendix C. The complete set of laboratory results for each monitoring location may be found on Form I of the respective laboratory batch data. Electronic Data Deliverables, in the format required by the OU-9 QAPP, were provided by the laboratory.

3.2. ANALYTICAL RESULTS

3.2.1. Results of Non-CLP Volatile Organic Compound Analyses

Groundwater samples were analyzed for Volatile Organic Compounds (VOCs) by Method 8010A/8020 (US EPA SW-846). The following compounds were detected: carbon tetrachloride, chloroform, tetrachloroethene, toluene, trichloroethene, vinyl chloride, cis-1,2-dichloroethene and trans-1,2-dichloroethene. (Table III.1). Figures 3.1 through 3.9 show the concentrations and sampling locations of these analytes.

Table III.1. Volatile Organic Compounds Detected by Method 8010A/8020

Monitoring Well No. *(MCL)*	Carbon Tetrachloride *(5.0)*	Chloroform *(80)*	PCE *(5.0)*	Toluene *(1,000)*	TCE *(5.0)*	Vinyl Chloride *(2.0)*	cis-1,2-DCE *(70)*	trans-1,2-DCE *(100)*
0137	---	---	---	---	1.4	---	---	---
0312	---	---	---	---	10	---	4.9	---
0315	3.6	---	---	---	5.7	---	---	---
0347	4.8	---	---	---	7.2	---	1.1	---
0386	---	---	---	---	7.8	---	---	---
0389	---	---	---	---	4.5	---	---	---
0410	---	3.4	13	---	22	13	150J	---
0411	---	---	---	---	14	---	2.7	---
P015	---	---	10	2.6	33	7	140J	1.3
P027	---	---	2.0	---	5.8	---	2.6	---

µg/L - micrograms per liter
DCE - dichloroethene
TCE - trichloroethene
PCE - tetrachloroethene
MCL - maximum contaminant level for drinking water
J - value is estimated quantity

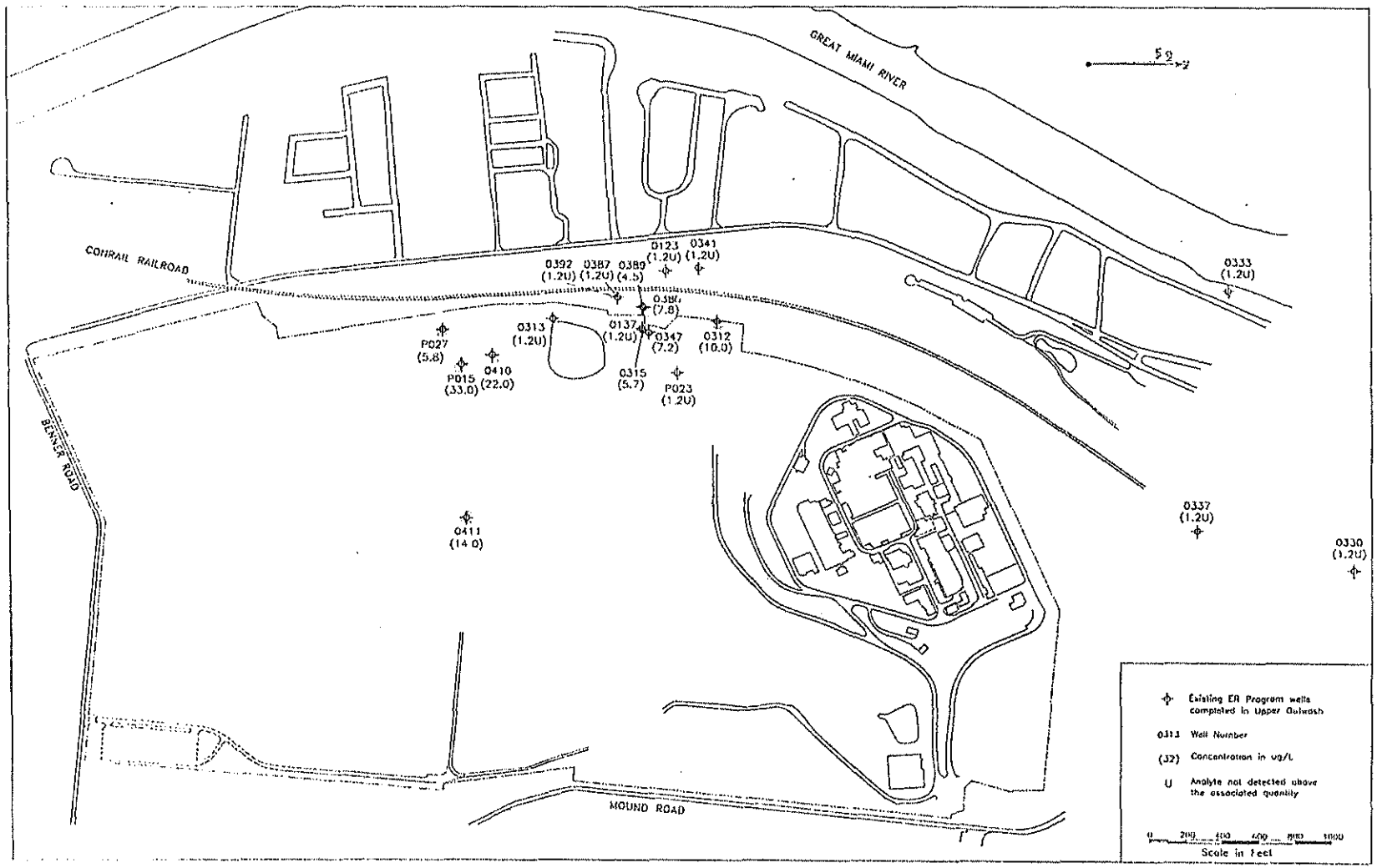

Figure 3.5. TCE concentrations in groundwater (μg/L), June 1995.

Table III.2. Detected Target Analyte List Metal Results by CLP ILM 03.0 for Unfiltered Samples

ANALYTE	WELL NUMBER					CRDL (µg/L)	Drinking Water Standard
	0123	0137	0312	0315	0341		
Aluminum	29.3 J	228	3110	12.3	36.8 J	20	50 to 200 SMCL
Antimony		1.0 J	0.35 J			10	6
Arsenic			8.2 J			10	50
Barium	71.5	36.2 J	78.8 J	198	111	200	2000
Beryllium			0.18 J	0.11 J		1	4
Bismuth		1.8 J	6.1 J			150	
Cadmium	0.09 J	7.0 J	4.1 J	0.32 J	0.19 J	5	5
Calcium	76600	42100	206000	165000	159000	5000	
Chromium	20.9	16.8	13300	206 J	8.4	10	100
Cobalt	0.28 J	2.1 J	281 J	1.9 J	0.89 J	50	
Copper		94.8	292	7.0 J		25	1300 MCLG
Iron	159	68900	64400	2870	645	100	300 SMCL
Lead	1.9 J	15.7 J	7.9 J	2.0 J	1.7 J	3	15 TT
Lithium	210		19 J		750	100	
Magnesium	32100	26200	85200	54800	79600	5000	
Manganese	420 J	319 J	2340 J	54.8 J	83 J	15	50 SMCL
Molybdenum	3.6 J	4.6 J	474 J	3.5 J	0.86 J	20	
Mercury						0.2	2
Nickel	24.5 J	13.4 J	11600 J	84.3	72.1 J	40	100
Potassium	13200 J	1730 J	6780 J	2820 J	44300 J	5000	
Selenium	1.4 J		1.6 J			5	50
Silver			0.72 J			10	100 SMCL
Sodium	643000 J	47100	57300	123000	1490000 J	5000	
Thallium						10	2
Tin		3.7 J	2.7 J			50	
Vanadium		22.9 J	85.2 J			10	
Zinc	1.5 J	35.2 J	74.9 J	4.0 J	2.4 J	20	5000 SMCL

Table III.2. Detected Target Analyte List Metal Results by CLP ILM 03.0 for Unfiltered Samples (cont.)

ANALYTE	WELL NUMBER										CRDL (µg/L)	Drinking Water Standard
	0347		0386		0387		0389		0392			
Aluminum	20.8	J	36.2	J	37.7	J			5430		20	50 to 200 SMCL
Antimony											10	6
Arsenic									4.8	J	10	50
Barium	159		92.3		130		95.4		78.6	J	200	2000
Beryllium									0.37	J	1	4
Bismuth									2.3	J	150	
Cadmium	0.15	J	0.23	J	0.13	J	0.11	J	2.2	J	5	5
Calcium	16400		124000		131000		155000		165000		5000	
Chromium	6.2	J	127		6.7		1.2	J	4040		10	100
Cobalt	0.61	J	3.0	J	0.4	J			34.7	J	50	
Copper			5.0	J	1.2	J	0.72	J	140		25	1300 MCLG
Iron	88.1	J	2920		105		18.2	J	28900		100	300 SMCL
Lead	2.4	J	2.1	J	1.4	J			12.7	J	3	15 TT
Lithium											100	
Magnesium	53600		37900		41100		40200		53300		5000	
Manganese	5.0	J	48		8.2	J	1.0	J	712	J	15	50 SMCL
Molybdenum	3.4	J	1.2	J	0.64	J	0.81	J	79.8	J	20	
Mercury											0.2	2
Nickel	17	J	156		28.1	J	4.4	J	1280	J	40	100
Potassium	2750	J	2040	J	3000	J	2400	J	4580	J	5000	
Selenium					1.6	J	3.1	J	1.4	J	5	50
Silver			0.56	J	0.5	J			0.36	J	10	100 SMCL
Sodium	15500		57700		56700		64200		42400	J	5000	
Thallium									2.5		10	2
Tin	1.7	J	1.4	J			2.0	J	3.2	J	50	
Vanadium			1.2	J					40	J	10	
Zinc	3.8	J	4.2	J	9.0	J	6.6	J	808	J	20	5000 SMCL

Table III.2. Detected Target Analyte List Metal Results by CLP ILM 03.0 for Unfiltered Samples (cont.)

ANALYTE	WELL NUMBER					CRDL (µg/L)	Drinking Water Standard
	0410	0411	P015	P023	P027		
Aluminum	61600	22300	16000	3230	23800	20	50 to 200 SMCL
Antimony	1.2 J		0.5 J		0.52 J	10	6
Arsenic	9.9 J	4.9 J	13.4	1.6 J	3.9 J	10	50
Barium	522	126 J	230	54.6 J	208 J	200	2000
Beryllium	4.2	1.2 J	1.1 J	0.44 J	1.4 J	1	4
Bismuth	7.3 J	2.2 J	2.7 J	1.8 J	2.6 J	150	
Cadmium	16.7	3.3 J	4.6	2160 J	4.7 J	5	5
Calcium	105000	201000	258000	255000	301000	5000	
Chromium	619	1450	35.8 J	19.2	35.3	10	100
Cobalt	59.2	47.3 J	10.4 J	4.5 J	28 J	50	
Copper	264	40.5	76.9	32.2	96.5	25	1300 MCLG
Iron	227000	54100	43400	33900	67500	100	300 SMCL
Lead	92.4 J	14.9 J	44.8 J	104	26.6	3	15 TT
Lithium	140	75 J	30 J	19 J	50 J	100	
Magnesium	488000	68100	94900	58900	86200	5000	
Manganese	5720	1070 J	707 J	921 J	1330 J	15	50 SMCL
Molybdenum	53.8 J	10.1 J	8.0 J	44.2 J	6.0 J	20	
Mercury	0.35					0.2	2
Nickel	305	117 J	40.8	19.6 J	62.7 J	40	100
Potassium	20000 J	12100 J	7100 J	8550 J	8900 J	5000	
Selenium		1.6 J				5	50
Silver						10	100 SMCL
Sodium	149000	63900	116000	101000	5230	5000	
Thallium			2.1			10	2
Tin	1.1 J	1.4 J	2.2 J		1.9 J	50	
Vanadium	231	53.4 J	27.2	17.7 J	65.3 J	10	
Zinc	668 J	92.1 J	370	139 J	236 J	20	5000 SMCL

All concentrations in micrograms per liter (µg/L).

MCLG - Maximum Contamination Level Goal. A non-enforceable concentration of a drinking water contaminant that is protective of adverse human health effects and allows an adequate margin of safety.

CRDL - Contract Required Detection Limit.

J - Numerical value is an estimated quantity.

SMCL - Secondary Maximum Contamination Level.

D - Duplicate

µg/L - micrograms per liter.

tt - Treatment technology action level.

U - Non-detected.

* - Significant concentration decrease between unfiltered and filtered ground water samples.

Table III.3. Detected Target Analyte List Metal Results by CLP ILM 03.0 for Filtered Samples

ANALYTE	WELL NUMBER					CRDL (µg/L)	Drinking Water Standard
	0123	0312	0313	0315	P027		
Aluminum	24.8 J	446 J	140	17.7 J	3430 J	20	50 to 200 SMCL
Antimony				0.68 J		10	6
Arsenic		2.6 J	1.9 J			10	50
Barium	69.1	28.1 J	177	192	88.3 J	200	2000
Beryllium			0.12 J	0.12 J	0.19 J	1	4
Bismuth		1.5 J	0.56 J		0.7 J	150	
Cadmium		1.2 J	0.57 J	0.62 J	0.51 J	5	5
Calcium	73600	190000	159000	155000	110000 J	5000	
Chromium		743 J	335	0.67 J	30.1	10	100
Cobalt	0.27 J	188 J	3.4 J	0.24 J	3.0 J	50	
Copper		30.3 J	19.2 J	2.6 J	12.1 J	25	1300 MCLG
Iron	8.6 J	20200 J	4380	27.8 J	7090 J	100	300 SMCL
Lead	1.3 J	2.4 J	2.5 J	1.8 J	9.2 J	3	15 TT
Lithium	220					100	
Magnesium	31700	78400	46300	51300	32800 J	5000	
Manganese	406 J	1730 J	68.7 J	3.7 J	110 J	15	50 SMCL
Molybdenum	2.3 J	89.7 J	2.2 J	2.6 J	3.4 J	20	
Mercury						0.2	2
Nickel	18 J	9290 J	159 J	50.3 J	14 J	40	100
Potassium	12800 J	6880 J	2750 J	2760 J	3820 J	5000	
Selenium						5	50
Silver						10	100 SMCL
Sodium	627000	60200	92900 J	115000	96700 J	5000	
Thallium						10	2
Tin					2.1 J	50	
Vanadium		11 J			8.5 J	10	
Zinc	1.3 J	55.9 J	12.1 J	5.1 J	32.3 J	20	5000 SMCL

J - Numerical value is an estimated quantity.

Operable Unit 9 Hydrogeologic Investigation: Groundwater Sweeps Report

3. Analytical Results

Table III.2. (page 2 of 9)

ANALYTE	0125	0126	0127	0128	0129	0130	0137	0138	0151	0152	0153	0154	0155
Arsenic, Soluble													
Arsenic, Total													
Barium, Soluble													
Barium, Total													
Cadmium, Soluble		/ ●		●									
Cadmium, Total					●		● / ●						
Chromium, Soluble									/ ●				
Chromium, Total										●			
Lead, Soluble				●									
Lead, Total	●	●		/ ●	/ ●		● / ●		● / ●				
Mercury, Soluble													
Mercury, Total							● / ●						
Selenium, Soluble													
Selenium, Total		●								/ ●			
Silver, Soluble													
Silver, Total							/ ●						
Tritium	●	● / ●					● / ●	● / ●		● / ●	● / ●	● / ●	● / ●
Plutonium–238							/ ●						
Uranium–234	● / ●								/ ●				
Uranium–235/236												●	
Uranium–238	● / ●								/ ●				
1,1,1–Trichloroethane													
1,2–cis–Dichloroethene												● / ●	● / ●
1,2–trans–Dichloroethene													
Bis(2–ethylhexyl)phthalate													
Tetrachloroethene													
Trichloroethene							● / ●			● / ●	● / ●	● / ●	● / ●
Trichlorofluoromethane													
Trichloromethane							●						● / ●
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event
/● - indicates an analyte detection during the Spring sampling event
▒ - shading indicates analyte detections above maximum contaminant levels

3. Analytical Results

Table III.2. (page 3 of 9)

ANALYTE	0156	0157	0158	0159	0160	0271	0301	0302	0303	0304	0305	0306	0307
Arsenic, Soluble					● / ●								
Arsenic, Total				●									
Barium, Soluble								● / ●		/ ●			
Barium, Total				●				● / ●		● / ●			
Cadmium, Soluble									/ ●	/ ●			
Cadmium, Total										● / ●			
Chromium, Soluble										/ ●			
Chromium, Total											● / ●		
Lead, Soluble				●			●			/ ●			
Lead, Total							/ ●		/ ●	● / ●		●	
Mercury, Soluble													
Mercury, Total													
Selenium, Soluble													
Selenium, Total													
Silver, Soluble										/ ●			
Silver, Total										/ ●			
Tritium						● / ●		● / ●	● / ●	/ ●	● / ●	● / ●	● / ●
Plutonium-238													
Uranium-234										● / ●			
Uranium-235/236							●			●	●		
Uranium-238										● / ●			
1,1,1-Trichloroethane													
1,2-cis-Dichloroethene						● / ●					● / ●		
1,2-trans-Dichloroethene											●		
Bis(2-ethylhexyl)phthalate													
Tetrachloroethene											● / ●		
Trichloroethene						● / ●					● / ●	● / ●	● / ●
Trichlorofluoromethane													
Trichloromethane											● / ●		●
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event
/● - indicates an analyte detection during the Spring sampling event
▒ - shading indicates analyte detections above maximum contaminant levels

3. Analytical Results

Table III.2. (page 4 of 9)

ANALYTE	0308	0309	0310	0311	0312	0313	0314	0315	0316	0317	0318	0319	0320
Arsenic, Soluble													
Arsenic, Total							● / ●						
Barium, Soluble		● / ●											
Barium, Total		●											
Cadmium, Soluble					/ ●		/ ●						
Cadmium, Total											/ ●		
Chromium, Soluble					/ ●	/ ●							
Chromium, Total					●	● / ●							
Lead, Soluble													
Lead, Total			●	●	●	● / ●	/ ●	●		/ ●	/ ●		
Mercury, Soluble													
Mercury, Total													
Selenium, Soluble													
Selenium, Total										●		/ ●	
Silver, Soluble													
Silver, Total													
Tritium			● / ●		● / ●	● / ●	● / ●	● / ●		● / ●	● / ●		
Plutonium–238													
Uranium–234					/ ●		●					●	
Uranium–235/236													
Uranium–238					/ ●		●					●	
1,1,1–Trichloroethane													
1,2–cis–Dichloroethene					● / ●			●					
1,2–trans–Dichloroethene					●								
Bis(2–ethylhexyl)phthalate													
Tetrachloroethene													
Trichloroethene					● / ●	● / ●		● / ●					
Trichlorofluoromethane													
Trichloromethane													
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event
/● - indicates an analyte detection during the Spring sampling event
▒ - shading indicates analyte detections above maximum contaminant levels

3. Analytical Results

Table III.2. (page 5 of 9)

ANALYTE	0321	0322	0323	0324	0325	0326	0327	0328	0329	0330	0332	0333	0334
Arsenic, Soluble												/ ●	
Arsenic, Total												●	
Barium, Soluble													
Barium, Total													
Cadmium, Soluble													
Cadmium, Total													
Chromium, Soluble												●	
Chromium, Total							▒●						
Lead, Soluble												●	
Lead, Total				●	● / ●	●							
Mercury, Soluble													
Mercury, Total													
Selenium, Soluble							/ ●						
Selenium, Total							/ ●		/ ●				
Silver, Soluble													
Silver, Total													
Tritium				▒● / ●									
Plutonium–238													
Uranium–234				●	●	/ ●							
Uranium–235/236													
Uranium–238													
1,1,1–Trichloroethane							●						
1,2–cis–Dichloroethene				● / ●				●					
1,2–trans–Dichloroethene													
Bis(2–ethylhexyl)phthalate						●		●					
Tetrachloroethene							▒●						
Trichloroethene				● / ●									
Trichlorofluoromethane													
Trichloromethane													●
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event
/● - indicates an analyte detection during the Spring sampling event
▒ - shading indicates analyte detections above maximum contaminant levels

3. Analytical Results

Table III.2. (page 6 of 9)

ANALYTE	0335	0336	0337	0341	0342	0343	0344	0345	0346	0347	0351	0353	0354
Arsenic, Soluble													
Arsenic, Total	/ ●												
Barium, Soluble	/ ●						● / ●						
Barium, Total	/ ●						● / ●						
Cadmium, Soluble						/ ●							
Cadmium, Total													
Chromium, Soluble		●											
Chromium, Total													
Lead, Soluble													
Lead, Total				/ ●	●			/ ●	/ ●		/ ●		
Mercury, Soluble													
Mercury, Total	/ ●												
Selenium, Soluble								/ ●	/ ●				
Selenium, Total													
Silver, Soluble										/ ●			
Silver, Total													
Tritium				/ ●		● / ●	● / ●	/ ●	● / ●	● / ●		/ ●	
Plutonium–238													
Uranium–234										● / ●			
Uranium–235/236					●								
Uranium–238										●			
1,1,1–Trichloroethane													
1,2–cis–Dichloroethene										● / ●			
1,2–trans–Dichloroethene										●			
Bis(2–ethylhexyl)phthalate						●							
Tetrachloroethene													
Trichloroethene										● / ●			
Trichlorofluoromethane													
Trichloromethane										●			
Vinyl Chloride													

otes:

- indicates an analyte detection during the Fall sampling event
- indicates an analyte detection during the Spring sampling event
- shading indicates analyte detections above maximum contaminant levels

3. Analytical Results

Table III.2. (page 7 of 9)

ANALYTE	0356	0370	0372	0373	0375	0376	0377	0378	0379	0380	0381	0382	0383
Arsenic, Soluble													
Arsenic, Total													
Barium, Soluble													
Barium, Total													
Cadmium, Soluble	/ ●									/ ●			
Cadmium, Total													
Chromium, Soluble				/ ●			● / ●				/ ●		
Chromium, Total				/ ●			● / ●						
Lead, Soluble												/ ●	
Lead, Total		●	/ ●	●		●	●		●	●			
Mercury, Soluble													
Mercury, Total													
Selenium, Soluble													
Selenium, Total													
Silver, Soluble										/ ●			
Silver, Total													
Tritium	/ ●	● / ●		● / ●	/ ●	● / ●	● / ●	● / ●	● / ●				
Plutonium–238													
Uranium–234	/ ●												
Uranium–235/236								●					
Uranium–238	● / ●	● / ●		●									
1,1,1–Trichloroethane							● / ●	● / ●					
1,2–cis–Dichloroethene		● / ●		● / ●									
1,2–trans–Dichloroethene		●											
Bis(2–ethylhexyl)phthalate				●						●			
Tetrachloroethene		● / ●		● / ●									
Trichloroethene		● / ●		● / ●	● / ●				● / ●				
Trichlorofluoromethane		●		● / ●									
Trichloromethane		● / ●		● / ●									
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event
/● - indicates an analyte detection during the Spring sampling event
▒ - shading indicates analyte detections above maximum contaminant levels

Table III.2. (page 8 of 9)

ANALYTE	0385	0386	0387	0388	0389	0393	0394	0397	0601	0602	0605	0607	0608
Arsenic, Soluble													
Arsenic, Total													
Barium, Soluble													
Barium, Total													
Cadmium, Soluble					/ ●								
Cadmium, Total													
Chromium, Soluble								/ ●				●	
Chromium, Total				/ ●									
Lead, Soluble													
Lead, Total			●					●	● / ●	●	/ ●		
Mercury, Soluble													
Mercury, Total										●			
Selenium, Soluble													
Selenium, Total				/ ●									
Silver, Soluble													
Silver, Total													
Tritium		● / ●	● / ●	● / ●	● / ●	● / ●	● / ●	● / ●	● / ●	● / ●	/ ●	● / ●	● / ●
Plutonium–238													
Uranium–234						● / ●			● / ●	/ ●			
Uranium–235/236													
Uranium–238													
1,1,1–Trichloroethane													
1,2–cis–Dichloroethene								●		●	/ ●	●	/ ●
1,2–trans–Dichloroethene													
Bis(2–ethylhexyl)phthalate													
Tetrachloroethene								● / ●					
Trichloroethene		● / ●			● / ●			● / ●	/ ●	●	/ ●	● / ●	/ ●
Trichlorofluoromethane													
Trichloromethane								●					
Vinyl Chloride													

Notes:

● - indicates an analyte detection during the Fall sampling event

/● - indicates an analyte detection during the Spring sampling event

▒ - shading indicates analyte detections above maximum contaminant levels

Table C.1. Detections Above Maximum Contaminant Levels

Parameter (µg/L)[a]	Location	Log Date	Result	MCL
1,2-cis-Dichloroethene	0370-0001	09/24/93	190.	70
	0370-1001	03/08/94	J 480.	70
	P015-0001	03/25/94	120.	70
Arsenic, total	0335-0001	04/01/94	58.0	50
Cadmium, total	0120-0001	10/14/93	J 13.1	5
Chloroethene (vinyl chloride)	P015-0001	03/25/94	17.	2
Chromium, soluble	0312-0001	04/13/94	8950.	100
	0373-0001	03/16/94	115.	100
Chromium, total	0115-0001	10/12/93	J 6060.	100
	0115-0001	03/22/94	2950.	100
	0117-0001	10/13/93	J 2870.	100
	0117-0001	04/14/94	J 2980.	100
	0120-0001	10/14/93	J 15100.	100
	0120-0001	04/14/94	J 2600.	100
	0152-0001	09/12/93	J 374.	100
	0301-0001	09/24/93	104.	100
	0305-0001	09/11/93	J 494.	100
	0305-0001	03/10/94	273.	100
	0306-0001	09/11/93	122.	100
	0312-0001	09/24/93	8190.	100
	0313-0001	09/13/93	258.	100
	0313-0001	03/17/94	820.	100
	0327-0001	09/27/93	J 177.	100
	0373-0001	03/16/94	228.	100
	0377-0001	09/26/93	174.	100
	0377-1001	09/26/93	191.	100
	0377-0001	03/28/94	415.	100
	0379-0001	03/15/94	104.	100
	0388-0001	03/28/94	J 171.	100
Lead, soluble	0128-1001	09/24/93	J 43.9	15
	0304-0001	04/05/94	23.7	15
	0382-0001	03/17/94	40.4	15
Lead, total	0046-0001	10/13/93	J 15.8	15
	0120-0001	10/14/93	J 26.4	15
	0125-0001	09/24/93	J 17.8	15
	0128-1001	04/04/94	J 44.4	15
	0137-0001	09/27/93	23.8	15
	0137-0001	03/28/94	18.4	15
	0151-0001	10/15/93	17.2	15
	0304-0001	09/16/93	J 43.0	15
	0304-0001	04/05/94	J 51.0	15
	0314-0001	03/16/94	J 22.4	15
	0317-1001	03/16/94		

Table C.1. (page 2 of 3)

Parameter (μg/L)[a]	Location	Log Date	Result	MCL
Lead, total (Continued)	0379-0001	09/26/93	16.0	15
	0602-0001	09/16/93	36.9	15
	P027-0001	03/21/94	29.0	15
Radium-226 (pCi/L)	0335-0001	04/01/94	39.47	20
Tetrachloroethene	0046-0001	10/13/93	5.1	5
	0046-0001	03/18/94	5.6	5
	0063-0001	10/13/93	J 27.	5
	0063-0001	03/18/94	23.	5
	0152-0001	03/25/94	5.1	5
	0153-0001	03/25/94	8.2	5
	0305-0001	09/11/93	16.	5
	0305-0001	03/10/94	22.	5
	0306-0001	03/10/94	7.9	5
	0307-0001	09/13/93	J 10.	5
	0307-0001	03/10/94	10.	5
	0313-0001	09/13/93	J 7.5	5
	0313-0001	03/17/94	11.	5
	0327-0001	09/27/93	J 12.	5
	0327-0001	03/30/94	11.	5
	0370-0001	09/24/93	140.	5
	0370-1001	03/08/94	J 290.	5
	0373-0001	09/25/93	J 49.	5
	0373-0001	03/16/94	48.	5
	0375-0001	03/14/94	8.9	5
	0397-0001	09/25/93	J 14.	5
	0397-0001	03/11/94	16.	5
	0601-0001	04/12/94	J 11.	5
	P015-0001	03/25/94	5.3	5
Trichloroethene	0063-0001	10/13/93	J 21.	5
	0063-0001	03/18/94	30.	5
	0152-0001	03/25/94	6.5	5
	0153-0001	09/12/93	5.9	5
	0153-0001	03/25/94	12.	5
	0305-0001	09/11/93	23.	5
	0305-0001	03/10/94	J 26.	5
	0306-0001	09/11/93	J 6.0	5
	0306-0001	03/10/94	J 12.	5
	0307-0001	09/13/93	6.7	5
	0307-0001	03/10/94	6.1	5
	0312-0001	09/24/93	J 22.	5
	0312-0001	04/08/94	46.	5
	0315-0001	09/12/93	8.6	5
	0315-0001	03/25/94	7.8	5

Table C.1. (page 3 of 3)

Parameter (μg/L)[a]	Location	Log Date	Result	MCL
Trichloroethene (Continued)	0347-0001	09/30/93	J 9.2	5
	0347-0001	03/24/94	J 11.	5
	0347-1001	03/24/94	J 8.5	5
	0370-0001	09/24/93	J 72.	5
	0370-0001	03/08/94	J 140.	5
	0370-1001	03/08/94	J 160.	5
	0373-0001	09/25/93	J 31.	5
	0373-0001	03/16/94	32.	5
	0386-0001	03/23/94	6.8	5
	0386-1001	03/23/94	6.6	5
	0397-0001	09/25/93	J 11.	5
	0397-0001	03/11/94	J 9.5	5
	0605-0001	04/12/94	J 5.7	5
	0608-0001	04/08/94	J 5.3	5
	P015-0001	03/25/94	28.	5
	P027-0001	03/21/94	5.4	5
Tritium (pCi/L)	0115-0001	10/12/93	46500.	20000
	0120-0001	10/14/93	33500.	20000
	0324-0001	09/16/93	23200.	20000
	0601-0001	09/25/93	158000.	20000
	0601-0001	04/12/94	76500.	20000
	0602-0001	04/08/94	20700.	20000
	0607-0001	10/14/93	25200.	20000
	0607-1001	10/14/93	25100.	20000
	0608-0001	04/08/94	20200.	20000

[a]All units in μg/L except as shown for radium-226 and tritium (pCi/L).
MCL - maximum contaminant level

SOIL SCREENING FACILITY BUILDING 30
MRC MOUND
WELL A & B

SAMPLE TYPE CONT
SAMPLE CONDITION WET
DATE SCREENED 06/30/87
DATE COLLECTED 06/30/87
SAMPLER NAME & HP C. SMITH [redacted]

WELL: ID.	SAMPLE NUMBER	GRAMS	WEIGHT FACTOR	GROSS CTS TH-232	GROSS CTS PU-238	TH 232 pCi/g	PU 238 pCi/g	GRID & SAMPLE LOCATION
A	15705	300	0.167	7797	1654	13.0	16	PLD 55 WEST
A	15706	300	0.167	62461	14067	107.3	573	RAILROAD LOADING BY TR 15

Doug -
these are the two samples Chet
& I told you about
Roy Mower

PREPARED BY : TROY J. PEARSON III
ALL SOIL SAMPLE ARE RAN FOR 400 SEC UNLESS SPECIFIED IN THIS REPORT .

COMPARISON OF ACTUAL SOIL GAS VALUES WITH CALCULATED ACCEPTABLE SOIL GAS VALUES

SCREENING POTENTIAL RELEASE SITES BASED ON SOIL GAS READINGS

Soil gas readings can be utilized in the PRS screening process to identify potential release sites that may present a potential soil contamination problem for volatile organics. The soil gas survey that was conducted at Mound as part of the "Reconnaissance Sampling Report--Soil Gas Survey and Geophysical Investigations, Mound Plant Main Hill and SM/PP Hill" investigated 8 volatile compounds. The concentrations of these compounds in the in the vapor phase within the pore spaces of the soil can be correlated to the actual soil contaminant concentrations by utilizing a method developed by ICF Kaiser Engineers. This technique has been used with US EPA Region IX approval at a large Superfund site contaminated with many of the same chemicals found at relatively low levels in soils at the Mound Plant.

The soil concentration can be estimated from the soil gas values by the following equation:

$$Ct = (Cg/Pb)*[[Pb * Kd / H] + [pw / H] + [pt - pw]]$$

where

Cg	concentration of volatile chemical concentrations as soil vapor in ng/ml
Pb	Bulk density of the soil in g/ml
Kd	soil/water partition coefficient in ml/g
H	Dimensionless Henry's Law Constant
pw	water filled porosity
pt	total porosity
Ct	target soil concentration in ng/g or ug/kg (ppb)

The technique that Mound Plant will use for screening a PRS is to compare the soil gas values obtained at a PRS with soil gas concentrations that are known to be below any regulatory or health based level of concern. The risk based guideline values for the Mound Plant (DOE, December 1995) soils are based upon 10^{-6} risk levels or a hazard index of 1. These values correspond to direct soil exposure to persons who's activities place them at the highest risk, in particular inhalation and ingestion by a Mound Plant construction worker.

Another potential exposure path must be considered, however. The potential for some of the organic contaminants to leach into ground water must be considered in developing protective soil screening levels. A "Mound Plant Soil Screening Level" paper explains the calculation of soil screening levels. For all of the chemicals that the soil gas survey identified, the calculated soil screening level soil concentrations are below the standard guideline values, therefore they are more conservative and are appropriate to be used as the basis for the soil gas calculations.

By re-arranging the equation, and using either the soil guideline values or the soil screening levels as the target soil concentration, a soil gas concentration can be calculated; this calculated soil gas concentration can be compared to the actual observed soil gas values:

$$Cg = (Pb*Ct)/[[Pb*Kd/H] + [pw/H] + [pt-pw]]$$

The values of the soil specific and chemical parameters for this equation are summarized as follows:

Pb	1.6	Bulk density of the soil in g/ml
pw	0.15	water filled porosity
pt	0.43	total porosity
foc	0.02	fraction organic material in soil (used in developing the SSL values)

Typical chemicals that are detected with soil gas sampling are:					
NAME	H	Kd	Calculated Acceptable	Calculated Acceptable	Calculated Acceptable
			Soil Screening Level Value	Soil Gas Reading	Soil Gas Reading
		ml/g	mg/kg (ppm)	ng/ml	ppb
Toluene	2.52E-01	3.42	22.06	1.56E+03	414600
Trichloroethene (TCE)	4.35E-01	2.24	0.07	1.26E+01	2400
111 Trichloroethane (TCA)	7.63E-01	2.2	3.01	9.46E+02	173400
Trans-1,2 Dichloroethene (DCE)	2.29E-01	1	0.70	1.41E+02	35700
cis-1,2 Dichloroethene (DCE)	1.85E-01	2.78	0.31	1.97E+01	5000
Freon 11	NA	NA			
Freon 113	NA	NA			
Tetrachloroethene (PCE)	7.09E-01	2.78	0.09	2.13E+01	3100

na not available

IF THE SOIL GAS READING IS BELOW THE VALUES IN THE CALCULATED SOIL GAS READING COLUMN (SHADED), THEN THERE IS NO THREAT TO GROUNDWATER FROM THIS PRS.

The soil screening level values are calculated using the Soil Screening Methodology. The Potential Release Site is assumed to be more than 100 meters from a potential drinking water source with an aquifer thickness of 15 meters and a source size of 10 meters. The hydraulic gradient is assumed to be 0.01 which is conservative for most of the Mound Plant PRSs. In special instances where the PRS lies less than 100 meters from a potential drinking water source, or the hydraulic gradient is much less than 0.01, new SSL values and new acceptable soil gas values will be calculated for that particular PRS.

MOUND

Environmental
Restoration
Program

Further Assessment

Soil Gas Confirmation Sampling

Mound Plant
Miamisburg, Ohio

November 1996

Revision 1

Department of Energy

EG&G Mound Applied Technologies

Table A.1

Detected Volatile Organic Compounds (µg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-AOJ-000074	SGC-AOJ-000075	SGC-AOJ-000076	SGC-A03-000079	SGC-A03-000081
PETREX Sample Area			AREA J	AREA J	AREA J	AREA 3	AREA 3
Acetone	NA	21000000		7 J			
1,2-Dichloroethene (total)	NA	43000000					
2-Butanone	NA	93000000					
Benzene	NA	8.90E+03					
Carbon Disulfide	NA	280000					
Chloroform	NA	3100					
Chloromethane	NA	NA					
Ethylbenzene	NA	480					
Methylene Chloride	NA	3.95E+05	10	12	11		6
Tetrachloroethene	NA	21000000					
Toluene	NA	250000			1 J	1 J	
Trichloroethene	NA	41000					
Xylene (total)	NA	430000000					

No entry - not detected
J - Numerical value is an estimated quantity
C - Identification confirmed by GC/MS
mg/kg - micrograms per kilogram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.1
Detected Volatile Organic Compounds (µg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000082	SGC-A03-000083	SGC-A03-000084	SGC-A03-000085	SGC-A03-000086
PETREX Sample Area			AREA 3	AREA 3	AREA 3	AREA 3	AREA 3
Acetone	NA	21000000		67			
1,2-Dichloroethene (total)	NA	43000000					
2-Butanone	NA	93000000		21			
Benzene	NA	8.90E+03					
Carbon Disulfide	NA	280000					
Chloroform	NA	3100					
Chloromethane	NA	NA					
Ethylbenzene	NA	480					
Methylene Chloride	NA	3.95E+05	5	7	5 J		9
Tetrachloroethene	NA	21000000					
Toluene	NA	250000				1 J	
Trichloroethene	NA	41000					
Xylene (total)	NA	430000000					

No entry - not detected
J - Numerical value is an estimated quantity
C - Identification confirmed by GC/MS
mg/kg - micrograms per kilogram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.1
Detected Volatile Organic Compounds (μg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000087	SGC-A21-000088	SGC-A22-000093	SGC-SDB-000097	SGC-SDB-000098
PETREX Sample Area			WEST	AREA 21	AREA 22	SDB	SDB
Acetone	NA	21000000	13				11
1,2-Dichloroethene (total)	NA	43000000					
2-Butanone	NA	93000000	4 J				
Benzene	NA	8.90E+03					
Carbon Disulfide	NA	280000					
Chloroform	NA	3100					
Chloromethane	NA	NA					
Ethylbenzene	NA	480					
Methylene Chloride	NA	3.95E+05	11			12	21
Tetrachloroethene	NA	21000000					
Toluene	NA	250000		2 J	1 J		70
Trichloroethene	NA	41000	26				
Xylene (total)	NA	430000000			1 J		

No entry - not detected
J - Numerical value is an estimated quantity
C - Identification confirmed by GC/MS
mg/kg - micrograms per kilogram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.2.
Detected Semivolatile Organic Compounds (µg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000080	SGC-A03-000081	SGC-A03-000082	SGC-A03-000083	SGC-A03-000085	SGC-A03-000086
PETREX Sample Area			AREA 3	AREA 3	AREA 3	AREA 3	AREA 3	AREA 3
Acenaphthene	NA	NA		89 J				
Acenaphthylene	NA	NA	280 J	220 J				
Anthracene	NA	64000000 J	150 J	150 J				
Benzo(a)anthracene	NA	4.10E+03 J	480	560		25 J	55 J	76 J
Benzo(a)pyrene	NA	410 J	850	660		28 J	54 J	70 J
Benzo(b)fluoranthene	NA	4100 J	640	580		25 J	53 J	55 J
Benzo(g,h,i)perylene	NA	NA J	590	310 J		26 J	29 J	47 J
Benzo(k)fluoranthene	NA	41000 J	630	580		27 J	56 J	64 J
Bis(2-ethylhexyl)phthalate	NA	2.15E+05 J						
Butylbenzylphthalate	NA	43000000						
Carbazole	NA	NA J	19 J	45 J				
Chrysene	NA	410000 J	500	690		32 J	65 J	83 J
Di-n-butyl phthalate	NA	21000000						
Di-n-octyl phthalate	NA	4300000						
Dibenz(a,h)anthracene	NA	410 J	180 J	110 J				23 J
Dibenzofuran	NA	NA	56 J	84 J				
Diethyl phthalate	NA	NA						
Fluoranthene	NA	8500000 J	780	890	110 J	52 J		150 J
Fluorene	NA	NA	89 J	81 J				
Indeno(1,2,3-cd)pyrene	NA	4.10E+03 J	580	440		16 J	33 J	39 J
2-Methylnaphthalene	NA	NA	25 J	79 J				
Naphthalene	NA	NA	79 J	45 J				
Phenanthrene	NA	NA J	370 J	520		18 J	28 J	70 J
Phenol	NA	130000000 J						
Pyrene	NA	6400000 J	690	930	92 J	50 J	98 J	130 J

No entry - not detected
J - Value is an est. quantity
D - Sample was diluted
NA - Value not available
H - Analyzed outside holding time
* - Unconfirmed due to interference
mg/kg - micrograms per kilogram

Table A.2.
Detected Semivolatile Organic Compounds (µg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000087	SGC-A21-000088	SGC-A22-000092	SGC-A22-000093	SGC-A22-000094	SGC-SDB-000097	SGC-SDB-000098
PETREX Sample Area			WEST	AREA 21	AREA 22	AREA 22	AREA 22	SDB	SDB
Acenaphthene	NA	NA							19
Acenaphthylene	NA	NA						40 J	
Anthracene	NA	64000000						33 J	39
Benzo(a)anthracene	NA	4.10E+03			23 J		51 J	160 J	100
Benzo(a)pyrene	NA	410			23 J		65 J	180 J	92
Benzo(b)fluoranthene	NA	4100			28 J		62 J	170 J	96
Benzo(g,h,i)perylene	NA	NA					48 J	65 J	46
Benzo(k)fluoranthene	NA	41000			21 J		69 J	160 J	95
Bis(2-ethylhexyl)phthalate	NA	2.15E+05		26 J		19 J			
Butylbenzylphthalate	NA	43000000							
Carbazole	NA	NA							50
Chrysene	NA	410000			25 J		76 J	170 J	130
Di-n-butyl phthalate	NA	21000000							
Di-n-octyl phthalate	NA	4300000							
Dibenz(a,h)anthracene	NA	410						35 J	22
Dibenzofuran	NA	NA							28
Diethyl phthalate	NA	NA						20 J	
Fluoranthene	NA	8500000	24 J		59 J		140 J	330 J	350
Fluorene	NA	NA							27
Indeno(1,2,3-cd)pyrene	NA	4.10E+03					42 J	110 J	62
2-Methylnaphthalene	NA	NA							
Naphthalene	NA	NA							
Phenanthrene	NA	NA	21 J		42 J		96 J	150 J	340
Phenol	NA	130000000							
Pyrene	NA	6400000	19 J		48 J		120 J	280 J	240

No entry - not detected
J - Value is an est. quantity
D - Sample was diluted
NA - Value not available
H - Analyzed outside holding time
* - Unconfirmed due to interference
mg/kg - micrograms per kilogram

Table A.3.

Detected Pesticides/PCB's (μg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A13-000060	SGC-AOJ-000067	SGC-AOJ-000071	SGC-A03-000081
PETREX Sample Area			AREA 13	AREA J	AREA J	AREA 3
Aroclor-1248	ND	380				
Aroclor-1254	ND	4300		52	44	
Alpha-Chlordane	ND	NA			14 *	
Gamma-Chlordane	ND	NA	3.7		12 *	
4,4'-DDT	9000	13000				3.7
Dieldrin	ND	185				
Endosulfan I	ND	NA *				
Endosulfan II	NA	NA				4.4
Endrin	ND	NA				
Heptachlor	ND	NA	2.9			

No entry - not detected
* - Unconfirmed due to interference
NA - Value not available
ND - No detections in background samples
mg/kg - micrograms per kilogram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.4.
Detected TAL Inorganics (mg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-AOJ-000071	SGC-AOJ-000072	SGC-AOJ-000073	SGC-AOJ-000074	SGC-AOJ-000075	SGC-AOJ-000076	SGC-AOJ-000077	SGC-AOJ-000078	SGC-A03-000079	SGC-A03-000080
PETREX Sample Area			AREA J	AREA J	AREA J	AREA J	AREA J	AREA J	AREA J	AREA J	AREA 3	AREA 3
TAL INORGANICS (mg/kg)												
Aluminum	19000	NA	7000	10900	11800	9220	7660	7730	12700	5570	4090	7450
Antimony	NA	85	0.93 B		0.77 B	0.25 B	0.26 B				0.93 B	
Arsenic	8.6	64	5.1	1.7 B	5	2 B	4.7	2 B	2.8	3 B	5.5	3.3
Barium	180	1.50E+04	44 B	48.5	66.7	49.9	45.4 B	53	85.8	38.7 B	34.4 BJ	21 B
Beryllium	1.3	0.7	0.13 B	0.68	0.41 B	0.49	0.47	0.43	0.42		0.13 B	0.16 B
Bismuth	NA	NA	1.1 B						1 B			
Cadmium	2.1	210	3.3		4.6				6.3	2.1		
Calcium	310000	NA	140000	73500	45800	99300	102000	88100	174000	143000	126000	133000
Chromium	20	1.10E+05	7.8	14.7	13.4	13.3	11.4	12.2	17	9.2	7.3 J	10.4
Cobalt	19	NA	6.2 B	9.6 B	9.9 B	8 B	8 B	6.8 B	11.1 B	4.1 B	6.8 B	7.7 B
Copper	26	NA	17.5	16.7	23.5	14.6	17.2	13.9	22.4	10.5	15 J	11.2
Cyanide	ND	4300										0.58 B
Iron	35000	NA	15200	23300	21900	17600	16400	16700	28700	9480	13400 J	20400
Lead	48	NA	16.9	9.7	26	19.9	12	8.2	8.8	5.6	9.4 J	9.6
Lithium	26	NA	11.5 B	20.1 B	15.8 B	19.9 B	15.2 B	13.1 B	22.9 B	5.6 B	13.6 B	26.6
Magnesium	40000	NA	44200	15300	14500	33900	33000	32300	37500	47400	49400 J	25300
Manganese	1400	27000	400	654	508	411	481	437	598	372	340 J	445
Mercury	ND	64		0.06 B		0.09 B		0.29				
Molybdenum	27	NA	1.4 B	1.3 B	1.8 B	0.86 B	1.2 B	2.3 B	2.8 B	1.6 B	2.1 B	
Nickel	32	4.30E+03	12	22.7	18.7	17.8	17.7	16.6	26	8.9 B	17.1	17
Potassium	1900	NA	1110 B	1890	1600	1760	1430	1290	1420	678 B	829 B	1400
Selenium	NA	NA										
Silver	1.7	1100										
Sodium	240	NA	482 B	228 B	171 B	182 B	164 B	236 B	1450 B	415 B	171 BJ	347 B
Thallium	0.46	NA										
Tin	20	NA	1.2 B	1 B	2.3 B	1.3 B	0.94 B	0.99 B	1.8 B	0.88 B	3.7 B	0.98 B
Vanadium	25	1500	12.7	18.5	24.1	16.4	15.8	18.5	24.2	12.6	10.8 J	8.8 B
Zinc	140	64000	50.9	51.1	67.6	58.8	60.7	48	75.2	38.7	43.6 J	39.6
OTHER INORGANICS												
% Solids (%)	NA	NA	86.1	87.6	94	88.5	85.3	86.8	85.8	89.4	88.1	86.6
Nitrate/Nitrite (mg-N/kg)	NA	NA	2.7	6.3	2.3	1.8	3.5	2.2	0.64	2.9	2.2	3.7

No entry - not detected
mg/kg - milligrams/kilogram
NA - Value not available
NC - Background not comp
ND - No detections in background samples
mg-N/kg - milligrams per kilogram, reported as nitrogen
J - Numerical value is an estimated quantity
B - Analyte detected in blanks associated with this sample
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.4.
Detected TAL Inorganics (mg/kg)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000081	SGC-A03-000082	SGC-A03-000083	SGC-A03-000084	SGC-A03-000085	SGC-A03-000086	SGC-A03-000087	SGC-A21-000088	SGC-A21-000089	SGC-A21-000090
PETREX Sample Area			AREA 3	AREA 3	AREA 3	AREA 3	AREA 3	AREA 3	WEST	AREA 21	AREA 21	AREA 21
TAL INORGANICS (mg/kg)												
Aluminum	19000	NA	4850	2070	3710	8760	5830	7860	3670	11100	14800	16500
Antimony	NA	85			0.39 B	0.4 B				0.65 B		
Arsenic	8.6	64	4.5	3.6 B	4.5	6.8	3.6	7.7	3.8 B	3.7 J	3.4	3.5
Barium	180	1.50E+04	34.9 B	26.9 B	29.6 B	72.6	39.7 B	68	30.4 B	95.5	77.3	128
Beryllium	1.3	0.7	0.16 B		0.13 B	0.45 B	0.32	0.41 B	0.12 B	0.01	0.42	0.60
Bismuth	NA	NA										1 B
Cadmium	2.1	210	0.28 B	0.21 B	0.17 B				0.1 B		6.1	7.1
Calcium	310000	NA	132000	164000	144000	61300	169000	62400	135000	6570 J	92800	7820
Chromium	20	1.10E+05	7.9	6	6	14	10.8	14.4	4.7	15.6	17.8	20.6
Cobalt	19	NA	5.1 B	2.1 B	4.7 B	9 B	6.5 B	8.2 B	3.1 B	12.9	12 B	13.4
Copper	26	NA	13.6	6.1	12.1	20.1	11.9	18.5	5.8	14.1	16.7	21.7
Cyanide	ND	4300				0.59 B		0.58 B				
Iron	35000	NA	12900	6180	8960	22500	15500	18600	6540	25600	29300	33200
Lead	48	NA	7.8	6.8	14.3	8.1	12.4	12	7	21.3 J	16.9	35.4
Lithium	26	NA	8.6 B	4.7 B	5.3 B	12.3 B	19 B	13.9 B	11.8 B	8.7 B	15.4 B	18.5 B
Magnesium	40000	NA	47500	85100	86000	20100	39900	12700	27700	2510	3530	3830
Manganese	1400	27000	305	279	267	466	430	594	289	804 J	649	982
Mercury	ND	64	0.06 B							0.06 BJ	0.07 B	0.1 B
Molybdenum	27	NA	1.9 B	1.4 B	2.2 B	2.7 B	1.3 B	1.8 B	0.68 B	1.7 B	1.9 B	1.4 B
Nickel	32	4.30E+03	13.2	6.1 B	8.4 B	22.5	14.6	17.3	6.6 B	17.9	20.4	28.5
Potassium	1900	NA	674 B	306 B	476 B	742 B	1150	1080 B	503 B	1060 B	1170 B	2420 B
Selenium	NA	NA										
Silver	1.7	1100				0.46 B			0.22 B			
Sodium	240	NA	218 B	464 B	318 B	124 B	355 B	142 B	282 B	95.6 BJ	121 B	95.4 B
Thallium	0.46	NA							0.84 B			
Tin	20	NA				1.4 B					2 B	2.4 B
Vanadium	25	1500	10.9	8	11.6	22.1	9.8	20.8	5.8	23.6	29.3	32
Zinc	140	64000	43.2	27	58.6	53.9	37.8	53	18	55.4	75.4	101
OTHER INORGANICS												
% Solids (%)	NA	NA	90.2	92.3	82	84.9	88.8	86	87.9	79.9	83.2	78.5
Nitrate/Nitrite (mg-N/kg)	NA	NA	2.2	1.4	1.6	13.1	6.8	8.6	0.93	3.4	1.9	5.2

No entry - not detected
mg/kg - milligrams/kilogram
NA - Value not available
NC - Background not comp
ND - No detections in background samples
mg-N/kg - milligrams per kilogram, reported as nitrogen
J - Numerical value is an estimated quantity
B - Analyte detected in blanks associated with this sample
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.5.

Detected Radionuclides (pCi/g)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-AOJ-000076	SGC-AOJ-000077	SGC-AOJ-000078	SGC-A03-000079	SGC-A03-000080
PETREX Sample Area			AREA J	AREA J	AREA J	AREA 3	AREA 3
Americium-241	ND	4.95					
Bismuth-207	ND	0.175					
Bismuth-210	ND	NA					
Cesium-137	0.42	4.60E-01			0.0687	0.244	
Cobalt-60	NC	0.1					
Plutonium-238	0.13	5.5	0.0855	0.834	1.06	1.84	0.0388
Plutonium-239/240	0.18	5.5	0.00207		0.00383	0.0107	
Potassium-40	37	NA	16.7	15.2	21.5	14.8	10.1
Radium-226+D	2	1.40E-01	0.658	0.861	0.765	0.879	0.519
Thorium-228+D	1.5	0.85		0.846	1.21	0.515	0.343
Thorium-230	1.9	44	1.18	1.14	0.837	1.01	0.63
Thorium-232	1.4	50	0.744	0.77	1.07	0.716	0.304
Uranium-234	1.1	37.5	0.814	0.679	0.702	0.819	0.523
Uranium-235+D	0.11	3.35	0.0345	0.0399	0.0361	0.0393	
Uranium-238+D	1.2	11	0.914	0.842	0.718	0.912	0.605

No entry - not detected
ND -No detections in background samples
NA - Data not available
NC - Background value not computed
pCi/g - picocuries per gram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.5.

Detected Radionuclides (pCi/g)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000081	SGC-A03-000082	SGC-A03-000083	SGC-A03-000084	SGC-A03-000085
PETREX Sample Area			AREA 3	AREA 3	AREA 3	AREA 3	AREA 3
Americium-241	ND	4.95					
Bismuth-207	ND	0.175					
Bismuth-210	ND	NA					
Cesium-137	0.42	4.60E-01					
Cobalt-60	NC	0.1					
Plutonium-238	0.13	5.5	0.219	0.039	0.0969	0.0456	0.118
Plutonium-239/240	0.18	5.5	0.0121				
Potassium-40	37	NA	8.51	12.4	3.49	4.46	8.21
Radium-226+D	2	1.40E-01	0.692	0.498	0.341	0.372	0.552
Thorium-228+D	1.5	0.85	0.464	0.647	0.133	0.69	1.18
Thorium-230	1.9	44	0.768	0.618	0.346	0.513	0.575
Thorium-232	1.4	50	0.445	0.659	0.114	0.438	0.89
Uranium-234	1.1	37.5	0.616	0.578	0.319	0.546	0.536
Uranium-235+D	0.11	3.35			0.0246		0.0371
Uranium-238+D	1.2	11	0.584	0.551	0.289	0.579	0.666

No entry - not detected
ND -No detections in background samples
NA - Data not available
NC - Background value not computed
pCi/g - picocuries per gram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)

Table A.5.

Detected Radionuclides (pCi/g)

ANALYTE	Background Value	Industrial Scenario Guideline Criteria	SGC-A03-000086	SGC-A03-000087	SGC-A21-000088	SGC-A21-000089	SGC-A212-000090
PETREX Sample Area			AREA 3	WEST	AREA 21	AREA 21	
Americium-241	ND	4.95					
Bismuth-207	ND	0.175					
Bismuth-210	ND	NA					
Cesium-137	0.42	4.60E-01		0.333	0.691	0.589	0.563
Cobalt-60	NC	0.1					
Plutonium-238	0.13	5.5	3.11	0.914	0.508	0.444	0.284
Plutonium-239/240	0.18	5.5	0.00943	0.0111	0.0216	0.0132	0.00901
Potassium-40	37	NA	15.9	6.28	23.3	17.5	26.6
Radium-226+D	2	1.40E-01	1.02	0.478	1.26	1.03	1.14
Thorium-228+D	1.5	0.85	0.773	0.35	0.954	0.855	1.27
Thorium-230	1.9	44	1.07	0.653	1.3	1.2	1.16
Thorium-232	1.4	50	0.806	0.455	1.01	0.826	1.07
Uranium-234	1.1	37.5	0.799	0.572	0.86	0.767	0.79
Uranium-235+D	0.11	3.35	0.0617			0.0591	
Uranium-238+D	1.2	11	0.966	0.596	0.897	0.803	1.16

No entry - not detected
ND -No detections in background samples
NA - Data not available
NC - Background value not computed
pCi/g - picocuries per gram
Red = above Guideline Criteria (GC)
Green = above GC and below Background
Magenta = above Background and Below GC
Blue = above Background (no GC)