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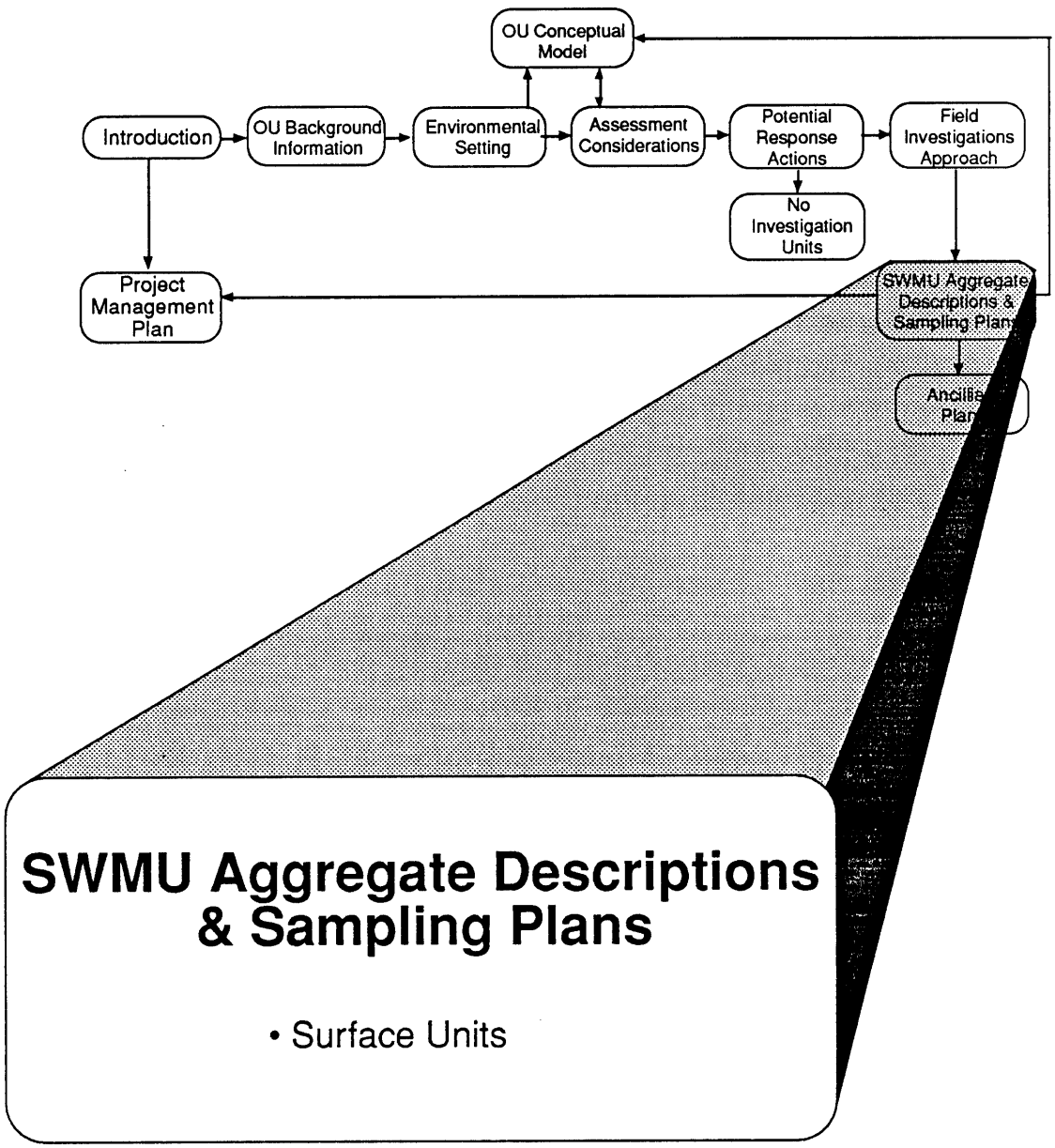
CHAPTER 14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14. SURFACE UNITS DESCRIPTION AND SAMPLING PLAN

14.1. Introduction

This chapter provides site descriptions and field sampling plans for several SWMUs that have the potential for past releases that were confined primarily to surface soils. The list below identifies the SWMUs addressed in this chapter, the general group in which they fall, and the section in which they are addressed.

- Storage Areas and Tanks
  - Section 14.2
    SWMU 21-003, PCB Container Storage Area
  - Section 14.3
    SWMU 21-004, Aboveground Tanks and Drain Lines
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    SWMU 21-028(d), (e), Active Container Storage Areas
  - Section 14.5
    SWMU 21-029, DP Tank Farm
  - Section 14.6
    SWMU 21-002(b), Inactive Container Storage Areas
- Surface Disposals
  - Section 14.7
    SWMU 21-013(b)–(f), Surface Disposal Areas
- Sewage Treatment Plant
  - Section 14.8
    SWMU 21-013(a), Surface Disposal Area, and
    SWMU 21-026, Sewage Treatment Plant

For all of the SWMUs in this chapter, data are needed on the presence or absence of contaminants in surface soil and subsurface soil. Identified potential contaminant migration pathways for all of the SWMUs include surface run-off, infiltration, and vapor phase transport (see Chapter 5). The erosive exposure of wastes is identified as a potential pathway at three SWMUs, 21-028 (d) and (e), 21-013 (b)–(g), and 21-013(a). Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for preliminary identification of potential response actions at TA-21 SWMUs are presented in Chapter 10. For the SWMUs listed in this chapter, the no-action alternative is identified as a potential appropriate remedial alternative for all SWMUs with the exception of SWMU 21-003, PCB container storage area. The field investigations at five of the SWMUs included in this chapter may determine that not all of these SWMUs are release sites. If it is determined that the SWMU is not a release site, the SWMU will be proposed for no further investigation. Other preliminary remedial alternatives identified for the SWMUs in this chapter include institutional controls, monitoring, treatment, removal and disposal, and removal and treatment (see Table 10-I).

The following paragraphs present a brief description of each of the SWMUs in this chapter and the field investigation proposed for each. For all SWMUs in this chapter, the field measurements and laboratory analyses for initial investigations are summarized by section in Tables 14-I and 14.1-II. The same information for subsequent investigations is presented in Tables 14.1-III and 14.1-IV. The strategy for field and laboratory analyses is presented for each SWMU in flow charts in Figs. 14.1-1 through 14.1-7.

PCB Container Storage Area (SWMU 21-003). This SWMU was a storage area for PCB-bearing equipment and PCB-contaminated waste, oils, solvents, and trash between 1978–1989. PCB contamination in surface soils is documented. The strategy for the field investigation at the PCB container storage area is presented in Fig. 14.1-1. Field measurements and laboratory analyses are summarized in Tables 14.1-I through 14.1-IV.

The field investigation is designed to incorporate and confirm earlier analytical data on PCB concentrations in surface soil samples. Results from an initial investigation of contamination in surface soils will be used to guide a required subsequent investigation to determine the lateral and vertical extent of contamination.

Aboveground Tanks and Drain Lines (SWMU 21-004). The SWMU includes three aboveground tanks and a drain line. No information on past releases from these units is available. The strategy for the field investigation is presented in Fig. 14.1-2. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II. No field investigation will be performed at TA-21-335 if analyses of swipe samples from the tank indicate that contaminants are not present.

Active Container Storage Area (SWMU 21-028(d) and (e). The areas for investigation are loading docks on the north side of Buildings TA-21-209 and -210. The sites are currently subject

to RCRA regulations. Because use of the sites predates RCRA definitions, the sites will be investigated to confirm that no environmental releases occurred before RCRA regulations went into effect. The strategy for the field investigation is presented in Fig. 14.1-3. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

DP Tank Farm (SWMU 21-029). The DP tank farm, consisting of 15 tanks, was active from January 1946 until February 1985. Tank removal was completed by July 1988. During excavation, only one tank, which contained diesel fuel, was found to have leaked. Soils in the area of fill stations were contaminated with fuel. Contaminated soils at the fill stations were remediated in 1988.

The objective of the field investigation at SWMU 21-029 is to confirm that contaminants are not present. The strategy for the field investigation is presented in Fig. 14.1-4. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

Inactive Container Storage Areas [SWMU 21-002(b)]. The site to be investigated is a former drum storage structure, TA-21-38, which is located southeast of Building TA-21-31. The structure was built in August 1945 and decommissioned in February 1966. No data are available on the contents of the drums that were stored in the building, nor is there a recorded history of spills or leaks.

The objective of the field investigation is to confirm the absence of contamination. The strategy for the field investigation is presented in Fig. 14.1-5. Field measurements and laboratory analyses for an initial investigation and a possible subsequent investigation are summarized in Tables 14.1-I through 14.1-IV.

Surface Disposal Area [SWMU21-013(b)–(f)]. This SWMU grouping addresses areas known or suspected to have been used in the past for surface disposal of various materials. No previous sampling data exist regarding potential contaminants at these sites.

The objective of the field investigation is to confirm the absence of contamination. The strategy for the field investigation is presented in Fig. 14.1-6. Field measurements and laboratory analyses for an initial and a possible subsequent investigation are summarized in Tables 14.1-I through 14.1-IV.

Surface Disposal Area and Sewage Treatment Plant. This grouping of SWMUs addresses three active sites at the sewage treatment plant and an inactive surface disposal area. The disposal area received sand from sand filter beds and sludge-drying beds of the sewage treat-

ment plant. No data exist regarding contamination of the inactive disposal area or of the area surrounding the sewage treatment plant. However, radionuclide assays on liquid effluents and sludges show that elevated values were present in some samples. Inorganic assays on sludges show that concentrations for many metals were considerably higher than concentrations considered to be background in area soils.

The objective of the field investigation is to confirm the presence or absence of contamination on subsurface soils, and, if contamination is present, to determine the extent of contamination. The strategy for the investigation is presented in Fig. 14.1-7. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

14.1–I SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 14.

Section	Description	Survey Areas: Land	Survey Areas: Radiological	Survey Areas: Geophysical	Surface: Soil Samples	Near Surface Soil Samples: No. of Locations	Near Surface Soil Samples: No. of Samples	Tank Samples: Swipes	Tank Samples: Liquid
14.2	PCB Ctr. Stg. Area	1			63				
14.3	Aboveground Tanks		10		5			3*	3*
14.4	Active Ctr. Stg. Area		4			8	8		
14.5	DP Tank Farm	6			2				
14.6	Inactive Ctr. Stg. Areas	1			8				
14.7	Surface Disposal Areas	6	10		36	36	180		
14.8	Sewage Treatment Plant		2		12	3	9		
	Total	14	26		126	47	197		3*

* Either Swipes or liquid samples will be collected, not both.

Section	Description	Boreholes: Shallow Number	Shallow Total Footage	Shallow No. of Samples	Vertical Number	Vertical Total Footage	Vertical No. of Samples	Angled Number	Angled Total Footage	Angled No. of Samples	Q A
14.2	PCB Ctr. Stg. Area										10
14.3	Aboveground Tanks	2	10	4							8
14.4	Active Ctr. Stg. Area										4
14.5	DP Tank Farm	10	100	40							10
14.6	Inactive Ctr. Stg. Areas										4
14.7	Surface Disposal Areas	36	270	108							32
14.8	Sewage Treatment Plant				1	30	6	3	151	32	13
	Total	48	380	152	1	30	6	3	151	32	81

14.1–II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 14.

	14.2	14.3	14.4	14.5	14.6	14.7	14.8			Total
Field Sample Screening										
Gross Gamma		9	8	42	8	323				390
Gross Alpha	63	9	8	42	8	323	59			512
Organic Vapor	63	9	8	42	8	323	59			512
Combustible Gas/Oxygen		4		40		108	59			211
Lithological Logging		4		40		323	38			405
Field Laboratory Measurements										
Gross Alpha	17	6		42		251	59			375
Gamma Spectrometry	17	6		42		251	59			375
Tritium	17					251	38			306
Volatile Organics	63	5		42		251				361
PCB	63									63
Soil Moisture							38			38
Chlorides, Nitrates							38			38
Laboratory Analysis										
Gamma Spectrometry	27	11	10	22	10	79	25			184
Tritium	27	11	10		10	79	25			162
Total Uranium	27	11	10		10	79	25			162
Isotopic Plutonium	27	11	10		10	79	25			162
Isotopic Uranium										
Strontium 90		11	10		10	79	25			135
VOA (SW 8240)	32	15	12	26	12	94	33			224
Semivolatiles (SW 8270)	31	13	11	25	11	90	29			210
Metals (SW 6010)	31	13	11	25	11	90	29			210
PCB (SW 8080)	31									31
TCLP Metals				25						25
Asbestos										
Ethanol				25						25

14.1-III SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 14.

Section	Description	Survey Areas: Land	Survey Areas: Radiological	Survey Areas: Geophysical	Surface: Soil Samples	Near Surface Soil Samples: No. of Locations	Near Surface Soil Samples: No. of Samples
14.2	PCB Ctr. Stg. Area						
14.3	Aboveground Tanks						
14.4	Active Ctr. Stg. Area						
14.5	DP Tank Farm						
14.6	Inactive Ctr. Stg. Areas				6		
14.7	Surface Disposal Areas				4	4	20
14.8	Sewage Treatment Plant						
	Total				10	4	20

Section	Description	Boreholes Shallow: Number	Boreholes Shallow: Total Footage	Boreholes Shallow: No. of Samples	Q A
14.2	PCB Ctr. Stg. Area	8	65	26	7
14.3	Aboveground Tanks				
14.4	Active Ctr. Stg. Area				
14.5	DP Tank Farm				
14.6	Inactive Ctr. Stg. Areas	3	15	6	4
14.7	Surface Disposal Areas	4	30	12	9
14.8	Sewage Treatment Plant				
	Total	15	110	44	20

14.1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 14.

		14.2				14.6	14.7				Total
Field Sample Screening											
Gross Gamma						7	36				43
Gross Alpha		26				7	36				69
Organic Vapor		26				7	36				69
Combustible Gas/Oxygen		26				2	12				40
Lithological Logging		26				2	36				64
Field Laboratory Measurements											
Gross Alpha		26				7	28				61
Gamma Spectrometry		26				7	28				61
Tritium						7	28				35
Volatile Organics		26				7	28				61
PCB		26									26
Soil Moisture											
Chlorides, Nitrates											
Laboratory Analysis											
Gamma Spectrometry		9				5	13				27
Tritium		9				5	13				27
Total Uranium		9				5	13				27
Isotopic Plutonium		9				5	13				27
Isotopic Uranium											
Strontium 90		9				5	13				27
VOA (SW 8240)		16				7	16				39
Semivolatiles (SW 8270)						6	15				21
Metals (SW 6010)						6	15				21
PCB (SW 8080)		15									15
TCLP Metals											
Asbestos							13				13
Ethanol											

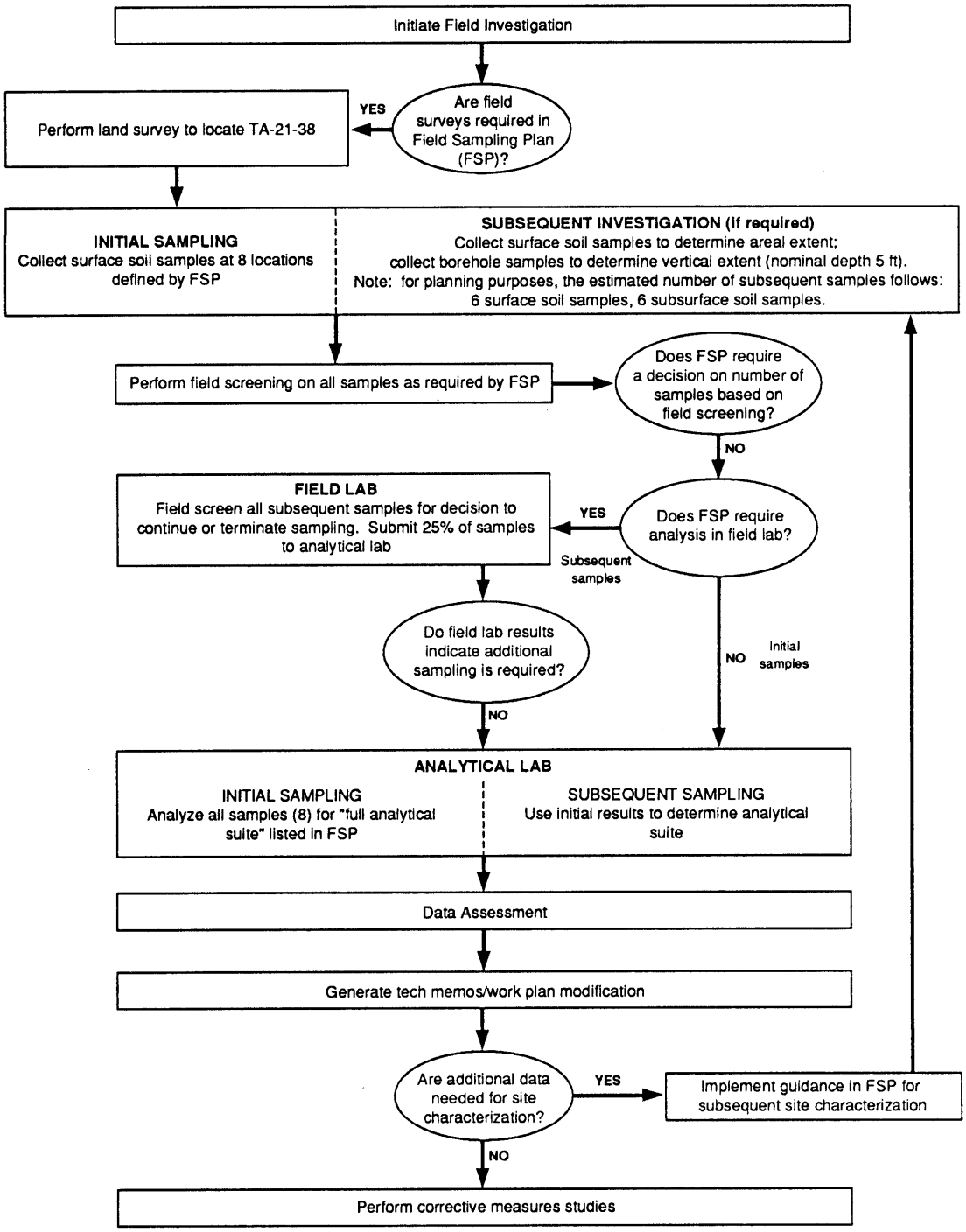


Fig. 14.1-1 Logic flow for the field investigations to investigate contamination at SWMU 21-002(b) former drum storage structure

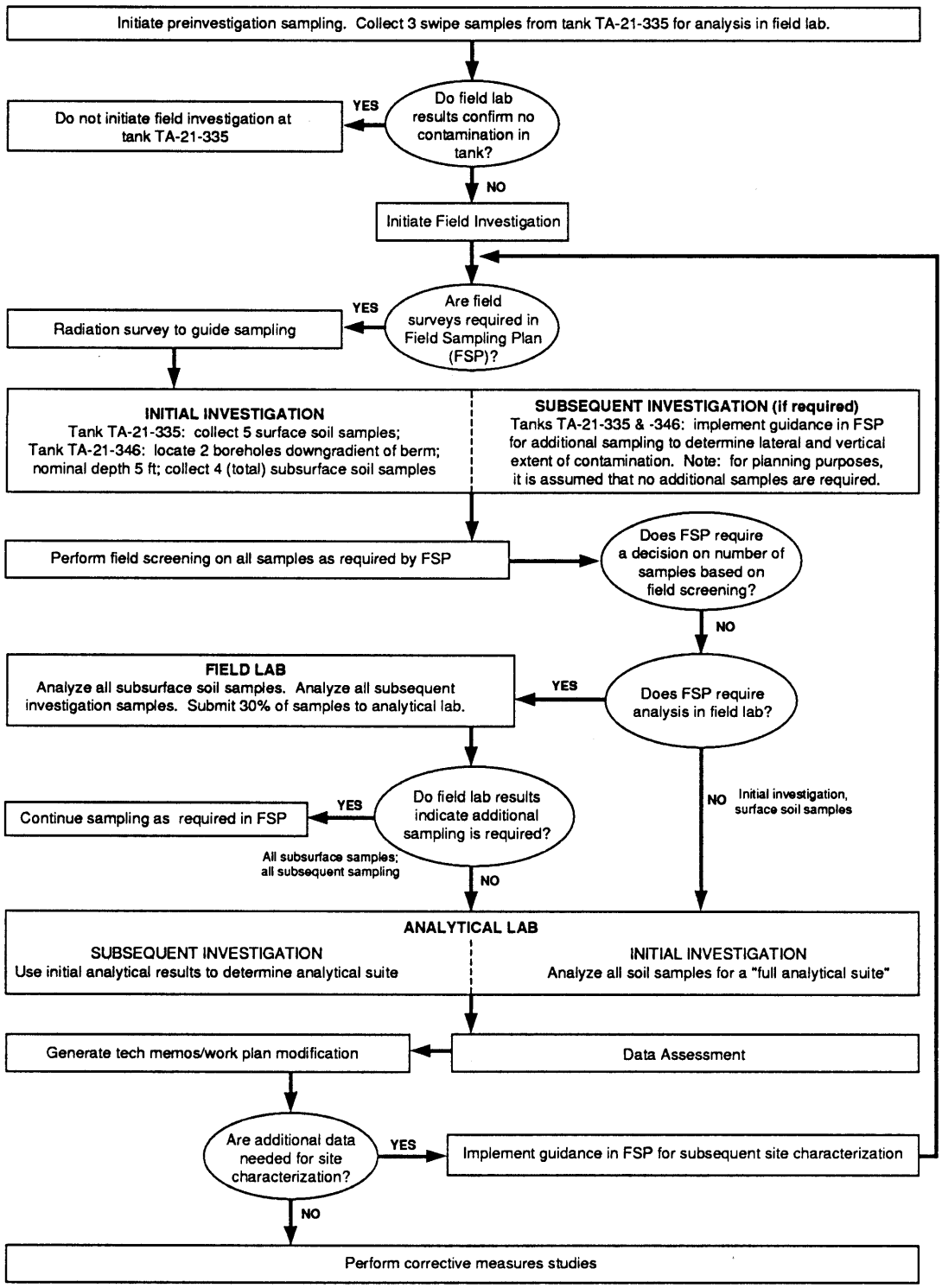


Fig. 14.1-2 Logic flow for the field investigation at SWMU 21-004, aboveground tanks and drain lines.

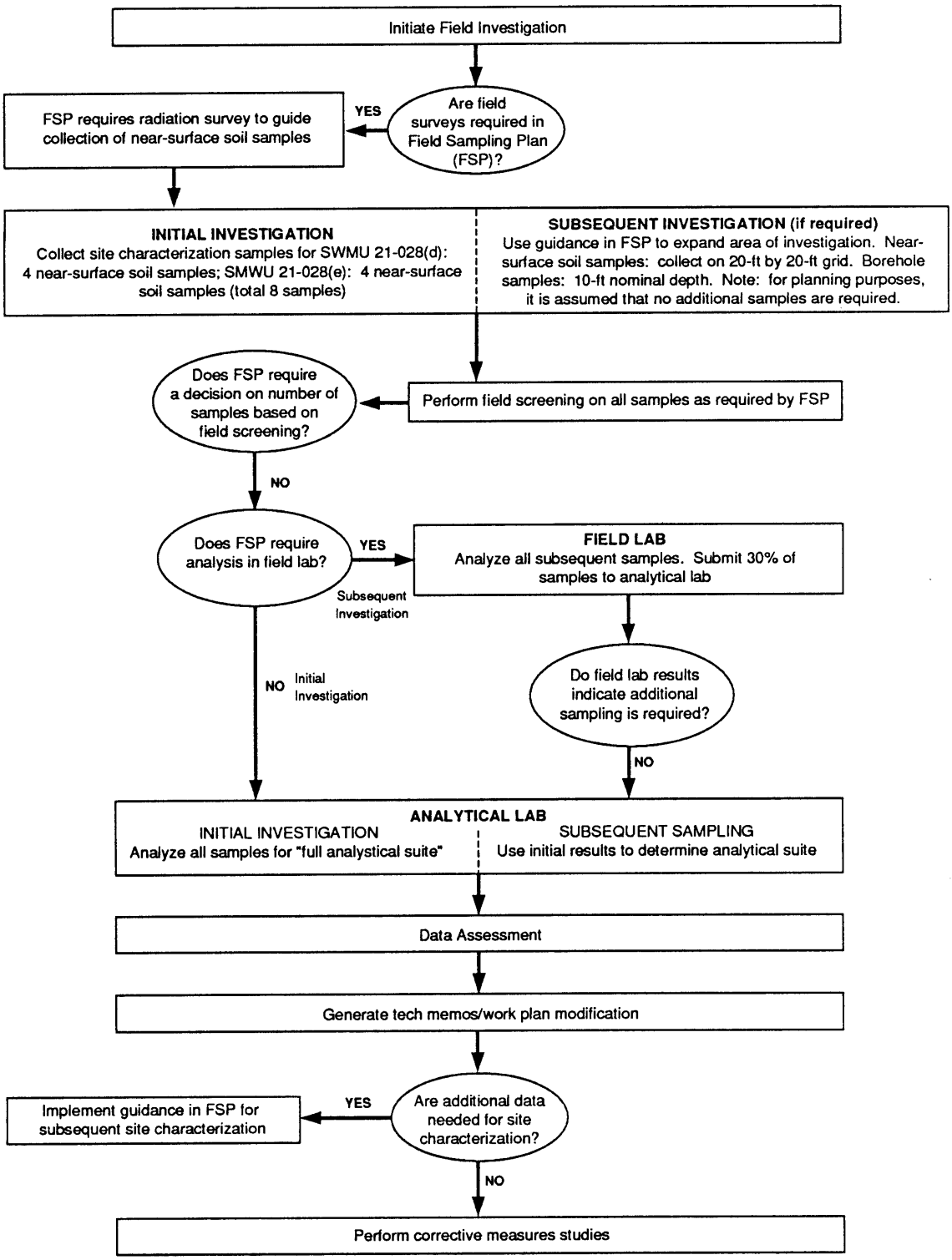


Fig. 14.1-3 Logic flow for the field investigation at SWMU 21-028(d), (e), active container storage areas.

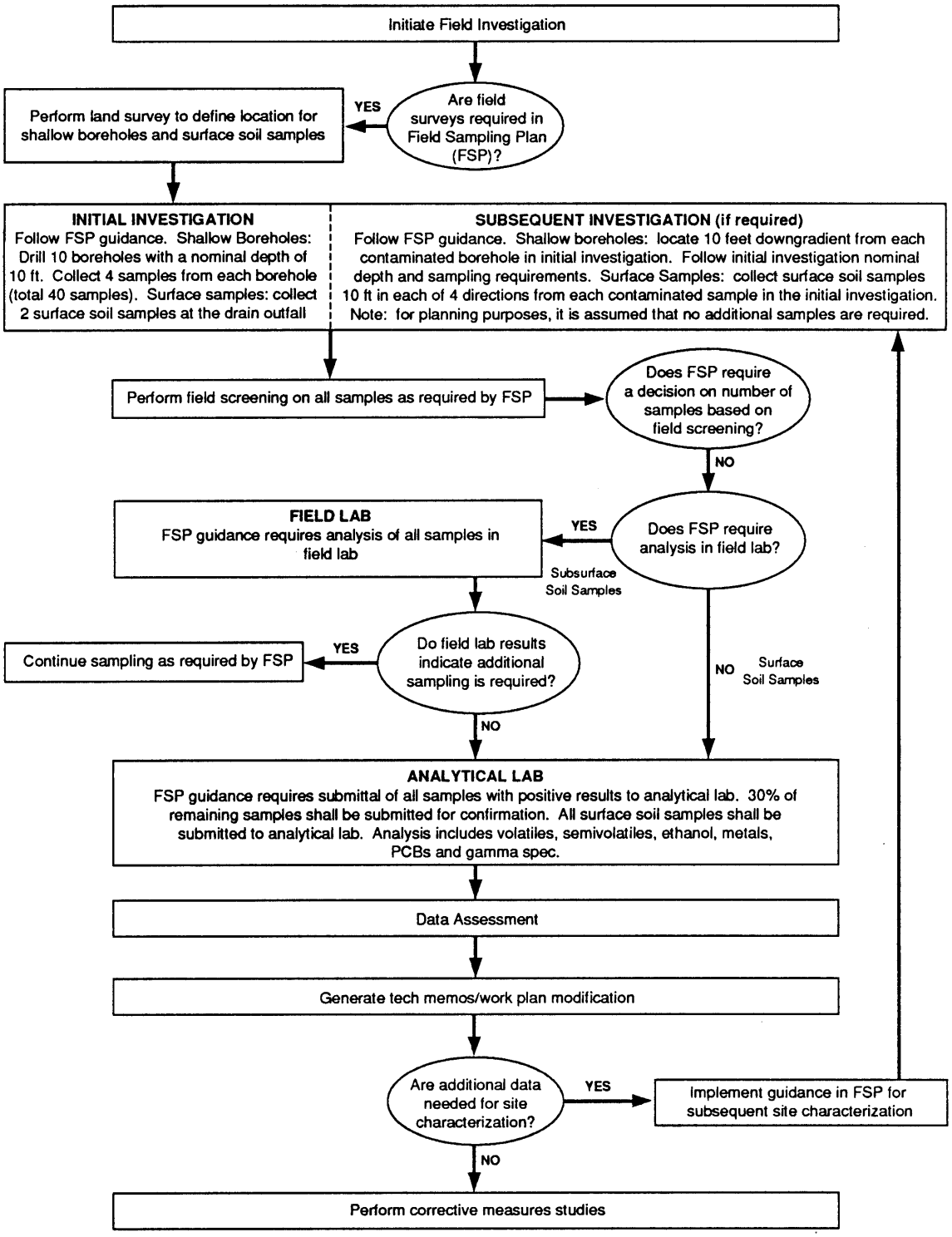


Fig. 14.1-4 Logic flow for field investigations at SWMU 21-029, DP tank farm.

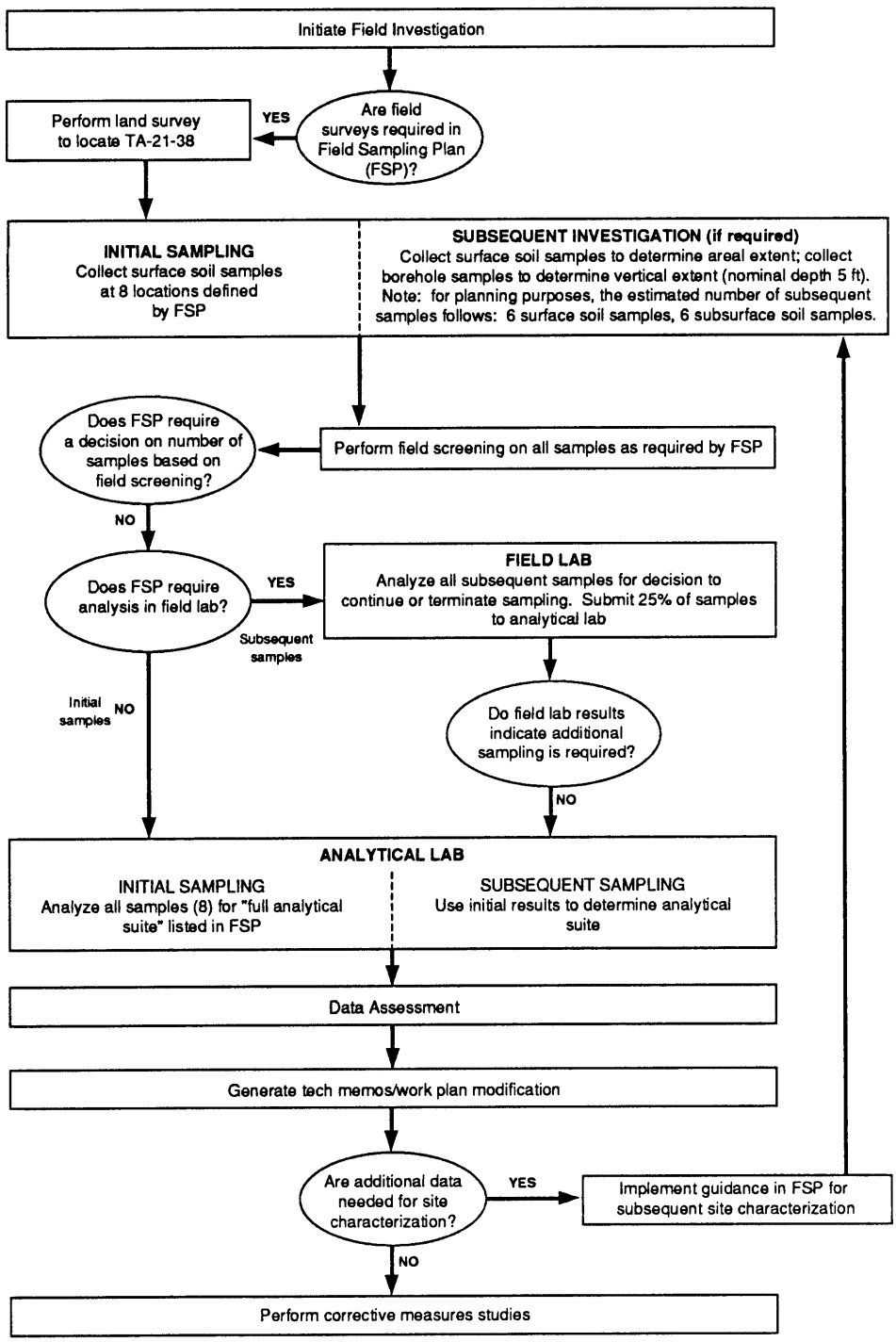


Fig. 14.1-5 Logic flow for the field investigations to investigate contamination at SWMU 21-002(b), inactive drum storage structure.

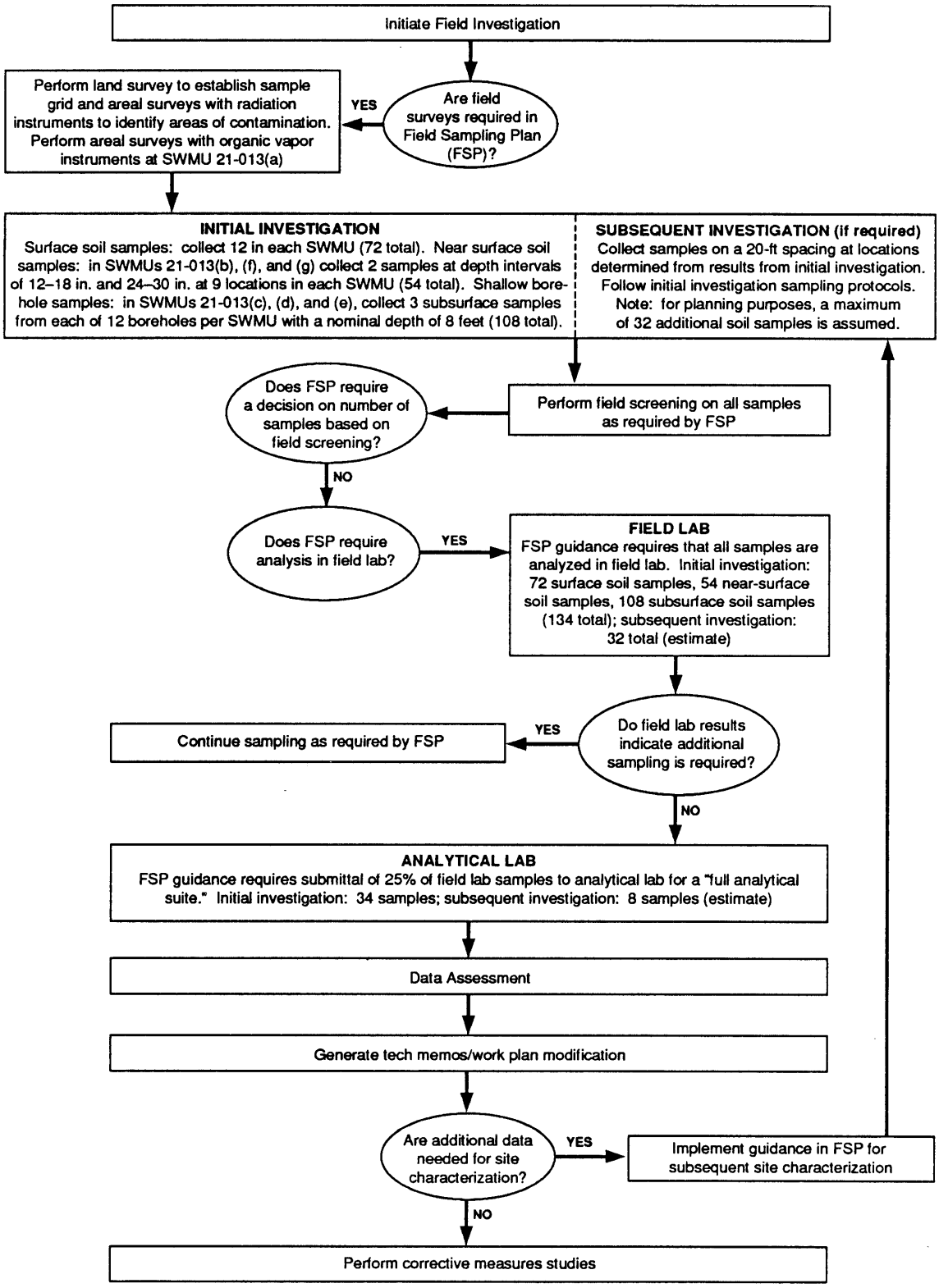


Fig. 14.1-6 Logic flow for field investigations at surface disposal areas.

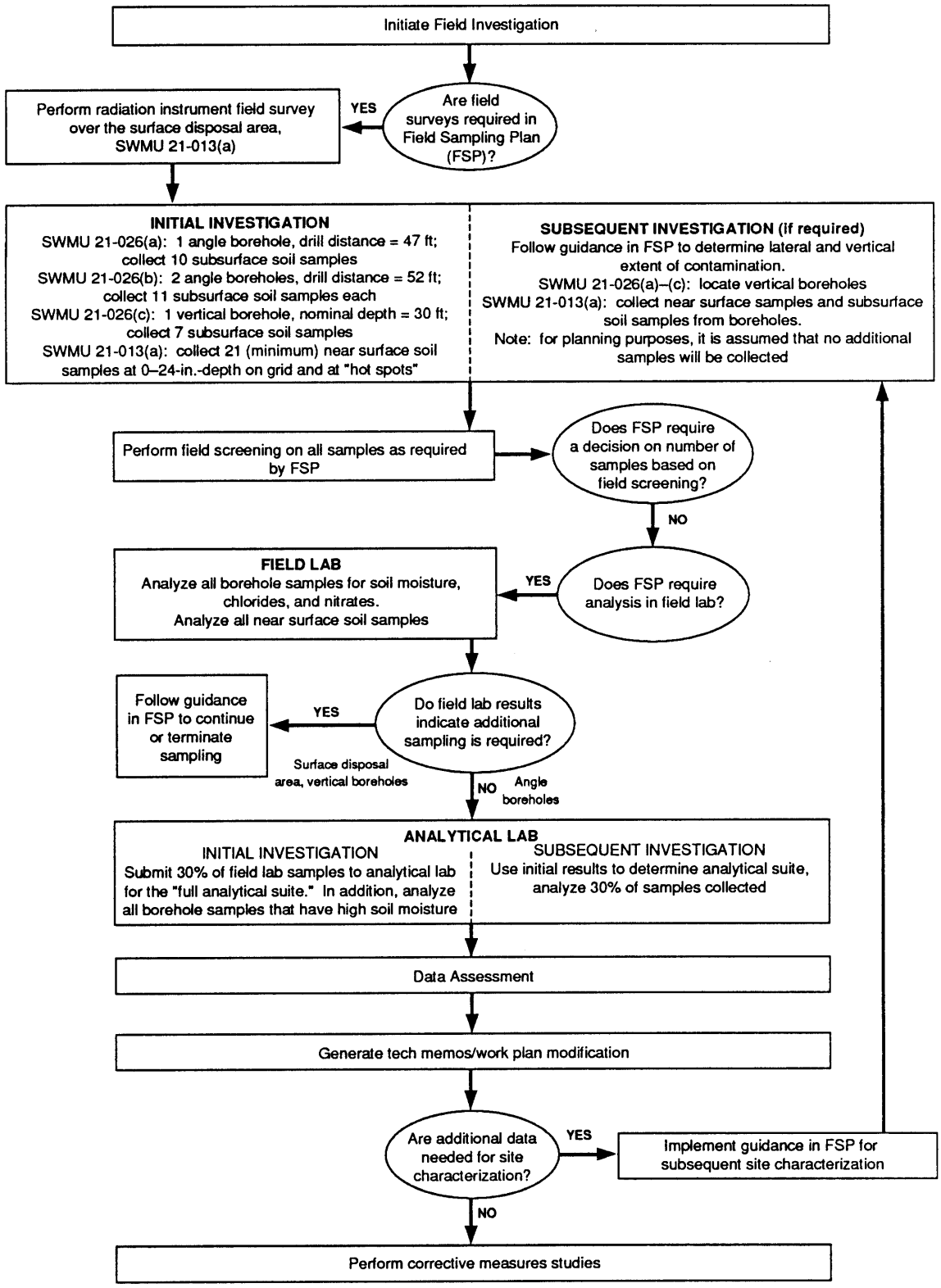


Fig. 14.1-7 Logic flow for the field investigation at SWMU 21-013(a), surface disposal area, and SWMU 21-026, sewage treatment plant.

14.2. PCB Container Storage Area

14.2.1. Site Description

This chapter describes the field investigations for the PCB-container storage area (SWMU 21-003). PCB-contaminated materials were stored inside Building TA-21-61, as well as on an area immediately east of the building (see Fig. 14.2-1). A portion of the storage area adjacent to the building is currently asphalted (a bermed drum storage pad). In the past, however, PCB-contaminated materials were stored there on the ground. Previous sampling has shown contamination to be present as a result of past operations at the storage area.

14.2.1.1. Site History

Construction of TA-21-61 was completed on September 30, 1950 (LASL no date). The building was originally used for nuclear propulsion program work (LASL 1958). No potential contaminants are known to be related to that work. Beginning in February 1978, the building and a bare earth pad directly east of the building were used for storage of capacitors and transformers containing PCB oil, PCB-contaminated pumps, and drums of PCB-contaminated waste oil, solvents and trash (Warren 1979; Warren 1980).

Use of the bare earth pad for storage of PCB-contaminated materials continued until October 1981 when part of the area was paved with asphalt and bermed. No excavation of the soil was performed prior to laying the asphalt pad (Weston 1991). Thereafter, the new asphalt pad was used for the temporary storage of drums containing less than 500 ppm PCB, and drums containing greater than 500 ppm PCB were stored inside TA-21-61 (Balo and Warren 1981). Building TA-21-61 and the asphalt storage pad continued to be used for storage of PCB-contaminated materials until August 1989 when the PCB storage area was moved to TA-54-39 (Hupke 1990).

The history of the PCB operations at TA-21-61 and the storage area east of the building is discussed in the Waste Management Site Plans for 1979-1981 and 1986 (Warren 1979; Warren 1980; Balo and Warren 1981; Warren and Balo 1987).

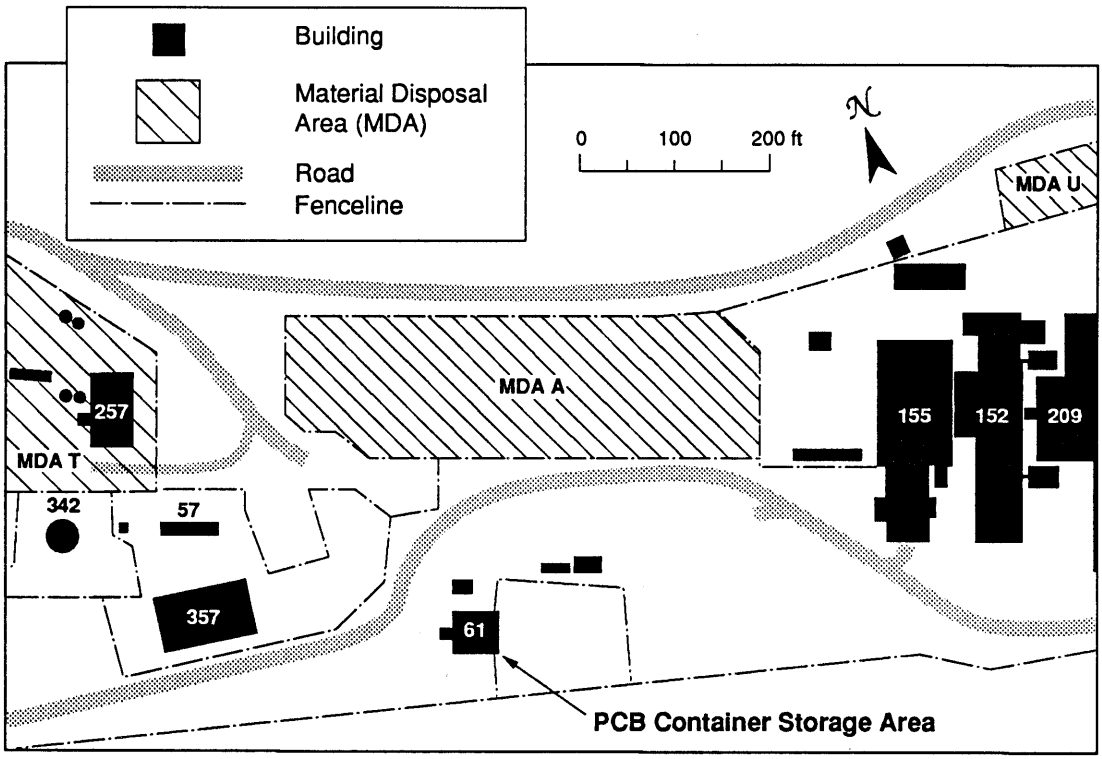


Fig. 14.2-1 Location of the former PCB Container Storage Area, TA-21-61 (Balo and Warren 1981; Warren and Balo 1987).

14.2.1.2. Existing Information

Grab samples of soil and asphalt were collected on July 21, 1988, on and around the asphalt pad adjacent to building TA-21-61. The sampling locations and analytical results are shown in Fig. 14.2-2. (Specific analytical results can be obtained from Group HSE-9 via data request number 7132 (LANL 1988e). These data indicate that the contamination is nonuniform, ranging from less than 10 ppm to approximately 95,000 ppm. The highest PCB concentrations are on or adjacent to the asphalt pad. PCB contamination was found to extend at least 30 ft east and west of the pad and 4 and 8 ft south and north, respectively. Concentrations off the pad remain elevated (in the range 10 to 1000 ppm), with a few interior and perimeter samples having concentrations less than 10 ppm. No data are available for greater distances from the pad.

During 1989, the interior of building TA-21-61 was decontaminated. PCB levels were reduced to 10 µg/100 cm^2 throughout the building. However, one area "outside of the TA-21-61 door on a concrete pad" could not be cleaned to that level (Alexander 1989). This may indicate the presence of PCB contamination around the exterior of the building.

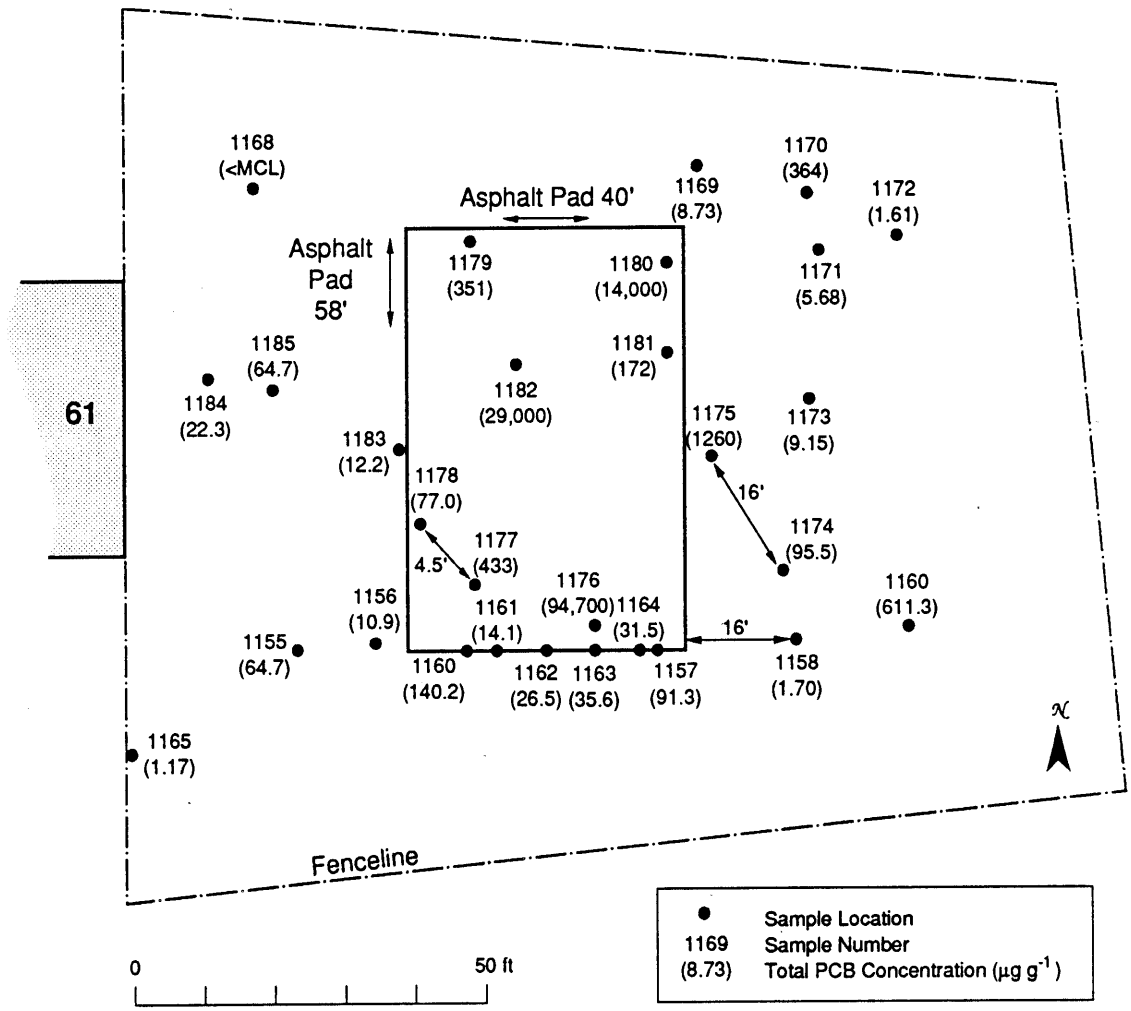


Fig. 14.2-2 Results of TA-21-61 sampling effort by HSE-7. (LANL 1989b)

14.2.1.3. Source Term

The primary contaminant of concern is PCB-contaminated oil and solvents. Kerosene and petroleum-based solvents were used at the storage area to rinse the transformers and capacitors after they had been drained of PCB oil. The frequency of performing this operation and the amount of solvent used each time are not known. It is possible, however, that releases of PCB-bearing solvents may have occurred.

Contaminants other than the PCB-bearing oils and solvents (such as organics, metals or radionuclides) are not known to be either present or absent at SWMU 21-003.

14.2.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at SWMU 21-003. Specific data required to assess contamination at SWMU 21-003 include the following:

1. Identify the presence of PCB-related contaminants (PCBs, oils, solvents) and other contaminants (organics, metals and radionuclides) using Level II and III data. PCBs have been identified in area soils. It is not known how extensive contamination is around the area, or beneath the asphalt pad.

2. If contaminants are identified in the area, determine the lateral and vertical extent of contaminant migration using surface and subsurface sampling and Level III analyses.

3. Identify the contaminants present using Level II and III data from drainages in the area of SWMU 21-003. Surface soil contamination known to exist in the area may have the potential for transport of contamination by water erosion in surface drainages.

14.2.3. Sampling/Investigation Rationale

PCBs are soluble in oil and in some solvents but are insoluble in water. Assuming the volume of oil and solvent releases was small and that water is ineffective for transporting PCBs, contaminant penetration is likely to be limited to the upper few feet of the soil profile. Thus, planned sampling depths are shallow.

Two phases of investigations can be planned for SWMU 21-003. The initial investigation consists of surface soil sampling to determine the extent of elevated levels of PCBs around Building TA-21-61 and at greater distances from the asphalt pad. These samples will be analyzed in the field laboratory for PCBs, with a percentage submitted to an analytical laboratory for confirmatory analyses. Field laboratory analyses will assist in defining the edge of the PCB contaminant plume. In addition, a percentage of the samples submitted for analytical laboratory analysis will be subjected to a full analytical suite to assess the presence of other contaminants. Results from the full analytical suite will be used to limit the analytical suites specified for samples collected in later investigations.

The drainage that collects run-off from the area of SWMU 21-003 is addressed in a separate investigation [see Sec. 15.3, SWMU 21-024(c)]. PCB analyses are specified for soil samples in the drainage investigation to supplement the information developed in this investigation.

The subsequent investigation will focus on determining the concentration levels and the depth of contaminant penetration into the soil beneath the asphalt pad and in other areas where surface contamination is observed. As above, the samples will be analyzed in the field laboratory for PCBs, with a percentage submitted to an analytical laboratory for a full suite of laboratory analyses.

14.2.4. Sampling Plan

14.2.4.1. Initial Investigation

Around the Asphalt Pad. Initial investigations in the vicinity of the asphalt pad will consist of 57 surface soil samples (for method see Sec. 11.5.2.1, Surface Soil Samples). The previously sampled area will be expanded to approximately 60 ft from the edges of the pad, with the new samples placed on a 20-ft grid, except at grid nodes in close proximity to previous sampling locations. The planned sampling locations are shown in Fig. 14.2-3.

If elevated contaminant levels in perimeter samples are identified by field laboratory analysis for PCBs (for method see Sec. 11.7.2.2, PCB Field Screening), the grid will be expanded, and additional surface samples will be taken until field laboratory results are uniformly below 10 ppm PCB.

Building TA-21-61. The initial investigation around building TA-21-61 is planned to include six surface soil samples taken within 5 ft of the building perimeter, two samples each on the north, west and south sides (the east side is covered by the grid described above). If elevated contaminant levels are identified by field laboratory analysis for PCBs, additional surface samples will be taken. It is planned that any additional surface samples will be located on grid nodes obtained by extending the 20-ft grid setup for investigations around the asphalt pad. Fig. 14.2-3 shows the planned locations of the initial six samples.

Numbers of Samples/Sample Analysis. For planning purposes, it is assumed that sampling around the asphalt pad results in 57 samples with no extension of the grid and that sampling around building TA-21-61 results only in the initial six samples.

It is planned that 30% of these surface soil samples (19 samples) will be subjected to analytical laboratory analysis for the full suite of analyses (in addition to PCB analyses) to determine if other contaminants are present at the edge of the contaminant plume where field laboratory analyses indicate an absence of contaminants. Based on the results, a more focused analytical suite can

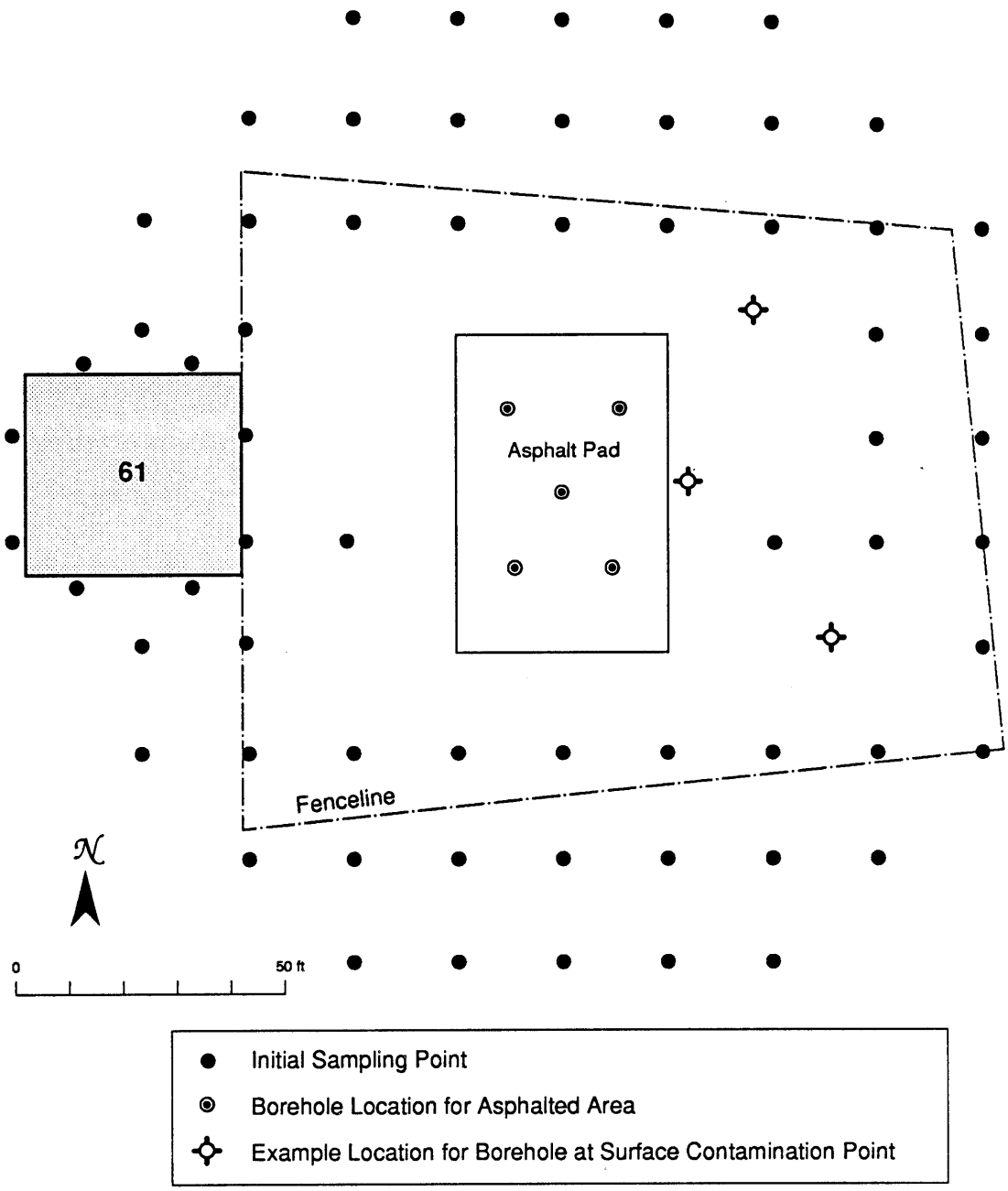


Fig. 14.2-3 Sampling locations at PCB container storage area.

be specified for subsequent sample analyses. The analytical requirements for initial investigation of SWMU 21-003 are shown in Table 14.2-I.

14.2.4.2 Subsequent Investigation

For SWMU 21-003, the subsequent investigation is not optional as it is for some other SWMU investigations. Rather, it is a planned subsequent investigation that allows results from the initial investigation to more closely focus the analytical requirements.

Around Building TA-21-61 and the Asphalt Pad. Based on the results of the initial investigations and the existing data from previous sampling, three boreholes will be sampled in areas of known surface contamination to evaluate the related depth of contamination (for method see Sec. 11.5.3.1, Shallow Boreholes). Figure 14.2-3 shows example locations for such boreholes. The nominal depth for these boreholes is 5 ft. This will result in the collection of six samples. No criterion for deciding to place additional boreholes is presented: it is not expected that additional boreholes will be needed.

Beneath the Asphalt Pad. An array of five boreholes will be sampled through the asphalt pad to determine contaminant concentrations as a function of depth (for method see Sec. 11.5.3.1, Shallow Boreholes). Figure 14.2-3 shows the planned locations for these boreholes. The nominal borehole depth is 10 ft. This will result in the collection of 20 samples. No criterion for deciding to place additional boreholes is presented: it is not expected that additional boreholes will be needed.

Numbers of Samples/Sample Analysis. The depth to which the boreholes will be drilled and sampled will be based on levels of PCBs or other indicator contaminants determined by field screening or field laboratory measurements (for methods see Sec. 11.6 and 11.7). For planning purposes, it is assumed that the boreholes terminate at the nominal depths and that the 26 samples are collected and analyzed in the field laboratory for radioactivity, volatile organics, and PCBs as indicated in Table 14.2-II. In addition, it is assumed that 30% of the samples will be submitted to the analytical laboratory for confirmatory analyses. The assumed analytical requirements for the subsequent investigation for SWMU 21-003 are shown in Table 14.2-II.

Table 14.2-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Asphalt Pad							X																												
Surface Soil Sample	1	0.0 – 6.0 in							X		X			X	X	X	X	X				E	E	E	E			E	E	E	E			
	2	0.0 – 6.0 in							X		X						X	X																
	3	0.0 – 6.0 in							X		X						X	X																
	4	0.0 – 6.0 in							X		X						X	X				E	E	E	E			E	E	E	E			
	5	0.0 – 6.0 in							X		X			X	X	X	X	X																
	6	0.0 – 6.0 in							X		X						X	X																
	7	0.0 –, 6.0 in							X		X						X	X				E	E	E	E			E	E	E	E			
	8	0.0 – 6.0 in							X		X						X	X																
Rinsate Blank																						X	X	X	X			X	X	X	X			
Field Blank																												X	X	X	X			
	9	0.0 – 6.0 in							X		X			X	X	X	X	X																
	10	0.0 – 6.0 in							X		X						X	X				E	E	E	E			E	E	E	E			
	11	0.0 – 6.0 in							X		X						X	X																
	12	0.0 – 6.0 in							X		X						X	X																
	13	0.0 – 6.0 in							X		X			X	X	X	X	X				E	E	E	E			E	E	E	E			
Field Duplicate																						E	E	E	E			E	E	E	E			
	14	0.0 – 6.0 in							X		X						X	X																
	15	0.0 – 6.0 in							X		X						X	X																
	16	0.0 – 6.0 in							X		X						X	X				E	E	E	E			E	E	E	E			
	17	0.0 – 6.0 in							X		X			X	X	X	X	X																
	18	0.0 – 6.0 in							X		X						X	X																
	19	0.0 – 6.0 in							X		X						X	X				E	E	E	E			E	E	E	E			
	20	0.0 – 6.0 in							X		X						X	X																
	21	0.0 – 6.0 in							X		X			X	X	X	X	X																

Table 14.2–I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21–003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	22	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	23	0.0 – 6.0 in							X		X						X	X															
	24	0.0 – 6.0 in							X		X						X	X															
	25	0.0 – 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
Rinsate Blank																					X	X	X	X			X	X	X	X			
Field Blank																											X	X	X	X			
	26	0.0 – 6.0 in							X		X						X	X															
	27	0.0 – 6.0 in							X		X						X	X															
	28	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	29	0.0 – 6.0 in							X		X			X	X	X	X	X															
	30	0.0 – 6.0 in							X		X						X	X															
	31	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	32	0.0 – 6.0 in							X		X						X	X															
	33	0.0 – 6.0 in							X		X			X	X	X	X	X															
	34	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	35	0.0 – 6.0 in							X		X						X	X															
	36	0.0 – 6.0 in							X		X						X	X															
	37	0.0 – 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
	38	0.0 – 6.0 in							X		X						X	X															
	39	0.0 – 6.0 in							X		X						X	X															
	40	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	41	0.0 – 6.0 in							X		X			X	X	X	X	X															
	42	0.0 – 6.0 in							X		X						X	X															
	43	0.0 – 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	44	0.0 – 6.0 in							X		X						X	X															
Rinsate Blank																					X	X	X	X			X	X	X	X			

Table 14.2-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis										
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Field Blank																											X	X	X	X			
	45	0.0 - 6.0 in							X		X			X	X	X	X	X															
	46	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	47	0.0 - 6.0 in							X		X						X	X															
	48	0.0 - 6.0 in							X		X						X	X															
	49	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
	50	0.0 - 6.0 in							X		X						X	X															
	51	0.0 - 6.0 in							X		X						X	X															
	52	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	53	0.0 - 6.0 in							X		X			X	X	X	X	X															
	54	0.0 - 6.0 in							X		X						X	X															
	55	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	56	0.0 - 6.0 in							X		X						X	X															
	57	0.0 - 6.0 in							X		X			X	X	X	X	X															
Building TA-21-61																																	
Surface Soil Sample	1	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
	2	0.0 - 6.0 in							X		X						X	X															
	3	0.0 - 6.0 in							X		X						X	X															
	4	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	5	0.0 - 6.0 in							X		X			X	X	X	X	X															
	6	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
Rinsate Blank																					X	X	X	X			X	X	X	X			
Field Blank																											X	X	X	X			
Trip [illegible]																											X						

Table 14.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Asphalt Pad and Building TA-21-61																																			
Shallow Borehole	1	0.0 - 2.5 ft							X		X	X	X	X	X		X	X				E	E	E	E		E	X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																
	2	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
Field Duplicate																												X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																
	3	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X				E	E	E	E		E	X			X			
Asphalt Pad																																		
Shallow Borehole	1	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X										X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X				E	E	E	E		E							
	2	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X										X			X			
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X																
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X																
	3	0.0 - 2.5 ft							X		X	X	X	X	X		X	X				E	E	E	E		E	X			X			
Rinsate Blank																						X	X	X	X		X	X			X			
Field Blank																												X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X																
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X										X			X			
	4	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X				E	E	E	E		E							

Table 14.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X										X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X																
	5	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X				E	E	E	E		E	X			X			
Field Duplicate																						E	E	E	E		E	X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X										X			X			
Rinsate Blank																						X	X	X	X		X	X			X			
Field Blank																												X			X			
Trip Blank																												X						

14.3. Aboveground Tanks and Drain Line

14.3.1. Site Description

This section describes the field investigations for three aboveground tanks [SWMUs 21-004(a)–(c)] and a drain line [SWMU 21-004(d)] at TA-21. The locations of these SWMU subunits are shown in Fig. 14.3-1. No information on past releases from these units is available.

14.3.1.1. Site History

Tank TA-21-335, SWMU 21-004(a), is a 6,000-gal. aboveground steel tank, 8-ft in diameter and 16-ft long, installed in 1974 (LANL 1990a). The tank is located about 2 ft above ground surface and is mounted on a steel cradle. The cradle that holds the tank is bolted to a concrete pad that covers the ground surface below the tank. No stains or evidence of leaks were noted on either the tank or the concrete pad during the TA-21 site reconnaissance walk-through (Roy F. Weston 1990).

There are conflicting explanations regarding the origin of the drain line connected to tank TA-21-335. A drawing (LASL 1960) shows a drain line originating from the mechanical room of Building TA-21-21. The drain line is described on the drawing as going to daylight, as well as going to sump TA-21-74. It is unclear, from these two descriptions, where the drain line is connected. Another drawing (LASL 1973) shows the tank connected to a drain line originating from Building TA-21-21, although it is not known where this line originates. A LANL source, onsite when the tank was installed in 1974, stated that the tank was connected to floor drains in building TA-21-21 (Trujillo 1991).

From the time of its installation in 1974, the tank has not been pumped out by HSE-7 (Buchholtz 1991), and there are no documented releases to the tank (Jones 1991; Trujillo 1991).

Tank TA-21-346 consists of two aboveground stainless steel tanks [SWMU 21-004(b)–(c)] located within an asphalt-lined berm, approximately 110 ft north of sump pump TA-21-223 (Fig. 14.3-1). Each tank is 9-ft high and 8 ft in diameter and has a capacity of 3,000 gal. (LANL 1990a). Both tanks are mounted on steel legs above the surface of the asphalt berm (Roy F. Weston 1990). The bermed area is 36-ft long by 18-ft wide and was originally designed to contain 6,000 gal. but actually has a capacity closer to 9,600 gal. (LASL 1979).

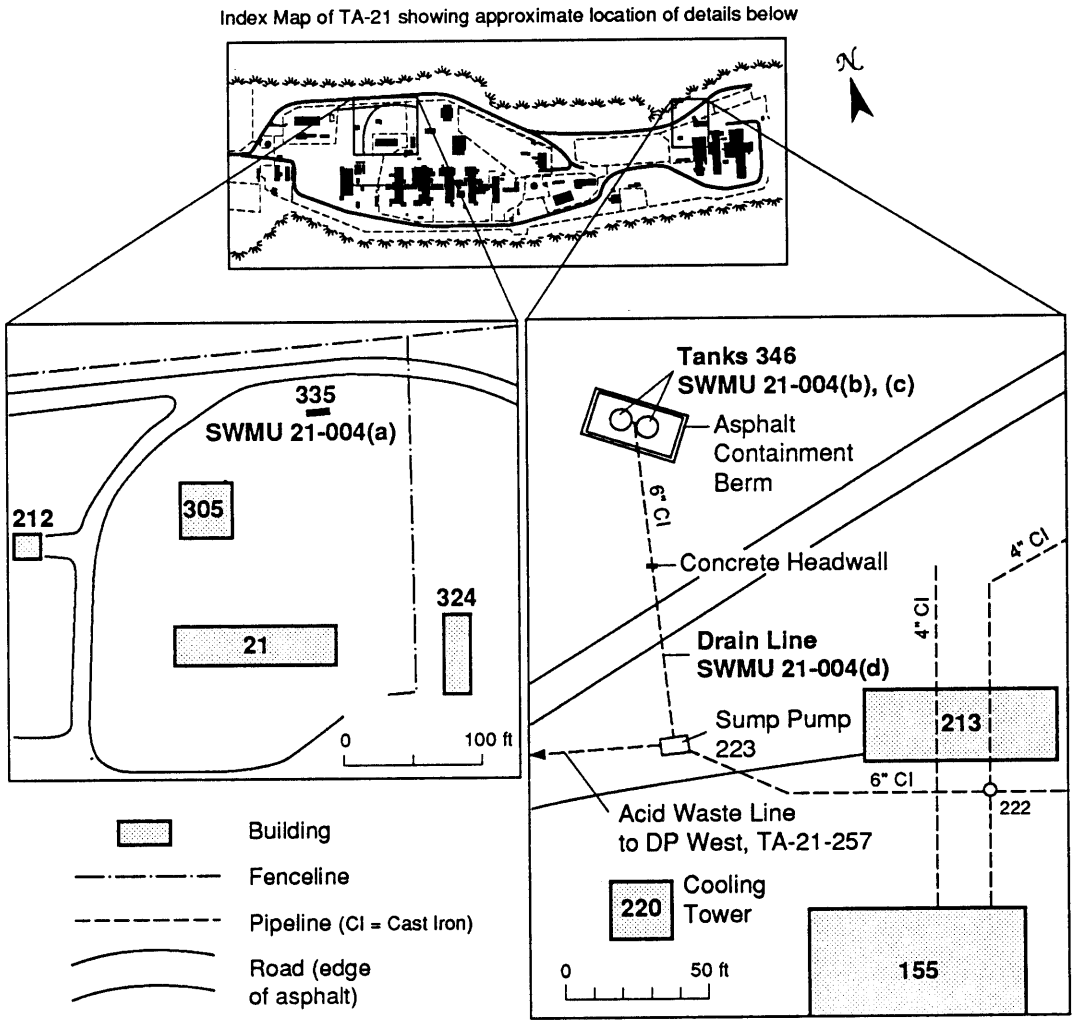


Fig. 14.3-1 Locations of the TA-21 aboveground tanks SWMU 21-004(a), (b), and (c) and the drain line [SWMU 21-004(d)] from sump TA-21-223 to aboveground tanks TA-21-346 [SWMU 21-004(b), (c)]. (LASL 1979; LANL 1983a)

pre-existing 6-in. drain line, SWMU 21-004(d), originating from sump pump TA-21-223. The sump pump is connected to the main TA-21 acid waste line and is responsible for pumping liquid waste produced at DP East to Building TA-21-257 at DP West for treatment (Fig. 14.3-1). The two tanks were installed to receive liquid waste from the sump, if it were to overflow.

Tanks TA-21-346 are reported to have been pumped out on two occasions over the past 12 years of operation. This liquid waste was sent back into sump TA-21-223. No leaks from the tanks or releases to the berm or the environment have occurred (Buchholtz 1991). No leaks on the tanks

or stains on the asphalt berm were observed during the TA-21 site reconnaissance walk-through (Roy F. Weston 1990).

A drain line, SWMU 21-004(d), discharged overflow from sump TA-21-223 directly into DP Canyon prior to 1964 and until 1979 when the tanks described above were installed (LASL 1967). The drain line was 61-ft long with a 6-in. diameter. Sometime during this 15-yr period, 14 ft of pipe was added to the end of the drain line, but any overflow from the sump would have continued to go to DP Canyon. During this time, the sump was not equipped with an overflow alarm system, and no discharges were documented (Garde 1975). The outfall from this drain line is addressed in Sec. 15.8. In 1979, the 14-ft section of pipe was replaced with 50 ft of new pipe, and the drain line was connected to tanks TA-21-346 (LASL 1979) as described above.

14.3.1.2. Existing Information

Tank TA-21-335. No data exist regarding contamination in or releases from SWMU 21-004(a). Some sample analysis results are available for outfall SWMU 21-024(l) (see Sec. 15.2), which is believed to have been located to the northeast of tank TA-21-335. The results showed zinc, ^{241}Am, $^{239/240}Pu$, and tritium to be present in concentrations above the normal background level for LANL (Ferenbaugh 1990; Purtymun et al. 1987). Semivolatile organic compounds present in concentrations above detection limits were all PAHs that are common constituents of asphalt. Therefore, they are not considered further.

Tank TA-21-346 and Drain Line. SWMUs 21-004(b)–(d) have received liquid waste from sump pump TA-21-223 and are assumed to be contaminated. No releases from the tanks to the asphalt berm or the environment are documented, and no chemical or radiological analyses have been performed on the liquid waste contained in the tanks TA-21-346 (Buchholtz 1991). Some sample analysis results are available for the outfall SWMU21-004(d), which predated SWMUs 21-004(b-c) (see Sec. 15.8). Mercury, $^{239/240}Pu$, and tritium were found to be present at concentrations above normal background level (DOE 1989).

14.3.1.3. Source Term

Tank TA-21-335. Vault TA-21-21 was used for storage of uranium and plutonium metal. Floor drains in the main vault rooms and the mechanical room of Building TA-21-21 might have carried liquids contaminated with uranium, plutonium, and organics. Although these contaminants may be suspected, no evidence exists that any liquids have reached SWMU 21-004(a) or have been released to the environment from it.

Tanks TA-21-346 and Drain Line. Waste potentially reaching SWMUs 21-004(b)–(d) is liquid industrial waste from DP East. This waste generally consists of diluted laboratory wastes and liquids from chilled water systems originating from operations at DP East. The waste discharged to the tanks may have been contaminated with tritium (Buchholtz 1991), polonium, and actinium (Merrill 1990), mercury and $^{239/240}Pu$, (DOE 1989). Other contaminants that may be present in the waste received by the tanks include uranium and thorium because materials containing these radionuclides were stored at DP East at the time of the TA-21 site reconnaissance walk-through (Roy F. Weston 1990). Chemical contaminants released to these tanks have not been documented (LANL 1990a).

14.3.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-004. Specific data required to assess contamination at SWMU 21-004 include the following:

1. Identify contaminants present within or on tanks TA-21-335 and TA-21-346 using Level II data. No data exist regarding contamination in or releases from these tanks, although tank TA-21-346 may have received contaminated waste from a sump.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and Level III analyses.

14.3.3. Field Sampling/Investigation Rationale

Tank TA-21-335. Because no information is available regarding releases to or from SWMU 21-004(a), preinvestigation sampling will determine whether the tank contents are contaminated. This preinvestigation activity will consist of monitoring the outside of the tank, the concrete pad beneath the tank, and the exposed portion of the drain line connected to the tank with radiological survey instruments and will include sampling the inside of the tank and its contents. The presence of contamination in the tank will justify further investigation of potential releases to the environment. Detecting no contamination in the tank will end the investigation in the area because no environmental contamination could have resulted from an uncontaminated tank.

The initial investigation (if required) will consist of a radiological survey of the area around tank TA-21-335. Areas of above-background level readings will be marked for soil sampling. If no above-background level areas are identified, surface sampling will be conducted at predetermined locations to confirm the survey results and to address nonradiological contaminants.

The surface samples will be submitted for laboratory analysis and will be subjected to a full

analytical suite to determine the types and concentrations of contaminants present. If contaminants are identified in the initial surface soil samples, then a subsequent investigation will collect subsurface samples from boreholes located in close proximity to the surface sampling locations to investigate the presence of contamination at depth.

In the subsequent sampling, the lateral extent of contamination, either at depth or on the surface, will be addressed by expanding the sampling program to include surface or subsurface soils of a wider area. Analytical results from the the initial samples will be used to limit the analytical suites specified for samples collected in the subsequent investigation.

Tanks TA-21-346. Because SWMUs 21-004(b)–(c) have received liquid waste from sump TA-21-223, the tanks are assumed to be contaminated. Therefore, investigation of the area around tanks TA-21-346 is warranted. A radiological survey within the asphalt containment berm will be performed to identify any above-background level readings that might suggest that environmental releases have occurred. Because the radiological survey will only detect the presence of radionuclides and not any other potential contaminants, two shallow boreholes will be drilled on the downgradient side of the berm to identify any other contaminants that were not detected during the survey. These contaminants may have been washed over the edges of the containment berm onto the soil or leaked through the berm to the environment at depth. A full analytical suite will be performed on the samples.

As a subsequent investigation, if contamination is found in the samples, the sampling program will be expanded over a wider area to define the extent of surface or subsurface contamination. Initial analysis results will be used to limit the analytical suites specified for samples collected in later investigations.

The drain line, SWMU 21-004(d), which connects tanks TA-21-346, SWMU 21-004(b)–(c), to sump pump TA-21-223 (see Fig. 14.3-2) will not be investigated in this sampling plan. The presence of contamination resulting from the original outfall from sump pump TA-21-223 will be addressed with regard to the outfall SWMU 21-024(d) (see Sec. 15.8).

14.3.4. Sampling Plan

14.3.4.1. Preinvestigation Sampling at Tank TA-21-335

The outside of tank TA-21-335, the concrete pad, and the exposed portion of the drain line feeding the tank will be surveyed with hand-held instruments (for method see Sec. 11.4.1).

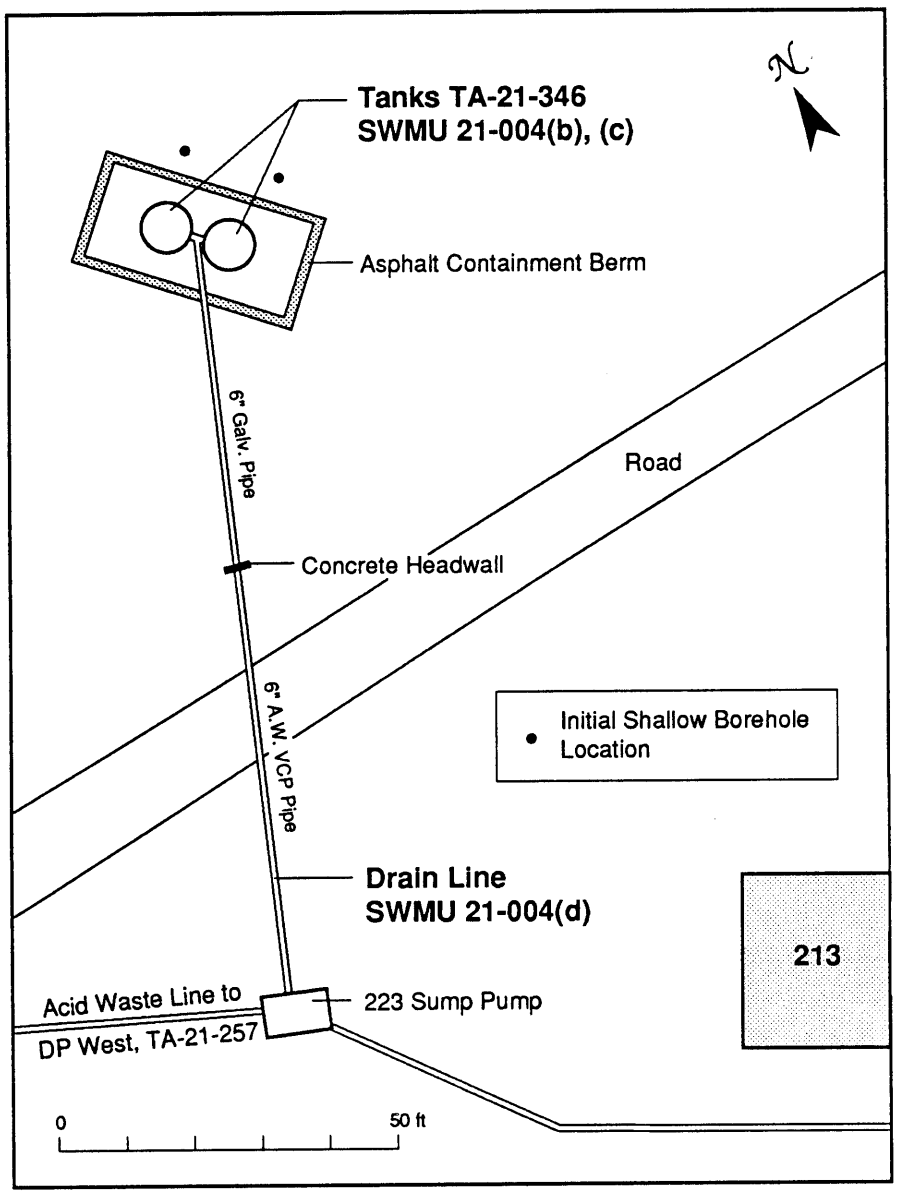


Fig. 14.3-2 Locations of the initial shallow boreholes to be drilled on the downgradient side of the asphalt berm at tanks TA-21-346. (LASL 1979)

Sampling within the tank will also be conducted (for method see Sec. 11.5.5). Because tank TA-21-335 has not received any documented releases, it is expected to be dry when sampling is performed (LANL 1990a; Trujillo 1991). A dry tank will require the collection of three replicate filter-paper swipes along the bottom of the tank (for method see Sec. 11.5.5.2). A tank containing liquid or sludge will require three replicate samples of the liquid (for method see Sec. 11.5.5.1). The purpose of tank sampling is not to gain quantitative data but only to determine if contamination is present in the tank; therefore, samples (swipes or liquid) will be sent to the field laboratory for analysis.

A total of three samples will be taken during tank sampling. The surveying and sample analysis requirements for the initial phase of the investigation are shown in Table 14.3-I. If no contamination is identified, no further action will be taken at tank TA-21-335.

14.3.4.2 Initial Investigation

Tanks TA-21-346. A radiological survey will be performed on the inside of the containment berm to assess whether environmental releases have occurred (for method see Sec. 11.4.1). In addition, two shallow boreholes will be drilled to a nominal depth of 5 ft on the downgradient (north) side of the asphalt berm (for method see Sec. 11.5.3.1) to identify any contamination that may have been released beneath the berm (Fig. 14.3-2).

A total of four samples will be analyzed from the area downgradient of tanks TA-21-346. The screening and sample analysis requirements for the initial phase of the investigation are shown in Table 14.3-I. If either no contamination is identified or contaminants are present at levels representative of TA-21 background level as determined by surface-sampling investigations detailed in Chapters 12 and 13, no further action will be taken at tanks TA-21-346.

Tank TA-21-335. If contamination is identified in the preinvestigation sampling, in the initial investigation a radiological survey of the area around the tank and the exposed portion of the drain line will be conducted within 15 ft of the structures (for methods see Sec. 11.4.1). Any areas of above-background level readings within the 15-ft area around the tank and the drain line will be marked and potentially sampled.

A total of three surface soil samples will be taken (for method see Sec. 11.5.2.1) from the marked areas having the highest readings. In addition, two surface soil samples will be taken at the northern and eastern edges of the concrete pad below the tank (Fig. 14.3-3).

If no areas of above-background level readings are identified from the radiological survey, the three surface samples that would have been taken in the areas of highest readings will be taken from the area around the tank and the drain line. Two will be taken at the southern and western edges of the concrete pad, and the third will be taken from a location along the drain line (Fig. 14.3-3).

A total of five surface samples will be taken from the area around tank TA-21-335 and its associated drain line. The samples will be submitted to the analytical laboratory. The analytical requirements for the initial investigation are shown in Table 14.3-I. If the five surface samples are found to be uncontaminated, the field investigation will end at this phase.

Table 14.3-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-004, ABOVEGROUND TANKS AND DRAINLINES.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Tank Survey TA-21-335																																	
Outside of Tank				X	X																												
Concrete Pad				X	X																												
Drainline				X	X																												
Tank Sampling TA-21-335																																	
Three filter swipes if dry														X	X																		
Three liquid samples if it contains liquid.														X	X		X																
Tank TA-21-346																																	
Radiological Survey				X	X																												
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X		X					X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X		X																
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X		X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X		X					X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Tank TA-21-335																																	
Radiological Survey				X	X																												
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				

Table 14.3-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-004, ABOVEGROUND TANKS AND DRAINLINES.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

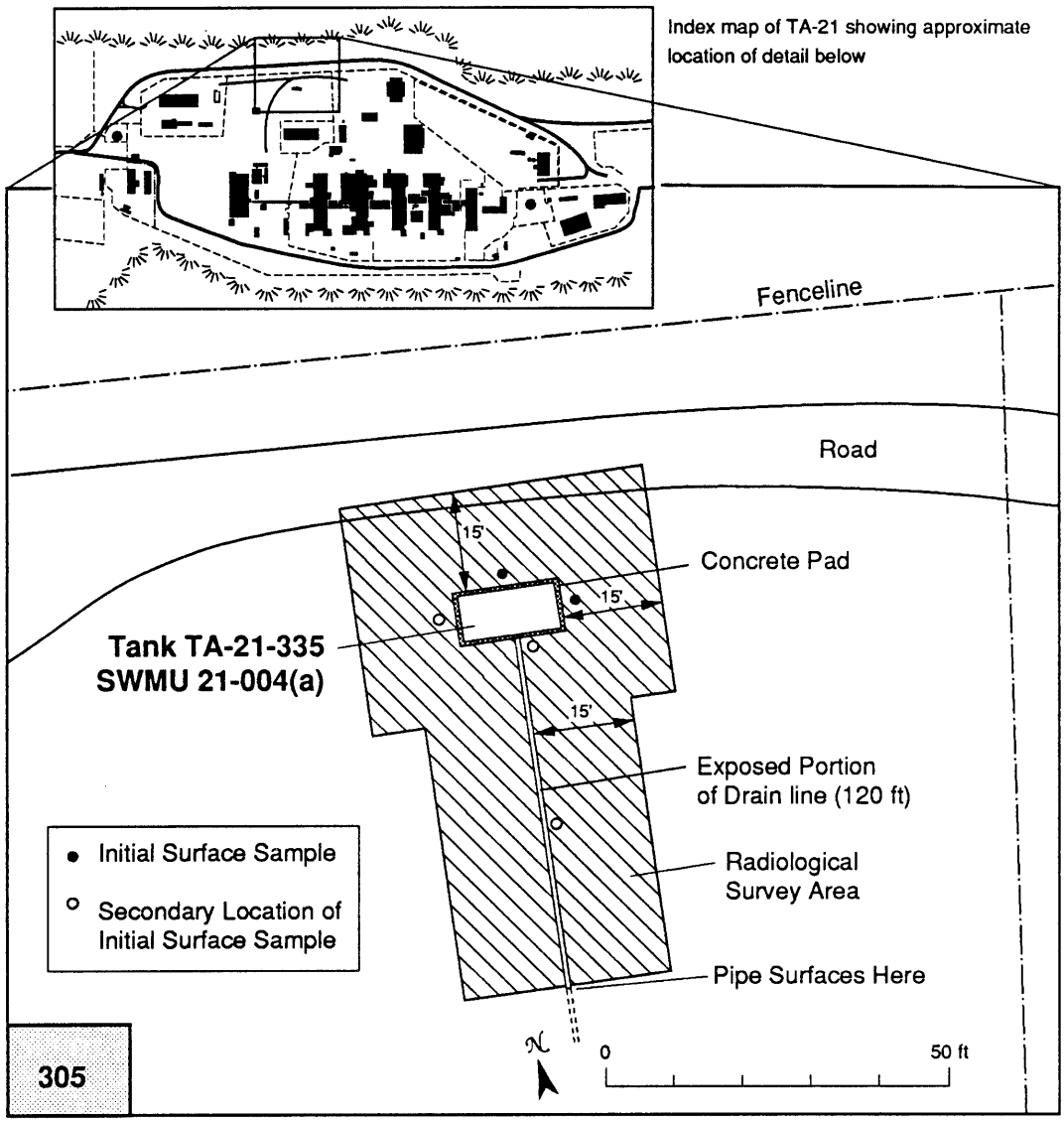


Fig. 14.3-3 Schematic showing the radiological survey around tank TA-21-335 and the drain line connected to the tank. Also shown are the two initial surface sampling locations and the three secondary sampling locations.

14.3.4.3 Subsequent Investigation

Tank TA-21-335. Although unexpected, if any surface soil samples are found by analytical laboratory analysis to be contaminated, shallow boreholes will be drilled to a nominal depth of 5 ft, in close proximity to the surface sampling locations to determine if deeper contamination is present (for method, see Sec. 11.5.3.1). For planning purposes, it is assumed that no subsequent investigation of surface or subsurface samples will be required.

Tanks TA-21-346. If contamination is found in the initial boreholes, the subsequent investigation in the area of these tanks will use additional surface soil samples (for method see Sec. 11.5.2.1) or shallow boreholes (for method see Sec. 11.5.3.1) to define the extent of contamination. A nominal depth of 5 ft would be used for each of the additional boreholes, unless initial results indicate another depth is appropriate. Additional borehole or surface sample locations would be placed at 20-ft spacings in an outward direction from the initial sampling points. However, for planning purposes it is anticipated that no additional boreholes or surface samples will be required.

14.4. Active Container Storage Areas

14.4.1 Site Description

This grouping of SWMUs addresses active sites that have historically been used as container storage areas (SWMU 21-028). Five subunits are included. SWMU 21-028(a) is discussed with MDA T in Sec. 16.3. SWMU 21-028(b) contains satellite container storage areas within buildings and is addressed in Chapter 20 as No Further Action Units. SWMU 21-0128(c) is addressed in Chapter 18 in conjunction with building decontamination and decommissioning. The remaining two subunits, SWMUs 21-028(d) and (e), are considered here. SWMU 21-028(e) units, located within Building 210, are addressed in Chapter 20.

These sites are currently a RCRA 90-day storage area and a satellite container storage area. However, the use of these areas predates those RCRA definitions, and concerns must be addressed regarding prior spills from waste containers. These sites will be investigated to confirm that there have been no prior environmental releases.

14.4.1.1 Site History

SWMU 21-028(d) is a 90-day storage site located on a 3-ft square concrete dock on the northwest side of Building TA-21-209, shown in Fig. 14.4-1. Building 209 is currently used for high-temperature chemistry, and in this building tritium is used for research. The starting date for the use of this area is assumed to be 1965, the date construction was completed (Nyhan 1990). Materials stored on the dock are

- 55-gal. drums of lithium-deuterium waste;
- 30- and 55-gal. drums of fissionable waste (waste containing natural uranium, natural thorium, ^{235}U, ^{238}U, ^{228}Th, ^{230}Th, and ^{232}Th); and
- gas cylinders of tritium-contaminated hydrogen and argon gas (Roy F. Weston 1990).

Containers not specifically labeled as waste but stored in the same area include

- cylinders of deuterium, argon, nitrogen, helium, and compressed hydrogen;
- 55-gal. drums of oil;
- acetone, convoil 20, ethanol, ethyl alcohol; and
- various solvents stored in a chemical safety cabinet (Roy F. Weston 1990).

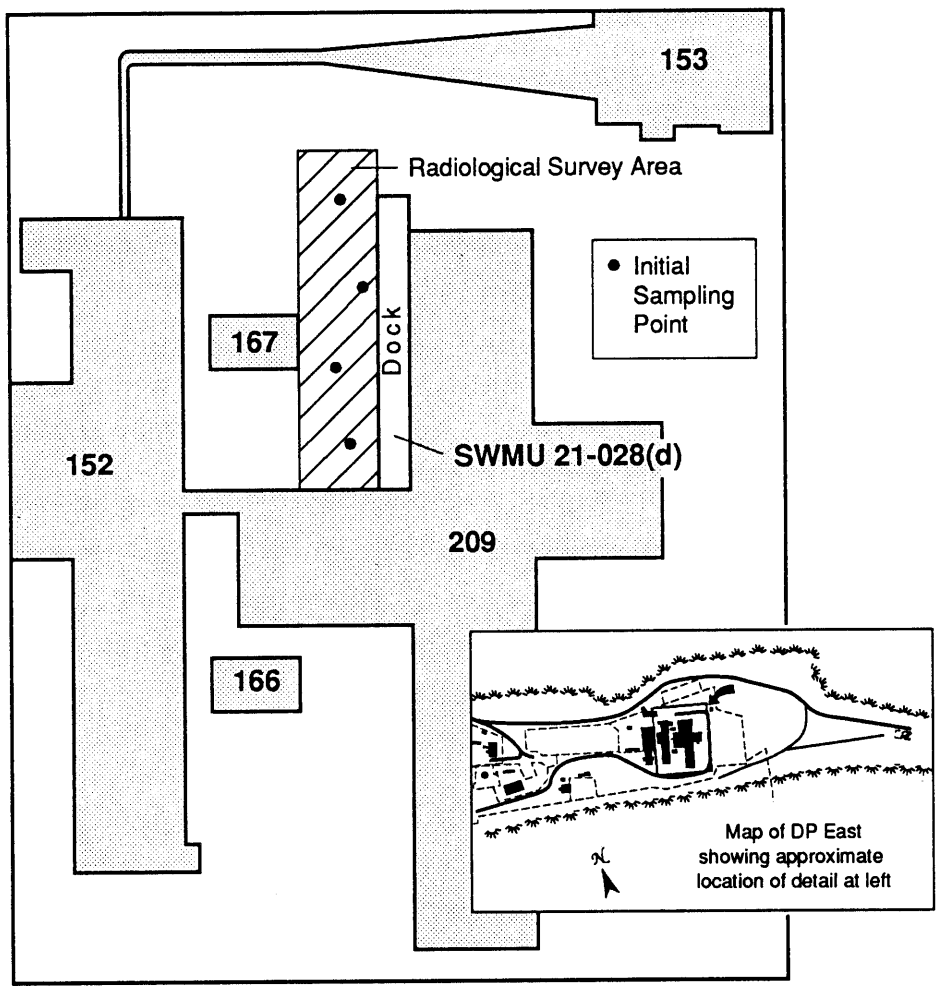


Fig. 14.4-1 Location of SWMU 21-028(d), radiological survey area, and potential sampling points. (LASL 1964)

SWMU 21-028(e) consists of three satellite container storage areas located at TA-21-210, shown in Fig. 14.4-2. The areas inside Room 128 and inside the south lab in Room 120 are addressed in Chapter 20. Only the area outside the north loading dock is considered here.

The starting date for the use of the north dock of Building TA-21-210 is assumed to be 1965, the date of construction (Nyhan 1990). The building is being used for geological core analysis (Roy F. Weston 1990) and, in the past, was listed as office space for plutonium research (LANL 1983c).

Materials reported stored on the north dock are

- alcohol, acetone, freon, acetone-contaminated wipes, and vacuum pump oil (LANL no date).

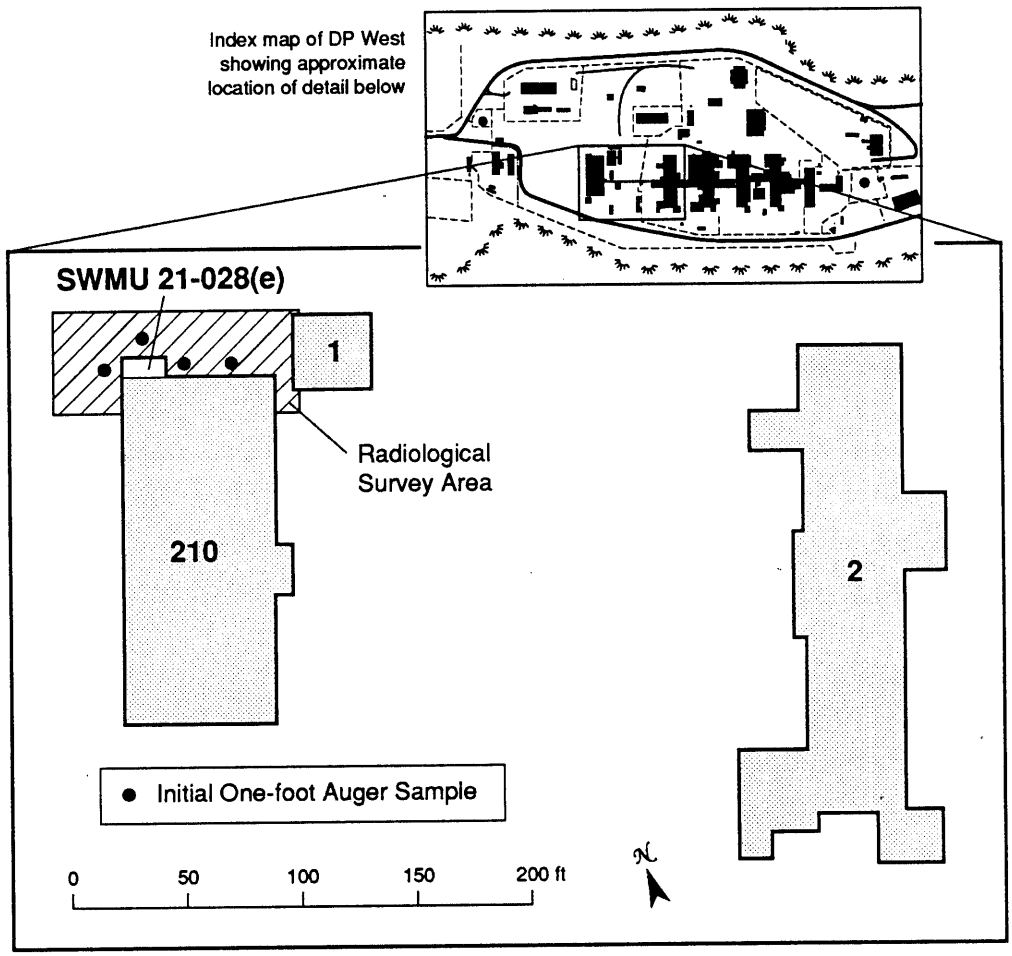


Fig. 14.4-2 Location of SWMU 21-028(e), radiological survey area, and potential sampling points. (LASL 1976)

During the TA-21 site reconnaissance walk-through, light cutting oil, dark cutting oil, sulfur-free cutting oil, and gas cylinders of helium and nitrogen were also observed on the dock. In addition, a chemical safety cabinet containing gasoline, freon, and acetone was located just east of the dock on the ground (Roy F. Weston 1990). Of the materials listed above, only the "acetone-contaminated wipes" labeling indicates waste.

14.4.1.2 Existing Information

No data exist regarding contamination on or around the docks of TA-21-209 and TA-21-210.

14.4.1.3 Source Term

There is no documentation of previous spills. No stains were noted on the docks or on the asphalt surrounding the docks (Roy F. Weston 1990). However, fissionable wastes at TA-21-209 and acetone-contaminated wipes at TA-21-210 were present. The source term would include those wastes as an indicator of the wastes that have historically been stored in those locations.

14.4.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-028. Specific data required to assess contamination at SWMUs 21-028(d) and (e), are to identify the contaminants present using Level II and III data. Contamination may be associated with the docks on the northwest side of TA-21-209 and on the north side of TA-21-210.

14.4.3 Sampling/Investigation Rationale

Spills at either loading dock would be impeded from infiltrating the soil by the widespread asphalt pavement in both areas. Only spills predating the pavement would potentially be present beneath the pavement. The date the area was paved is not known but is probably the same as the date of the construction of the buildings. The initial investigation of these areas will consist of field radiological surveys of the areas around the docks and near surface soil samples from beneath the pavement in the immediate vicinity of the docks.

A full analytical suite will be used for these samples. Data interpretation will need to take into account contaminants that may be related to the asphalt pavement rather than waste spills.

If significant contamination is encountered in any of the samples, a subsequent investigation to collect surface and subsurface soil samples may be required. The analytical suite for the subsequent sampling may be adjusted to address more specific analytes based on the initial investigation.

14.4.4 Sampling Plan

14.4.4.1 Initial Investigation

SWMU 21-028(d). A 130-ft by 20-ft area will be marked off for field radiological surveys, as shown in Fig. 14.4-1 (for method see Secs. 11.4.1.1 and 11.4.1.2). The radiological survey will

identify contamination on the pavement from spills of radioactive material and may serve as a guide for selecting locations for soil sampling.

Four near-surface soil samples (to a 6-in. depth, after the removal of asphalt and base material) will initially be taken in the surveyed area (for method see Sec. 11.5.2.1). The sample locations will be placed in the areas of the highest readings from the field radiological surveys. If high readings are not noted, the placement of the sample locations should be as in Fig. 14.4-1.

SWMU 21-028(e). Radiological contamination is not expected here; however, a confirmatory field radiological survey will be conducted in the area identified in Fig. 14.4-2 (for methods see Secs. 11.4.1.1 and 11.4.1.2). If elevated readings are noted, soil-sampling locations will be placed at those points. Otherwise, four near-surface soil samples (to a 6-in. depth, after the removal of asphalt and base material) will be taken around the north dock at the locations identified in Fig. 14.4-2 (for methods see Sec. 11.5.2.1).

The investigations at these two SWMUs will result in eight soil samples. All samples will be submitted to the analytical laboratory for a full analytical suite. Analysis requirements are identified in Table 14.4-I. If no contamination is identified, no further action will be taken at SWMUs 21-028(d) and (e).

14.4.4.2 Subsequent Investigation

If contamination is detected in the initial soil samples, shallow boreholes will be used to investigate the presence of deeper contamination (for method see Sec. 11.5.3.1). A nominal depth of 10 ft will be used. Additional near-surface samples or shallow boreholes will be placed at 20-ft spacings until the lateral extent of contamination is determined.

For planning purposes, it is assumed that no subsequent investigation will be required.

Table 14.4-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-028(D) AND (E), ACTIVE CONTAINER STORAGE AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
SWMU 21-028(d) Dock Area																																		
Radiological Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
Field Duplicate																							X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
SWMU 21-028(e) Dock Area																																		
Radiological Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in*						X	X		X												X	X	X	X		X	X	X	X				
Rinsate Blank																							X	X	X	X		X	X	X	X				
Field Blank																													X	X	X				
Trip Blank																													X						

* depth beneath removed asphalt pavement and base material

14.5. DP Tank Farm

14.5.1. Site Description

TA-21 contains a release-site identified as the DP Tank Farm, SWMU 21-029. The DP Tank Farm site is the former location of 15 fuel storage tanks and two fill stations located on the north side and at the far west end of DP Road (Zia Company 1948). All tanks and structures were decommissioned and removed in 1988. Sample analysis results indicate little potential for significant environmental contamination.

14.5.1.1. Site History

The DP Tank Farm, consisting of 15 tanks, was located near the northern edge of DP Mesa on a slope that descends from DP Road into DP Canyon. An earthen berm 4-ft high ran for 397 ft along the northern site boundary. A storm drain line extended through the northeastern corner of the earthen berm and discharged to an outfall in DP Canyon (Fig. 14-5.l).

The tank farm was active from January 1946 until February 1985 (Pan Am 1986). Tank removal was completed by July 1988. Descriptive information for the 15 tanks is presented in Table 14.5-l. There are discrepancies in the reported substances stored in the tanks. Each tank may have stored different products at different times; however, all of the tanks appear to have stored petroleum hydrocarbon products. Tank TA-21-ATF-11 may also have stored ethanol.

Of the 15 tanks that were excavated and removed in 1988, only one tank was found to have leaked. Tank TA-21-ATF-10 was found to have a leaking gasket (McInroy 1988). It is assumed that the leaking gasket was located where the gravity flow pipe met the tank. Approximately 4 cu yd of contaminated soil was removed. This tank contained diesel fuel; therefore, the contaminated soil was not considered a hazardous waste (Gunderson 1985).

14.5.1.2. Existing Information

Between November 1984 and July 1988, a number of sampling events took place. A variety of samples was obtained from different areas of the Tank Farm. Liquid and sludge samples from the tanks, as well as surface and subsurface soil samples, were taken to determine the presence of hazardous waste. The discussion below identifies general areas of potential contamination.

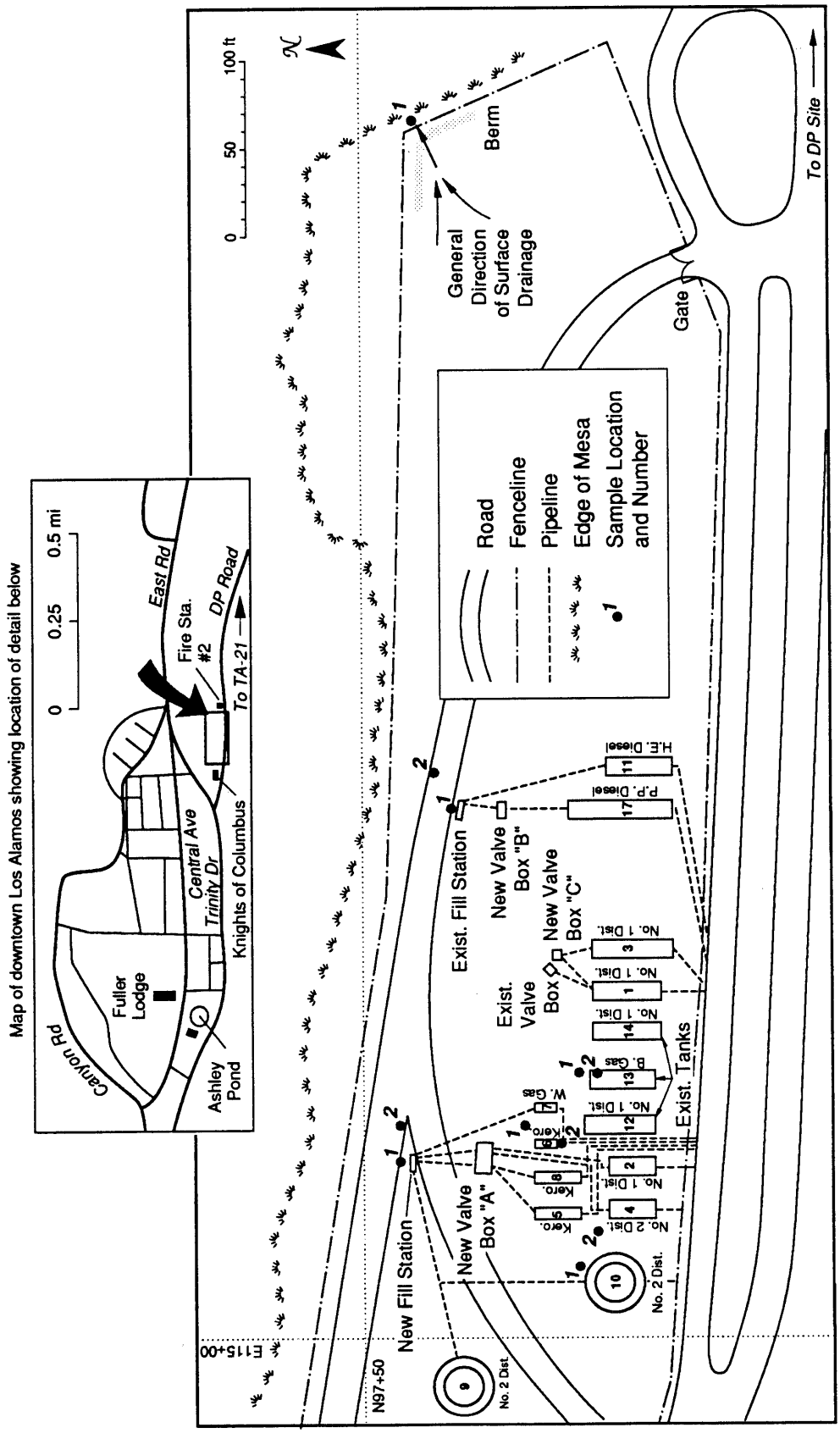


Fig. 14.5-1 Sampling locations for the field investigation of the former DP Tank Farm, SWMU 21-029 (shown as built). (Zia Company 1948)

TABLE 14.5-I
DESCRIPTION OF FORMER STORAGE TANKS AT DP TANK FARM (SWMU 21-030)[a]

Tank No.	Tank Structure Number	Capacity (gallons)	Substance Stored
1	TA-21-ATF-1	28,500 or 21,000	No. 2 fuel oil or diesel
2	TA-21-ATF-2	14,900 or 21,500 or 14,994	No. 2 fuel oil or diesel
3	TA-21-ATF-3	23,900 or 26,000 or 23,967	No. 2 fuel oil or diesel
4	TA-21-ATF-4	14,900 or 22,000 or 14,994	No. 2 fuel oil or diesel
5	TA-21-ATF-5	5100 or 5500 or 5170	kerosene or diesel
6	TA-21-ATF-6	2100 or 3000 or 2099	kerosene or gasoline
7	TA-21-ATF-7	2900 or 2500 or 2978	kerosene or leaded gasoline or gasoline
8	TA-21-ATF-8	5100 or 5500 or 5170	kerosene or diesel
9	TA-21-ATF-9	21,600 or 25,000 or 21,644	No. 2 fuel oil or diesel
10	TA-21-ATF-10	21,600 or 25,000 or 21,644	No. 2 fuel oil or diesel
11	TA-21-ATF-11	23,900 or 38,000 or 23,967	diesel or leaded gasoline or ethanol alcohol

Tank No.	Tank Structure Number	Capacity (gallons)	Substance Stored
12	TA-21-ATF-12	20,200 or 38,000 or 20,266	No. 2 fuel oil or kerosene
13	TA-21-ATF-13	24,700 or 36,000 or 24,770	gasoline or diesel
14	TA-21-ATF-14	20,200 or 26,500 or 20,226	No. 2 fuel oil or diesel
17	TA-21-ATF-17	51,000 or 49,000 or 51,015	diesel or leaded gasoline or gasoline

IT Corp. 1987; LANL 1989a; Pan Am. 1986a; and Zia Co. 1983.

Tanks

In 1985, liquid and sludge samples from the tanks were taken to determine if they must be classified as a hazardous waste (Gunderson 1985). The results indicated that the contents were mainly petroleum distillates and, in one instance, up to 50% ethyl alcohol (Fritz 1985). Analysis of the liquids for radiation showed no contamination (Montoya 1986). The information contained in this section was obtained from memos. The analytical methods, original laboratory reports, and chain of custody reports were not available.

Surface Soils

In 1984 and 1985, surface soils were obtained at the drain outfall, the fill stations, and along the southern base of the berm. A summary of the results is given in Tables 14.5-II and 14.5-III (Fritz 1985). Lead results were all less than the detection limit of 1 µg/L (LANL 1988b). Seven of eleven samples analyzed for arsenic were below the detection limit of 0.0016 mg/L. The concentration of arsenic in the remaining samples was very low and on the same order-of-magnitude as

TABLE 14.5-II
ANALYSES OF SOIL SAMPLES COLLECTED NOVEMBER 27, 1984 FROM DP ROAD TANK FARM[a]

Sample Location[b]	Lead Results (mg L^{-1})	Arsenic Uncertainty (±)	Net Total[c] Results (mg L^{-1})	Uncertainty (±)	Organic (mg g^{-1})
B-2	<0.100	0.012	0.0019	0.0005	<19.0
B-4	<0.100	0.018	<0.0016	0.0001	<19.0
B-5B	<0.100	0.021	0.0025	0.0005	20.0
B-6	<0.100	0.042	<0.0016	0.0003	<19.0
B-8	<0.100	0.044	<0.0016	0.0002	<19.0
B-9W	<0.100	0.026	<0.0016	0.0003	<19.0
B-9E	<0.100	0.019	<0.0016	0.0004	20.0
B-10	<0.100	0.060	<0.0016	0.0002	<19.0
B-10E	<0.100	0.088	0.0042	0.0005	9.5
B-11	<0.100	0.030	0.0027	0.0004	0.5
B-11B	<0.100	0.026	<0.0016	0.0003	8.5

[a]Source: Ahlquist 1985a.
[b]See source for sample location.
[c]Lower limit of detection = 0.38 mg g-1 soil, uncertainty ± 25%.

TABLE 14.5-III
ANALYSES OF BACKGROUND SOIL SAMPLES (CONTROLS) COLLECTED JANUARY 17, 1985
FOR DP ROAD TANK FARM[a]

	Lead		Arsenic	
Sample Location[b]	Results (mg L^{-1})	Uncertainty (±)	Results (µg L^{-1})	Uncertainty (±)
1	<0.100	0.004	<0.0016	0.0002
2	<0.100	0.023	0.0018	0.0003

[a]Ahlquist 1985a.
[b]See source for sample location.

the detection limit for arsenic. Net total organics were detected in five of eleven samples and were highest at the two fill stations; uncertainties were on the order of 25%. Background soil samples analyzed for lead and arsenic provided results similar to actual samples (Table 14.5-III) (Fritz 1985). The Environmental Protection Group (HSE-8) concluded that the surface soil at the DP Tank Farm was not hazardous waste (Barr 1988), and the small volumes of contaminated soil could be mixed with onsite soil rather than being trucked to the dump (Ahlquist 1985a). It is not clear whether EPA analytical methodology was followed for the soil sample analysis or if the samples were analyzed by EPA Extraction Procedure (EP) Toxicity. The original laboratory reports and chain of custody reports were not available.

Subsurface Soils

In 1985, depth sampling was suggested for any areas where tank leaks were found and in the fuel-soaked soil in the vicinity of the two fill stations (Ahlquist 1985b). No documentation of the location or depth at which the 1985 samples were collected, nor laboratory results from their analysis, can be located. However, this does indicate that fuel-saturated soils existed at the tank farm.

During the decommissioning of the DP Tank Farm in 1988, soil sampling and analyses for lead by EP Toxicity were performed in the locations of former tanks TA-21-ATF-7, TA-21-ATF-11, and TA-21-ATF-17. Twenty-two samples were collected from these three former tank locations (McInroy 1988). The results for tanks TA-21-ATF-11 and TA-21-ATF-17 showed all soil samples

contained <1 µg/L lead (LANL 1988a; LANL 1988b). Five of the six samples of soil beneath tank TA-21-ATF-7 contained 1 µg/L or less lead (LANL 1988c). The sixth soil sample beneath tank TA-21-ATF-7 showed 238 µg/L lead. However, the high value was considered to be an outlier because a duplicate sample showed <l µg/L lead (LANL 1988c). Based upon these analyses, the soil beneath the three gasoline tanks was considered to be free of contamination. The original laboratory reports and chain of custody reports are not available.

In June 1988, soil sampling of the fill station areas was initiated. Soils were excavated, sampled, and analyzed for lead and BTX (benzene, toluene, o-xylene, and m-xylene). It is not clear whether EPA analytical methodology was followed for sample analysis, and the original laboratory reports and chain of custody reports are not available. All lead analyses showed concentrations <2 µg/L lead (LANL 1988d). The BTX results (Begay 1988a) from this round of sampling are presented in Table 14.5-IV. Elevated concentrations of BTX were documented in excavated soil. However, concentrations of BTX in soil remaining after excavation were one to two orders-of-magnitude lower. Surrogate recoveries for these BTX analyses ranged from 0 to 58%. The area was considered clean and was backfilled.

14.5.1.3. Source Term

Number 2 fuel oil, diesel, kerosene, gasoline, leaded gasoline, ethanol, and their hazardous constituents (such as lead and benzene) are considered to be potential contaminants in soil at the former DP Tank Farm.

14.5.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-029. Specific data required to assess contamination at SWMU 21-029 include the following:

1. Determine the location of the former tank farm structures. This area has been decontaminated and decommissioned, and obvious locations of former structures no longer exist.

2. Identify the contaminants present using Level II and III data. Prior sampling may have addressed the major locations and contaminants of concern at the DP Tank Farm. However, available documentation is considered to be insufficient to support a recommendation of no further action for this site.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by subsurface soil sampling and Level III analyses.

Table 14.5-IV
BTX Analyses of Soil Samples Collected June 16, 1988 from the East and West Fill Stations at DP Road Tank Farm[a]

Sample Description	Sample No.	% Surogate Recovery	Analyte Concentration ($\mu g\ kg^{-1}$) Benzene	Toluene	O-xylene	M-xylene
Soil Removed from West Dock	88.04804	32	4.5	47.2	16.0	39.5
	88.04805	0	26.1	1127.5	703.0	5.1
Soil Removed from East Dock	88.04806	58	12.7	340.1	156.4	36.1
	88.04807	43	9.1	73.5	12.7	33.8
	88.04808	0	669.7	<MDL	1928.3	135.9
Soil Remaining in Excavation (West Dock)	88.04799	25	<MDL	22.5	2.18	12.7
	88.04800	32	<MDL	29.9	25.4	23.2
Soil Remaining in Excavation (East Dock)	88.04801	30	<MDL	31.8	21.4	24.0
	88.04802	30	2.5	26.8	1.5	12.5
	88.04803	28	3.0	27.3	2.9	13.9

[a]Source: Begay 1988a.

MDLs (minimum detectable limit) for analytes are 5.0, 45.0, 3.0, and 10.0 $\mu g\ kg^{-1}$ for benzene, toluene, o-xylene, and m-xylene, respectively.

14.5.3. Sampling/Investigation Rationale

A single phase of investigation is expected to be sufficient for SWMU 21-029, although an approach for a subsequent investigation is identified in case it is needed. The investigation focuses on identification of the former structures where contamination was known to exist. Boreholes and surface samples will be taken to confirm the presence or absence of the compounds identified from previous sampling and analysis.

A possible subsequent investigation, which is not expected to be needed, would include additional boreholes or surface samples to identify migration of residual contamination.

The samples taken during the initial investigation will be submitted for VOAs, semivolatiles, metals analysis (SW-6010 and TCLP), and ethanol. This analytical suite was selected to address the following specific contaminants. VOAs were selected because benzene, toluene, ethyl benzene, and xylene are common contaminants of gasoline and diesel and are best characterized with VOA analysis. TCLP metals for lead and SW-6010 for total metals are being performed because tetraethyl lead (or TEL) was a common contaminant of leaded gasoline, which was stored in some of the tanks. Lead is considered a RCRA-regulated metal and for that reason TCLP analysis is appropriate. Arsenic is listed in the SW-6010 analysis and was included in earlier LANL analysis. Ethanol was identified as a contaminant of a tank liquid sample. Ethanol was not included in the volatile analyte list and is added as an additional required analysis. Semivolatiles are selected because some common gasoline contaminants are semivolatiles.

14.5.4. Sampling Plan

14.5.4.1. Initial Investigation

The former structures that are included in the initial investigation are: Tank TA-21-ATF-6 for confirmatory analyses because this tank may have held leaded gasoline; Tank TA-21-ATF-10, which had a leaking gasket; Tank TA-21-ATF-13 for confirmatory analyses because this tank may have held leaded gasoline; the east and west fill stations, which exhibited fuel-soaked soil during the course of decontamination and decommissioning; and the drain outfall. These former locations will be surveyed and marked in the field based on LANL Drawing #Z-252 (ZIA company 1948).

Tanks/Fill Stations. Two shallow boreholes will be drilled at each of the three tank and two fill locations (for method see Sec. 11.5.3.1). The first borehole will be placed 5 ft downgradient

(north) of the furthest downgradient point of the former structure. The second may be randomly placed within the area formerly occupied by the structure. These locations are roughly indicated in Fig. 14.5-1. The nominal depth of these boreholes is 10 ft. Each borehole will result in four samples, for a total of 40 to be collected. All samples that screen positive for volatile organic compounds (for method see Sec. 11.6.2.1 and 11.6.2.2) will be submitted for analytical laboratory analysis. Thirty percent of the remaining samples will also be submitted. The field screening and analytical requirements are shown in Table 14.5-V. If no contamination is identified, no further action will be taken at the tanks/fill stations.

Drain Outfall. Two surface soil samples will be taken at the drain outfall (see Sec. 11.5.2.1). The first surface soil sample will be placed 5 ft downgradient (northeast) of the release point of the drain outfall. The second may be randomly placed within the next 20 ft of the drainage pattern. These two locations are roughly indicated in Fig. 14.5-1. Both samples will be submitted for laboratory analysis as indicated in Table 14.5.V.

Numbers of Samples/Sample Analysis. For planning purposes it is assumed that an initial total of 40 samples will be taken for the tanks/fill stations and 2 samples for the drain outfall. Radiological screening will be performed; however, radionuclide contamination is not anticipated and is not expected to produce any samples. The analytical and screening requirements for the initial investigation of SWMU 21-029 are shown in Table 14.5-V. If no contamination is identified, no further action will be taken at the drain outfall.

14.5.4.2 Subsequent Investigation

Additional shallow boreholes and/or surface sample locations may be required if significant contamination is found during field screening and/or analysis.

Tanks and Fill Stations. An additional shallow borehole will be drilled 10 ft downgradient from each contaminated borehole. These will be drilled to a nominal depth of 10 ft (for method see Sec. 11.5.3.1).

Drain Outfall. Additional surface soil samples (for method see Sec. 11.5.2.1) will be taken 10 ft in each of four directions from each contaminated sample.

For planning purposes, it is assumed that no additional sampling and analysis are required.

Table 14.5-V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
East Fill Station							X																										
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X																
Field Duplicate																						E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																
West Fill Station							X																										
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X		X																
Rinsate Blank																						X						X	X	X		X		X
Field Blank																												X	X	X		X		X
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
Drain Outfall							X																										
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X			X	X		X					X						X	X	X		X		X
	2	0.0 – 6.0 in						X	X		X			X	X		X					X						X	X	X		X		X
Tank AFT-6							X																										

Table 14.5–V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis										
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X		X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
Field Duplicate																					E						E	E	E		E		E
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X																
Rinsate Blank																					X						X	X	X		X		X
Field Blank																											X	X	X		X		X
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																
Tank AFT-10							X																										
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																
Tank AFT-12							X																										
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X		X				E						E	E	E		E		E
Field Duplicate																					E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X																

Table 14.5-V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X																	
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X																	
		7.5 – 10.0 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
Rinsate Blank																						X						X	X	X		X		X
Field Blank																												X	X	X		X		X
Trip Blank																												X						

14.6. Inactive Container Storage Areas

14.6.1. Site Description

This section describes the field investigations for an inactive container storage area located at TA-21 [SWMU 21-002(b)] (Fig. 14.6-1). SWMU 21-002(a) addresses sites that were used in the past for container storage but which no longer exist or are no longer used for that purpose. This SWMU is discussed in Chapter 18, SWMUs for Coordination with Building D&D Description and Sampling Plan.

14.6.1.1. Site History

SWMU 21-002(b) includes a former drum storage structure, TA-21-38, which was located southeast of Building TA-21-31 (LANL 1990). TA-21-38 was a 10-ft high, 15-ft by 36-ft wood frame structure built in August 1945 and decommissioned in February 1966 (LASL no date). No contaminated soil was removed nor was any clean backfill brought into the area of the building following D&D. TA-21-38 had a roof and was enclosed on three sides with tin siding and is believed to have had a concrete floor, although this has not been verified. The north side of the structure was open (Nyhan 1990). Upright 55-gal. drums were stored inside TA-21-38 and were also stored immediately to the southeast of the building on the ground (LANL 1990a). The contents of these drums are not known.

14.6.1.2. Existing Information

No data exist regarding contamination in the area of the former drum storage building, TA-21-38.

14.6.1.3. Source Term

The contaminant source term represented by the drums stored in and around TA-21-38 is not known.

14.6.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-002(b). Specific data required to assess contamination at SWMU 21-002(b) include the following:

1. Determine the location of former building, TA-21-38.

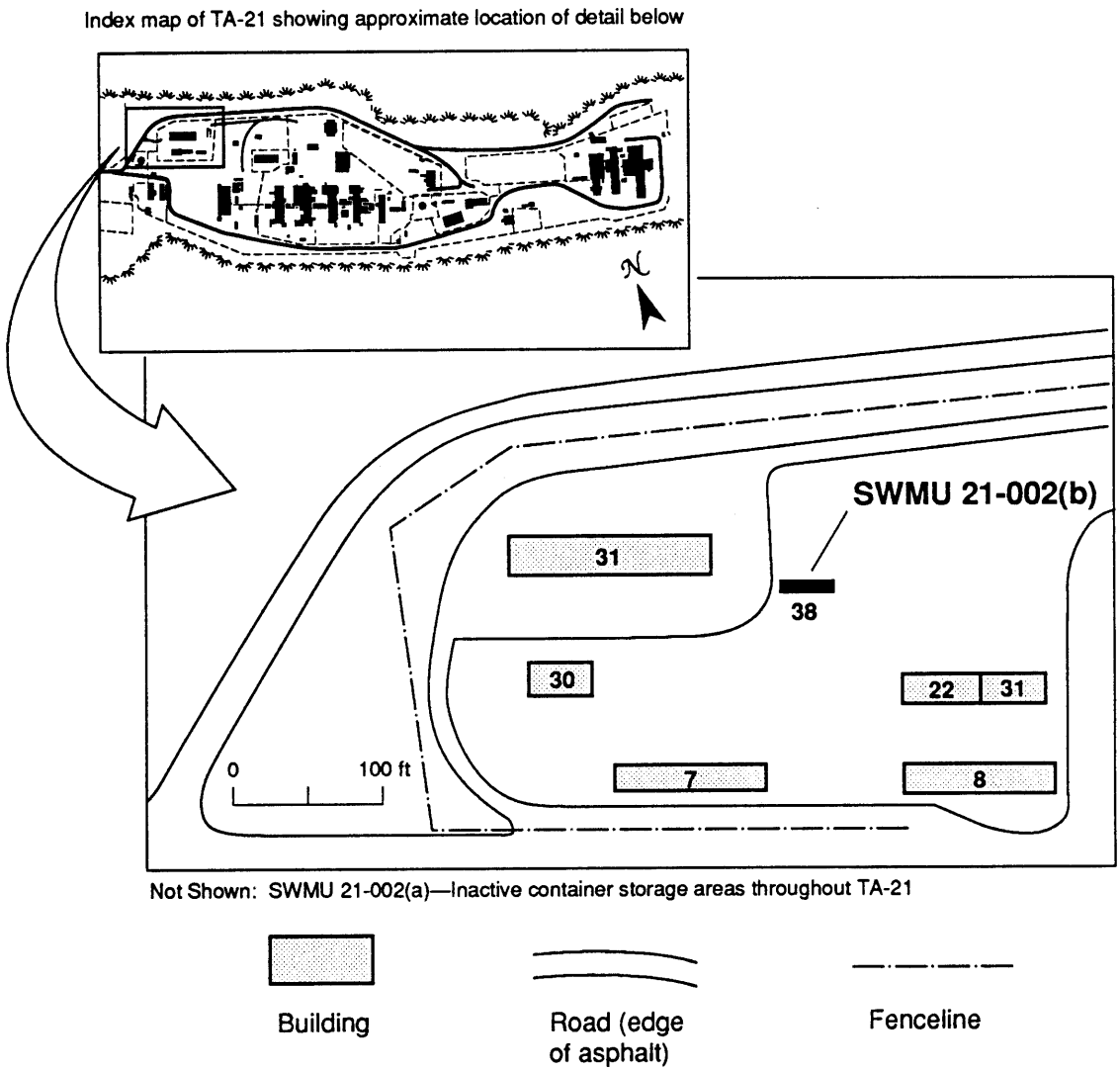


Fig. 14.6-1 Location of the inactive container storage area SWMU 21-002(b), TA-21-38. (LASL 1964a)

2. Identify the contaminants present using Level II and III data. Drums, gas cylinders, and other containers were stored throughout TA-21, and some were reported to have leaked.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface soil sampling and Level III analysis.

14.6.3. Sampling/Investigation rationale

An initial and subsequent investigation is planned for SWMU 21-002(b). No information is available regarding actual spills from stored containers or their probable contaminants; therefore, the initial investigation is intended to identify the presence of contaminants in the most probable areas. Surface soil samples will be taken at eight locations covering the area of the former building and outside storage. Because specific contaminant species cannot be identified at this time, a full analytical suite will be specified for these samples.

If contaminants relating to the storage operations are identified in the initial samples, the sampling program will be expanded to include subsurface soils and surface sampling of a wider area. The analytical suite may be focused more closely to specific analytes in these subsequent investigations, based on results from initial samples.

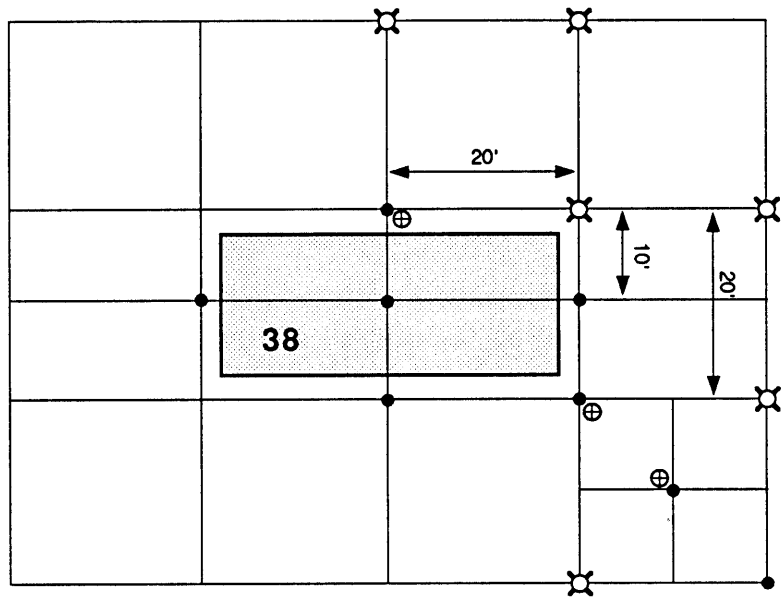
14.6.4. Sampling Plan

14.6.4.1 Initial Investigation

The former location of TA-21-38 will be determined from a LANL engineering drawing (LASL 1964) and will be surveyed and marked in the field.

Five surface sampling locations will be placed in the area of the former TA-21-38 and three in the outside storage area (for method see Sec. 11.5.2.1, Surface Soil Samples). Fig. 14.6-2 shows the eight initial sampling locations. One is located in the center of the former location of TA-21-38. Additional locations are placed 10 ft north and south, and 20 ft east and west of the central location. These four locations, at roughly the edges of the former structure, will detect contamination that may have been washed onto the surrounding soil. Three sampling locations are planned southeast of the structure's former location to detect contamination that may have resulted from the storage of drums outside on the ground.

The field screening and sample analysis requirements for the initial phase of investigations at SWMU 21-002(b) are shown in Table 14.6-I. If no contamination is identified, no further action will be taken at SWMU 21-002(b).



- ● Initial Surface Soil Sample
- ⌘ Additional Surface Soil Sample (Example)
- ⊕ Borehole Location (Example)

Fig. 14.6-2 Sampling locations at SWMU 21-002(b), TA-21-83.

14.6.4.2 Subsequent Investigations

If contaminants are identified in the initial samples, contaminants and their concentrations will be compared with results of the general surface sampling described for the TA-21 OU in Chapter 12. If the contaminants present and their concentrations are not significantly different, this contamination will be addressed with general OU-wide surface contamination. However, if contaminants at this SWMU are different, the subsequent investigation will include additional surface soil samples over a wider area to define the extent of contamination and shallow boreholes to assess the depth of contamination. Based on initial investigation results, analytical requirements for the subsequent investigation may be limited to a set of indicator contaminants. Additional surface soil samples will be taken at 20-ft spacings (for method see Sec. 11.5.2.1, Surface Soil Samples) until the extent of contamination is determined. Shallow boreholes will be sampled in close proximity to contaminated surface sampling locations to determine the depth of contaminant penetration (for method see Sec. 11.5.3.1, Shallow Boreholes). A nominal depth of 5 ft will be used for each of the boreholes.

For planning purposes, it is assumed that no more than three boreholes (resulting in six samples) and six additional surface soil samples will be required to define the vertical and lateral extent of contamination. Example locations for the additional surface soil samples and the boreholes are shown in Fig. 14.6-2. In the absence of any knowledge of potential contaminants, it is assumed for planning purposes that a full analytical suite will be specified for subsequent investigation samples, as shown in Table 14.6-II. Field screening will be used as appropriate in the subsequent investigation to minimize analytical laboratory analysis.

Table 14.6-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-002(B), DRUM STORAGE AREA.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
TA-21-38																																
Surface Soil Samples	1	0.0 - 6.0 in					X	X	X		X										X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
Field Duplicate																					X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
Outside Storage Area																																
	6	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
	7	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
	8	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
Rinsate Blank																					X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
Trip Blank																											X						

Table 14.6–II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-002(B), DRUM STORAGE AREA.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
TA-21-38 and Outside Storage Location																																	
Shallow Boreholes	1	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		2.5 – 5.0 ft																															
	2	0.0 – 2.5 ft																															
		2.5 – 5.0 ft																															
	3	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		2.5 – 5.0 ft																															
Surface Soil Samples	1	0.0 – 6.0 in																															
	2	0.0 – 6.0 in						X	X		X			X	X	X	X					X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
	3	0.0 – 6.0 in						X	X		X			X	X	X	X																
	4	0.0 – 6.0 in						X	X		X			X	X	X	X																
	5	0.0 – 6.0 in						X	X		X			X	X	X	X																
	6	0.0 – 6.0 in						X	X		X			X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

14.7. SURFACE DISPOSAL AREAS

14.7.1. Site Description

This section describes the field investigations for six currently inactive surface disposal areas, SWMUs 21-013(b)–(g). This SWMU grouping addresses areas that were, or may have been, used in the past for surface disposal of various materials.

They are located predominantly in the western portion of TA-21 near MDAs B and V, and near Building TA-21-61. Figure 14.7-1 (LANL 1983a) shows the locations of SWMUs 21-013(b), (d), (e), and (g). Figure 14.7-2 (LANL 1983a) shows the locations of SWMUs 21-013(c) and (f).

A seventh surface disposal area, SWMU 21-013(a), is included in Sec. 14.8 as an aggregate to SWMU 21-026, sewage treatment plant.

14.7.1.1. Site History

SWMU 21-013(b) is located on the southern edge of DP Mesa, southwest of MDA V. This area contains concrete building debris, which was pushed into Los Alamos Canyon. This debris was from the 1965 demolition of Building TA-21-33 (L.O. 3196-21, W.O. 5-417-035) (LANL 1983c). Building TA-21-33 was a wooden structure, which was found to be contaminated with plutonium dust (Romero 1963) and possibly perchloric acid (Romero 1965). The wooden building was burned after being moved to MDA G, but all structural concrete was to be disposed of in Los Alamos Canyon (LASL 1965). It is not known if other materials were disposed of at SWMU 21-013(b).

SWMU 21-013(c) is located northeast of the High Temperature Chemistry Building, TA-21-209. The area is 85 ft from the DP East fence, where it makes right angles east of MDA U, and 122 ft from LASL Marker KI 1968, just south of the road to the sanitary treatment plant. This potential surface disposal area was found during the 1988 ER Program site visit. The area was disturbed and appeared to contain building debris (LANL 1990a). It is not known when materials were disposed of at SWMU 21-013(c).

SWMU 21-013(d) is a potential disposal area located north of the old Laundry Building TA-21-20 and north of DP Road. This area is also referred to as the "cold dump" and is believed to have been a disposal site for nonradioactive waste chemicals and/or materials. According to the LANL/Pan Am History Book (LASL no date), the Safety Training Building TA-21-45 was relocated

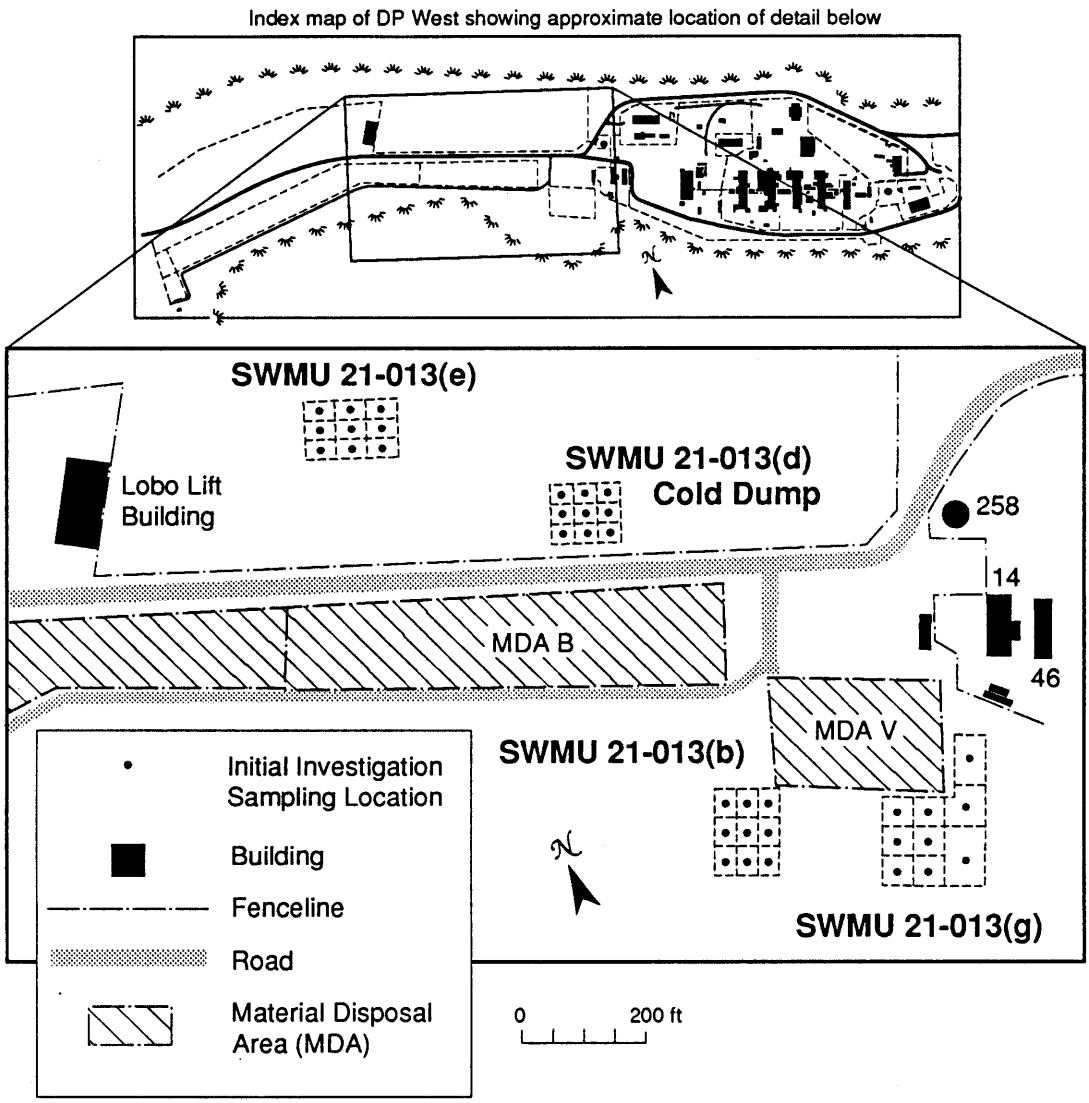


Fig. 14.7-1 Surface disposal areas SWMUs 21-013(b), (d), (e), and (g) locations and sampling grids. (LANL 1983a)

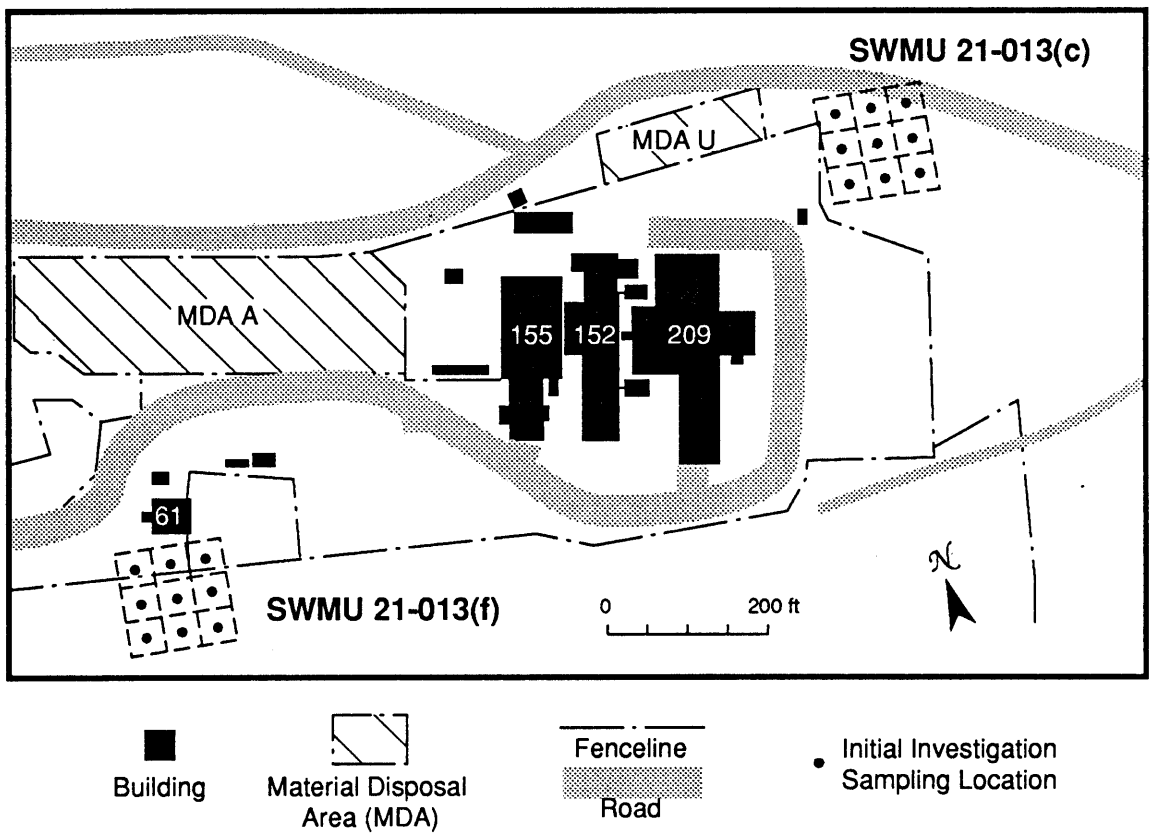


Fig. 14.7-2 Surface disposal areas SWMUs 21-013(c) and (f) locations and sampling grids. (LANL 1983a)

to this area in 1947 and subsequently removed in 1954. In September 1955, a fenced area existed in the approximate location of former Building TA-21-45 (LASL 1955), which could have enclosed a pit or trench. Currently, the only structure remaining near the SWMU 21-013(d) location is septic tank structure TA-21-124 (abandoned but not removed in 1966), which may be used to locate this surface disposal area. This area may have been scraped and the "cold dump" removed (LANL 1990a). There are no records available that indicate the types, quantities, or dates in which wastes may have been disposed of at SWMU 21-013(d).

SWMU 21-013(e) has been used to dispose of construction debris (LANL 1990a). Such debris, including soil piles and drain pipes were observed during the 1988 ER Program site visit at this location (Nyhan 1990a). Little is known about this site except that it is located northwest of the cold dump [SWMU 21-013(d)], 308 ft east of the fence adjacent to the Lobo Lift building and 175 ft north of the fence along DP Road. It is not known when materials were disposed of at SWMU 21-013(e).

SWMU 21-013(f) may not exist. Identification of this SWMU is based wholly on photographic evidence (LANL 1990a). A 1949 aerial photograph (LASL 1949, No. 12241) of the area currently occupied by Building TA-21-61, which is still in existence, showed a series of mounds on the mesa top. A photograph taken in 1950 (LASL 1950, No. 15925) shows that the mounds had been removed and replaced by Building TA-21-61. Because construction activities were not underway on TA-21-61 until July 11, 1950 (LANL no date a), these mounds cannot be explained by foundation preparation activities for this building. However, septic tank structure TA-21-56 and Laboratory Building TA-21-59, which are nearby, were constructed in May 1945 and July 1945, respectively; and construction activities on these two structures could have resulted in the "mounds" observed in the 1949 photo. It is not known if or when materials were disposed of at SWMU 21-013(f).

SWMU 21-013(g) consists of two drain lines (along with other building debris), which were observed during an ER Program site visit (Nyhan 1990). The area is located immediately south of MDA V. The two drain lines were originally believed to be associated with drainage from MDA V. A subsequent investigation determined that the two drain lines are only sections of discarded pipe and are not associated with MDA V as originally supposed (LANL 1990a). The origin of the two drain lines and other debris and date in which they were disposed of at SWMU 21-013(g) are not known.

14.7.1.2. Existing Information

SWMUs 21-013(c), (e), (f), and (g). No data exist regarding potential contaminants at these surface disposal areas.

SWMU 21-013(b) consists of concrete building debris from demolition of Building TA-21-33. A contamination survey of the building interior was conducted in 1963, and various surfaces were found to be contaminated with plutonium dust. Surface counts ranged from 1000 c/m (counts per minute) to 20,000 c/m alpha (Romero 1963). Another report (Romero 1965) states that perchloric acid contamination may have existed in the building interior exhaust hoods.

SWMU 21-013(d), the "cold dump," has been investigated by a geophysical survey and a biased subsurface soil gas sampling program. Interpretation of the geophysical data indicated that there was no geophysical evidence indicating the presence of trenches or buried waste (LANL 1989). Judgmental subsurface soil gas sampling (for volatile organic compounds only) was performed at eight locations at 1.7- to 4-ft depths. LANL (1989) states that 1,1,1-trichloroethane was identified in one sample, as does the SWMU Report (LANL 1990). However, a re-evaluation of the soil gas data collected by the U.S. DOE (LANL 1989) from this area has determined that the presence of 1,1,1-trichloroethane is the result of its residual contamination within the sampling equipment. Therefore, whether 1,1,1-trichloroethane is present is questionable.

The ground surface at SWMU 21-013(d) was also screened for radioactivity and for organic vapors. No radioactivity in excess of natural background radiation (cited as approximately 26-36 μR/h) was detected. Organic vapors were screened with a photoionization detector. Organic vapor concentrations ranged from 1-7 units (LANL 1989).

14.7.1.3. Source Term

SWMUs 21-013(c), (e), (f), and (g). No previous sampling data exist regarding potential contaminants at these surface disposal areas. Therefore, the contaminant source term is not known.

SWMU 21-013(d). Re-evaluation of the subsurface soil gas sampling data has eliminated concern for 1,1,1-trichloroethane. Field screening at SWMU 21-013(d) did not indicate the presence of radioactive or organic vapor contaminants. Therefore, the contaminant source term for SWMU is also not known.

SWMU 21-013(b). The concrete building debris from Building TA-21-33 may be contaminated with plutonium and possible perchloric acid. Contamination of the area could have occurred as a

consequence of operations, leakage from either of the two underground waste lines, or during the operation of cutting the building into two sections prior to its offsite burning and disposal.

14.7.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-013(b-g). Specific data required to assess contamination at SWMUs 21-013(b)–(g) include the following:

1. Identify the contaminants present using Level II and III data. The contamination of surface disposal areas is unknown, with the possible exception of concrete debris from Building TA-21-33. The debris may be contaminated with plutonium and perchloric acid.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface soil and debris sampling and Level III analysis.

14.7.3. Sampling/Investigation Rationale

14.7.3.1. Initial Investigation

SWMUs 21-013(c), (d), and (e). These SWMUs are accessible to investigation using vehicle-mounted equipment. The initial investigation is intended to identify the presence of contamination in the soil and to determine the depth of the soil and debris. Field radiation surveys (at all three SWMUs) and organic vapor surveys [at SWMU 21-013(d) only] will be used to identify areas of gross contamination. Surface soil samples and shallow borehole core samples will be collected at grid locations and at locations identified by the field surveys. The thickness of the soil layer overlying the tuff will be determined from the borehole cores.

Field screening of the ground surface for organic vapors will initially be performed only at SWMU 21-013(d). This area is presently the only one in which historical information indicates potential disposal of waste chemicals. Other surface disposal areas may be screened for organic vapors if stained areas are visible and if field screening samples detect above-background level concentrations.

SWMUs 21-013(b), (f), and (g). These SWMUs are inaccessible to motorized equipment because they are physically located over, or on the edge of, Los Alamos Canyon. Investigation of these areas will be accomplished with hand-operated sampling equipment. The initial investigation is intended to identify the presence of contamination within the soil and to determine the

thickness of the soil layer overlying the tuff. If contamination is identified within the soil layer sampled, it will be assumed that the entire soil column at specific locations might be contaminated.

A field survey will be conducted at each surface disposal area to screen the surface for radioactivity to define any locations of gross contamination. Surface and manually collected shallow subsurface soil samples will be collected at grid locations and at locations exhibiting above-background level radioactivity.

14.7.3.2. Subsequent Investigation

The need for a subsequent sampling program will be based upon analysis of data from the initial investigation. If implemented, a subsequent sampling program would focus on collection of additional surface and subsurface samples to determine the vertical and lateral extent of contamination. The analytical suite for a subsequent investigation may be focused to specific analytes based on results from the initial investigation.

14.7.4. Sampling Plan

14.7.4.1. Initial Investigation

General Requirements: The SWMU locations will be determined using Fig. 14.7-1 [SWMUs 21-013(b), (d), (e), and (g)], and Fig. 14.7-2 [SWMUs 21-013(c) and (f)], and visual identification in the field. The visual boundaries of each area will be staked and then gridded into nine approximately equal-sized segments. The center of each grid will also be staked as indicated in Figs. 14.6-1 and 14.7-2.

A field survey will be conducted at each area to define locations of gross radioactive contamination (for method see Sec. 11.4.1.2). Organic vapor surface screening will also be performed at SWMU 21-013(d) (for method see Secs. 11.6.2.1 and Sec. 11.6.2.2). It is anticipated that above-background level radioactivity or organic vapor concentrations will identify no more than three additional sampling locations at any of the surface disposal areas.

The center of nine grid segments, in addition to any locations identified during the field survey, will be sampled as indicated in Figs. 14.7-1 and 14.7-2 (LANL 1983a). A surface soil sample (for method see Sec. 11.5.2.1.) will be taken at each location. This will result in a maximum of 12 samples per SWMU (72 total, 18 to analytical laboratory).

All samples will be field-screened and processed in the field laboratory. Twenty-five percent of the samples will be submitted to an analytical laboratory for additional analyses. Because the purpose of this investigation is largely to identify the presence of contaminantns, the 25% selected should include all that have an indication of contamination based on field laboratory measurements. Because no firm information is available to define the contaminants that may be present, the samples will be subjected to a full analytical suite. The field survey, field screening, and sample analysis requirements for the initial investigation are shown in Table 14.7-I. If contaminants are identified, samples may be reanalyzed for asbestos, because some of these surface disposal areas may contain building rubble. If no contamination is identified, no further action will be taken at SWMUs 21-013(b-g).

SWMUs 21-013(c), (d), and (e). Shallow boreholes will be used to sample subsurface soil at all grid locations and locations identified by the field surveys (for method see Sec. 11.5.3.1). The nominal borehole depth is 7.5 ft but may be stopped shallower once native tuff has been penetrated to 2 to 3 ft. It is assumed that no more than three subsurface samples will be collected at any location, for 36 samples per SWMU (108 total, 27 to analytical laboratory). This investigation will determine the depth of soil and debris in the disposal area and will allow evaluation of the presence of contaminants in the underlying tuff.

SWMUs 21-013(b), (f), and (g) Near-surface soil samples will be collected at all grid locations and locations identified by the field surveys (for method see Sec. 11.5.2.4). This sampling will be accomplished by modifying the method, so that near surface samples will be collected only from the 12- to 18-in. and 24- to 30-in. intervals. Certain sampling intervals can be omitted because wastes should be mixed and dispersed if this was a disposal area. This will minimize the number of samples taken for analysis. This modification will result in two near-surface samples collected at each location, for 18 per SWMU (54 total, 14 to analytical laboratory). Again, 25% of the samples will be sent to the analytical laboratory for analysis.

The maximum depth sampled will be approximately 2.5 ft and may be shallower if native tuff is encountered. If the tuff has not been encountered at the maximum depth sampled at any or all locations, its depth will be measure using a narrow steel rod driven downward until significant resistance is encountered. The indication that tuff has been encountered will be based on field judgement. The total depth from the surface to the tuff will be measured. This depth will allow calculation of the volume of potentially contaminated material. If contamination is found in the initial investigation, this information will be useful for planning subsequent investigations. This investigation will not provide information on any contamination of the underlying tuff.

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
21-013(c)							X																												
Radiological Survey				X	X																														
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																		
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																		
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																		
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
Surface Soil Sample	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
Field Duplicate																						E	E	E	E		E	E	E	E					
Shallow Borehole	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																		
Surface Soil Sample	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis										
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Shallow Borehole	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Rinsate Blank																					X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
Shallow Borehole	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
Surface Soil Sample	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
Shallow Borehole	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
21-013(d)							X																										
Radiological Survey				X	X																												
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Trip Blank																												X					
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
Surface Soil Sample	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Shallow Borehole	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
Shallow Borehole	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
Surface Soil Sample	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Shallow Borehole	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X	X			

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Field Blank																												X	X	X				
Shallow Borehole	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
21-013(e)							X																										
Radiological Survey				X	X																												
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Field Duplicate																						E	E	E	E		E	E	E	E				
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																

Table 14.7–I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21–013(B) – (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gross Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
																					X	X	X	X		X	X	X	X				
Rinsate Blank																											X	X	X				
Field Blank																											X						
Trip Blank																																	
Surface Soil Sample	2	0.0 – 6.0 in																															
Shallow Borehole	2	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	3	0.0 – 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	3	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
Field Duplicate																					E	E	E	E		E	E	E	E				
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	4	0.0 – 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	4	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	5	0.0 – 6.0 in						X	X		X		X	X	X	X	X																
Shallow Borehole	5	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E				
Surface Soil Sample	6	0.0 – 6.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
Shallow Borehole	6	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X																
Surface Soil Sample	7	0.0 – 6.0 in						X	X		X		X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Shallow Borehole	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
21-013(b)							X																											
Radiological Survey				X	X																													
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E			
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X															
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E			
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X															
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X								E	E	E	E		E	E	E	E			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X				X	X	X	X		X	X	X	X			
Rinsate Blank																											X	X	X			
Field Blank																																
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Field Duplicate																						E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
21-013(f)							X																										
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
								X	X		X		X	X	X	X	X																
Near Surface Soil (bias)	2	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X																				
		18.0 - 24.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil (bias)	3	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X																				
		18.0 - 24.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	1	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X																				
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X		X																				
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis										
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Field Duplicate																																		
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
																													X					
Trip Blank							X																											
21-013(g)				X	X																													
Radiological Survey																																		
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																	

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
Near Surface Soil	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
Near Surface Soil	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E				
Field Duplicate																					E	E	E	E		E	E	E	E				
Rinsate Blank																					X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Trip Blank																												X					

14.7.4.2. Subsequent Investigation

If contaminants are identified from the initial investigation, subsequent sampling programs at any of these SWMUs would focus on collection of surface and subsurface samples to determine the vertical and lateral extent of contamination. Additional sampling locations will be established at 20-ft spacings in the direction data are required. Surface and shallow subsurface sampling will be conducted according to the methods identified above, until the extent of contamination is determined.

For planning purposes, it is assumed that no more than four additional locations will be sampled and that this is required at only two of the SWMUs. Based on results from the initial investigation, analytical requirements may be limited to a specific set of indicator contaminants. Additionally, initial samples may be analyzed for asbestos if other contamination is found. For planning purposes it is assumed that the same analytical scheme used in the initial investigation with the addition of asbestos will be used here. A maximum of four additional samples at four locations at each of two SWMUs is assumed for this investigation. (28 samples, 7 to analytical laboratory).

Table 14.7-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-013(B) - (G) SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
SWMU 21-013(c),(d), and (e)																																		
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
Surface Soil Sample	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E			E	
Field Duplicate																						E	E	E	E		E	E	E	E			E	
Field Triplicate																						E	E	E	E		E	E	E	E			E	
Shallow Borehole	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
SWMU 21-013(b),(f), and (g)																																		
Near Surface Soil	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E			E	
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																	

Table 14.7-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-013(B) - (G) SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X															
Rinsate Blank																					X	X	X	X		X	X	X	X			X	
Field Blank																											X	X	X				
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E			E	
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X															
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X				E	E	E	E		E	E	E	E			E	
Field Duplicate																					E	E	E	E		E	E	E	E			E	
Field Triplicate																					E	E	E	E		E	E	E	E			E	
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X															
		6.0 - 12.0 in						X	X		X		X																			
		12.0 - 18.0 in						X	X		X		X	X	X	X	X															
		18.0 - 24.0 in						X	X		X		X																			
		24.0 - 30.0 in						X	X		X		X	X	X	X	X															
Trip Blank																											X					

14.8 SEWAGE TREATMENT PLANT

14.8.1 Site Description

This chapter describes the field activities for the sewage treatment plant [SWMU 21-026(a)-(c)] and a surface disposal area [SWMU 21-013(a)], both located at the eastern end of DP Mesa at TA-21 (Fig. 14.8-1). This grouping of SWMUs addresses sites that are still in use and a site that is inactive and may have previously treated wastewater from TA-21 containing radiological and inorganic contamination.

14.8.1.1 Site History

SWMU 21-026(a)–(c) includes TA-21-227 sewage treatment plant, TA-21-230 sand filter/sludge drying beds, and TA-21-348 dosing siphon chamber (Fig. 14.8-2).

This sewage treatment plant replaced septic tank/filter field and septic tank/surface discharge systems throughout TA-21 including those which served TA-21-1, TA-21-3, TA-21-4, TA-21-5, TA-21-14, TA-21-30, TA-21-31, TA-21-61, TA-21-152, TA-21-155, TA-21-209, TA-21-210, TA-21-257, TA-21-357, and TA-21-361 (LASL 1964b; LASL 1965a). Some of the floor drains in these buildings may be connected to the sanitary sewer line, as well. Construction began on the sewage treatment plant and four sludge drying beds on July 13, 1965, and was completed by February 18, 1966 (LASL no date). Sanitary liquid wastes were then diverted to one major sanitary waste line along the southern edge of DP Mesa (LASL 1966c; Nyhan 1990) (Fig. 14.8-3 and 14.8-4). The sewage treatment plant treats sanitary wastes and cooling water from TA-21 facilities (LANL 1990a). The plant has also received water from decontamination activities, janitor's scrub water, and waste from other operations at TA-21 (LANL 1990a; Nyhan 1990).

SWMU 21-026(a), the sewage treatment plant (TA-21-227), is an extended aeration sanitary waste treatment plant consisting of a grit chamber, comminuter, digester, aeration tank, and clarifier (Emelity et. al. 1972; Zia Company 1986). Originally, effluent leaving TA-21-227 after treatment was released at a concrete spillpad located on the southern edge of DP Canyon (LASL 1966b). Presently, the effluent is sent from TA-21-227 to the dosing siphon chamber (TA-21-348), then to two sand filter beds, and finally to the original outfall in DP canyon (LANL 1990b; Barnett 1990).

Since 1966, several modifications have been made to the sewage treatment plant. In 1976, a concrete box and flume, as well as a flow meter, were installed at the inlet to facilitate influent

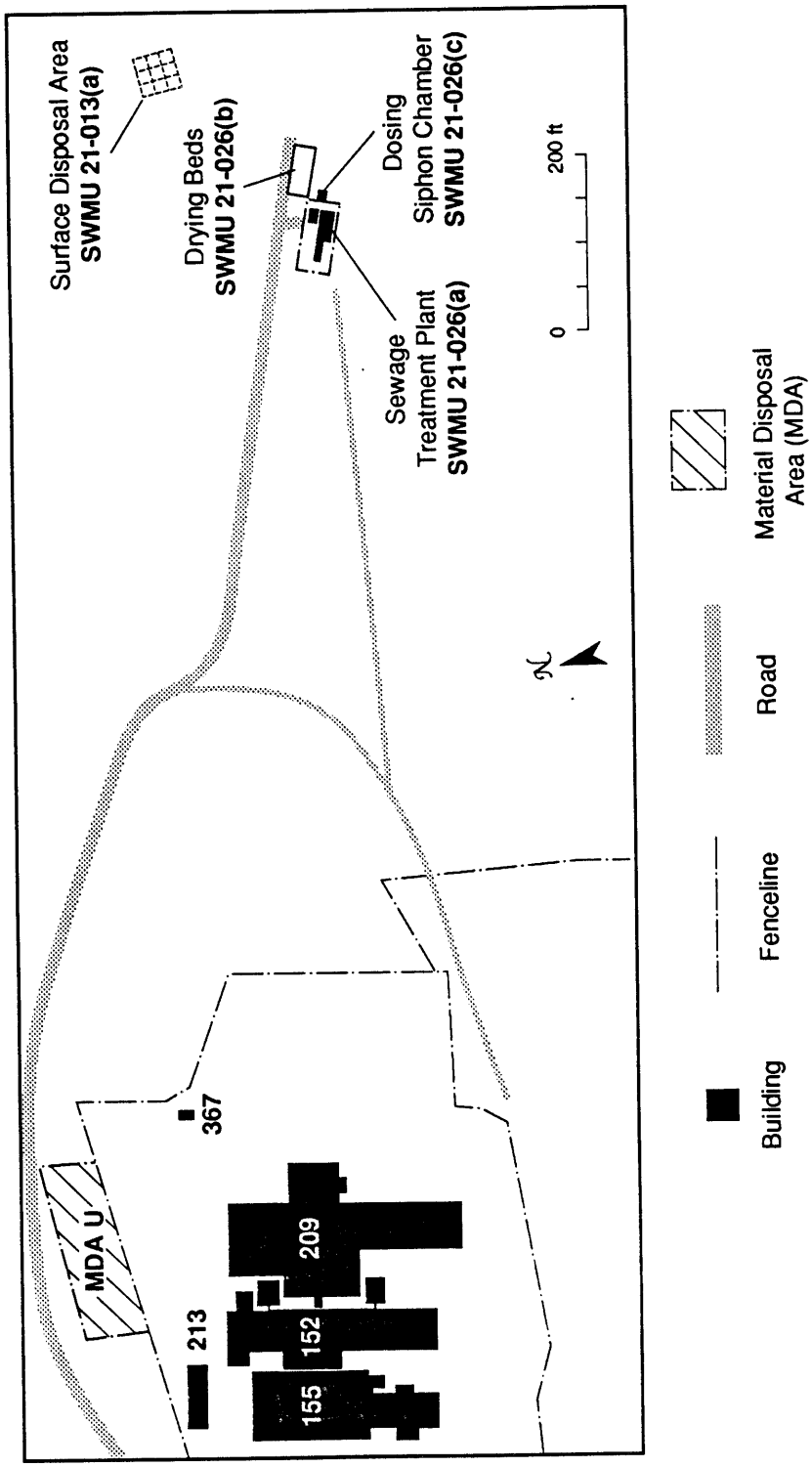


Fig. 14.8-1 Location of the TA-21 sewage treatment plant. (LASL 1966a)

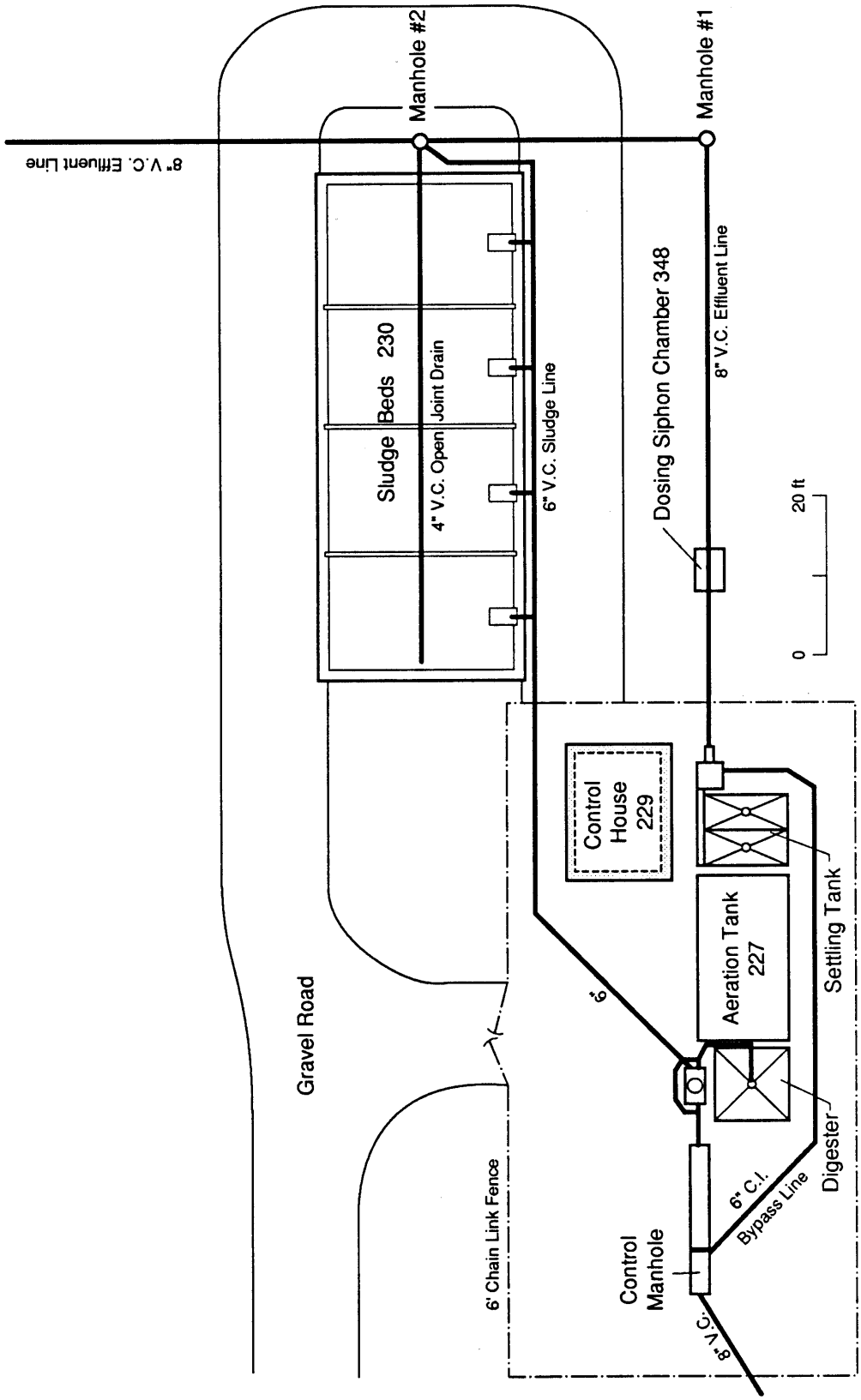


Fig. 14.8-2 Schematic of the TA-21 sewage treatment plant layout. (LASL 1966b)

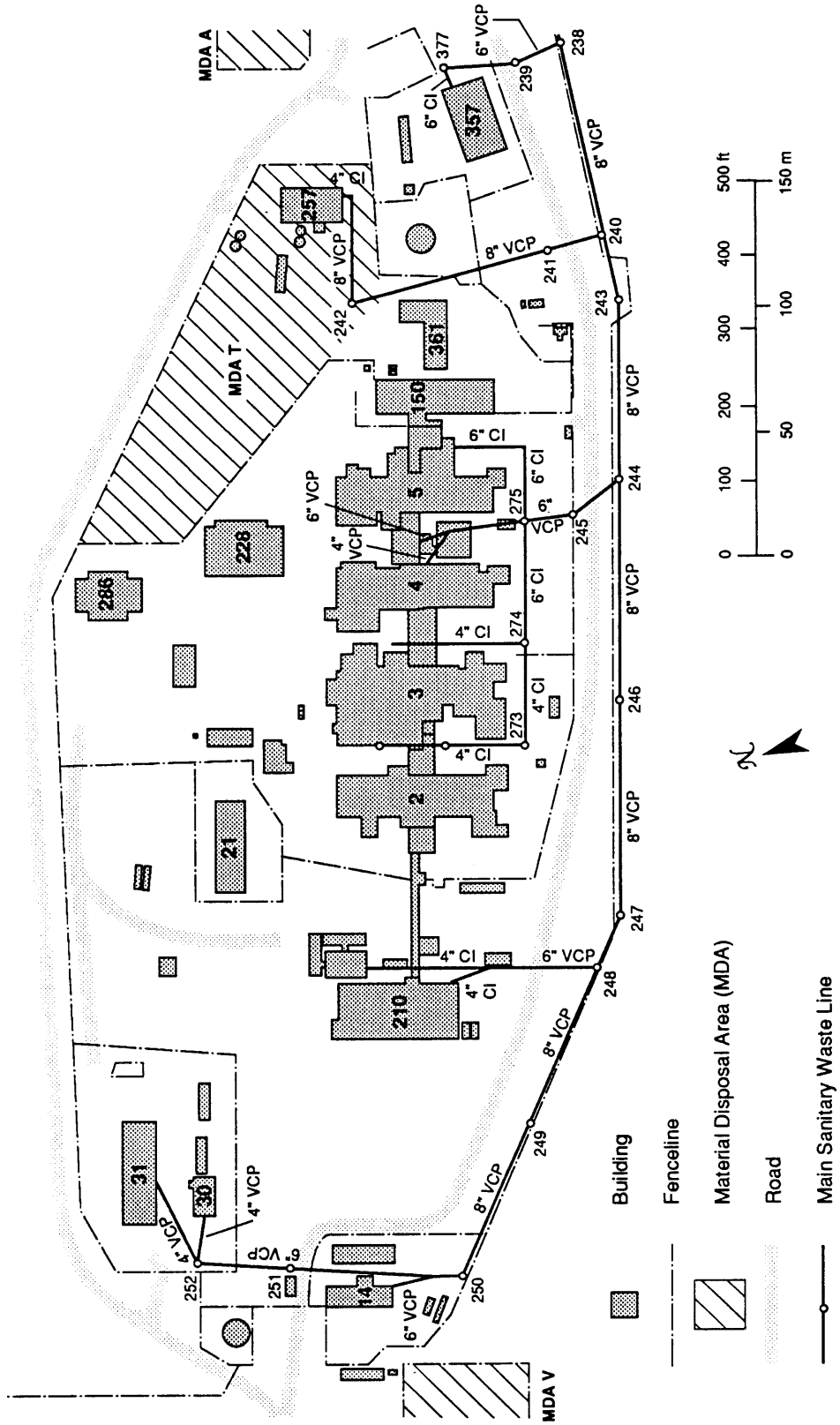


Fig. 14.8-3 Map of DP West showing the location of the main sanitary waste line. (Zia Company 1975)

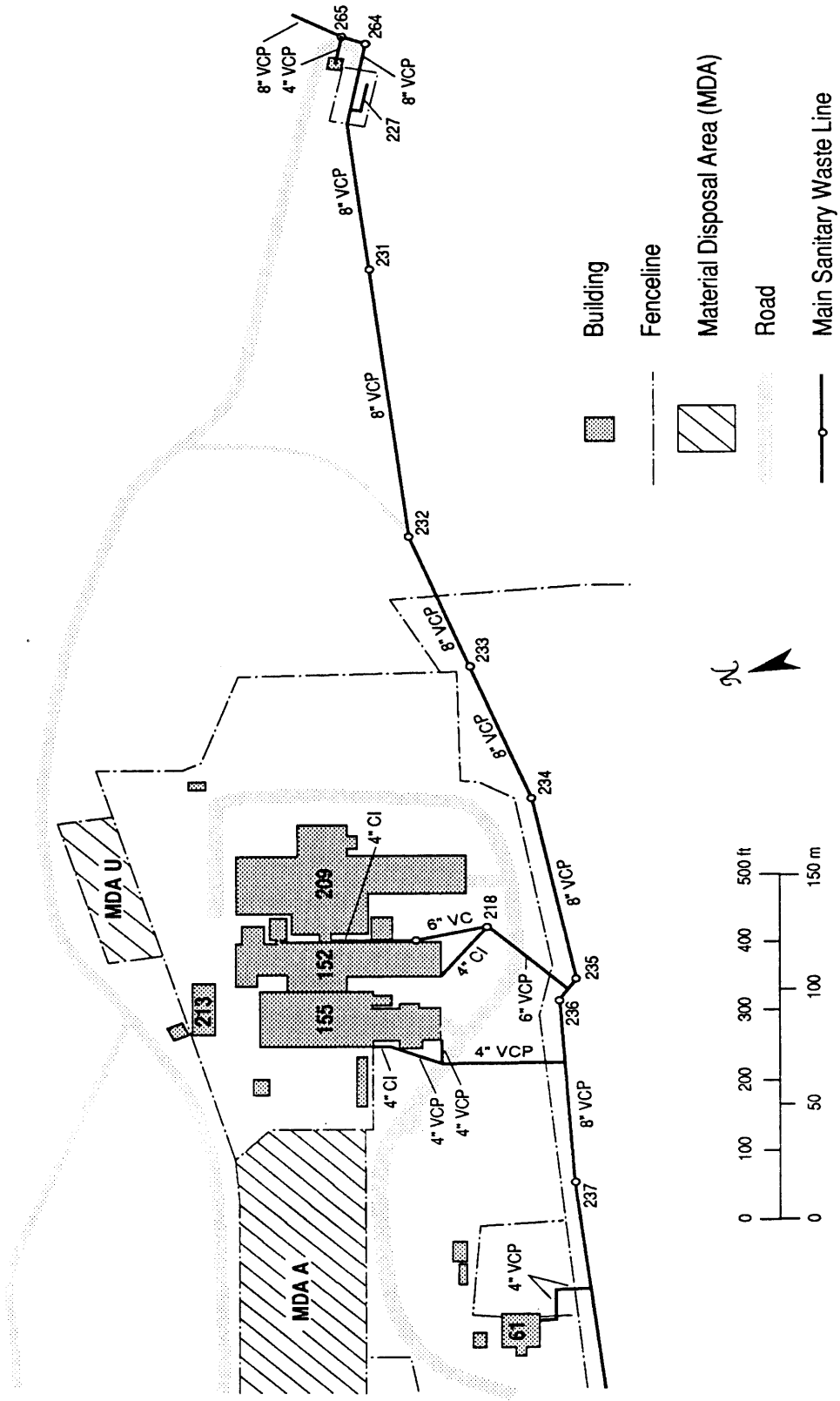


Fig. 14.8-4 Map of DP East showing the location of the main sanitary waste line. (Zia Company 1975)

flow measurements (Zia Company 1976). In May of 1990, a gauging station wet well was constructed about 85 ft north of the eastern-most sludge drying bed and about 36 ft from the existing concrete spillpad. The effluent flow meter was moved to this location, and this station now monitors the effluents discharged to DP Canyon through NPDES outfall 05S (LANL 1990d).

SWMU 21-026(b) was modified in May 1990. At this time, two of the original four sludge drying beds (TA-21-230) were converted into sand filters (LANL 1990b; Barnett 1990). These received effluent from the chlorine contact chamber and filtered the wastewater in its final stage of treatment. Four new, 4-in. PVC lines were installed in the two western-most sand filter beds and the two remaining eastern-most sludge drying beds. These lines carry effluent from the beds to the gauging station and on to the outfall in DP Canyon (LANL 1990b). The old 4-in. drain tile line was removed, and old connections were plugged with concrete (LANL 1990b).

Each sand filter/sludge drying bed is 14.5 by 23 ft with 4-ft-deep concrete walls. The sand in each bed is located about 2 ft from the top of the bed walls and is about 1-ft thick on the west side of each bed, grading to about 2-ft thick on the east side. The plant is currently overdesigned for the amount of waste being treated. Presently, only the two western-most sand filter beds are regularly used to filter treated wastewater before it is discharged to DP Canyon (Barnett 1990).

SWMU 21-026(c), the chlorine contact chamber (TA-21-348), was converted in the late spring or early summer of 1990 to a dosing siphon chamber (LANL 1990c; Barnett 1990). The structure is a 5-ft by 7-ft by 8-ft deep concrete tank located outside of the chain link fence, on the eastern side of TA-21-227. The chlorine contact chamber was used to treat wastewater with chlorine disinfectant but was taken out of operation because of the reduced flow through the plant and decreased fecal coliform counts (Barnett 1990). Effluent now enters the dosing siphon chamber from the plant until the chamber is full, when it is then pumped to the two western sand filter beds. The line that connects the dosing siphon chamber to manhole TA-21-264 and the outfall in the canyon was plugged with concrete when the chamber was converted (LANL 1990c).

SWMU 21-013(a) includes an inactive surface disposal area near TA-21-227 (Fig. 14.8-1). The top layer of sand from the two sand filter beds and two sludge drying beds has previously been disposed at this location near the sewage treatment plant (LANL 1990a). This disposal site is located north of the sewage treatment plant, on the southern edge of DP Canyon, just east of the new gauging station, and is thought to be identified by a pile of sand (LANL 1990a). The area is listed under SWMU 21-013(a), surface disposal areas, but will be addressed in this sampling plan in conjunction with SWMU 21-026, sewage treatment plant, because it appears to be part of the operations at the sewage treatment plant, as well as its close proximity. At present, sand is no

longer disposed of at SWMU 21-026; the upper layer of sand contained in the two eastern sludge drying beds is scraped off periodically and taken to TA-54 for disposal (Barnett 1990).

14.8.1.2 Existing Information

No data exist regarding contamination in the area of the sewage treatment plant or the inactive surface disposal area nearby. However, wastewater flow has been measured, and contaminant assays have been performed on sanitary wastewater as well as sewage sludge from the plant.

Flow data were collected for the sewage treatment plant at TA-21 from October 1978 through June 1990. A reduction in the wastewater flow rate occurred during this period and may correlate to the reduction in personnel at TA-21 (Nyhan 1990).

Radionuclide assays were performed on liquid effluents from June 1976 through 1989, including gross alpha, gross beta, gamma, and tritium (Nyhan 1990). Table 14.8-I presents a summary of those data; the average values for gross alpha, gross beta, gamma, and tritium for this period were 6.5 pCi/L, 12 pCi/L, 270 pCi/L, and 2,600 pCi/L, respectively. High values of 120 pCi/L gross alpha were recorded August 10, 17, and 26, 1976; the high value of 92 pCi/L gross beta was recorded on May 27, 1976; the high value of 1,600 pCi/L gamma was recorded in May 1988; and the high value of 34,800 pCi/L tritium was recorded for November 26 through December 10, 1979. There does not appear to be any temporal pattern to the presence of radionuclides in wastewater. Background data for water are not available; therefore, comparisons to background level cannot be made.

TABLE 14.8-I
RADIONUCLIDE ASSAYS FOR TA-21 SEWAGE TREATMENT PLANT LIQUID EFFLUENT
(1976—1989)

	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (pCi/L)	Tritium (pCi/L)
Average	6.5	12	-68	2600
Standard Deviation	11	11	430	3800
Minimum	0.005	0.007	-1100	0
Maximum	120	92	1600	35000
Number of Assays	157	157	50	146

Radionuclide assays were performed on sludge collected in the sludge drying beds between March 1979 through December 1985 (Nyhan 1990). Table 14.8-II presents a summary of those data; the average values for gross alpha, gross beta, and gamma for this period were 1,600 pCi/g, 71 pCi/g, and 240 pCi/g, respectively. The high value of 21,000 pCi/g gross alpha was recorded on March 8, 1982; the high value of 430 pCi/g gross beta was recorded on March 8, 1982; and the high value of 2,050 cpm/g gross gamma was recorded on June 2, 1979. No tritium assays were performed. There does not appear to be any temporal pattern to the presence of radionuclides in sludge. The average value for gamma in sewage sludge is significantly higher than concentrations of gross gamma considered to be background level in area soils (Sec. 2.4.2). No other comparisons to background data can be made.

TABLE 14.8-II
RADIONUCLIDE ASSAYS FOR TA-21 SEWAGE TREATMENT PLANT SLUDGE(1979—1985)

	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (cpm/g)
Average	1600	62	240
Standard Deviation	5400	110	570
Minimum	18	4	8.2
Maximum	21000	4300	2100
Number of Assays	14	14	22

Inorganic assays were also performed on sludge in the period between June 1976 and December 1985 (Table 14.8-III) (Nyhan 1990). Background values have not been established for sewage effluent and sludge. However, results of inorganic analyses show that in the majority of individual samples, boron, chromium, nickel, copper, zinc, arsenic, mercury, and lead concentrations in sewage sludge were significantly higher than concentrations considered to be background level in area soils (Sec. 2.4.2).

14.8.1.3 Source Term

SWMU 21-026(a)–(c). No data exist regarding contamination in and around the sewage treatment plant. Wastes treated at the sewage treatment plant are primarily domestic; however, there may be other contaminants that have entered the main sanitary waste line. Water from

TABLE 14.8-III

RESULTS OF NONRADIOACTIVE ASSAYS (HEAVY METALS) PERFORMED ON SLUDGE FROM THE TA-21 SEWAGE TREATMENT PLANT[a]

Date	CMB-1 Sample Number	B (mg/g)	V (mg/g)	Cr (mg/g)	Mn (mg/g)	Fe (%)	Ni (µg/g)	Cu (µg/g)	Zn (µg/g)	As (µg/g)	Se (µg/g)	Mo (µg/g)	Ag (µg/g)	Cd (µg/g)	Sn (µg/g)	Ba (µg/g)	Hg (µg/g)	Pb (µg/g)
6/25/76[b]	3265	500	150	400	200	.3-3.0	100	1500	2000	<1000	<1000	200	1500	30	300	1000	<100	600
5/5/77	TA-21-STP	100	100	100	80	.4	150	1000	800	<1000	–	60	300	<60	–	1000	<600	400
6/30/77	TA-21-STP	30	80	200	100	1	40	800	2000	<200	–	20	400	10	–	1000	<20	300
9/26/77	9594	10	150	100	50	2	30	800	1000	<100	–	50	100	<10	–	200	<10	300
12/16/77	10972	40	80	300	200	2	100	800	3000	<200	–	8	60	<20	–	1500	<60	400
2/21/78	10972	30	50	200	150	2	80	1000	3000	<200	–	8	80	<20	–	1500	<60	400
5/1/78	11454	20	40	250	100	1	20	400	3000	<200	–	10	60	<20	–	800	<60	300
7/19/78	11880	8	30	80	150	1	30	600	1200	<200	–	6	50	<20	–	600	<60	200
9/27/78	12145	20	15	100	60	1	30	800	3000	<200	–	6	20	<20	–	400	<60	300
3/21/79	12936	15	20	80	100	1.5	20	400	2000	<200	–	6	40	<20	–	600	<20	500
6/15/79	13499	20	60	100	200	2	30	1000	1500	<200	–	15	40	<20	–	400	<60	400
7/2/79	13499	20	50	80	200	2	40	1000	1500	<200	–	15	60	<20	–	400	<60	500
10/1/79	13972	20	50	80	50	6	40	1000	3000	<100	–	10	40	<20	–	400	<60	400
3/7/80	14764	20	40	200	200	3	50	2000	2500	<100	–	60	150	<20	–	800	<60	500
5/26/80	15471	30	50	120	150	2	50	800	3000	<100	–	10	60	<20	–	300	<20	400
7/10/80	15832	40	80	300	60	1	100	1200	3000	<100	–	20	40	<20	–	500	<20	300
10/10/80	16590	30	50	300	120	2	80	1000	2500	<100	–	15	100	<20	–	2500	<20	400
1/28/81	17550	30	150	400	160	1.5	100	1000	1500	<100	–	20	80	<20	–	1200	<20	500
5/18/81	18907	20	40	300	200	2.0	100	600	3000	<100	–	40	80	20	–	1500	<20	400
11/3/81	21177	40	60	100	150	1.8	10	100	1000	<200	–	6	4	<20	–	200	<20	100
3/8/82	22383	30	30	250	200	1	40	1000	3000	<200	–	10	40	<20	–	4000	<20	200
6/15/82	23364	40	50	400	300	2	60	1000	2000	<100	–	30	50	<20	–	5000	<20	400
7/29/82	23859	30	140	400	400	1.4	80	1600	2500	<200	–	15	40	<20	–	4000	<20	200
10/14/82	24724	80	40	500	300	3	60	1000	3000	<200	–	30	30	<20	–	5000	<20	300
3/18/83	83321	–	–	275 (.9)	237 (4.2)	1.0 (0.1)	97 (8.4)	935 (1)	1470 (280)	3.4	–	–	9.7 (1.1)	15.3 (1)	–	540 (74)	36 (2)	180 (20)
5/26/83	–	–	–	121 (6)	268 (42)	4.6 (0.5)	61 (14)	745 (420)	2220 (640)	3.3 (0.74)	–	–	26 (5.6)	14 (.3)	–	87 (6.6)	39 (1)	278 (55)
3/15/84	85080	–	–	329 (27)	418 (2.9)	1.7 (0.1)	63.4 (2)	1570 (43)	2640 (471)	<0.0001	–	–	–	26.8 (2.5)	–	669 (269)	21.4 (2.5)	21.3 (.75)
6/8/84	85.77018	–	–	212	503	2.1	106	1040	1840	9.7	–	–	29.2	13.8	–	1440	16.6	239
8/20/84	85.77056	–	–	224	469	1.85	77.5	1010	1840	4.63	–	–	17.3	6.75	–	4590	15.0	233
11/26/84	85.77064	–	–	172	425	1.75	55.5	924	1708	34.9	–	–	34.9	7.58	–	1574	22.9	7.58
6/5/85	85.77121	–	–	130 (26)	300 (60)	.79 (.16)	58 (12)	930 (190)	1400 (280)	5.4 (1.8)	–	–	4 (0.8)	12 (2.4)	–	1700 (340)	250 (50)	230 (46)
11/18/85	85.77072	–	–	245 (49)	339 (68)	1.2 (.24)	43 (8.6)	1000 (912)	400 (364)	7.0 (1.4)	–	–	8 (1.6)	18 (4.0)	–	2100 (420)	20 (21)	316 (34)
12/20/85	85.78421	–	–	100 (73)	50 (57)	.10 (.11)	40 (37)	500 (416)	400 (364)	23 (5.0)	–	–	21 (4.0)	10 (2.0)	–	360 (100)	22 (4.0)	50 (47)
1986	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1987	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1988	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1989	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a]Source: Nyhan 1990.
[b]Data from 6/25/76 through and including 10/14/82 was submitted by HSE-7.

decontamination activities, from janitor's scrub water, and from wastes (chemical, radioactive, or mixed) produced in specific operations may have resulted in small amounts of plutonium, uranium, americium, tritium, cesium, strontium, organic constituents, and inorganic constituents in the plant sludge (Nyhan 1990). The quantity of contaminated waste that has entered the sewage treatment plant by way of sanitary drains and/or floor drains is not known.

SWMU 21-013(a). No data exist regarding contamination in and around the sand disposal area. Assays for gross alpha, gross beta, gamma, and inorganic constituents were performed by HSE-8 on sludge from the sewage treatment plant. These assays showed the presence of radionuclides and heavy metals (Nyhan 1990). Because sand was used to filter solids from the sludge, it may be assumed that sand placed in the surface disposal area may be contaminated with radionuclides and inorganic constituents.

14.8.2 Objectives and Data Needs

The objective of this investigation is to confirm the presence or absence, and determine the extent of contamination, at SWMU 21-026(a)–(c) and SWMU 21-013(a).

Specific data required to assess contamination at SWMU 21-026(a)–(c) include the areas around the sewage treatment plant TA-21-227, around the sand filter/sludge drying beds TA-21-230, and around the dosing siphon chamber TA-21-348 as follows:

1. Identify the contaminants present using Level II and III data due to leakage beneath the sewage treatment plant (Building TA-21-227), to leakage beneath the sand filter/sludge drying beds (TA-21-230), and to leakage beneath the dosing siphon chamber (TA-21-348). In the course of processing contaminated wastewater, the potential exists, however small, that leakage occurred from one or more operations at the sewage treatment plant.

2. If contaminants are identified at the sewage treatment plant, the sand filter/sludge drying beds, or the dosing siphon chamber, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface sampling and Level III analyses.

Specific data required to prove absence of contamination at SWMU 21-013(a) include the following:

1. Determine the location of the surface disposal area.

2. Confirm absence of contaminants using Level II and III data. The processing of contaminated wastewater produced contaminated residual sand and sewage sludge, which may also have contaminated the environment when it was disposed.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and Level III analyses.

4. Identify contaminants present using Level II and Level III data from drainages in the area of SWMU 21-013(a). Surface soil contamination in the area, if known to exist, may have the potential for transport of contamination by water erosion in surface drainages.

14.8.3 Sampling/Investigation Rationale

SWMU 21-026(a)–(c). The initial investigation consists of angled drilling and subsurface soil sampling to determine if contamination is present under TA-21-227 [SWMU 21-026(a)], TA-21-230 [SWMU 21-026(b)], and TA-21-348 [SWMU 21-026(c)]. Contaminant assessment under these buildings cannot otherwise be performed by vertical drilling. These samples will be analyzed for nitrates and chlorides because both are associated with human domestic waste (Sawyer and McCarty 1978). The samples will also be submitted for soil moisture determinations because relatively high moisture content in native soils may indicate leakage from the wastewater treatment plant. If indications of leakage are found at any of the three SWMUs under investigation, then additional sample analyses will be performed by the analytical laboratory.

If required, a subsequent investigation at some or all of the three SWMUs to define the nature and extent of contamination will be conducted by vertical drilling. Samples will be submitted to the analytical laboratory for a full suite of analyses unless sample results from the initial investigation allow specification of a more focused analytical suite.

SWMU 21-013(a). The initial investigation will include field radiological surveys on a rectangular grid. Surface and near-surface soil sampling will be performed within each grid cell. Based on results from field laboratory analyses, further surface and near-surface sampling along the original or a more closely spaced grid may be required. Thirty percent of the samples will be submitted to an analytical laboratory for confirmatory analyses.

Based on the results from the initial investigations, a subsequent investigation may include additional surface and near-surface soil sampling and may also include any drainages that collect run-off from the surface disposal site. Subsequent sampling will be used to determine the extent or depth of contamination in and around the surface disposal area. These samples will be submitted for a full analytical suite of analyses unless sample results from the initial investigation allow specification of a more focused analytical suite.

14.8.4 Sampling Plan

14.8.4.1. Initial Investigations

The sampling and analysis requirements are shown in Table 14.8-IV. Soil moisture determinations will be performed for borehole samples from the sewage treatment plant area because relatively high moisture content in native soils may indicate leakage from the wastewater treatment plant. Nitrates and chlorides will also be analyzed because both are associated with human domestic waste (Sawyer and McCarty 1978). If contamination is not identified, no further action will be taken at SWMUs 21-0026(a)–(c).

SWMU 21-026(a). An angled borehole will be placed on the north side of TA-21-227, 5 ft from the building in the area between the building and the 6-in. cast iron sludge line to the drying beds (see Fig. 14.8-5). A drilling angle of 24 degrees from vertical will be used (for method see Sec. 11.5.3.3). Figure 14.8-6 provides a graphic representation of the drilling to be performed at TA-21-227. The borehole will pass under the northern edge of the building at an initial depth of 11 ft. The length of the borehole will be extended 20 ft beyond the center of the aeration tank for a total length of 47 ft, a total depth of 43 ft, and provide 10 samples.

Determinations for soil moisture will also be performed in the field laboratory (for methods see Sec. 11.7). All samples that exhibit relatively high soil moisture content will be sent to the analytical laboratory for a full suite of analyses (Table 14.8-IV), and 30% of uncontaminated or questionable samples (based on field laboratory analyses) will also be sent to the analytical laboratory. The results from the analytical laboratory will determine the need for subsequent investigations.

This should identify any contamination that may have migrated outward and downward from the tank. Although the borehole is to be drilled directly below the aeration tank, any contamination resulting from potential leaks in the digester and settling tanks located in the building should be detected as well because of the small size of the building.

SWMU 21-026(b). Two angled boreholes will be drilled beneath the sludge drying/sand filter beds. The locations of these boreholes are shown in Fig. 14.8-5. One borehole will be placed 3 ft from the north wall of the sand filters. This borehole will be drilled under the sand filters at an angle of 27 degrees from vertical. The second borehole will be placed 3 ft from the south wall of the sludge drying beds at an angle of 27 degrees from vertical (for method see Sec. 11.5.3.3). Figure 14.8-7 is a graphic representation of the drilling to be performed at TA-21-230. Both boreholes will pass under the beds at an initial depth of 6 ft. The boreholes will be extended for

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) - (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
21-026(a)																																			
Angled Borehole	1	0.0 - 5.0 ft							X		X	X	X	X	X	X			X	X															
		5.0 - 10.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
		10.0 - 15.0 ft							X		X	X	X	X	X	X			X	X															
		15.0 - 20.0 ft							X		X	X	X	X	X	X			X	X															
		20.0 - 25.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
		25.0 - 30.0 ft							X		X	X	X	X	X	X			X	X															
		30.0 - 35.0 ft							X		X	X	X	X	X	X			X	X															
		35.0 - 40.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
		40.0 - 45.0 ft							X		X	X	X	X	X	X			X	X															
		45.0 - 47.0 ft							X		X	X	X	X	X	X			X	X															
Trip Blank																												X							
21-026(b)																																			
Angled Borehole	1	0.0 - 5.0 ft							X		X	X	X	X	X	X			X	X															
		5.0 - 10.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
		10.0 - 15.0 ft							X		X	X	X	X	X	X			X	X															
		15.0 - 20.0 ft							X		X	X	X	X	X	X			X	X															
		20.0 - 25.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
		25.0 - 30.0 ft							X		X	X	X	X	X	X			X	X															
		30.0 - 35.0 ft							X		X	X	X	X	X	X			X	X															
		35.0 - 40.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E		E	E	E	E					
		40.0 - 45.0 ft							X		X	X	X	X	X	X			X	X															
		45.0 - 50.0 ft							X		X	X	X	X	X	X			X	X															

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) - (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis														
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		50.0 - 52.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E					
Trip Blank																										X								
Angled Borehole	2	0.0 - 5.0 ft							X	X	X	X	X	X	X			X	X															
		5.0 - 10.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
Rinsate Blank																				X	X	X	X		X	X	X	X						
Field Blank																										X	X	X						
		10.0 - 15.0 ft							X	X	X	X	X	X	X			X	X															
		15.0 - 20.0 ft							X	X	X	X	X	X	X			X	X															
		20.0 - 25.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
		25.0 - 30.0 ft							X	X	X	X	X	X	X			X	X															
		30.0 - 35.0 ft							X	X	X	X	X	X	X			X	X															
		35.0 - 40.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
		40.0 - 45.0 ft							X	X	X	X	X	X	X			X	X															
		45.0 - 50.0 ft							X	X	X	X	X	X	X			X	X															
		50.0 - 52.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
																										X								
Trip Blank																																		
21-026(c)																																		
Vertical Borehole	1	0.0 - 5.0 ft							X	X	X	X	X	X	X			X	X															
		5.0 - 10.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
		10.0 - 15.0 ft							X	X	X	X	X	X	X			X	X															
		15.0 - 20.0 ft							X	X	X	X	X	X	X			X	X															
		20.0 - 25.0 ft							X	X	X	X	X	X	X			X	X	E	E	E	E		E	E	E	E						
		25.0 - 30.0 ft							X	X	X	X	X	X	X			X	X															
21-013(a)				X	X																													
Radiological Survey									X		X	X		X	X					E	E	E	E		E	E	E	E						
Surface Soil Sample	1	0.0 - 6.0 in																																

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) - (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	2	0.0 - 6.0 in							X		X	X		X	X																		
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
	3	0.0 - 6.0 in							X		X	X		X	X																		
	4	0.0 - 6.0 in							X		X	X		X	X																		
	5	0.0 - 6.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
Field Duplicate																						E	E	E	E		E	E	E	E				
	6	0.0 - 6.0 in							X		X	X		X	X																		
	7	0.0 - 6.0 in							X		X	X		X	X																		
	8	0.0 - 6.0 in							X		X	X		X	X																		
	9	0.0 - 6.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
Surface Soil Sample (bias)	1	0.0 - 6.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
	2	0.0 - 6.0 in							X		X	X		X	X																		
	3	0.0 - 6.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
Near Surface Soil	1	6.0 - 12.0 in							X		X	X		X	X																		
		12.0 - 18.0 in							X		X	X		X	X																		
		18.0 - 24.0 in							X		X	X		X	X																		
	2	6.0 - 12.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
		12.0 - 18.0 in							X		X	X		X	X																		
		18.0 - 24.0 in							X		X	X		X	X																		
	3	6.0 - 12.0 in							X		X	X		X	X																		
		12.0 - 18.0 in							X		X	X		X	X							E	E	E	E		E	E	E	E				
		18.0 - 24.0 in							X		X	X		X	X																		
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

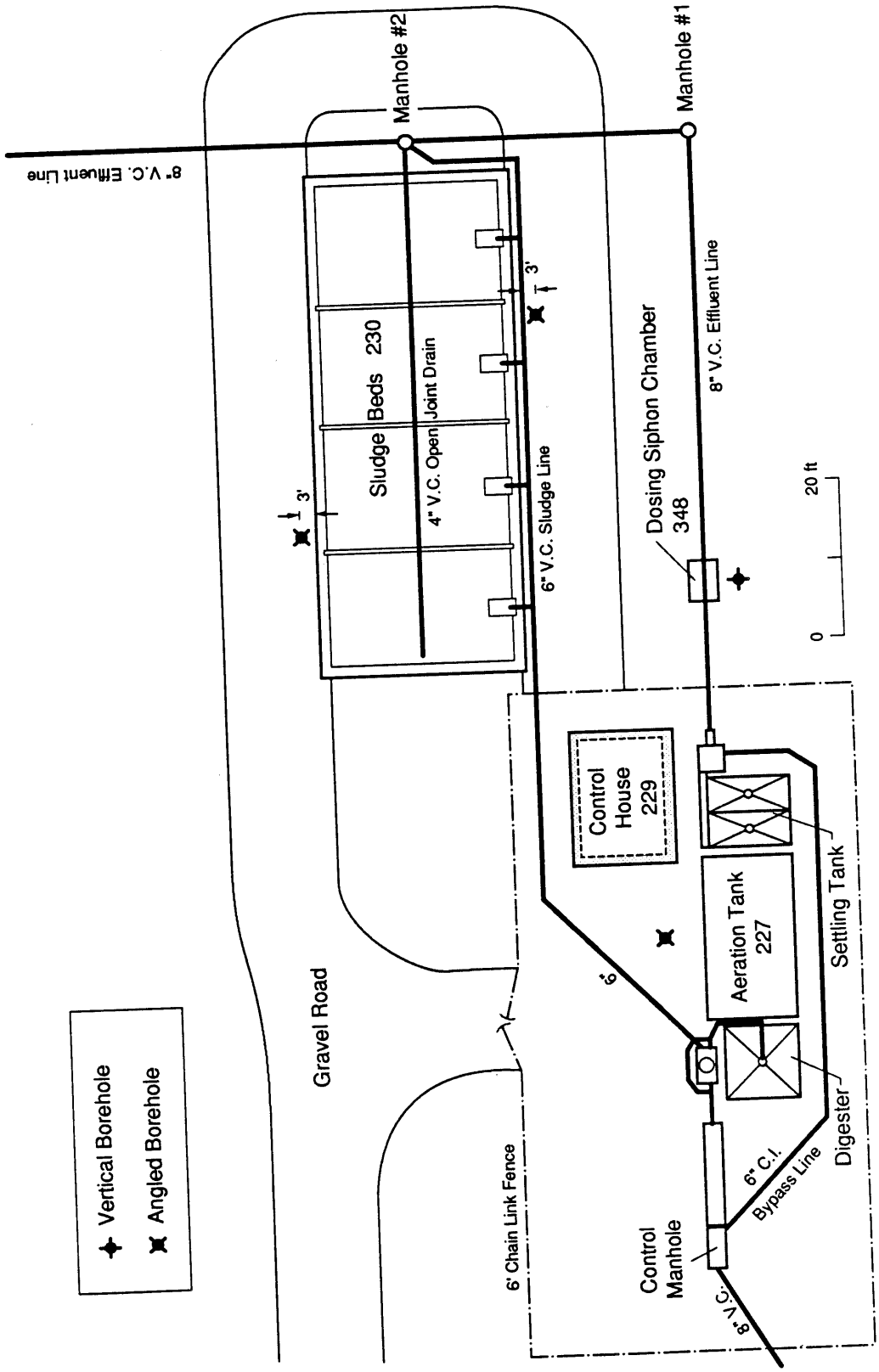


Fig. 14.8-5 Initial borehole locations for the initial investigation of SWMUs 21-026(a), (b), and (c) at the sewage treatment plant. (LASL 1966b)

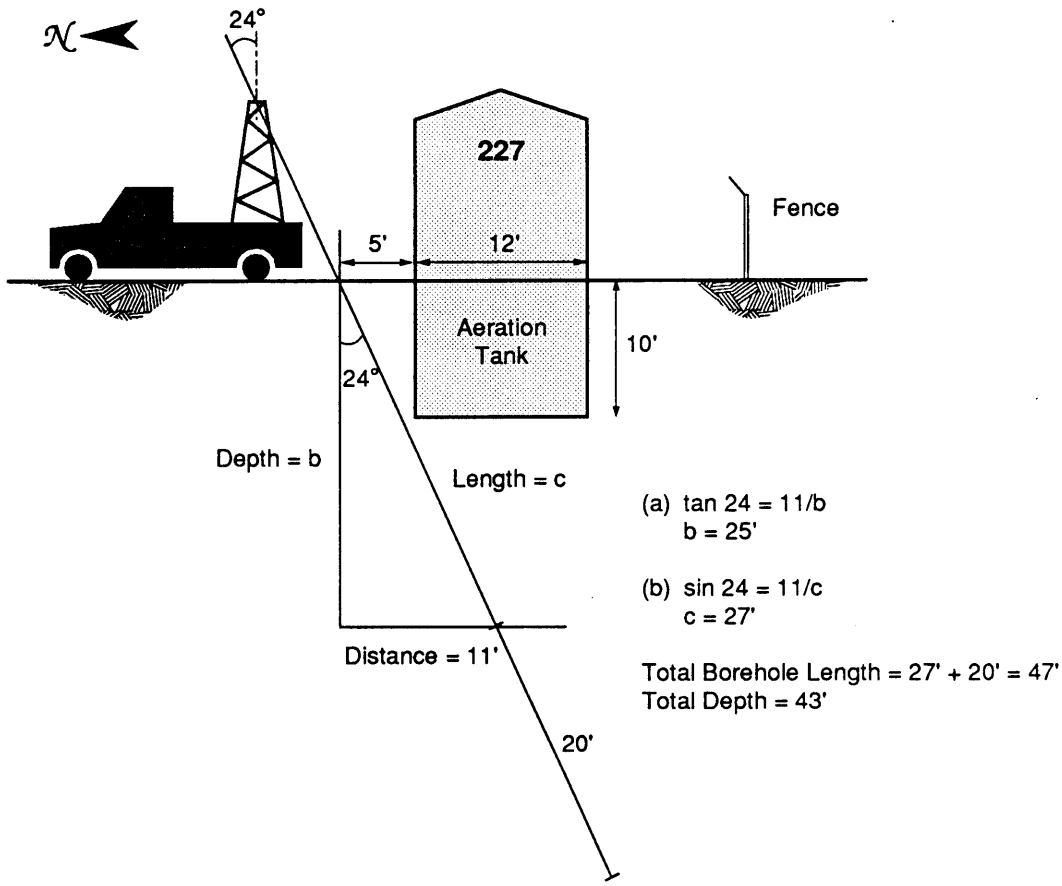


Fig. 14.8-6 Graphic representation of drilling to be performed under the initial investigation at TA-21-227 [SWMU 21-026(a)].

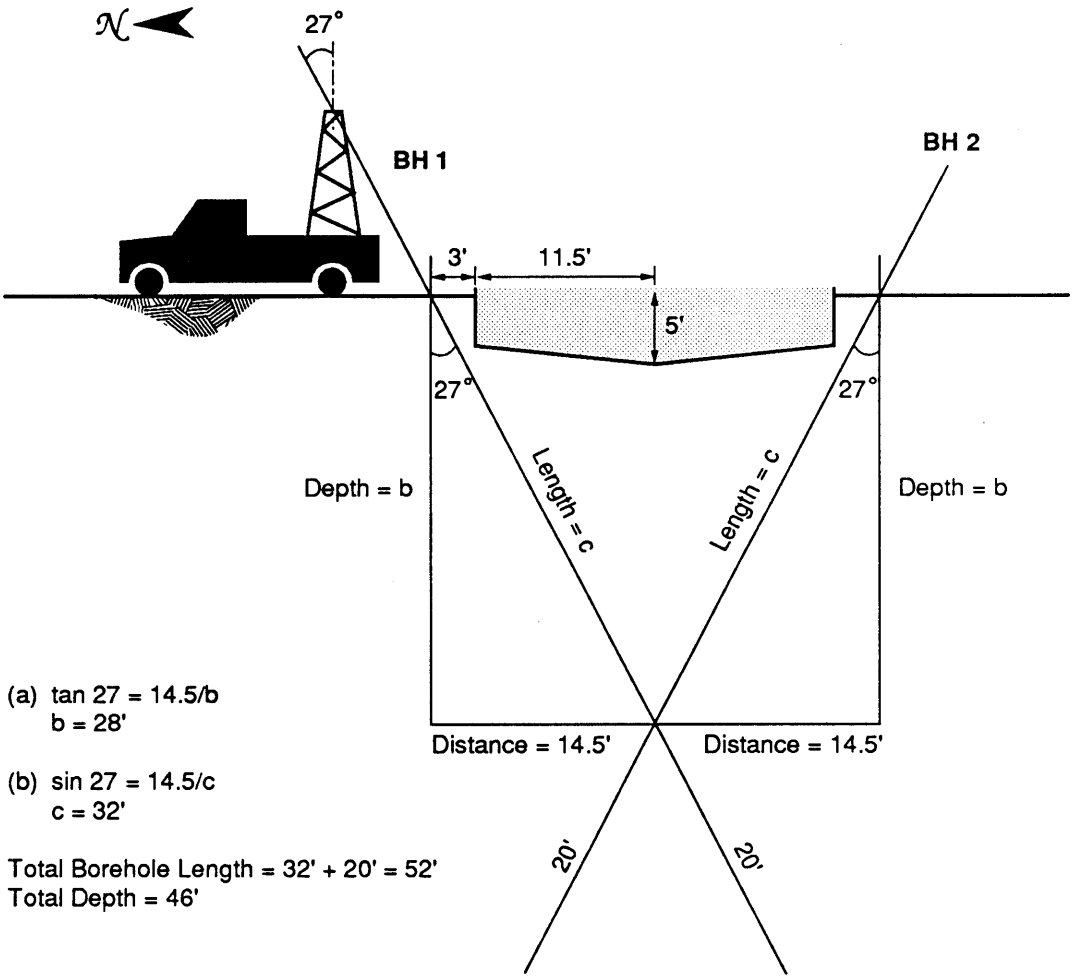


Fig. 14.8-7 Graphic representation of drilling to be performed under the initial investigation at TA-21-230 [SWMU 21-026(b)].

20 ft beyond the center of the sand filter and sludge drying beds to locate any contamination that may have migrated outward and downward from the beds. Each borehole will be 52 ft in length, reach a total depth of 46 ft, and result in 11 samples.

Determinations for soil moisture, chlorides, and nitrates will be performed in the field laboratory. The selection of samples for analysis will follow the same protocol as for SWMU 21-026(a) above. This should identify any contamination that may have migrated outward and downward.

SWMU 21-026(c). One vertical borehole will be drilled on the south side of the dosing siphon chamber (Fig. 14.8-5). The borehole will be placed close to the outside of the barrier that surrounds the structure. The nominal depth for this borehole is 30 ft (for method see Sec. 11.5.3.2). A total of seven samples will result.

Determinations for soil moisture, chlorides, and nitrates will also be performed in the field laboratory. The selection of samples for analysis will follow the same protocol as for SWMU 21-026(a) above. This should identify any contamination that may have migrated outward and downward.

SWMU 21-013(a). Visual reconnaissance of the surface disposal area will be accomplished in the company of the sewage treatment plant operator. The approximate "center," and the approximate extent, or boundary, of the surface disposal area will be flagged. This area is approximately 45 by 45 ft and will be divided into nine 15- by 15-ft grid cells. The entire area will be field-surveyed for radiological contaminants (for methods see Sec. 11.4.1).

Surface soil sampling locations will be at the center of each grid cell, resulting in nine potential sampling locations (for method see Sec. 11.5.2.1) (Fig. 14.8-8) Surface soil samples will be collected in grid cells determined to lie within the sand disposal area, based on the radiological surveys or visual observations. In addition, judgmental surface soil samples will be taken at a maximum of three "hot spots" identified in the field survey. Based on field screening and field laboratory analyses, the surface sampling grid may be extended. At a maximum of three areas of surface contamination, near-surface soil samples will be taken to a maximum depth of 24-in. (for method see Sec. 11.5.2.4).

For planning purposes, it is assumed that nine grid locations plus three "hot spot" locations will be surface sampled, and at three of these locations, three additional samples will be taken to reach a 24-in. depth. This totals 21 samples to be processed in the field laboratory. Thirty percent of the samples from this investigation will be submitted for a full analytical suite of analyses (six samples).

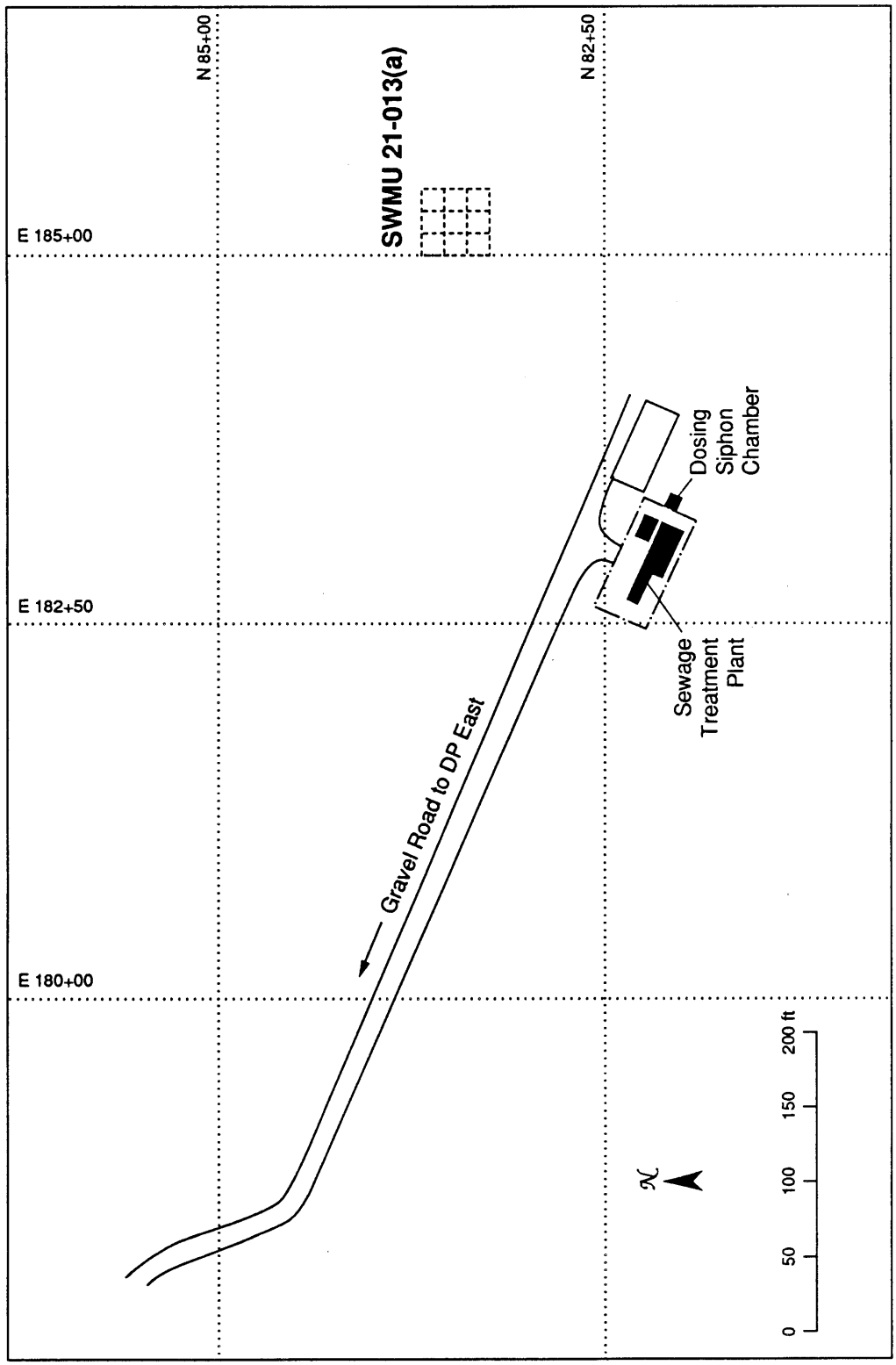


Fig. 14.8-8 Schematic of the sampling grid for the surface disposal area at the sewage treatment plant, TA-21. (LANL 1983d)

14.8.4.2. Subsequent Investigations

SWMU 21-026(a)–(c). From the initial boreholes at each of the three SWMUs, it will be possible to determine whether contamination exists and if the contaminant plume extends laterally. If the contaminant plume is identified under each facility, then vertical boreholes will be drilled at these facilities (for method see Sec. 11.5.3.2).

The first vertical borehole will be placed 20 ft south of the sewage treatment plant, TA-21-227, and the second will be placed 20 ft north, in line with the initial borehole (Fig. 14.8-9). The nominal depth is assumed to be 50 ft but will be based on analysis of results from initial investigations.

If contamination is found around the sand filters/sludge drying beds, TA-21-230, three vertical boreholes will be drilled (Fig. 14.8-10). These will be located 20 ft from the north wall of the two sludge drying beds in line with the angled borehole; 20 ft east of the sludge drying beds, in line with manhole 21-265; and 20 ft from the west end of the sand filter beds in line with manhole 21-265. The nominal depth of these three boreholes is assumed to be 50 ft but will be based on results from the initial investigation.

If contamination is found at the dosing siphon chamber, TA-21-348, one additional borehole will be drilled (Fig. 14.8-910. This borehole will be located 20 ft southeast of the southeast corner of the dosing chamber.

It is anticipated that no more than four additional boreholes will be required to define the lateral and vertical extent of contamination from any one of the three SWMUs. For planning purposes, however, it is assumed that no additional boreholes are required and that no additional sample analyses will be needed.

SWMU 21-013(a). From the initial surface and near surface soil samples, it will be possible to determine whether contamination exists, the primary direction of the contaminant dispersal, and whether the contaminant depth is greater than 2 ft. Surface sampling in a wider area may be employed to define the extent of the area. If a contaminant plume is identified, then shallow boreholes will be employed to define the subsurface extent. A nominal depth of 10 ft is appropriate.

For planning purposes, it is assumed that no additional sampling will be required.

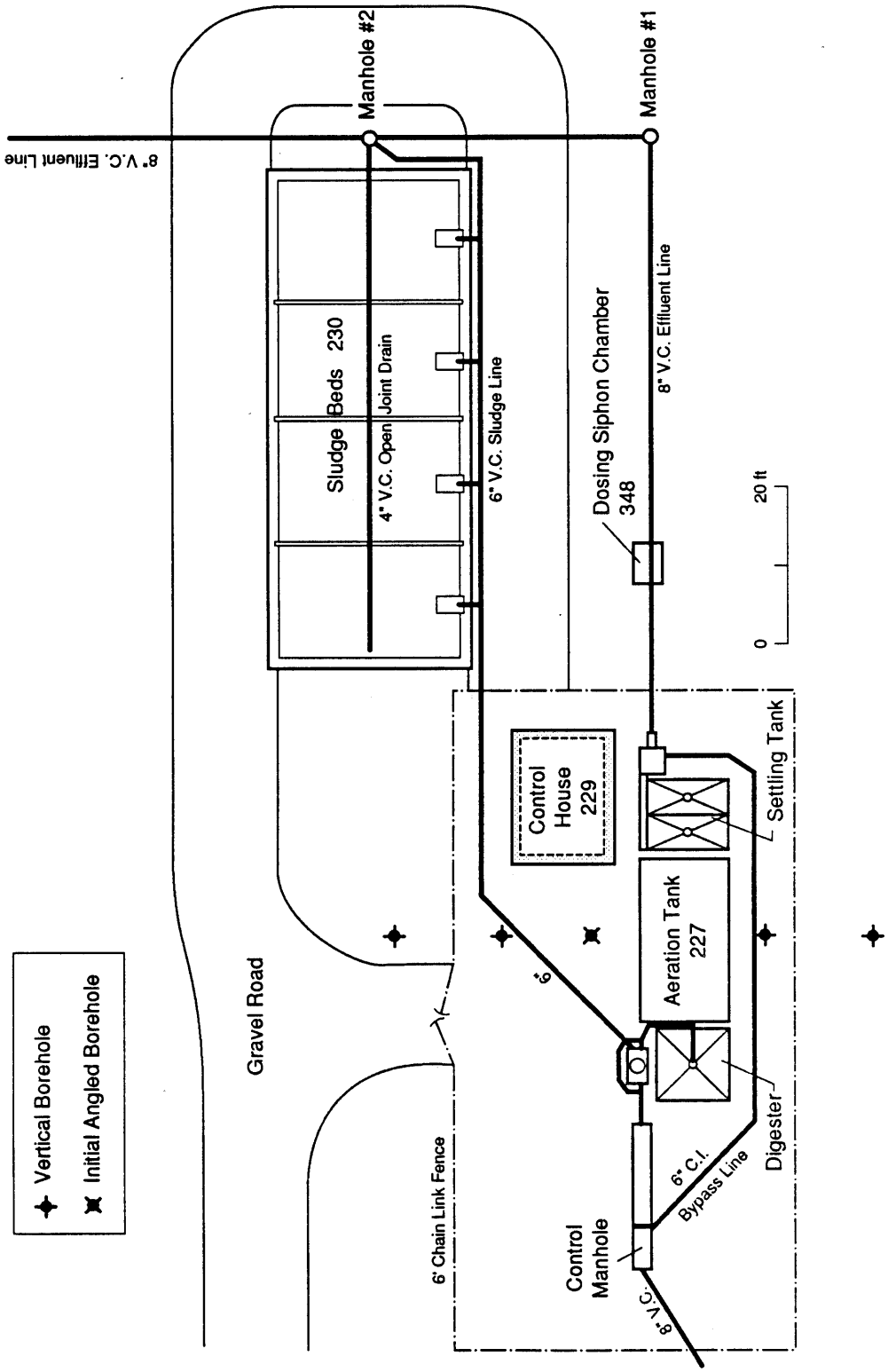


Fig. 14.8-9 Locations of additional boreholes to be drilled under the subsequent investigation at TA-21-227. (LASL 1966b)

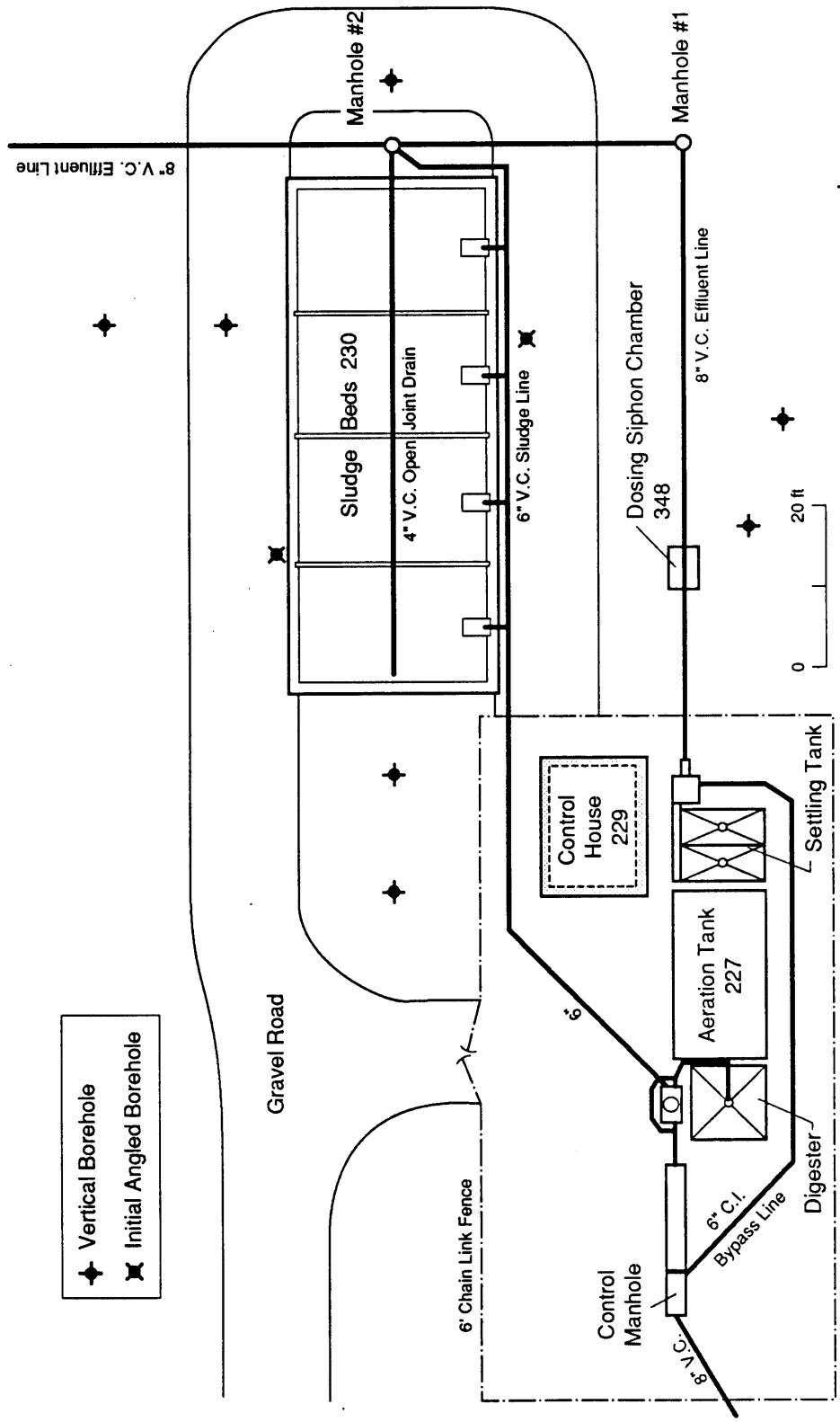


Fig. 14.8-10 Locations of additional boreholes to be drilled under the subsequent investigation at TA-21-230. (LASL 1966b)

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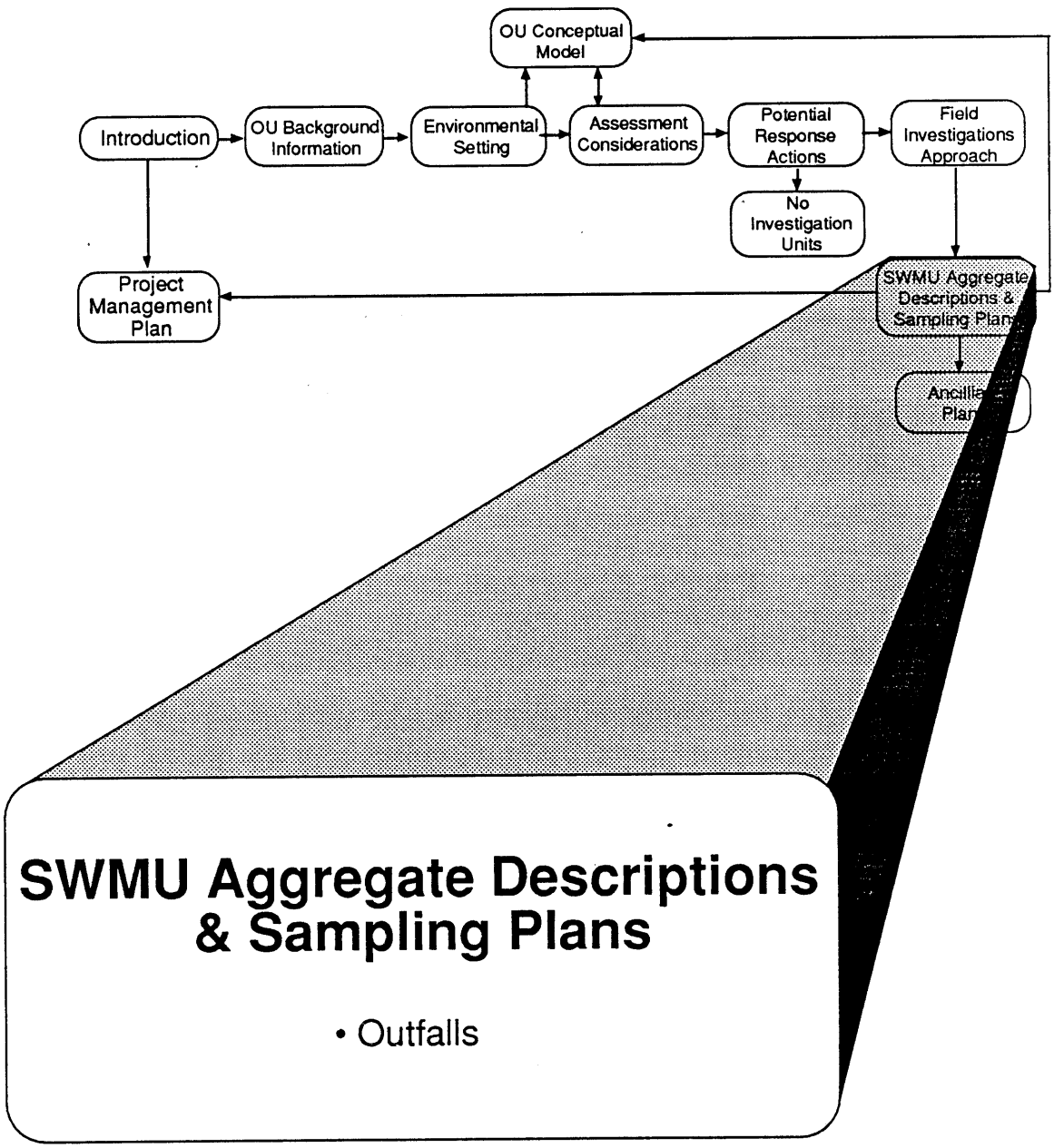
CHAPTER 15


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plan
Ancillary Plan
SWMU Aggregate Descriptions & Sampling Plans
• Outfalls

15. OUTFALLS DESCRIPTION AND SAMPLING PLAN

15.1 Introduction

This chapter addresses outfalls from liquid waste systems listed as SWMUs in several SWMU groups that include the following:

- SWMU 21-004, Aboveground Tanks and Drain Lines
- SWMU 21-006, Underground Seepage Pits
- SWMU 21-011, New Industrial Waste Treatment Plant
- SWMU 21-013, Surface Disposal Areas
- SWMU 21-022, Acid Waste Lines and Sumps and
- SWMU 21-023, Decommissioned Septic Systems
- SWMU 21-024, Inactive Septic Systems/Outfalls
- SWMU 21-026, Wastewater Treatment Plant and
- SWMU 21-027, Surface Discharge

The majority of the outfalls covered under these SWMUs were previously identified as part of the CEARP investigation (LANL 1987). Table 15.1-I lists outfalls by SWMU number and cross references the CEARP identifier. In addition, some outfalls that have not been classified as SWMUs are also addressed. These are identified by EPA NPDES numbers and are considered in this work plan because of uncertainties in the history of releases predating NPDES permitting. Figures 15.1-1 and 15.1-2 show the general location of each outfall.

Two outfalls identified as part of SWMU 21-013(g) (CEARP identifiers 3ac and 3ad) were both erroneously identified as outfalls. They are discarded sections of pipe, which project from the upper portion of a slope descending into Los Alamos Canyon from the south perimeter of MDA V. This location corresponds to a surface disposal area, SWMU 21-013(g), where debris from the demolition of buildings was pushed over the edge of the mesa. These will no longer be considered outfalls, but investigations are planned under the more appropriate category of Surface Disposal Areas, Sec. 14.7.

TABLE 15.1-I
DISCHARGE SYSTEMS

SWMU Number	CEARP Identifier	Associated Facilities	Previously Sampled
21-004(d)	TA-21-3n	Sump 223	*
21-006(b)	TA-21-3u	Pit 118/Bldg 2	*
21-011(k)	TA-21-3o, NPDES EPA 050050	Bldg 257	*
21-022(h)	TA-21-3a, NPDES EPA 03A032	Bldg 150	
21-023(c)	TA-21-3y	Tank 62/Bldg 33	*
21-024(a)	TA-21-3m	Tank 53/Bldg 9	
21-024(b)	TA-21-3g	Tank 55/Bldg 17	*
21-024(c)	TA-21-3h	Tank 56/Bldg 54	*
21-024(d)	TA-21-3f	Tank 106/Bldg 1	*
21-024(e)	TA-21-3e	Tank 123/Bldg 20	*
21-024(f)	TA-21-3k	Tank 124/Bldg 45	*
21-024(g)	TA-21-3l	Tank 125/Bldgs 7 & 31	*
21-024(h)	TA-21-3i	Tank 56/Bldg 54	*
21-024(i)	TA-21-3j	Tank 181/Bldg 152	*
21-024(j)	No CEARP Identifier	Tank 194/Bldg 155	
21-024(k)	No CEARP Identifier	Tank 219/Bldg 209	
21-024(l)	TA-21-3x	Bldg 21	*
21-024(m)	TA-21-3z	Bldg 209	
21-024(n)	TA-21-3aa	Bldg 155	*
21-024(o)	TA-21-3ab	Bldg 46	*
21-026(d)	TA-21-3w, NPDES EPA SSS05S	Bldg 227	
21-027(a)	TA-21-3d	Bldg 3	*
	TA-21-3p, NPDES EPA 03A031	Cooling Tower 143	*
	TA-21-3ae	Bldg 3	*
	TA-21-3af	Bldg 3/Cooling Tower 143	
21-027(b)	TA-21-3q	Bldg 152	
	TA-21-3r, NPDES EPA 03A034	Cooling Towers 166 & 167	
21-027(c)	TA-21-3c	Bldg 6	
21-027(d)	No CEARP Identifier	Tank 47	
—	TA-21-3b, NPDES EPA 03A037	Bldg 314	
—	TA-21-3s, NPDES EPA 03A036	Cooling Tower 220	
—	TA-21-3t, NPDES EPA 03A035	Cooling Tower 210	
—	TA-21-3v, NPDES EPA 03A037	Bldg 314	
Not an outfall	TA-21-3ac	MDA V	*
Not an outfall	TA-21-3ad	MDA V	
—	TA-21-3ag, NPDES EPA 02A129	Bldg 357	*
—	No CEARP Identifier, NPDES EPA 04A142	Cooling Tower 149	

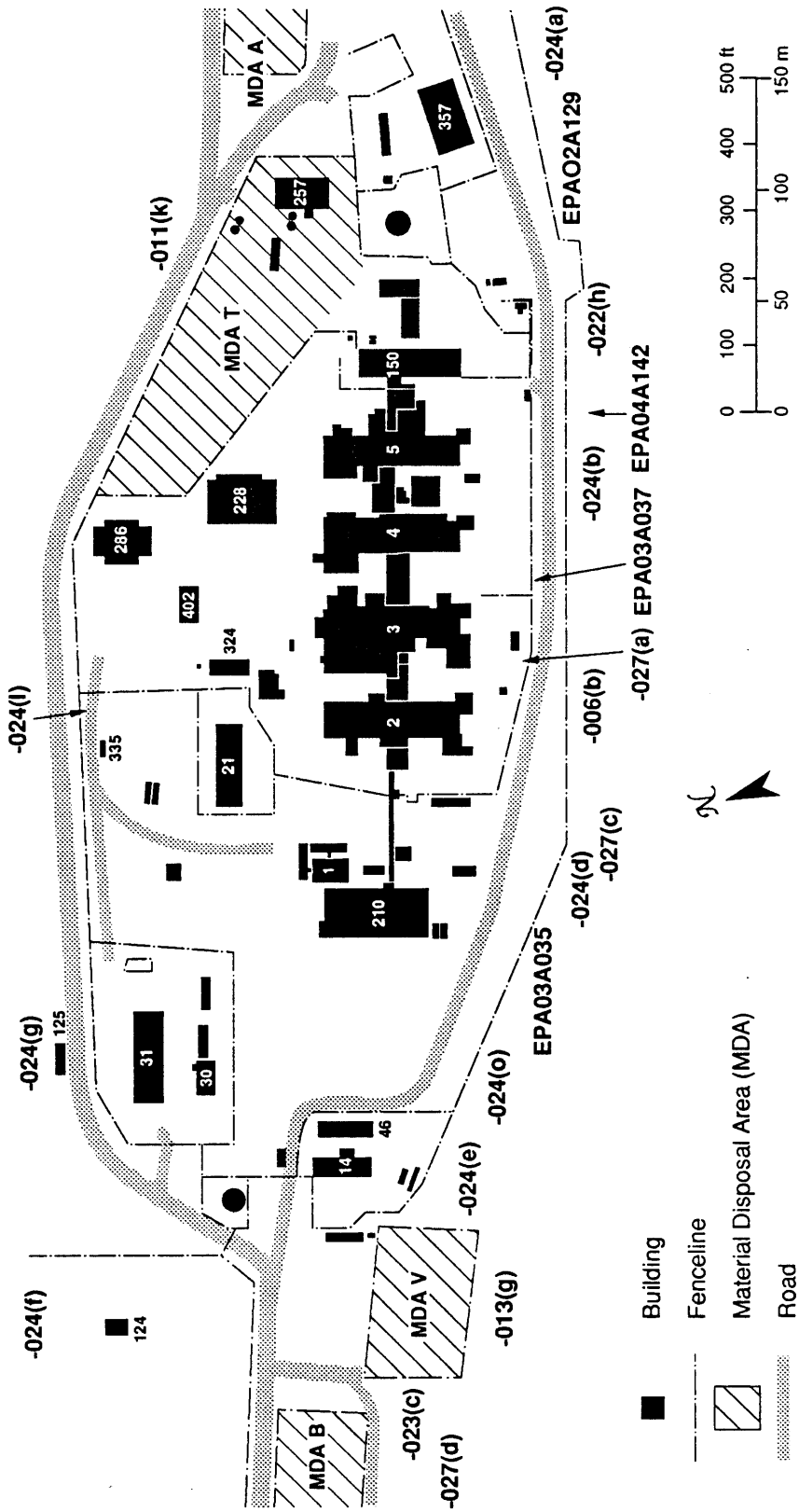


Fig. 15.1-1 Locations of outfalls at DP West.

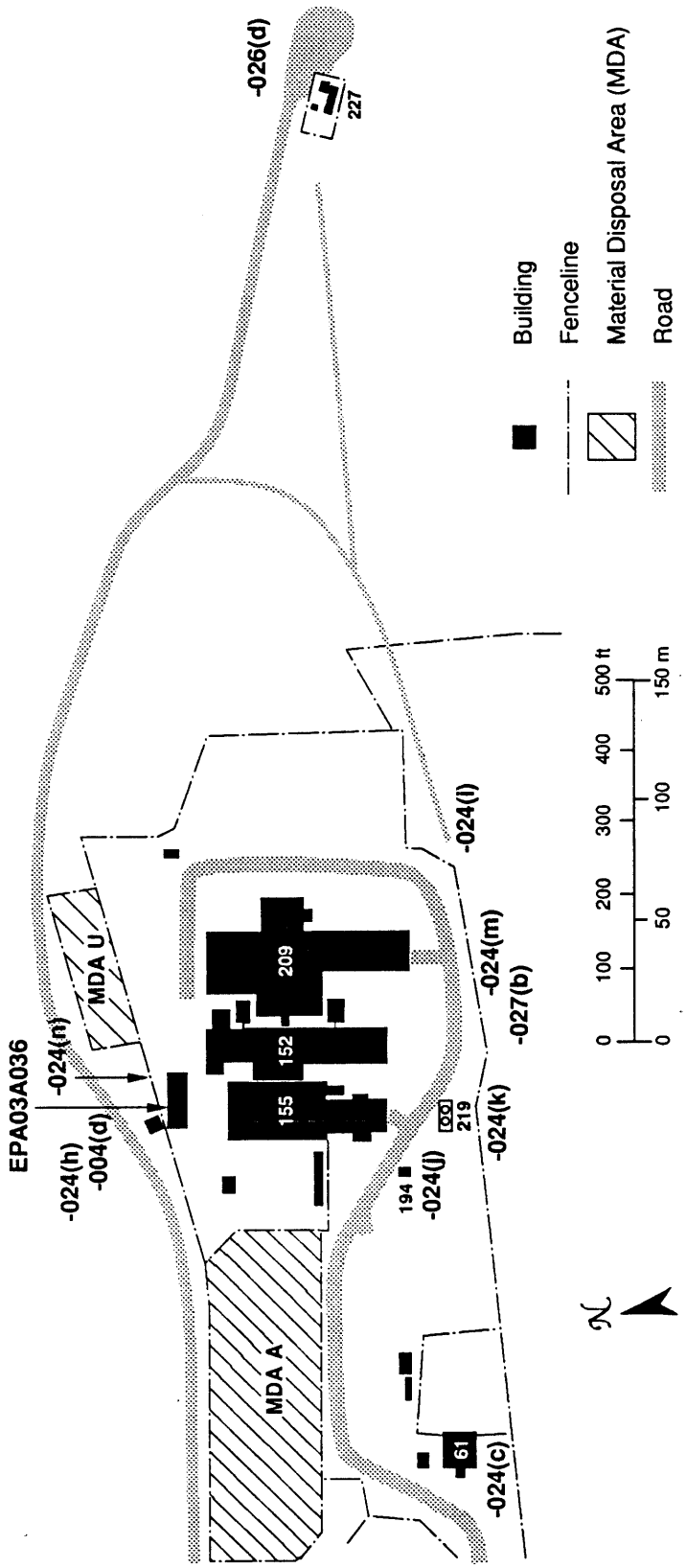


Fig. 15.1-2 Locations of outfalls at DP East.

15.1.1 Outfall Groups

There are 30 individual outfalls covered in this chapter; they are organized into nine sections, as follows:

- 15.2 Outfalls with Undetermined Locations
  SWMU 21-023(c)
  SWMU 21-024(a)
  SWMU 21-024(g)
  SWMU 21-024(l)
  SWMU 21-027(c)
  SWMU 21-027(d)

- 15.3 Outfalls with Septic Tanks
  SWMU 21-024(b)
  SWMU 21-024(c)
  SWMU 21-024(d)
  SWMU 21-024(e)
  SWMU 21-024(i)

- 15.4 Direct Discharge Outfalls
  SWMU 21-011(k)
  SWMU 21-022(h)
  SWMU 21-024(n)
  SWMU 21-024(o)
  SWMU 21-026(d)

- 15.5 Surface Drainage South of TA-21-3
  SWMU 21-027(a)

- 15.6 Septic Tanks
  SWMU 21-024(j)
  SWMU 21-024(k)

- 15.7 Surface Drainage South of TA-21-155
  SWMU 21-024(m)
  SWMU 21-027(b)

- 15.8 Surface Drainage North of TA-21-155
  SWMU 21-004(d)
  SWMU 21-024(h)

- 15.9 Special Cases
  SWMU 21-006(b)
  SWMU 21-024(f)

- 15.10 NPDES Discharge Systems
  EPA 02A129
  EPA 03A035
  EPA 03A036
  EPA 03A037
  EPA 04A142

A summary of the investigations planned in this chapter is given in Sec. 15.1.6.

15.1.2 Previous TA-21 Outfall Sampling

Surface soil samples of 18 outfalls at TA-21 were taken between October 25, 1988, and October 21, 1988 (DOE 1989). This was a subset of the 32 known outfalls at that time. NPDES-permitted outfalls and outfalls directly over the abrupt north face of Los Alamos Canyon were not sampled.

Outfall sample locations were screened with three instruments: Micro R meter, FIDLER, and Geiger-Mueller detector. Surface soil samples were analyzed at an EPA-certified laboratory for radioactive constituents, metals, volatiles, BNAs, pesticides, and oil and grease. The following radionuclides were analyzed: ^{241}Am, ^{137}Cs, ^{238}Pu and $^{239/240}Pu$ (isotopic), ^{226}Ra, ^{90}Sr, ^{232}Th, $2^{34}U$, and $^{235/238}U$ (isotopic).

Because only one sample was taken at each outfall, this data will only be used to indicate what contaminants may be present at a given outfall. Generally, analytical results showed metals and radionuclides in numerous samples. All samples with elevated inorganic contaminants (metals) also had radioactive constituents present.

DOE Headquarters conducted environmental sampling at Los Alamos, April 25 through June 23, 1988 (DOE 1989b). DOE environmental survey problem numbers 6 and 19 contained sampling locations at TA-21. Soils near NPDES Outfall 50 suspected to be contaminated with heavy metals and radionuclides by waste water discharged from TA-21-257 [see Sec. 15.4 SWMU 21-01(k)] were sampled as part of DOE environmental survey problem number 6. Soil adjacent to waste freon drums southwest of the TA-21-3 drainage ditch was sampled under DOE environmental survey problem number 19. These analytical results are discussed in conjunction with Outfalls under SWMU 21-027(a) in Sec. 15.5.

15.1.3 Approach to Outfalls Characterization

Two concepts are inherent in the plans developed for characterizing the outfalls. First, based on a review of reconnaissance sampling data of 19 samples from 18 outfalls (DOE 1989a), it has been found in every case that if there were no radioactive contaminants, there also were no nonradioactive contaminants present. (Note: the reconnaissance sampling results are presented in the following sections.) In some cases, radioactivity was detected in the absence of other contamination, but the reverse was not observed. This observation leads to the use of radioactivity as an indicator of the presence of contamination as a field tool.

Second, based on the results of the reconnaissance sampling, it is believed that minimal contamination is present in the outfall drainages of TA-21. An objective of the characterization of the outfalls is to supplement the small number of available sample analysis results by providing additional data from locations having a high probability of being contaminated, if contaminants are present. To ensure that the sample analyses provide a defensible basis for planning further actions, a full analytical suite will be used for most samples. This approach will provide additional information on contaminants that have been measured in the past; and confirmation of the absence of other contaminant species.

These data will be used to assess necessary actions at each outfall. It is expected that many will not require further action, and those for which some action may be needed may best be addressed in the context of a removal action rather than further characterization.

15.1.4 Outfall Drainage Sampling Strategy

The concept of using the presence of radioactivity as a field tool is an important part of the characterization strategy in several of the outfall drainages. In a number of cases, either the outfall location or the exact drainage path from an outfall is uncertain. Where possible, field radiation surveys will be employed to identify those locations or paths, so they may be sampled explicitly. This is referred to as Strategy A and is used in several of the sampling plans presented in this chapter. When field radiation surveys are not successful in defining the locations or paths, the alternative approach will be to bound the possible locations with sampling points. This is referred to as Strategy B and is used in vague drainages when Strategy A is unsuccessful. A third strategy, Strategy C, will be used for clearly defined drainage paths where there is little uncertainty in the flow path of a discharge. Such drainages will be sampled in the channel, preferably from ponding or pooling areas.

Formal statements of Strategies A, B, and C are provided below. These will be referenced as needed by the sampling plans presented in this chapter.

1. **Strategy A.** If a drainage pattern is identified by the field radiological survey, surface soil samples (0–6 in. or at differing depths as detailed in the field sampling plans) will be taken from the contaminated areas that define the pattern. Surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison. Fig. 15.1-3 is a graphic representation of this sampling scheme.

2. **Strategy B.** If no pattern of contamination is found using Strategy A, a series of surface soil samples (0–6 in. or at differing depths as detailed in the field sampling plans) will be taken from the slope below the best identified location of the outfall discharge. Three sampling points will be

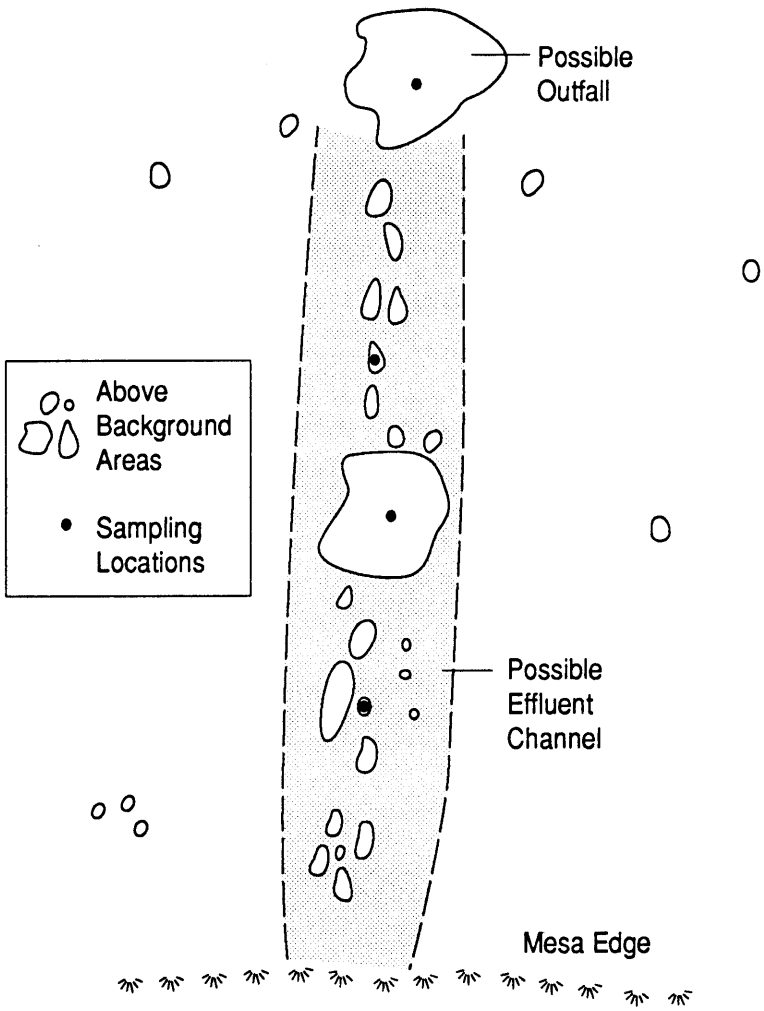


Fig. 15.1-3 Sampling strategy A.

spaced at nominal 5-ft intervals in a line across the probable drainage path. These three sample groups will be placed at roughly 15-ft intervals down the flow path between the outfall and the mesa edge. This method is expected to give a reasonable probability of bounding the effluent channel, recognizing the potential for errors in determining the location of the outfall. The spacing between the three sample groups may vary depending on the proximity to the mesa edge, the need to sample a bench below the mesa edge, and other factors. Figure 15.1-4 is a graphic representation of this sampling scheme. As for Strategy A, surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison.

3. **Strategy C.** If no pattern of contamination is found using Strategy A for drainages with well-defined channels (assumed to be stable channels), surface soil sampling (0–6 in. or differing depths as detailed in the field

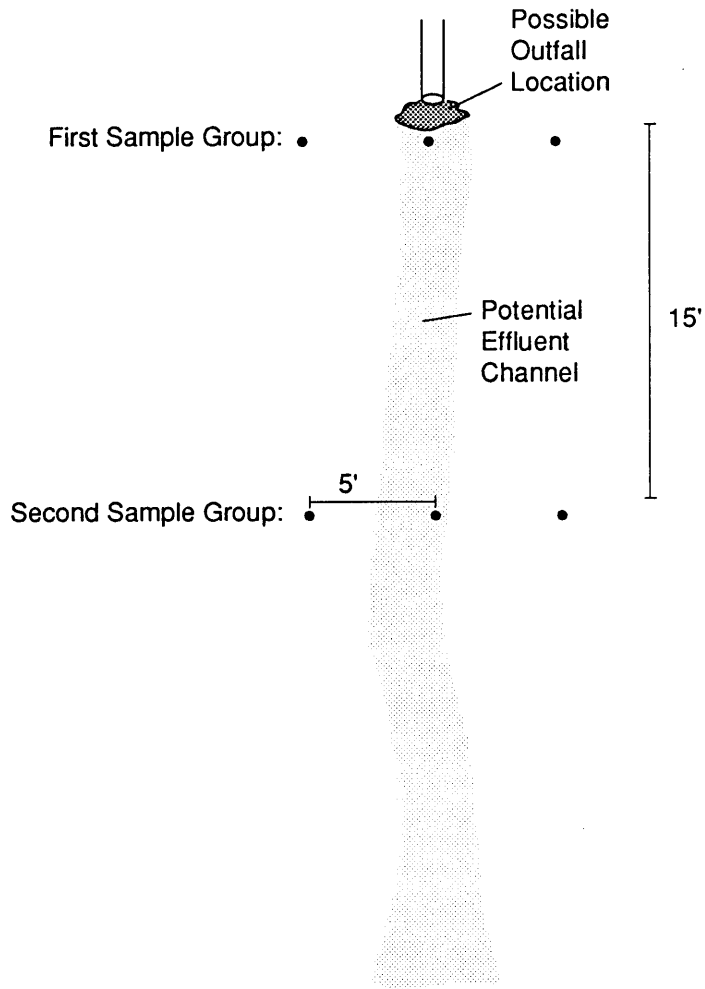


Fig. 15.1-4 Sampling strategy B.

sampling plans) will be done in the channel. In general, one sample location will be at the point of discharge, and at least one additional location will be sampled in a pooling area or likely sedimentation point 15 to 50 ft from the discharge. Surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison. Figure 15.1-5 illustrates this strategy.

For all three strategies, the number of sampling locations, the type of sampling method, and the depth to be sampled may vary from investigation to investigation. In addition, the number of points sampled down the course of each drainage may differ based on the specific characteristics of the drainage channel. As stated above, OU-wide surface soil contaminant levels determined

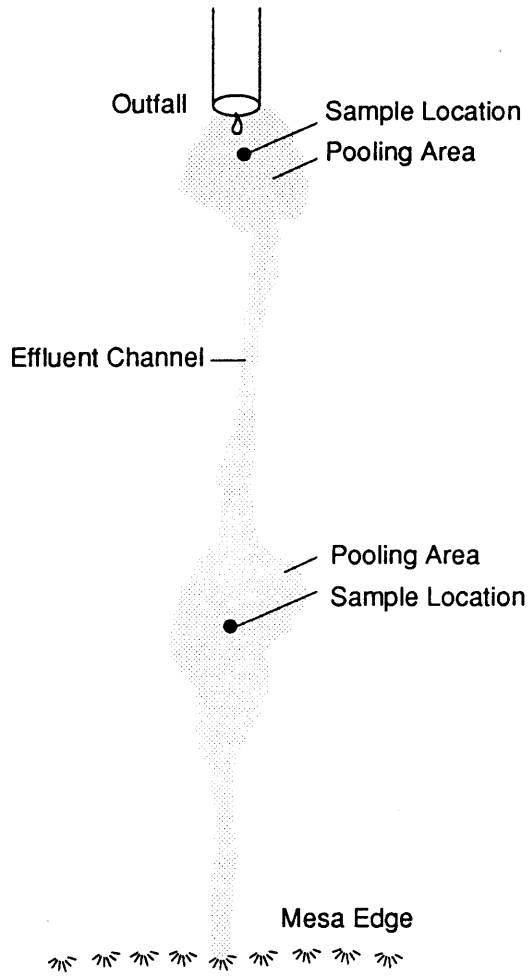


Fig. 15.1-5 Sampling strategy C.

as part of OU-wide characterization will aid in distinguishing contaminant levels because of site-wide releases or other influences not related to discharges from contaminated outfalls.

15.1.5 Septic Tank Sampling Strategy

A single borehole will be drilled and sampled at existing septic tanks at the point where leakage is most likely (beside the center of the tank or near tank inlet or outlet line), to define the presence and depth of contamination. This information will provide input to the CMS for planning septic tank removal. No further RFI septic tank characterization will be conducted.

15.1.6 Summary of Chapter 15 Outfall Sampling

For outfalls, the pathways of concern identified in Chapter 5 include surface run-off, infiltration, and vapor-phase movements. The no-action alternative was identified in Chapter 10 as a potential appropriate remedial alternative for all of the SWMUs listed in this chapter. The review of available information has determined that the field investigations at seven of the SWMUs [21-006(b), -024(f), (h), (g), (k), and (m), and -027(b)] and at the NPDES systems may determine that environmental releases have not occurred at these sites. After this determination, the site will be proposed for no further investigation. Other preliminary remedial alternatives identified for this chapter's SWMUs include treatment, removal and disposal, and removal and treatment. The analysis of preliminary remedial alternatives for each SWMU is tabulated in Table 10-I. The strategy for the field investigations to characterize the SWMUs in this chapter is presented in Fig. 15.1-6. The field survey measurements and field screening measurements are defined in Chapter 11. Tables 15.1-II and 15.1-III summarize measurements and analyses for subsurface soil samples to be taken during the initial investigation at all outfalls addressed in this chapter.

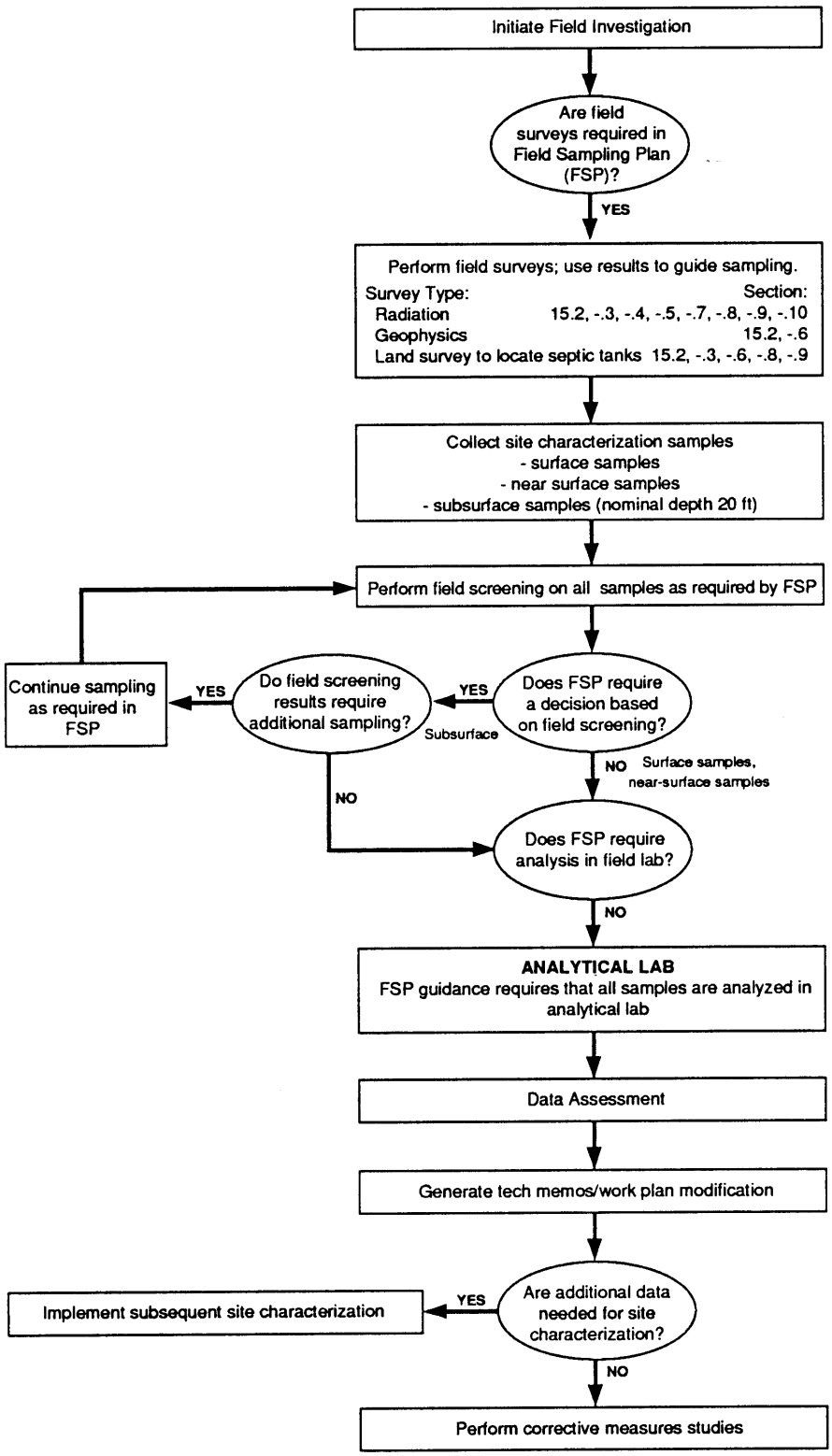


Fig. 15.1-6 Logic flow for field investigations to characterize outfalls.

15.1-II SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 15.

Section	Description	Survey Areas			Surface	Near Surface Soil Samples		Trench	
		Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples	No. of Locations	No. of Samples
15.2	Undetermined Locations	9	12	1	24	12	30	1	
15.3	Outfalls with Septic Tanks	7	10		1	11	26	4	
15.4	Direct Discharge Outfalls		8		4	11	31		
15.5	Drainage South TA-21-3		2		14				
15.6	Septic Tanks	2	2	2					
15.7	Drainage South of TA-21-155		2			2	6		
15.8	Drainage North of TA-21-155	1	4			9	27	1	
15.9	Special Cases		4		6	3	9		
15.10	NPDES Discharge Systems		10			10	30		
	Total	19	54	3	49	58	159	6	

Section	Description	Boreholes						Q A
		Shallow			Vertical			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
15.2	Undetermined Locations				3	60	12	15
15.3	Outfalls with Septic Tanks				5	100	20	11
15.4	Direct Discharge Outfalls							7
15.5	Drainage South TA-21-3				2	40	8	4
15.6	Septic Tanks				4	80	16	5
15.7	Drainage South of TA-21-155							4
15.8	Drainage North of TA-21-155				1	20	4	7
15.9	Special Cases	1	10	4	1	20	4	7
15.10	NPDES Discharge Systems							7
	Total	1	10	4	16	320	64	67

15.1-III SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 15

	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	15.10		Total
Field Sample Screening											
Gross Gamma	66	47	35	22	16	6	31	23	30		276
Gross Alpha	66	47	35	22	16	6	31	23	30		276
Organic Vapor	67	51	35	22	16	6	32	23	30		282
Combustible Gas/Oxygen	13	20		8	16		5	8			70
Lithological Logging	12	21		8	16		4	8			69
Field Laboratory Measurements											
Gross Alpha											
Gamma Spectrometry											
Tritium											
Volatile Organics											
PCB											
Soil Moisture											
Laboratory Analysis											
Gamma Spectrometry	75	54	39	24	18	8	35	27	34		314
Tritium	75	54	39	24	18	8	35	27	34		314
Total Uranium	75	54	39	24	18	8	35	27	34		314
Isotopic Plutonium	75	54	39	24	18	8	35	27	34		314
Isotopic Uranium											
Strontium 90	75	54	39	24	18	8	35	27	34		314
VOA (SW 8240)	81	58	42	26	21	10	38	30	37		343
Semivolatiles (SW 8270)	80	57	41	25	19	9	37	29	36		333
Metals (SW 6010)	80	57	41	25	19	9	37	29	36		333
PCB (SW 8080)		11									11
TCLP Metals											
Isotopic Thorium		54	39	24	18	8	35	27			205

15.2 Outfalls with Undetermined Locations

15.2.1 Site Description

The six outfalls described in this section have no physical evidence to indicate their location. They have been grouped together because similar investigations are planned to determine locations and identify the presence of contamination.

15.2.1.1 History

SWMU 21-023(c) was a septic system (CEARP identifier 3y) that routed sewage from Building TA-21-33 through septic tank TA-21-62 to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.2-1). TA-21-33 was the old waste treatment laboratory where research into recovery of plutonium from liquid process wastes was performed. TA-21-33 (SWMU 21-009) and associated drain lines are addressed in Sec. 17.3.

The septic system included a concrete tank, 3-ft 6-in. wide by 7-ft long and 5-ft 10-in. deep, and the associated 4-in.-diameter vitrified clay pipe (VCP). The septic tank was probably built in the first half of 1948 (LASL 1948) and was removed on April 12, 1965, when it was taken to the "contaminated dump" (MDA G), as was Building TA-21-33 (Jenike 1965).

No evidence of either the outfall or the septic tank has been identified in the field. The flow pattern for the area below the septic tank may have been altered as a result of the 1965 removal of the building and the tank because some rubble is known to have been bulldozed over the mesa edge (see Sec. 14.7, Surface Disposal Areas). It is also unknown whether the drain line from the sump discharged onto the mesa or at the mesa edge. The end of the outfall line was reported to be 40 ft from the septic tank (LASL 1958).

SWMU 21-027(d) (no CEARP identifier) consisted of a 4-in. steel drain line that extended from the catch basin around a fuel tank (TA-21-47) south toward Los Alamos Canyon (Fig. 15.2-1). The line drained storm run-off from the bermed area around TA-21-47. Originally this line discharged where building TA-21-33 (see above) was built but was extended toward the south rim of DP Mesa as a result of the construction of that building. The drain line was removed in March 1965 (LASL 1965).

SWMU 21-024(a) was a septic system (CEARP identifier 3m) that routed sewage from Building TA-21-9 through septic tank TA-21-53 (abandoned in place in 1966) to the surface on the south

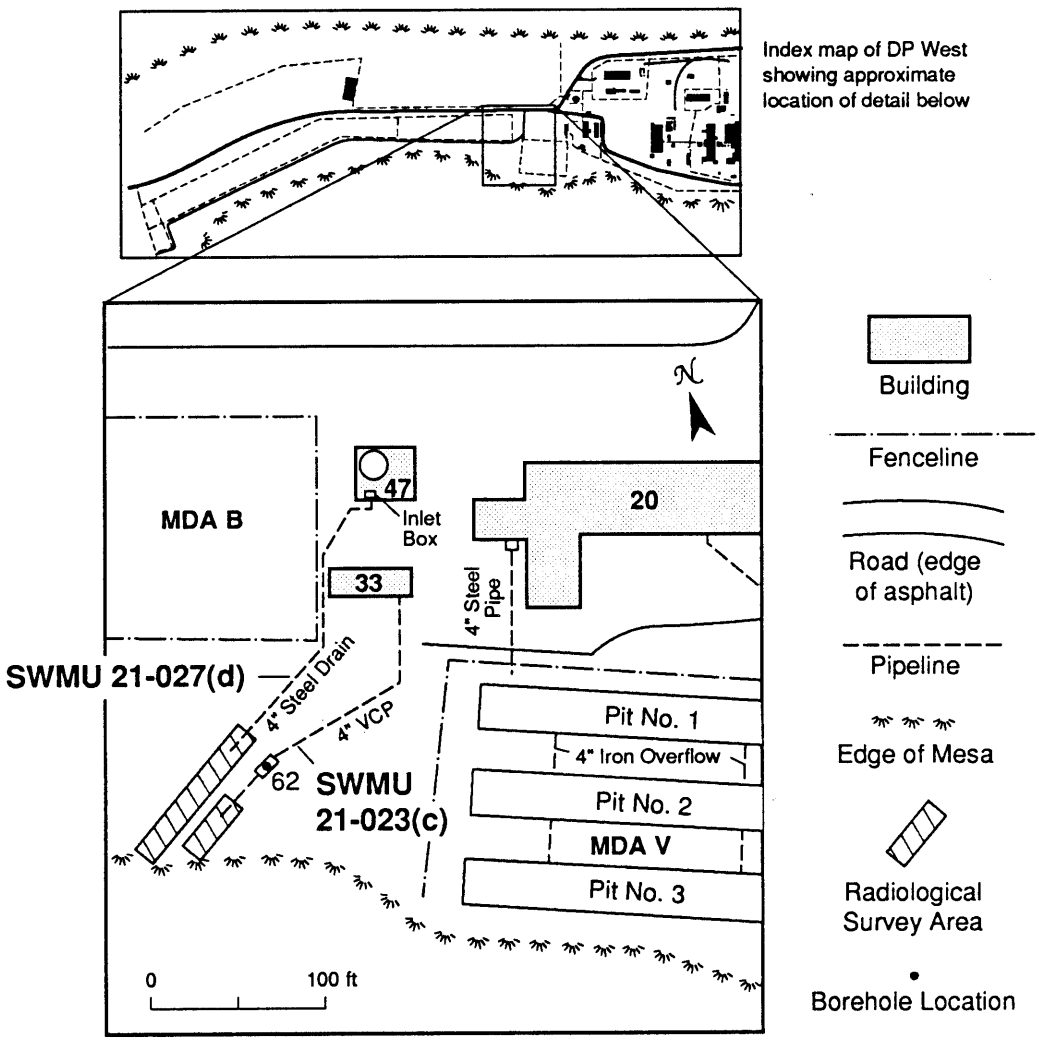


Fig. 15.2-1 Location of SWMUs 21-023(c) and 21-027(d), and radiological survey areas. (LASL 1958b, 1961)

rim of DP Mesa above Los Alamos Canyon (Fig. 15.2-2). TA-21-9 was the old steam plant. The reinforced concrete septic tank is 8-ft wide by 16-ft long and 7-ft 9-in. deep, and the drain lines are 6-in. VCP (LASL 1958d). Currently, there is no surface expression of the outfall line or the septic tank, although there is a sign bearing the designation "Septic Tank 53" south of the perimeter road, south of Building TA-21-9.

A number of blowdown lines from TA-21-9 also run south toward Los Alamos Canyon (LASL 1958d). Releases from these lines would commingle with those from the septic system, clouding the origin of any contaminants. The blowdown lines were reported to have been abandoned

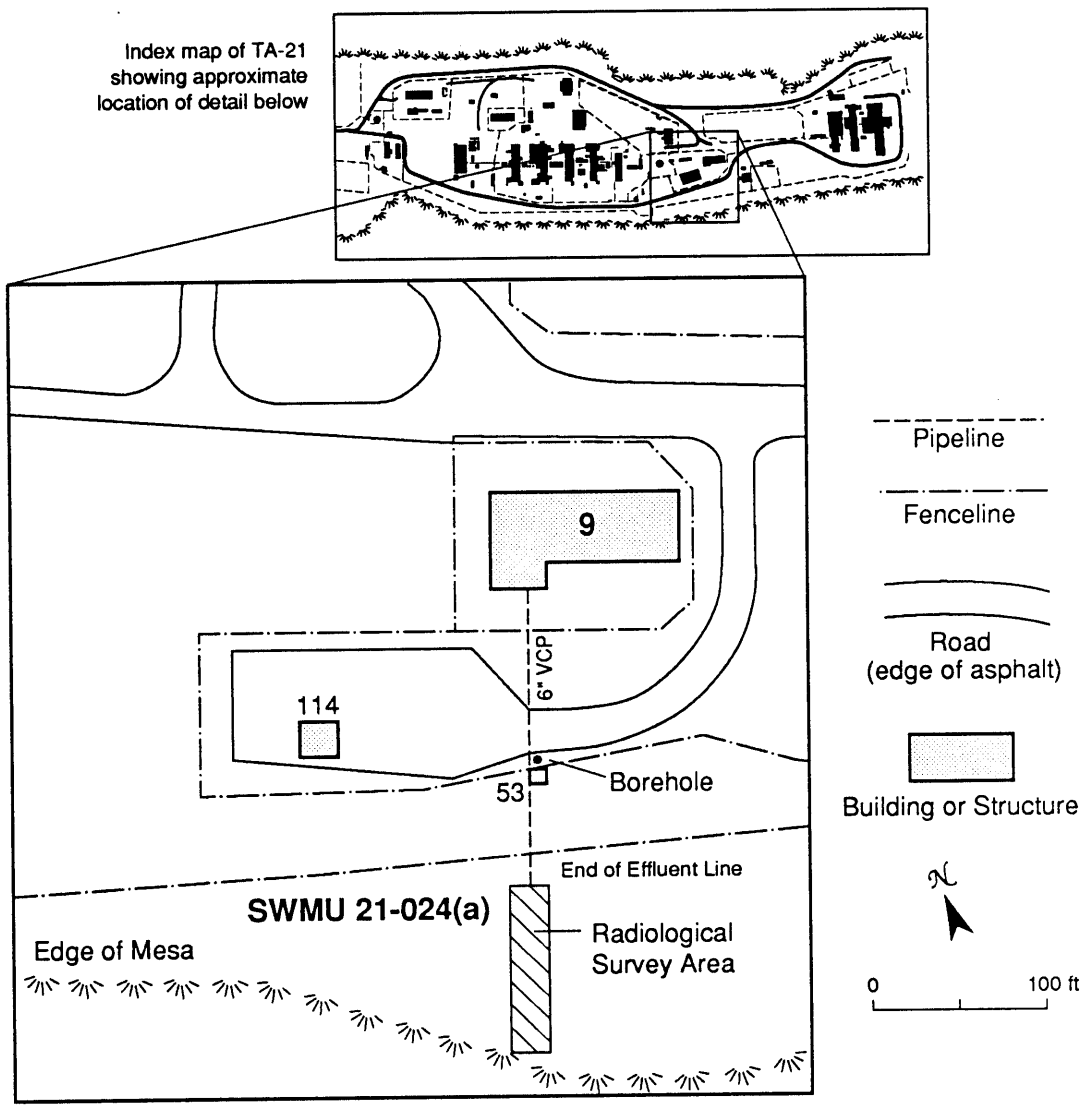


Fig. 15.2-2 Location of SWMU 21-024(a), septic tank sampling borehole, and radiological survey area. (LASL 1958d)

when the blowdown was routed to seepage pits and a dry well. These other components of the blowdown system (SWMU 21-012) are addressed in Sec. 17.4, Dry Wells.

An ER Program site visit on July 26, 1988, identified an enclosed pipeline, assumed at that time to be the outfall associated with SWMU 21-024(a), which went down the canyon wall and entered the ground on the canyon floor. Recent investigations have confirmed that pipeline as a high-pressure gas line. Therefore, no physical evidence of an outfall has been identified in the field.

SWMU 21-024(g) was a septic system (CEARP identifier 3l) that routed sewage from Buildings TA-21-7 and TA-21-31 through septic tank TA-21-125 (abandoned in place in 1966) to the surface on the north rim of DP Mesa above DP Canyon (Fig. 15.2-3). Building TA-21-7 was a warehouse and Building TA-21-31 an electronics shop. The reinforced concrete septic tank is 9-ft 6-in. wide by 18-ft long and 5-ft deep. The drain lines used in this septic system are 4-in. VCP (LASL 1958a).

There is no surface evidence of either the outfall or the septic tank. An outfall marker was placed at the sign identifying tank TA-21-125. Based on the reported distance to a nearby storm drain (LASL 1958a), the tank and outfall are probably 10 ft west of the current marker.

SWMU 21-024(l) (CEARP identifier 3x) originated in the mechanical room of Building TA-21-21 as a floor drain. It discharged to the north toward DP Canyon. TA-21-21 is the vault used for storage of plutonium and uranium metal. No drawing has been found showing the path of the drain to the outfall. It is possible that the outfall was near the present location of an aboveground tank, TA-21-335. A second likely location is a culvert approximately 40 ft northeast of TA-21-335 (Fig. 15.2-4). A CEARP marker was placed near the culvert.

SWMU 21-027(c) (CEARP identifier 3c) is reported to be a 4-in. VCP exiting from the southeast corner of Building TA-21-6 (Fig. 15.2-5). TA-21-6 housed a machine shop and cafeteria and was removed in 1966 (LASL 1968b). The drain line is believed to have been abandoned in place (LANL 1990). It discharged to the south on DP Mesa, approximately 50 ft inside the south perimeter fence (LASL 1961) in a broad, gently sloping area with no readily identified channel. It is approximately 50 ft further from the fence to the mesa edge.

15.2.1.2 Existing Information

Three of the outfalls were sampled in October 1988 as part of an ER Program reconnaissance sampling program. The soil samples collected were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work protocols for Target Compound List volatile organic compounds, semi-volatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. When these analysis results are cited below, they are referenced DOE 1989.

SWMU 21-023(c) was sampled at a single point in the outfall channel, 8 ft southwest of the outfall marker. Positive analysis results are summarized in Table 15.2-I (DOE 1989a). Compar-

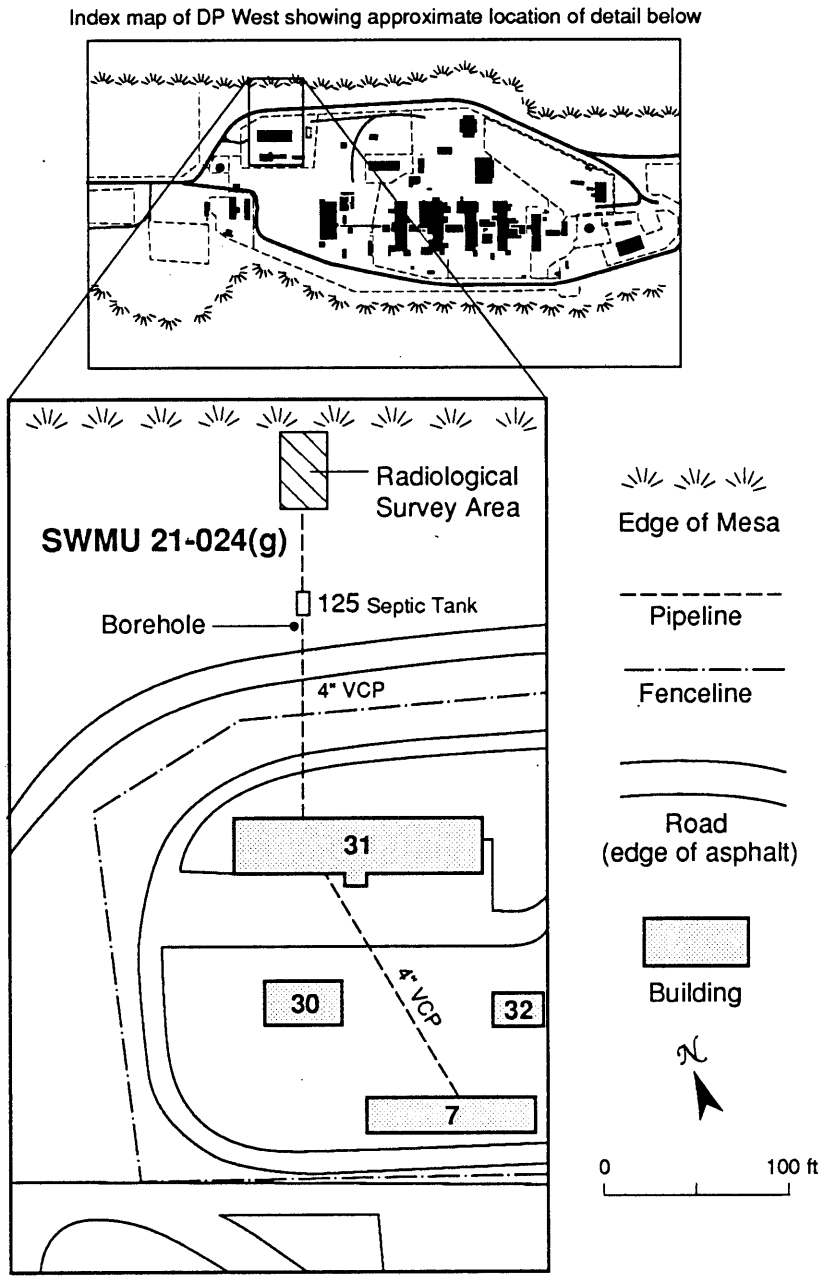


Fig. 15.2-3 Radiological survey area and septic tank sampling location at SWMU 21-024(g). (LASL 1958a)

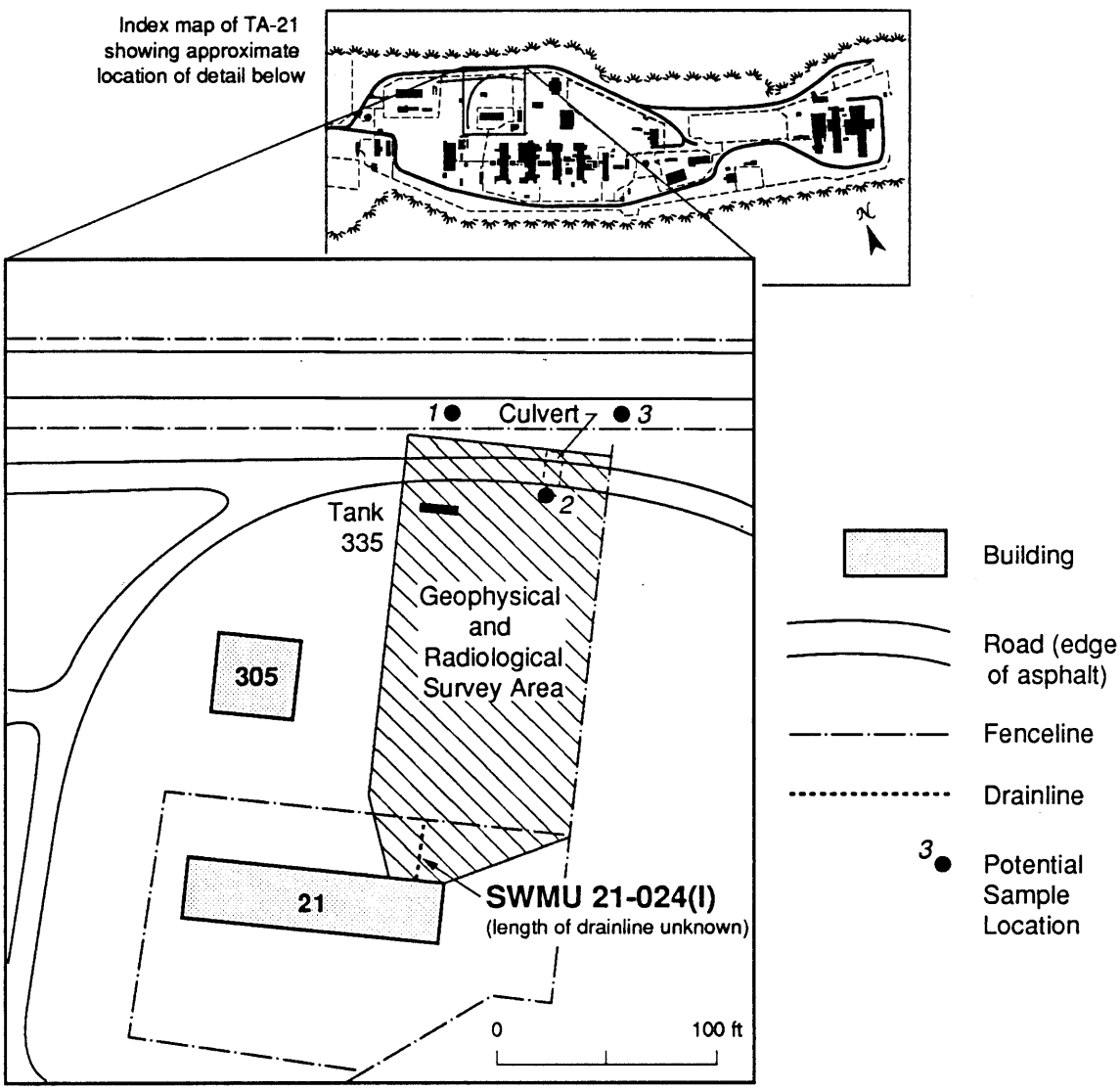


Fig. 15.2-4 Location of SWMU 21-024(I), geophysical and radiological survey area, and potential sampling locations. (LASL 1960; LANL 1983)

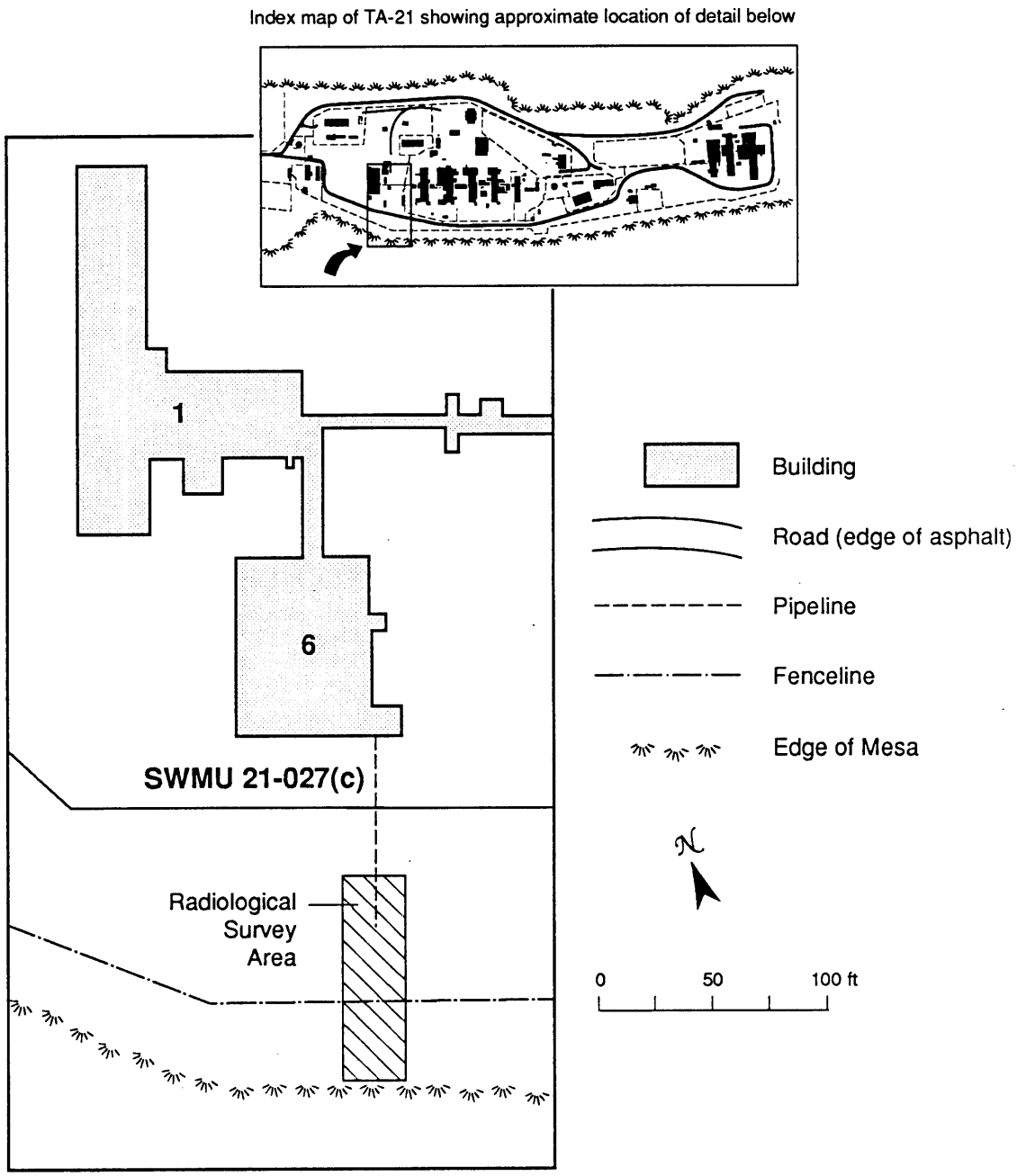


Fig. 15.2-5 Location of SWMU 21-027(c) and radiological survey area. (LASL 1961)

TABLE 15.2-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS
21-023(c), 21-024(g) and (l)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-023(c)	ALUMINUM, TOTAL	3370	MG/KG	33	65,000
	BARIUM, TOTAL	50.8	MG/KG	33	850
	CALCIUM, TOTAL	869	MG/KG	826	—
	CHROMIUM, TOTAL	3.0	MG/KG	2.0	75
	COPPER, TOTAL	4.7	MG/KG	4.0	19
	IRON, TOTAL	3610	MG/KG	17	26,600
	LEAD, TOTAL	53.8	MG/KG	8.0	54
	MANGANESE, TOTAL	157	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	244	MG/KG	49.8	—[c]
	ZINC, TOTAL	18.9	MG/KG	4.0	78
	Radionuclides				
	PLUTONIUM-239	0.2	PCI/G	0.1	0.025
	RADIUM-226	1.0	PCI/G	0.1	2.5
	THORIUM-232	1.1	PCI/G	0.2	1.8
	TRITIUM	5.0	PCI/ML	2.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.1	1.7
	Volatile Organics				
SWMU 21-024(g)	TETRACHLOROETHENE	13	UG/KG	6	—[c]
	Metals				
	Sample #1				
	ALUMINUM, TOTAL	1590	MG/KG	27	65,000
	BARIUM, TOTAL	38.5	MG/KG	27	850
	CALCIUM, TOTAL	1460	MG/KG	680	—
	CHROMIUM, TOTA	L2.9	MG/KG	2.0	75
	IRON, TOTAL	2820	MG/KG	14	26,600
	LEAD, TOTAL	69.4	MG/KG	14	54
	MANGANESE, TOTAL	104	MG/KG	2.0	770
	OIL & GREASE BY GRAVIMETRIC	848	MG/KG	51	—[c]
	ZINC, TOTAL	25.4	MG/KG	4.0	78
	Sample #2				
	ALUMINUM, TOTAL	3690	MG/KG	50	65,000
	ARSENIC, TOTAL	15.4	MG/KG	10	7.1
	BARIUM, TOTAL	137	MG/KG	50	850
	CADMIUM, TOTAL	4.8	MG/KG	2.0	0.37
	CALCIUM, TOTAL	3920	MG/KG	1250	—

TABLE 15.2-I (continued)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	CHROMIUM, TOTAL	22.6	MG/KG	4.0	75
	COPPER, TOTAL	57.1	MG/KG	6.0	19
	IRON, TOTAL	5170	MG/KG	25	26,600
	LEAD, TOTAL	77.2	MG/KG	11	54
	MAGANESE, TOTAL	216	MG/KG	4.0	770
	MERCURY, TOTAL	12.2	MG/KG	0	0.03
	NICKEL, TOTAL	18.9	MG/KG	10	18.5
	OIL & GREASE BY GRAVIMETRIC	2280	MG/KG	62	—[c]
	VANADIUM, TOTAL	52	MG/KG	13	—
	ZINC, TOTAL	399	MG/KG	6.0	78
	Radionuclides				
	Sample #1				
	RADIUM-226	0.9	PCI/G	0.1	2.5
	THORIUM-232	0.5	PCI/G	0.2	1.8
	TRITIUM	5.0	PCI/ML	2.0	0.0072
	URANIUM-234	0.6	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7
	Sample #2				
	CESIUM-137	0.8	PCI/G	0.1	0.44
	PLUTONIUM-239	2.7	PCI/G	0.4	0.025
	RADIUM-226	1.1	PCI/G	0.1	2.5
	STRONTIUM-90	0.2	PCI/G	0.1	0.88
	THORIUM-232	0.9	PCI/G	0.1	1.8
	TRITIUM	900	PCI/ML	20	0.0072
	URANIUM-2348.9	PCI/G	0.7		
	URANIUM-238	5.0	PCI/G	0.5	1.7
	Volatile Organics				
SWMU 21-024(I)	DICHLOROMETHANE -METHYLENE CHLORIDE[a]	75	UG/KG	55	—[c]
	Semi-Volatile Organics[b]				
	BENZO (A) ANTHRACENE	2200	UG/KG/	2000	—[c]
	BENZO (A) PYRENE	2500	UG/KG	2000	—[c]
	BENZO (B) FLUORANTHENE	2100	UG/KG	2000	—[c]
	BENZO (G,H,I) PERYLENE	2200	UG/KG	2000	—[c]
	BENZO (K) FLUORANTHENE	2500	UG/KG	2000	—[c]
	CHRYSENE	2800	UG/KG	2000	—[c]

TABLE 15.2-I (continued)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	FLUORANTHENE	5600	UG/KG	2000	—[c]
	PHENANTHRENE	4900	UG/KG	2000	—[c]
	PYRENE	6200	UG/KG	2000	—[c]
	Metals				
	ALUMINUM, TOTAL	6210	MG/KG	32.4	65,000
	BARIUM, TOTAL	65.6	MG/KG	32.4	850
	CALCIUM, TOTAL	1500	MG/KG	811	—
	CHROMIUM, TOTAL	5.3	MG/KG	1.6	75
	COPPER, TOTAL	6.1	MG/KG	4.1	19
	IRON, TOTAL	6150	MG/KG	16.2	26,600
	LEAD, TOTAL	14.6	MG/KG	3.7	54
	MAGNESIUM, TOTAL	1110	MG/KG	811	4,700
	MANGANESE, TOTAL	160	MG/KG	2.4	770
	OIL & GREASE BY GRAVIMETRIC	1550	MG/KG	53.5	—[c]
	VANADIUM, TOTAL	12.3	MG/KG	8.1	—
	ZINC, TOTAL	195	MG/KG	3.2	78
	Radionuclides				
	AMERICIUM	0.4	PCI/G	0.1	—
	CESIUM-137	0.4	PCI/G	0.1	0.44
	PLUTONIUM-239	3.4	PCI/G	0.4	0.025
	RADIUM-226	1.6	PCI/G	0.2	2.5
	STRONTIUM-90	0.3	PCI/G	0.1	0.88
	THORIUM-232	1.2	PCI/G	0.2	1.8
	TRITIUM	55	PCI/ML	3.0	0.0072
	URANIUM-234	1.1	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.1	1.7

[a]This a common analytical laboratory contaminant. It is listed here for completeness.
[b]The polynuclear aromatic hydrocarbons (PAHs) listed here are common constitutents of asphalt, and are listed here for completeness. They are not contaminants of concern.
[c]Background assumed to be zero.
[d]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.

ing the results to the data presented in Sec. 4.2.4 indicates above-background levels of $^{239/240}Pu$ and tritium. Oil and grease were found in concentrations greater than the detection limit by gravimetric analysis.

SWMU 21-027(d). There is no quantitative information for this outfall.

SWMU 21-024(a). There is no quantitative information available for this outfall.

SWMU 21-024(g) was sampled at two locations, 13 ft 4 in. and 28 ft east of the CEARP marker. Results of these analyses are shown in Table 15.2-I (DOE 1989a). Comparing the results to the data presented in Sec. 4.2.4 indicates above-background levels of $^{239/240}Pu$, tritium, ^{234}U ^{238}U, ^{137}Cs, lead, arsenic, mercury, zinc, copper, cadmium, and nickel. Tetrachloroethene and oil/grease were found in concentrations above the detection limit.

SWMU 21-024(l) was sampled 2 ft 2 in. east-southeast of the CEARP marker in a roadside ditch. Results of these analyses are shown in Table 15.2-I (DOE 1989a). Comparing the results to the data presented in Sec. 4.2.4 indicates above-background levels of ^{241}Am, $^{239/240}Pu$, tritium, and zinc. Dichloromethane, which is a common lab contaminant, was found in concentrations greater than the detection limit as was oil/grease by gravimetric analysis. All the polynuclear aromatic hydrocarbons (PAHs) found are common constituents of asphalt and therefore are not considered further.

SWMU 21-027(c). No quantitative information exists for this outfall.

15.2.1.3 Source Term

Plutonium and tritium, which are site-wide contaminants, may be found at all outfalls.

SWMU 21-023(c) sample analysis has identified $^{239/240}Pu$ and tritium. Potential contaminants from research at TA-21-33 include plutonium-process organic solvents, such as hexone, penta-ether, and tri-n-butyl phosphate. Other by-products of plutonium processing may include nitrates, chlorides, mercury, americium, thorium, cobalt, uranium, and zirconium.

SWMU 21-027(d). Organics from petroleum products are the only likely contaminants to be discharged from this outfall, which originates in the catch basin around fuel tank TA-21-47. However, contaminants resulting from outfall SWMU 21-023(c) may also be found because of the proximity of the two outfalls.

SWMU 21-024(a) was a septic system serving TA-21-9, the steam plant, which did not house any operations producing hazardous materials. However, fuel oil leaks from the boiler may have entered the septic system by way of floor drains, and common boiler blowdown constituents, such as sulfite and copper salts, may have entered the system in the same way.

SWMU 21-024(g) sample analysis identified lead, arsenic, copper, mercury, zinc, oil/grease, tetrachloroethene, and the radionuclides $^{239/240}Pu$, tritium, ^{234}U, and ^{238}U. In addition, organic solvents used to clean electronic equipment, such as carbon tetrachloride, may be present because of operations in the electronics shop.

SWMU 21-024(l) sample analyses identified zinc, ^{241}Am, $^{239/240}Pu$, tritium, and oils. Uranium is also a possible contaminant because the outfall reportedly originated in TA-21-21, which was used to store uranium and plutonium metal.

SWMU 21-027(c). The most likely contaminants from this outfall are organic solvents and oils used in the machine shop portion of TA-21-6. Hazardous and radioactive contaminants are not likely to have been present, based on the presence of the cafeteria in this building.

15.2.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at each of these areas. The specific data required to assess contamination at these areas include the following:

1. Determine the locations of septic tanks TA-21-62, TA-21-125, and TA-21-53 and locate the discharge point for the six outfalls. In many cases, there is no physical evidence of the outfall or septic system.

2. Identify the contaminants present using Level II and III data. No quantitative data exist for three outfalls. For the remaining outfalls, radionuclide, metals, and some organic contaminants were previously identified.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.2.3. Sampling/Investigation Rationale

The outfall and septic tank locations [except SWMU 21-024(l)] will be marked in the field by surveys based on old engineering drawings.

Strategy A will be used to identify appropriate soil sampling locations in the outfall drainage path. In the event no drainage path is identified, Strategy B will be used (for Strategy A and B, see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to the releases from the outfalls.

The septic tank locations will be sampled by borehole cores for SWMUs 21-023(c), 21-024(a), and 21 -024(g). These tanks received and held all of the liquid discharged to their septic system and may have had environmental releases through leakage or overflow. A single borehole for each septic tank will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

This investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory; no field laboratory analyses will be used; and no additional investigations are envisioned.

15.2.4. Sampling Plan

SWMU 21-023(c). The field radiological survey (for method see Sec. 11.4.1.2) will be performed in a rectangle 20-ft wide and extending from the outfall location to the mesa edge (Fig. 15.2-1). If the outfall is found to be at the mesa edge, the survey area will be a rectangle 20-ft wide by 40-ft long extending outward from the cliff face on the bench directly below the outfall.

Surface soil samples (for method see Sec. 11.5.2.1) will be taken from six locations in the likely flow channel, according to Strategy A or B (see Sec. 15.1.4). For Strategy B, the first group will be located 5 ft downslope from the outfall. The second set will be located 15 ft downslope from the first set. One or both of these sampling sets may be located on the bench depending on the surveyed location of the outfall. Either approach will generate six samples.

The borehole drilled at septic tank TA-21-62 will have a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The borehole will be placed so that it passes through the center of the former location of the septic tank. Four samples will be collected (at 5-ft intervals).

The field surveying and analytics to be performed on the 10 samples for this SWMU are shown in Table 15.2-II.

SWMU 21-027(d). The field radiological survey will be performed in an area 20-ft wide extending from the outfall to the mesa edge (Fig. 15.2-1). Six surface soil samples will be taken from the outfall area according to either Strategy A or B.

Table 15.2–II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-023(c)																																	
Survey				X	X		X																										
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	4	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
	5	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	6	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
TA-21-82																																	
Vertical Borehole	1	0.0 – 5.0 ft					X	X	X		X	X	X									X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
21-027(d)																																	
Survey				X	X		X																										
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
	4	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	6	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
21-024(a)																																	

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
Survey																																
Near Surface Soil	1	0.0 – 6.0 in		X	X		X																									
		6.0 – 12.0 in						X	X		X																					
Rinsate Blank								X	X		X										X	X	X	X		X	X	X	X			
Field Blank																					X	X	X	X		X	X	X	X			
																					X	X	X	X		X	X	X	X			
		12.0 – 18.0 in																									X	X	X			
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			
	3	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			
	4	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			
	5	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			
	6	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			
Field Duplicate																					X	X	X	X		X	X	X	X			
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			
TA-21-53																																
Vertical Borehole	1	0.0 – 5.0 ft				X	X	X		X	X	X									X	X	X	X		X	X	X	X			
		5.0 – 10.0 ft					X	X		X	X	X									X	X	X	X		X	X	X	X			
		10.0 – 15.0 ft					X	X		X	X	X									X	X	X	X		X	X	X	X			

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
21-024(g)																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
	4	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
	6	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
TA-21-125																																		
Tank Excavation							X				X	X																						
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X				

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-024(l)																																		
Survey				X	X	X	X																											
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	6	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
21-027(c)																																		
Survey				X	X		X																											
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																						X	X	X	X		X	X	X	X				
Field Duplicate																												X	X	X				
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	6	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Trip Blank																												X						

Analytics for the six samples and the field survey are presented in Table 15.2-II.

SWMU 21-024(a). The field radiological survey will be performed in an area 20-ft wide from the surveyed location of the outfall to the mesa edge (Fig. 15.2-2).

Contamination discharged from this outfall is unlikely. Near-surface soil samples to a depth of 18 in. (three samples per location, for method see Sec. 11.5.2.4) will be taken at six locations in the drainage channel. They will be taken at the locations showing the highest survey readings if Strategy A is successful. If Strategy B is used, the groups of three will be placed near the discharge point, the mesa edge, and at the midpoint between the two. Near-surface soil sampling is specified because the soil in this area is deeper than in other areas. This investigation results in a total of 18 soil samples.

The borehole to be drilled at septic tank TA-21-53 will have a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed at the north end of the septic tank near the inlet line. To do this, it may be necessary to remove soil from the upper portion of the septic tank in order to positively identify the inlet line location.

Analytics to be performed on the 22 samples gathered from this outfall system are shown in Table 15.2-II.

SWMU 21-024(g). The field radiological survey (for method see Sec. 11.4.1.2) for this outfall system will be conducted in an area 20-ft wide between the outfall and the mesa edge (Fig. 15.2-3).

Near-surface soil samples to a 12-in. depth (two 6-in. sample intervals) will be taken from six locations in the area draining the outfall (for method see Sec. 11.5.2.4). Locations will be selected by Strategy A or B, as appropriate. For Strategy B, the first group of three will be located at the outfall discharge point, and a second group will be located approximately 5 ft above the mesa edge. This investigation totals 12 soil samples.

Septic tank TA-21-125 will be sampled by drilling a borehole at its south end near the inlet line (for method see Sec. 11.5.3.2). This borehole will be drilled to a nominal depth of 20 ft and will result in four samples.

Table 15.2-II specifies the field survey and the analytics to be performed on the 16 samples for this outfall system.

SWMU 21-024(l). No engineering drawing has been found showing the location of the outfall discharge point; thus it is not possible to locate the outfall by land survey. A geophysical survey (for method see Sec. 11.4.2.1) will be used to locate the outfall discharge point by following the 3-in. cast iron drain line as it exits building TA-21-21 (LASL 1960). The geophysical survey will begin at the north end of the mechanical room and trend northeast toward the north perimeter road (Fig. 15.2-4).

If the geophysical survey does not locate the discharge point, then a field radiological survey (for method see Sec. 11.4.1.2) will be performed in the same area. If the geophysical survey does locate the discharge point, the field radiological survey will be confined to an area downgradient from the outfall.

If either type of survey locates a discharge point or effluent channel, six surface soil samples (for method see Section 11.5.2.1) will be taken according to Strategy A or B as appropriate. If Strategy B is employed, the first set of three will be located 1 ft downgradient from the outfall location, and the second set will be located roughly 15 ft further downgradient.

If neither type of survey is successful, two surface soil samples will be taken at each of the three locations shown in Fig. 15.2-4. The first location is in the ditch just outside of the security fence north of TA-21-335, the closest collection point to the suspected outfall location. The second location is at the south end of a culvert passing under the road inside the security fence. This location collects drainage from the entire area south of Building TA-21-21 and will be a good location to detect contaminants if the outfall discharged inside the fence. The third location is at the entrance to a culvert that passes under the perimeter road. This culvert collects drainage from both of the other two sampling locations, and, in addition, from the entire area to the south and west. This makes it a good location to sample for contamination discharging to any part of the area north of TA-21-21.

The analytics to be performed on the six samples gathered from the outfall are shown in Table 15.2-II.

SWMU 21-027(c). The area for the field radiological survey (for method see Sec. 11.4.1.2) will be 40-ft wide, running from the outfall to the mesa edge (Fig. 15.2-5). Surface soil samples (see Sec. 11.5.2.4) will be taken from each of six locations in the outfall area according to Strategy A or B.

The analytics to be performed on the six samples from this outfall are presented in Table 15.2-II.

15.3. Outfalls with Septic Tanks

15.3.1. Site Description

This section addresses outfall channels originating from septic systems that remain in place. The five septic systems discussed here [SWMUs 21-024(a)–(d), and (i)] are mentioned in the CEARP Phase I report (LANL 1987) as five of the six most likely to have received radioactively contaminated sewage.

15.3.1.1. History

SWMU 21-024(b) is a septic system (CEARP identifier 3g) that routed sewage from Building TA-21-17 through septic tank TA-21-55 to the surface south of Building TA-21-5 (Fig. 15.3-1). Building TA-21-17, which was removed in 1969, connected Buildings TA-21-4 and TA-21-5. Septic tank TA-21-55 is constructed of reinforced concrete, measuring 4-ft wide by 8-ft long and located 6.5 ft below ground surface. The inlet and outlet drain lines are 6-in. VCP.

At the present time, the outfall consists of a short cast iron pipe emerging from the backfill inside the security fence. There is a gentle slope, approximately 70 ft to the cliff edge, with no defined channel. It is possible that, when operational, the outfall pipe extended farther south toward the mesa edge.

SWMU 21-024(c) is a septic system (CEARP identifier 3h) that routed sewage from Building TA-21-54 (removed in 1969) through septic tank TA-21-56 (abandoned in place in 1966) to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.3-2). The reinforced concrete septic tank measures 4 ft by 8 ft and is located 6 ft below ground surface. The drain lines are 4-in.-diameter VCP. The tank is located south of the PCB-storage area (SWMU 21-003) at TA-21-61. At the present time, a 4-in. VCP surfaces above a gentle slope extending approximately 15 ft to the cliff edge. There is a vaguely defined channel.

SWMU 21-024(d) is a septic system (CEARP identifier 3f) that routed sewage from Building TA-21-1 (removed in 1965) through septic tank TA-21-106 to the surface on the south rim above Alamos Canyon (Fig. 15.3-3). The septic tank is constructed of reinforced concrete, measuring 9.5 ft by 18 ft and is located 5 ft below ground surface. The drain lines are 6-in. VCP. At the present time, the outfall drain line from this septic system runs south to the edge of DP Mesa where it terminates at the cliff edge.

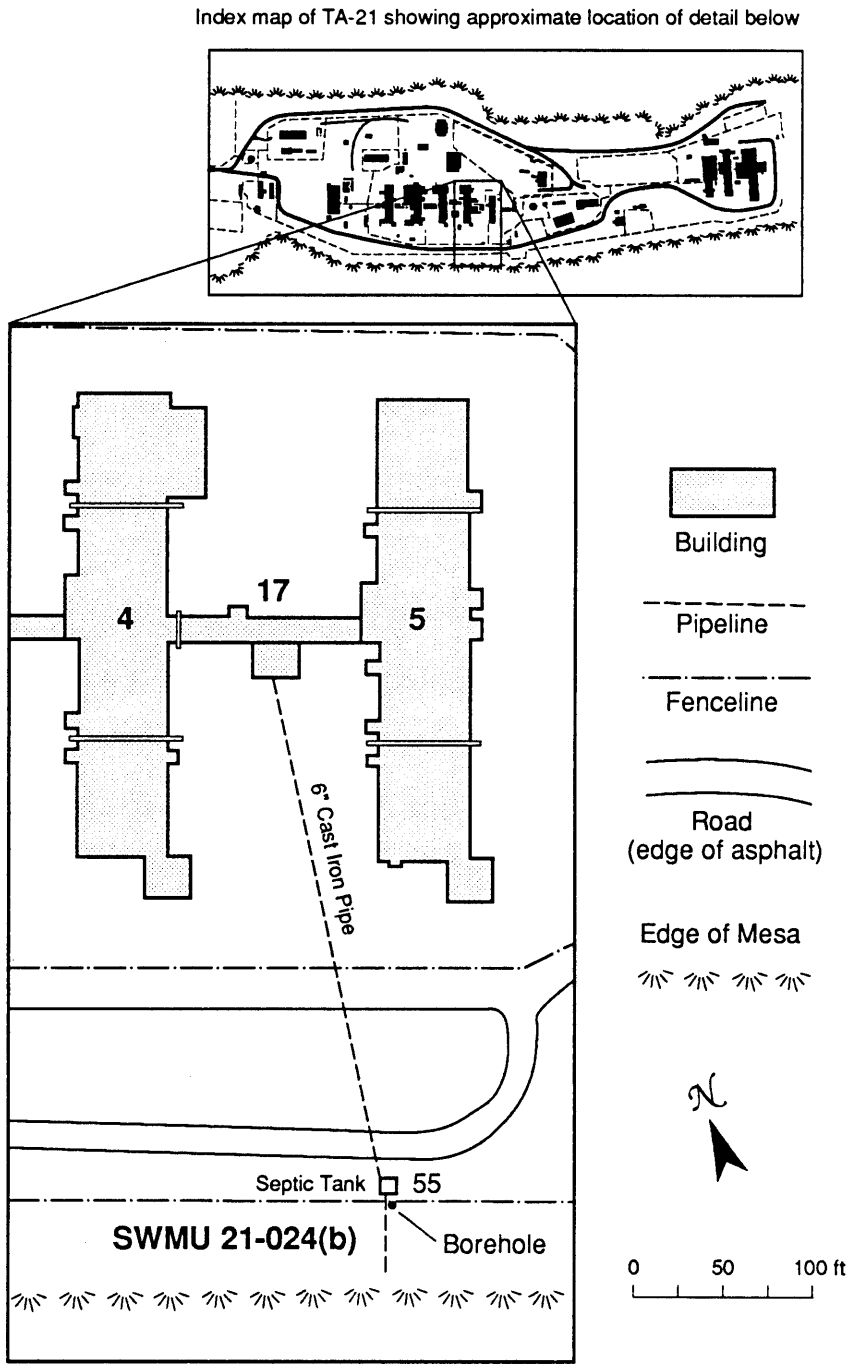


Fig. 15.3-1 Location of SWMU 21-024(b) as it appeared in 1961 on the south side of Building 17. (LASL 1961)

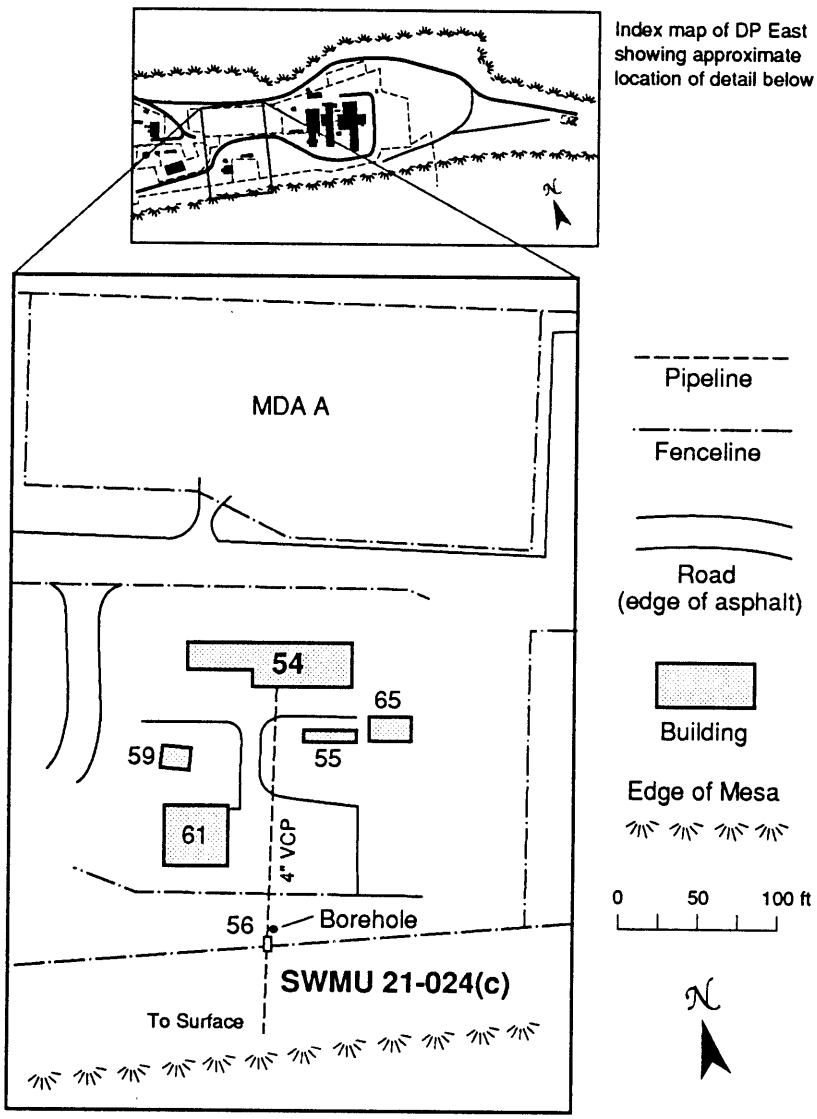


Fig. 15.3-2 Location of SWMU 21-024(c) as it appeared on the south side of Building 54 (now removed) in 1958. (LASL 1958d)

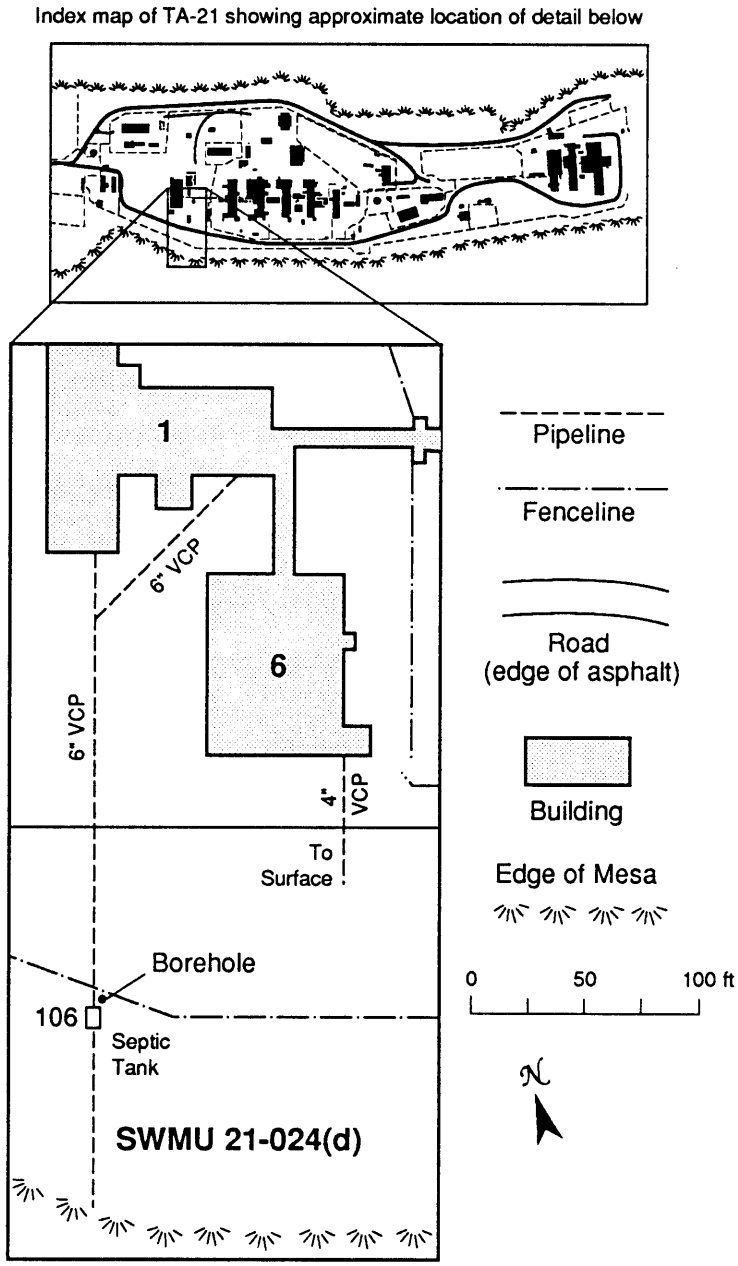


Fig. 15.3-3 Location of SWMU 21-024(d) as it appeared on the south side of Building 1 in 1961. (LASL 1961)

SWMU 21-024(e) is a septic system (CEARP identifier 3e) that routed sewage from Building TA-21-20, the former laundry, (removed in 1965) through septic tank TA-21-123 to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.3-4). TA-21-123 is a 1000-gal. steel tank, measuring 6 ft 4 in. by 11 ft 4 in. The drain lines entering and exiting the tank are 6-in. VCP.

At the present time, a survey stake marks the location of the outfall. The outfall area is broad and open, with a poorly defined channel. The outfall is located approximately 20 ft from the southern edge of DP Mesa. Below the DP Mesa cliff is a broad bench with a second drop-off to the canyon floor.

SWMU 21-024(i) is a septic system (CEARP identifier 3j) that routed sewage from Building TA-21-152 through septic tank TA-21-181 (abandoned in place in 1965) to the surface southeast of TA-21-209 (Fig. 15.3-5). Formerly, the blowdown from cooling towers at Buildings TA-21-166 and TA-21-167 was routed to this outfall. The septic system discharged effluent via a 6-in. VCP. The reinforced concrete septic tank measures 5 ft by 10 ft, and is located 7 ft 9 in. below ground surface. The VCP from the septic system surfaces in a broad open area with a gentle slope extending approximately 30 ft to the south cliff edge of DP Mesa.

15.3.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results obtained from the ER Program reconnaissance sampling for the five SWMUs in this section are presented in Table 15.3-I.

SWMU 21-024(b) was sampled at a single location, 2 ft 1 in. south of the outfall pipe's discharge point. Analysis of this sample showed dichloromethane, a common lab contaminant, and oil/grease in concentrations above detection limits. Comparing the analytical results with the background levels in Sec. 4.2.4 shows elevated levels of lead and above-background concentrations of the radionuclides ^{241}Am, $^{239/240}Pu$, and tritium.

SWMU 21-024(c) was sampled at a single point in the outfall channel, 8 ft from the end of the outfall pipe. Comparing the analytical results from this sample with Sec. 4.2.4 background levels

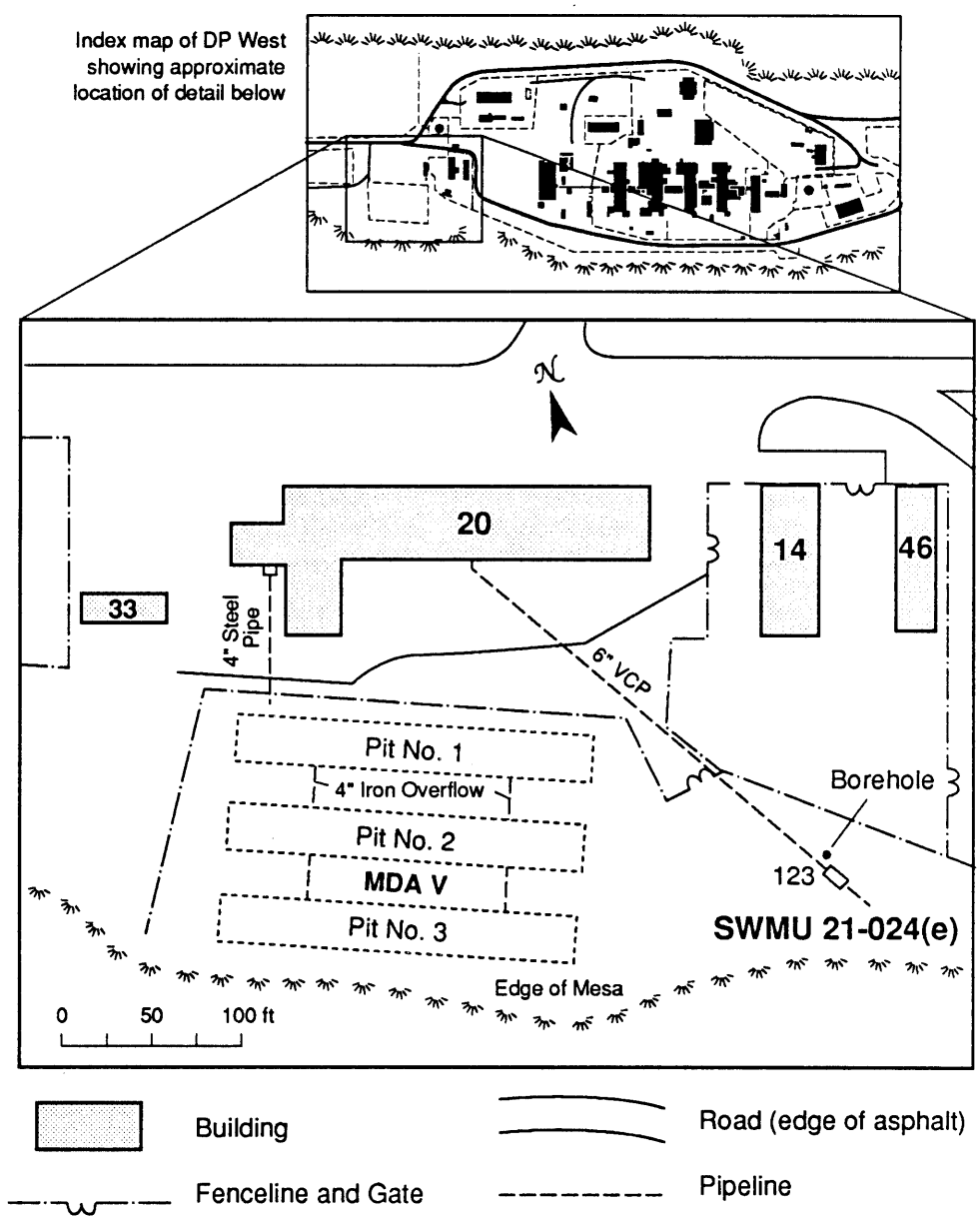


Fig. 15.3-4 Location of SWMU 21-024(e) as it appeared on the south side of Building 20 (now removed) in 1958. (LASL 1958b, 1961)

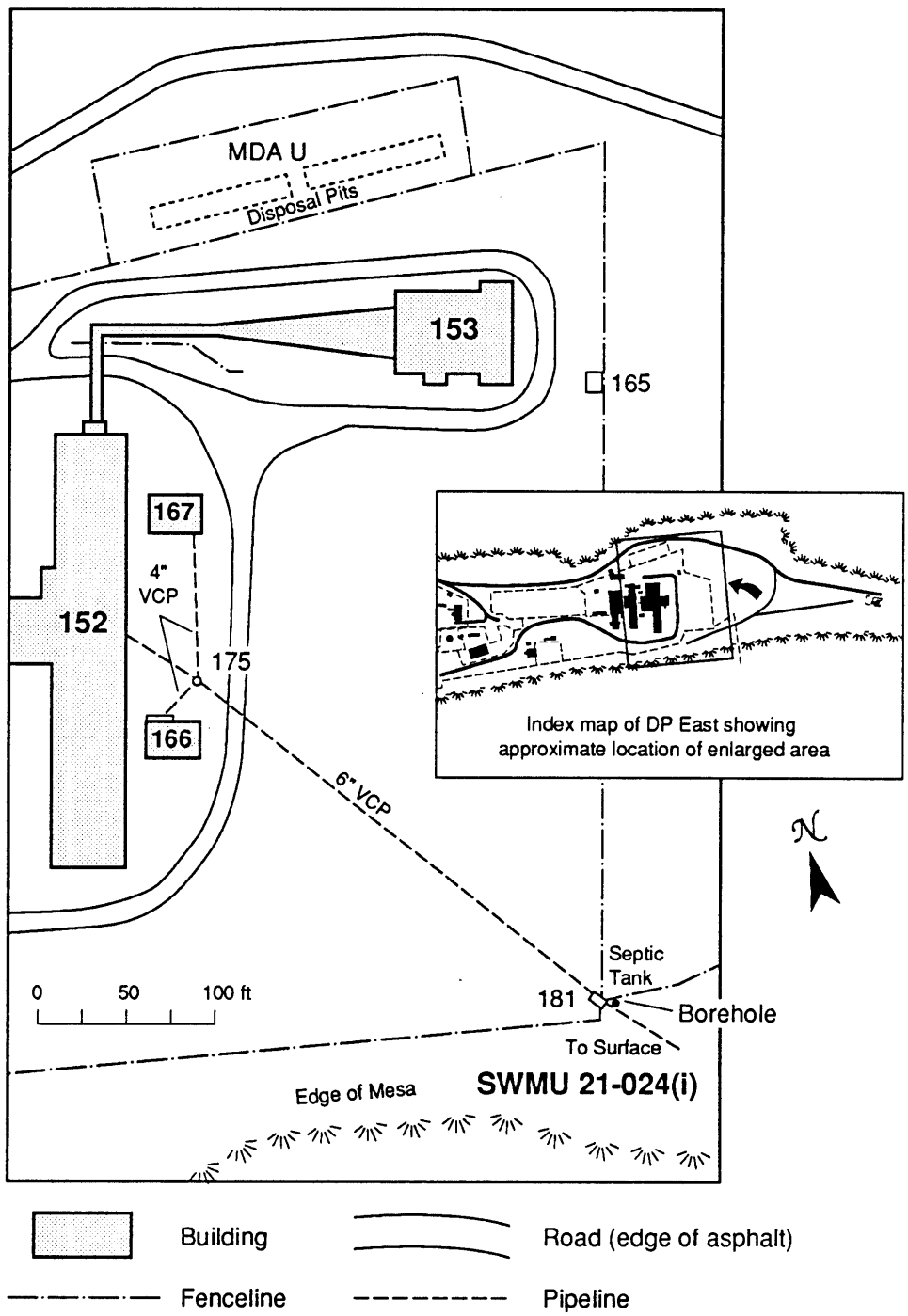


Fig. 15.3-5 Location of SWMU 21-024(i) as it appeared to the east of Building 152 in 1958. (LASL 1958e)

TABLE 15.3-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUs
21-024(b), (c), (d), (e), and (i)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-024(b)	POTASSIUM, TOTAL	1240	MG/KG	846	—
	VANADIUM, TOTAL	15.3	MG/KG	8.5	—
	ZINC, TOTAL	58.8	MG/KG	3.4	78
	ALUMINUM, TOTAL	7890	MG/KG	33.8	65,000
	BARIUM, TOTAL	91.5	MG/KG	33.8	850
	CALCIUM, TOTAL	2450	MG/KG	846	—
	CHROMIUM, TOTAL	6.4	MG/KG	1.7	75
	COPPER, TOTAL	7.9	MG/KG	4.2	19
	IRON, TOTAL	6900	MG/KG	16.9	26,600
	LEAD, TOTAL	31.8	MG/KG	16.9	54
	MAGNESIUM, TOTAL	1290	MG/KG	846	11,700
	MANGANESE, TOTAL	208	MG/KG	2.5	770
	OIL & GREASE BY GRAVIMETRIC[b]	818	MG/KG	49.3	—[b]
	Radionuclides				
	AMERICIUM	0.5	PCI/G	0.1	—
	CESIUM-137	0.2	PCI/G	0.1	0.44
	PLUTONIUM-239	6.1	PCI/G	0.3	0.025
	RADIUM-226	0.8	PCI/G	0.1	2.5
	STRONTIUM-90	0.5	PCI/G	0.3	0.88
	THORIUM-232	0.9	PCI/G	0.2	1.8
	TRITIUM	13	PCI/ML	2.0	.0072
	URANIUM-234	1.2	PCI/G	0.2	—
	URANIUM-238	0.8	PCI/G	0.2	1.7
	Volatile Organics				
	DICHLOROMETHANE-METHYLENE CHLORIDE[a]	69	UG/KG	52	—[b]
	Metals				
SWMU 21-024(c)	ALUMINUM, TOTAL	5970	MG/KG	39.4	65,000
	ARSENIC, TOTAL	6.0	MG/KG	2.0	7.1
	CALCIUM, TOTAL	1190	MG/KG	984	—
	CHROMIUM, TOTAL	144	MG/KG	2.0	75
	COPPER, TOTAL	143	MG/KG	4.9	19
	IRON, TOTAL	6050	MG/KG	19.7	26,600
	LEAD, TOTAL	556	MG/KG	196	54
	MANGANESE, TOTAL	44.2	MG/KG	3.0	770

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	MERCURY, TOTAL	8.0	MG/KG	1.0	0.03
	NICKEL, TOTAL	10.8	MG/KG	7.9	18.5
	OIL & GREASE BY GRAVIMETRIC	8350	MG/KG	50.3	—[b]
	SILVER, TOTAL	15.2	MG/KG	2.0	—
	VANADIUM, TOTAL	19.0	MG/KG	9.8	—
	ZINC, TOTAL	90.6	MG/KG	3.9	78
	Radionuclides				
	AMERICIUM	1.6	PCI/G	0.2	—
	CESIUM-137	0.2	PCI/G	0.1	0.44
	PLUTONIUM-238	0.3	PCI/G	0.1	0.005
	PLUTONIUM-239	17	PCI/G	1.0	0.025
	RADIUM-226	0.8	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.3	0.88
	THORIUM-232	1.2	PCI/G	0.2	1.8
	TRITIUM	18000	PCI/ML	1000	0.0072
	URANIUM-234	17	PCI/G	1.0	—
	URANIUM-235	0.7	PCI/G	0.2	—
	URANIUM-238	8.1	PCI/G	0.8	1.7
	Volatile Organics				
	DICHOLORMETHANE-METHYLENE CHLORIDE[a]	69	UG/KG	51	—[b]
	Metals				
SWMU 21-024(d)	ALUMINUM, TOTAL	3300	MG/KG	29	65,000
	BARIUM, TOTAL	60.3	MG/KG	29	850
	CALCIUM, TOTAL	2890	MG/KG	728	—
	CHROMIUM, TOTAL	5.5	MG/KG	2.0	75
	COPPER, TOTAL	18.4	MG/KG	4.0	19
	IRON, TOTAL	3290	MG/KG	15	26,600
	LEAD, TOTAL	39.6	MG/KG	8.0	54
	MAGNESIUM, TOTAL	735	MG/KG	728	4,700
	MANGANESE, TOTAL	160	MG/KG	2.0	770
	MERCURY, TOTAL	0.19	MG/KG	0	0.03
	NICKEL, TOTAL	7.2	MG/KG	6.0	18.5
	OIL & GREASE BY GRAVIMETRIC	127	MG/KG	51	—[b]
	POTASSIUM, TOTAL	897	MG/KG	728	—
	SILVER, TOTAL	2.4	MG/KG	2.0	—
	VANADIUM, TOTAL	8.7	MG/KG	8.0	—
	ZINC, TOTAL	61.5	MG/KG	4.0	78
	Radionuclides				
	AMERICIUM	1.1	PCI/G	0.3	—
	CESIUM-137	0.4	PCI/G	0.1	0.44

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	PLUTONIUM-238	0.8	PCI/G	0.2	0.005
	PLUTONIUM-239	16	PCI/G	1.0	0.025
	RADIUM-226	1.5	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	140	PCI/ML	10	0.0072
	URANIUM-234	2.1	PCI/G	0.2	—
	URANIUM-238	1.4	PCI/G	0.2	1.7
	Metals				
SWMU 21-024(e)	ALUMINUM, TOTAL	4300	MG/KG	34	65,000
	ARESENIC, TOTAL	3.0	MG/KG	2.0	7.1
	BARIUM, TOTAL	121	MG/KG	34	850
	CALCIUM, TOTAL	1650	MG/KG	837	—
	CHROMIUM, TOTAL	13.2	MG/KG	2.0	75
	COPPER, TOTAL	14.5	MG/KG	4.0	19
	IRON, TOTAL	4180	MG/KG	17	26,600
	LEAD, TOTAL	43.3	MG/KG	19	54
	MAGNESIUM, TOTAL	883	MG/KG	837	4,700
	MANGANESE, TOTAL	227	MG/KG	4.0	770
	MERCURY, TOTAL	0.31	MG/KG	0	0.03
	OIL & GREASE BY GRAVIMETRIC	433	MG/KG	51.5	—[b]
	VANADIUM, TOTAL	19.2	MG/KG	8.0	—
	ZINC, TOTAL	102	MG/KG	4.0	78
	Radionuclides				
	AMERICIUM	0.5	PCI/G	0.2	—
	CESIUM-137	0.7	PCI/G	0.1	0.44
	PLUTONIUM-238	0.3	PCI/G	0.1	0.005
	PLUTONIUM-239	17	PCI/G	1.0	0.025
	RADIUM-226	1.3	PCI/G	0.1	2.5
	THORIUM-232	0.9	PCI/G	0.1	1.8
	TRITIUM	65	PCI/ML	3.0	0.0072
	URANIUM-234	4.6	PCI/G	0.6	—
	URANIUM-238	3.3	PCI/G	0.5	1.7
	Metals				
SWMU 21-024(i)	ALUMINUM, TOTAL	5190	MG/KG	38.1	65,000
	ARSENIC, TOTAL	38.9	MG/KG	19	7.1
	BARIUM, TOTAL	2900	MG/KG	38.1	850
	BERYLLIUM, TOTAL	1.6	MG/KG	0.95	2.9
	CADMIUM, TOTAL	3.6	MG/KG	0.95	0.37
	CALCIUM, TOTAL	2210	MG/KG	952	—
	CHROMIUM, TOTAL	145	MG/KG	1.9	75
	COPPER, TOTAL	83.4	MG/KG	4.8	19
	IRON, TOTAL	6540	MG/KG	19	26,600

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	LEAD, TOTAL	187	MG/KG	38.1	54
	MAGNESIUM, TOTAL	1220	MG/KG	952	4,700
	MANGANESE, TOTAL	130	MG/KG	2.9	770
	MERCURY, TOTAL	0.97	MG/KG	0.1	0.03
	NICKEL, TOTAL	9.7	MG/KG	7.6	18.5
	OIL & GREASE BY GRAVIMETRIC	3520	MG/KG	56.5	—[b]
	SELENIUM, TOTAL	0.97	MG/KG	0.95	—
	VANADIUM, TOTAL	161	MG/KG	9.5	—
	ZINC, TOTAL	1530	MG/KG	3.8	78
	Radionuclides				
	PLUTONIUM-239	3.9	PCI/G	0.5	0.025
	RADIUM-226	2.7	PCI/G	0.3	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	13000	PCI/ML	1000	0.0072
	URANIUM-234	43	PCI/G	2.0	—
	URANIUM-235	1.2	PCI/G	0.3	—
	URANIUM-238	11	PCI/G	1.0	1.7
	Volatile Organics				
	DICHOLORMETHANE-METHYLENE[a]	100	UG/KG	57	—[b]

[a]This is a common analytical laboratory contaminant. It is listed here for completeness.
[b]Background assumed to be zero.
[c]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent Basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.

shows elevated concentrations of zinc, copper, lead, and mercury, and above-background levels of the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and ^{234}U, ^{235}U, and ^{238}U. In addition, oil/grease and dichloromethane were found in concentrations above detection limits.

SWMU 21-024(d) was sampled 8 ft south of the CEARP outfall marker. Analytical results showed elevated concentrations of mercury, above-background levels of ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and concentrations of oil and grease above detection limits.

SWMU 21-024(e) was sampled 5 ft 3 in. south of the CEARP outfall marker. Comparison of the analytical results from this sample with background levels given in Sec. 4.2.4 shows elevated concentrations of mercury, zinc, and above-background levels for ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, ^{234}U, ^{238}U, and ^{137}Cs. Oil and grease were found above the detection limits by gravimetric analysis.

SWMU 21-024(i) was sampled at a single location below the discharge point. Sample analysis indicates dichloromethane and oil/grease to be present above the detection limits. By comparison to background levels given in Sec. 4.2.4, elevated concentrations of arsenic, barium, beryllium, chromium, copper, lead, mercury, selenium, vanadium, radium, and zinc were found in the sample. In addition, ^{238}Pu, tritium, ^{226}Ra, ^{234}U, and ^{235}U, and ^{238}U were found to be present in concentrations above background levels.

15.3.1.3. Source Term

SWMU 21-024(b) sample analysis has identified lead, ^{241}Am, $^{239/240}Pu$, and tritium, to be present in the soils at this outfall.

SWMU 21-024(c) sample analysis identified chromium, copper, lead, mercury, zinc, and the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, ^{234}U, ^{235}U, and ^{238}U to be present. In addition, PCBs may be present in the area of this SWMU because it is down slope from the PCB storage area at TA-21-61.

SWMU 21-024(d) sample analysis showed above-background levels of mercury, ^{241}Am, ^{238}Pu, $^{239/240}Pu$, and tritium to be present in the soils at this outfall.

SWMU 21-024(e) sample analysis has identified mercury, zinc, and the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and ^{234}U, ^{238}U, and ^{137}Cs to be present in the soils at this outfall. In addition to these, phosphates and various organics are likely to be present at the outfall because Building TA-21-20 was a laundry.

SWMU 21-024(i) Sample analysis determined that barium, chromium, copper, lead, mercury, selenium, vanadium, zinc, cadmium, and the radionuclides ^{238}Pu, tritium, ^{226}Ra, ^{234}U, ^{235}U, and ^{238}U were present above background level. In addition, various laboratory chemicals, both organic and inorganic, could be present because of the research performed in Building TA-21-152.

15.3.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at each of these areas. The specific data required to assess contamination at each of these areas include the following:

1. Identify the contaminants present using Level II and III data for the outfall discharge points and below the septic tanks. Radionuclides, metals, and some organic contaminants were previously identified.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.3.3. Sampling/Investigation Rationale

The outfall and septic tank locations will be marked in the field by surveys based on old engineering drawings [except for SWMU 21-024(d), which is visible at the surface]. Potential environmental contamination from five discharge systems in this section will be characterized by soil sampling in the area of the outfall and the septic tank.

All of the septic tanks addressed in this section [SWMUs 21-024 (b)–(e) and (i)] received and held all of the liquid discharged to their septic systems and may have had environmental releases through leakage or overflow. Each of the septic tank locations will be sampled by borehole cores near either the inlet or outlet drain lines because these are the most likely places for leakage. Excavation will be necessary to uncover the top of the septic tanks in order to provide positive locations of the tanks and drain lines before drilling begins. A single borehole for each septic tank will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

The drainage channels associated with each outfall will be surveyed with direct reading radiological instruments as described in Sec. 15.1.4. Strategy A will be used to identify appropriate soil sampling locations in the outfall drainage path. In the event that no sampling locations are identified from the radiological survey, Strategy C will be employed (for Strategy A and C see

Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow comparison to local contaminant levels unrelated to the releases from the outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.3.4. Sampling Plan

All field radiological surveys will be performed in a rectangle 10-ft wide and extending from the outfall location to the mesa edge according to the method described in Sec. 11.4.1.2.

SWMU 21-024(b). Near-surface soil samples (see Sec. 11.5.2.4 for method) will be taken from three locations below the discharge point in the outfall channel, according to Strategy A or C (see Sec. 15.1.4). Three soil samples will be taken at each location to a total depth of 18-in. (three 6-in. sample intervals), resulting in nine samples. For Strategy C, the three sampling sites will be at small pooling areas located 7 ft, 20 ft, and 35 ft south of the southern perimeter fence.

The borehole at septic tank TA-21-55 will be drilled to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The borehole will be placed on the outlet side (south) of the septic tank because of the proximity of the road on the inlet side. Four samples will be collected (at 5-ft intervals).

Analyses to be performed on the 13 samples collected in this outfall investigation are shown in Table 15.3-II.

SWMU 21-024(c). Near-surface soil samples (see method 11.5.2.4) will be collected to a depth of 12 in. (two 6-in. intervals) at two locations in the outfall channel, according to either Strategy A or C (see Sec. 15.1.4). If the field radiological survey is successful in identifying sampling locations, the samples will be taken according to Strategy A. If the survey proves unsuccessful, Strategy C will be employed. Under Strategy C, the first sampling location will be in the ponding area at the outfall discharge point, and the second sampling location will be in a small ponding area at the mesa edge. Either approach will result in four samples.

The borehole to be drilled at septic tank TA-21-56 will have a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed at the north end of the septic tank near the inlet line.

Table 15.3-II shows the analytics for the eight samples taken in the investigation of this SWMU.

Table 15.3–II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-024(b)																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Field Duplicate																						X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
TA-21-55																																		
Tank Excavation							X				X	X																						
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
21-024(c)																																		
Survey				X	X																													
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X	X		X	
Rinsate Blank																						X	X	X	X		X	X	X	X	X		X	
Field Blank																												X	X	X	X			
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X	X		X	
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X	X		X	

Table 15.3-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Survey: Gross Gamma	Field Survey: Low-Energy Gamma	Field Survey: Electromagnetic	Field Survey: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha		Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium	
Field Duplicate																					X	X	X	X		X	X	X	X	X		X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X	X		X	
TA-21-56																																		
Tank Excavation							X				X	X																						
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		5.0 – 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		10.0 – 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		15.0 – 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
21-024(d)																																		
Survey				X	X																												
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X		X								X	X	X	X		X	X	X	X			X	
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
TA-21-106																																		
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		5.0 – 10.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		10.0 – 15.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		15.0 – 20.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
21-024(e)																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Field Duplicate																					X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Bins ... nk																					X	X	X	X		X	X	X	X			X	

Table 15.3-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
Field Blank																												X	X	X			
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
TA-21-123																																	
Tank Excavation							X				X	X																					
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
21-024(i)																																	
Survey				X	X		X																										
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
TA-21-181																																	
Tank Excavation							X				X	X																					
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
Field Duplicate																						X	X	X	X		X	X	X	X			X
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
Rinsate Blank																						X	X	X	X		X	X	X	X			X
Field Blank																												X	X	X			
Trip Blank																												X					

The area above this outfall contains a PCB-contaminated area (SWMU 21-003, see Sec. 14.2). Because of that site, PCBs have been added to the analytical suite for this investigation.

SWMU 21-024(d). One surface soil sample (for method see Sec. 11.5.2.1) will be collected from a small pool located 13 ft south of the CEARP outfall marker at the very edge of DP mesa. Near-surface soil samples (for method see Sec. 11.5.2.4) will be taken at a single location on the bench directly below the outfall, at the point where effluent running over the mesa edge collects. Three samples will be taken at this location to a total depth of 18 in. (three 6-in. intervals). Field radiological surveys will be used at both locations in an attempt to identify the best point for sampling contaminants.

The borehole at tank TA-21-106 will be placed on the north (influent) side of the septic tank and will be drilled to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). This will result in a total of four samples. This septic tank will not need to be excavated because the upper portions of it are already exposed and the inlet line can be located.

The analytics to be performed on the eight samples in this SWMU are presented in Table 15.3-II.

SWMU 21-024(e). Near-surface soil samples will be taken from two locations near the outfall. A depth of 12 in. (two 6-in. intervals) will be sampled at each of the locations. Field radiological surveying will be used to determine the two sampling locations according to Strategy A. If the radiological survey fails to provide sampling locations, Strategy C will be employed. Under Strategy C, the first sampling location will be 4 ft south of the CEARP outfall marker. This is a large pooling area that collects run-off from the entire area around the outfall. The second sampling location will be on the bench below the point where effluent runs over the mesa edge. Either approach, A or C, will yield a total of four samples.

The borehole at septic tank TA-21-123 will be drilled to a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed on the north end of the septic tank near the inlet drain line.

Table 15.3-II shows the analyses to be performed on the eight samples collected for this outfall.

SWMU 21-024(i). Three near-surface soil sampling locations sampled to a depth of 12 in. (two 6-in. intervals) will be used in the characterization of this outfall (for method see Sec. 11.5.2.4). If the field radiological survey is successful, the sampling locations will be taken in the three areas of highest readings according to Strategy A. If Strategy C is necessary, the three locations will be 8 ft, 30 ft, and 55 ft southeast of the CEARP outfall marker in the channel bed.

Septic tank TA-21-181 will be sampled by drilling a borehole near the outlet (southeast) side of the septic tank. This borehole will be to a nominal depth of 20 ft, resulting in a total of four samples.

The analytics to be performed on the 10 samples gathered for this SWMU are presented in Table 15.3-II.

15.4. Direct Discharge Outfalls

15.4.1. Site Description

This chapter addresses five outfalls that are associated with direct discharge systems: SWMUs 21-011(k), 21-022(h), 21-024(n and o), and 21-026(d). They have been grouped together because of similarities in configuration and suspected contaminants.

15.4.1.1. Site History

SWMU 21-011(k) (NPDES outfall No. EPA050050, CEARP identifier 3o) routed industrial wastewater from Building TA-21-257 through tanks TA-21-112 and TA-21-113 The discharge line runs northeast toward DP Canyon and discharges onto the north side of DP Mesa (Fig. 15.4-1). The wastewater was fed into the tanks from Building TA-21-257, the new industrial waste treatment plant (SWMU 21-011). This plant replaced and improved operations from Building TA-21-35 in the treatment of wastes from the plutonium purification process. The wastes treated were liquids remaining after the plutonium extraction, which contained a variety of radioactive and chemical constituents. The line from Tanks 112 and 113 is a 4-in. VCP that discharged to an outfall ditch and is no longer active (LASL 1976b). There is currently no visible sign of a ditch; however, there is a 4-in. cast iron line approximately 55 ft north of the perimeter road in the area where the outfall ditch would have ended. A gently sloping, rocky surface extends from the outfall pipe approximately 30 ft to the canyon rim.

SWMU 21-022(h) (NPDES outfall No. EPA03A032, CEARP identifier 3a) runs from the southeast corner of building TA-21-150 (plutonium fuel service building) and flows through sump TA-21-202 discharging to the north edge of DP Mesa (Fig. 15.4-2). It currently discharges only treated cooling water (LANL 1987). Previously, the outfall system was connected to the basement, floor, and roof drains in Building TA-21-150 (LASL 1961) and discharged industrial wastewater.

The line is currently a 24-in. corrugated metal pipe (CMP), which extends to the canyon rim. However, it is probable that this is not the original piping. The area around the pipe is broad, gently sloping and does not display a defined channel.

SWMU 21-024(n) is a drain (CEARP identifier 3aa) exiting Building TA-21-155 and discharging northward into DP Canyon (Fig. 15.4-3). TA-21-155 has been a warehouse, warehouse/laboratory, and currently contains a furnace. TA-21-155 is listed on a structure locater, although there is no reference to the type of furnace. It is believed to be a heating unit for DP East (LANL 1990).

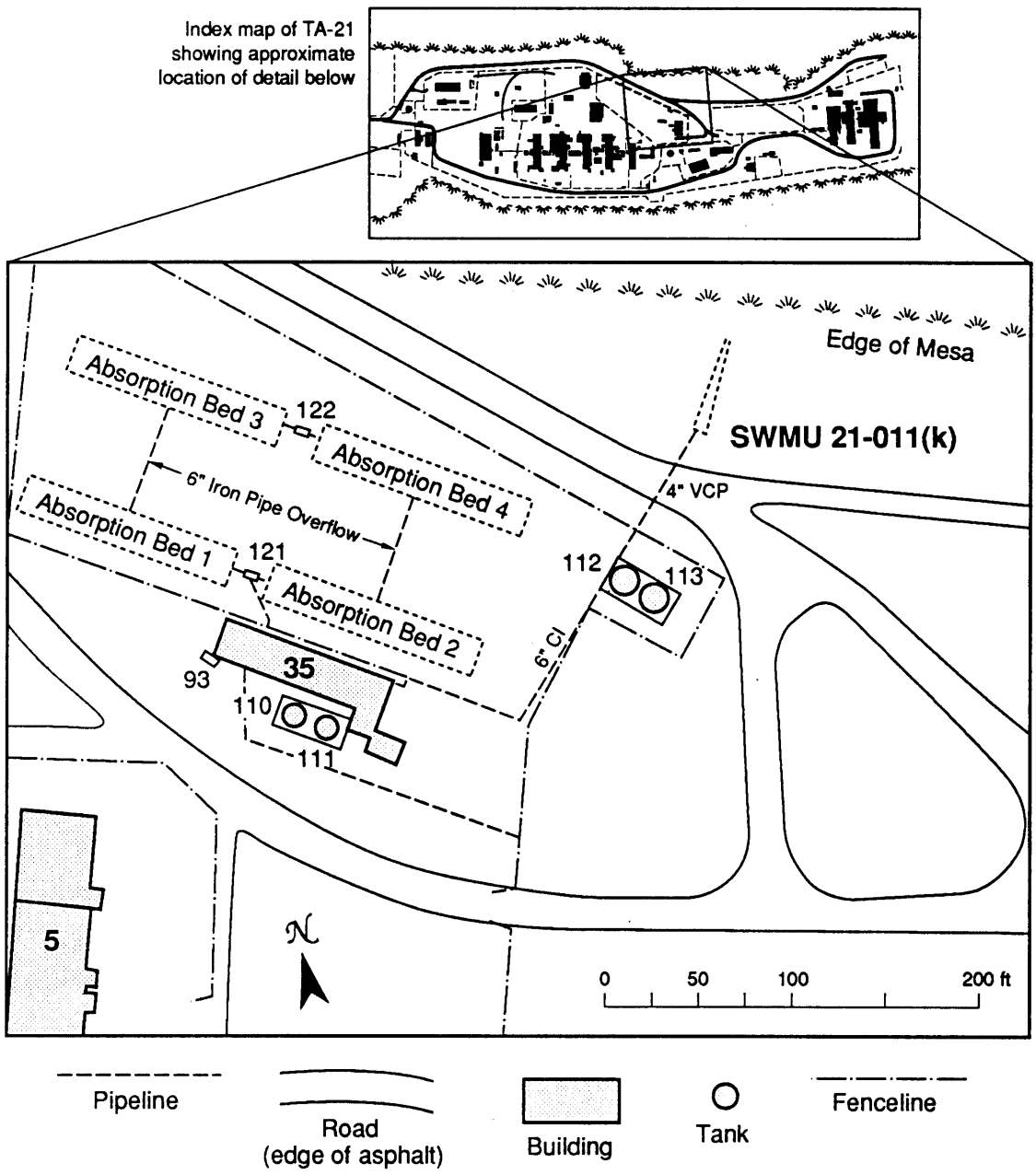


Fig. 15.4-1 Location of SWMU 21-011(k) in 1958. (LASL 1958c, 1961)

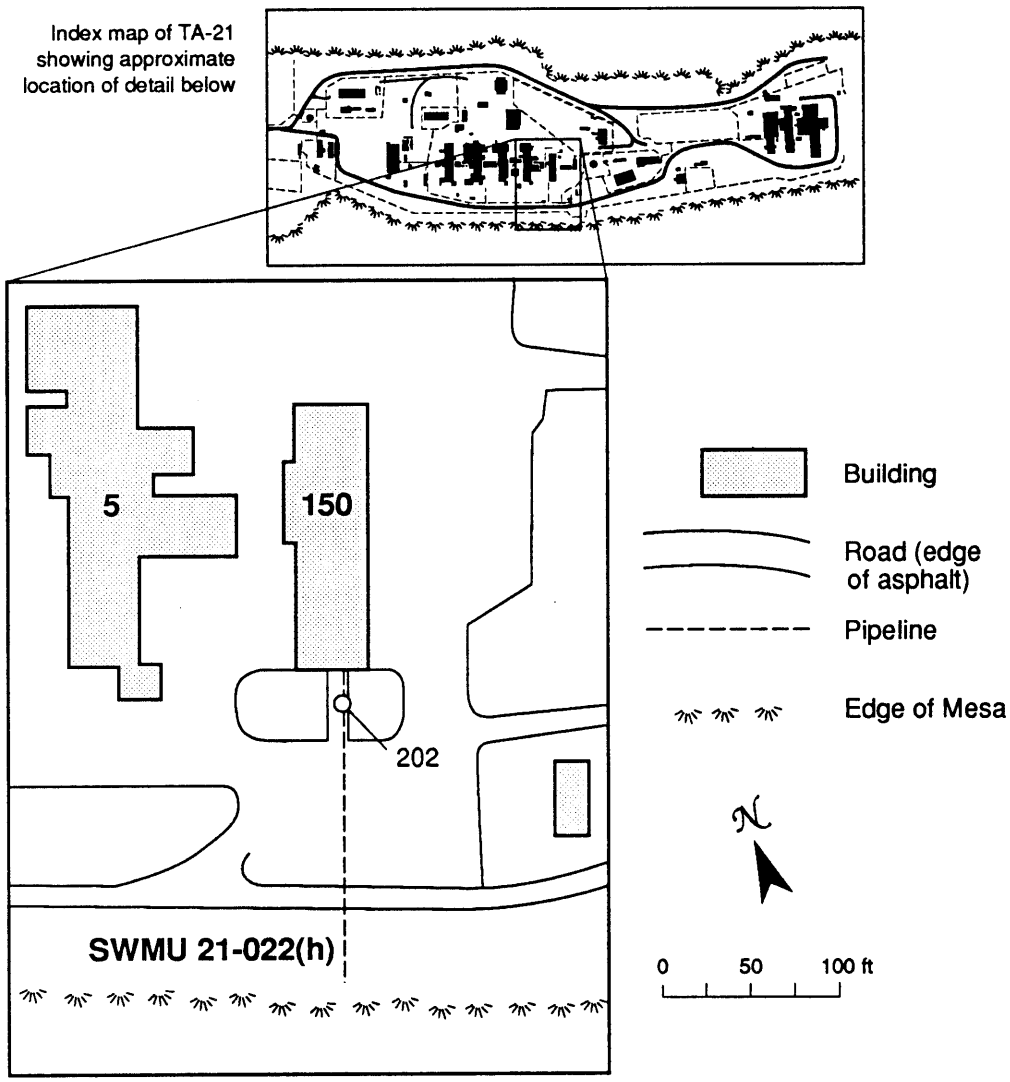


Fig. 15.4-2 Location of SWMU 21-022(h) as it appeared on the south side of Building 150 in 1975. (LASL 1976a)

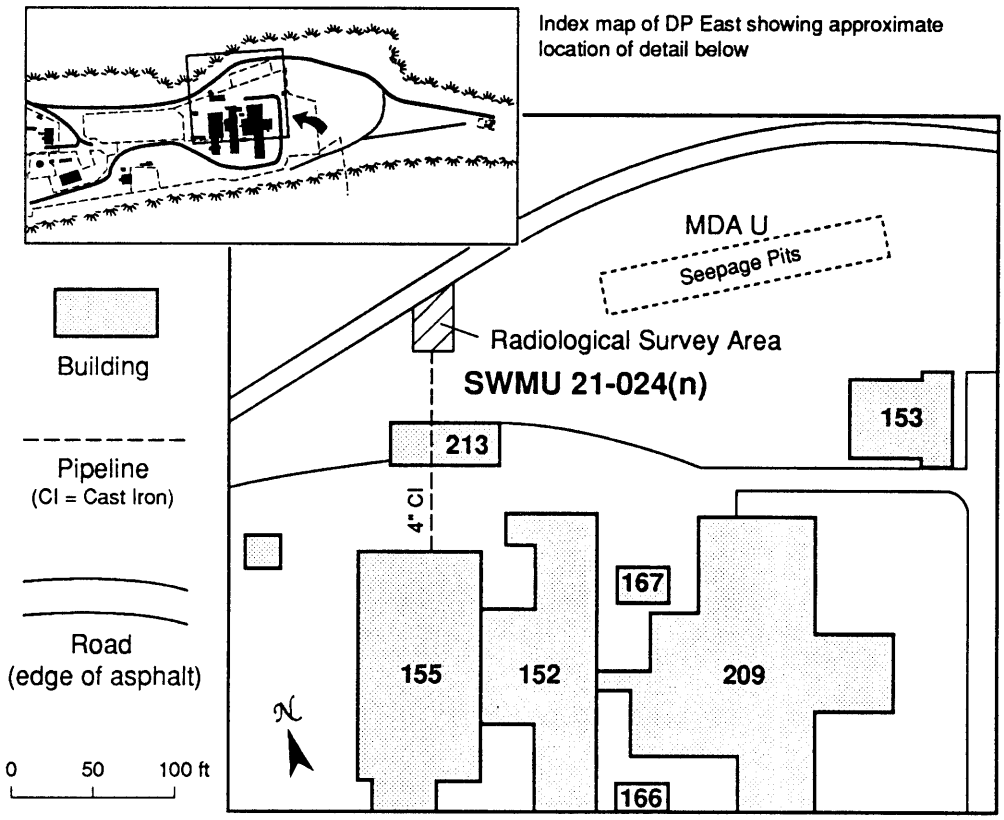


Fig. 15.4-3 Location of SWMU 21-024(n) near MDA U as it appeared in 1975. (LASL 1976a)

The drain system consists of CMP exiting a concrete bulkhead and discharging onto a gravel road immediately adjacent to MDA U. There is no evidence of a channel, which has probably been covered by the road. The effluent flowed north to the ditch paralleling the north perimeter road. From there, it flowed east to a culvert that passes under the north perimeter road and into DP Canyon.

SWMU 21-024(o) is a 4-in. VCP drain (CEARP identifier 3ab) reported to have served Building TA-21-46, the old diesel plant, which was converted to a warehouse between 1957 and 1964. The drain discharges to the south into Los Alamos Canyon (Fig. 15.4-4). The actual outfall pipe has not been located, but is shown on an engineering drawing (LASL 1958b). The area around the probable outfall location is broad and gently sloping, and the flow pattern can still be identified.

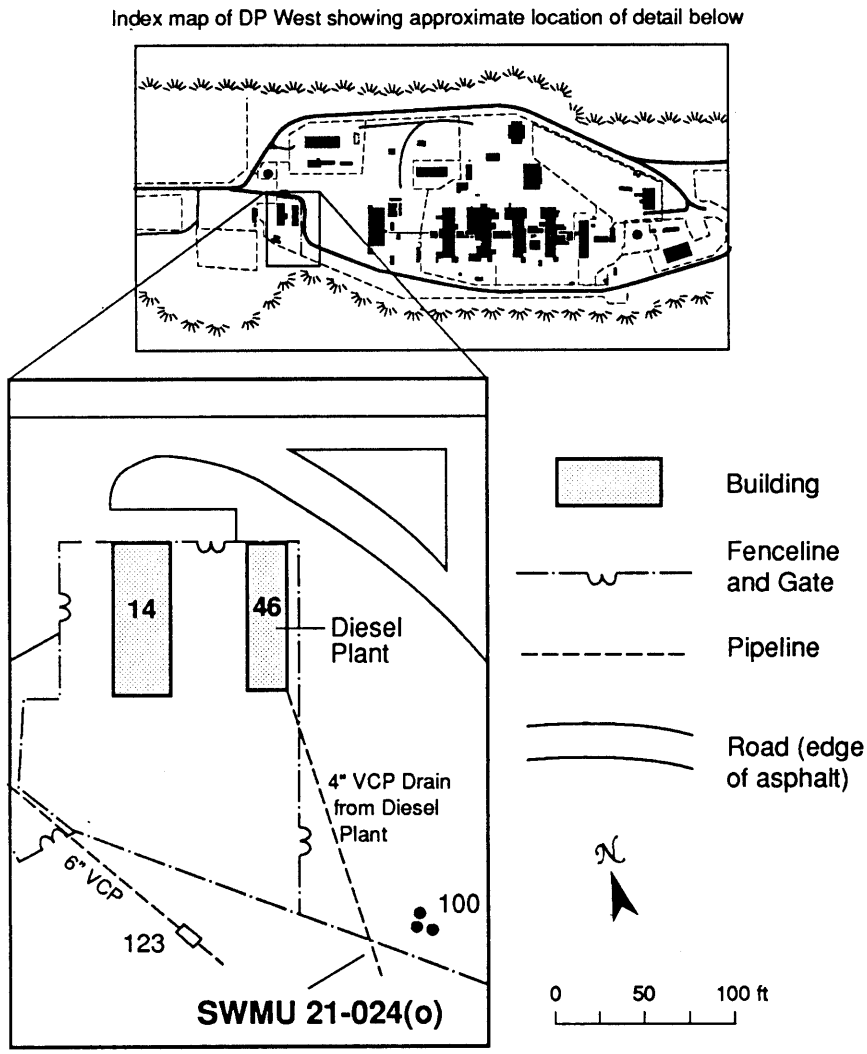


Fig. 15.4-4 Location of SWMU 21-024(o) as it appeared on the south side of Building 46 in 1958. (LASL 1958b)

SWMU 21-026(d) is a treated sewage water line (NPDES outfall No. EPASSS055, CEARP identifier 3w) discharging from the sewage treatment plant, Building 227, SWMU No. 21-026. The discharge flows into a concrete channel on the north edge of DP Mesa and runs down a steep, natural channel into DP Canyon (Fig. 15.4-5).

15.4.1.2. Existing Information

Two of the SWMUs in this section [21-024(n) and (o)] were sampled in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989b). Those soil samples were analyzed

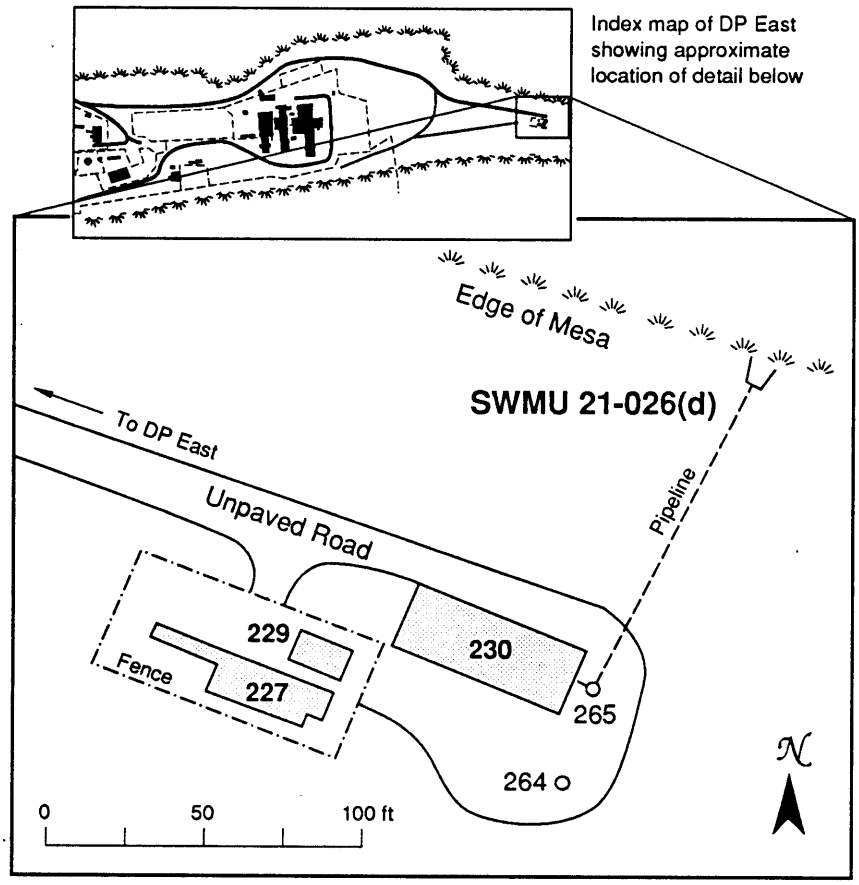


Fig. 15.4-5 Location of SWMU 21-026(d). (LANL 1983)

according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, $^{234/235}U$, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results, obtained from the ER Program reconnaissance sampling for the two SWMUs sampled, are presented in Table 15.4-I.

SWMU 21-011(k) was investigated by the DOE as environmental problem No. 6 (DOE 1989a). Three surface soil samples were collected from the effluent channel; one 23 ft from the end of the outfall pipe and two from below the canyon rim (Fig. 15-4.6). Table 15.4-II presents the analyses and results for the three samples. The analytical methods for these samples were not included in the reference and cannot be identified. Information in this table compared to data in Sec. 4.2.4 indicates cadmium, copper, nickel, $^{230/232}Th$, ^{235}U ^{238}U, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, ^{90}Sr, ^{233}Pa, ^{40}K, and ^{137}Cs in excess of background level.

TABLE 15.4-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR
SWMUs 21-024 (n) and (o)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-024(n)	ALUMINUM, TOTAL	4960	MG/KG	38	65,000
	BARIUM, TOTAL	81.4	MG/KG	38	850
	CALCIUM, TOTAL	1910	MG/KG	938	—
	CHROMIUM, TOTAL	4.8	MG/KG	2.0	75
	COPPER, TOTAL	12.4	MG/KG	6.0	19
	IRON, TOTAL	6310	MG/KG	19	26,600
	LEAD, TOTAL	7.5	MG/KG	2.0	54
	MANGANESE, TOTAL	229	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	1310	MG/KG	53	—[b]
	VANADIUM, TOTAL	12.9	MG/KG	10	—
	ZINC, TOTAL	95.9	MG/KG	4.0	78
	Radionucides				
	PLUTONIUM-239	0.5	PCI/G	0.1	0.025
	RADIUM-226	1.2	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.2	0.88
	THORIUM-232	0.8	PCI/G	0.1	1.8
	TRITIUM	53	PCI/ML	3.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	1.0	PCI/G	0.2	1.7
	Metals				
SWMU 21-024(o)	ALUMINUM, TOTAL	2340	MG/KG	37	65,000
	BARIUM, TOTAL	37.8	MG/KG	37	850
	CALCIUM, TOTAL	970	MG/KG	914	—
	IRON, TOTAL	2970	MG/KG	18	26,600
	LEAD, TOTAL	27.9	MG/KG	4.0	54
	MANGANESE, TOTAL	159	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	2580	MG/KG	51.3	—[b]
	ZINC, TOTAL	58	MG/KG	4.0	78
	Pesticides - PCBs				
	AROCLOR-1260	250	UG/KG	160	—[b]
	Radionuclides				
	CESIUM-137	0.2	PCI/G	0.1	0.44
	RADIUM-226	0.8	PCI/G	0.1	2.5
	TRITIUM	4.0	PCI/ML	2.0	0.0072

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	URANIUM-234	0.4	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7

[a]The upper limit of background was defined by Purtymun et al (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

SWMU 21-022(h) No quantitative information is available.

SWMU 21-024(n) was sampled 2 ft 6 in. west of the CEARP marker, directly under the opening of the 10 in. drainpipe as part of the 1988 reconnaissance sampling (DOE 1989b). Table 15.4.I lists the contaminant concentrations found in this sample. A comparison of this table with the background level information in Sec. 4.2.4 indicates above background levels of zinc, tritium, and $^{239/240}Pu$.

SWMU 21-024(o) was sampled as part of the 1988 reconnaissance sampling (DOE 1989b). A sample was taken 3 ft 6 in. south of the CEARP marker. Results of the sample analysis are presented in Table 15.4-I. These analyses indicate tritium concentrations above background levels and Arochlor 1260 (PCB) in concentrations above the detection limit.

SWMU 21-026(d) discharges the sewage treatment plant. As detailed in Sec. 14.7, assays of effluent indicate presence of gross alpha, gross beta, gamma, and tritium. Specific radionuclides causing the gross alpha and beta activity are not identified.

15.4.1.3. Source Term

SWMU 21-011(k) is not expected to have discharged contaminants other than those identified in the previous sampling based on actual samples obtained in the area. They are: cadmium, copper, nickel, ^{235}U, ^{238}U, ^{238}Pu, $^{239/240}Pu$, ^{230}Th, ^{232}Th, ^{241}Am, ^{90}Sr, ^{233}Pa, ^{40}K, and ^{137}Cs in excess of background level.

SWMU 21-022(h) is currently an NPDES-permitted discharge, but historical operations in TA-21-150 may have discharged contaminants to this outfall system. If present, potential contaminants

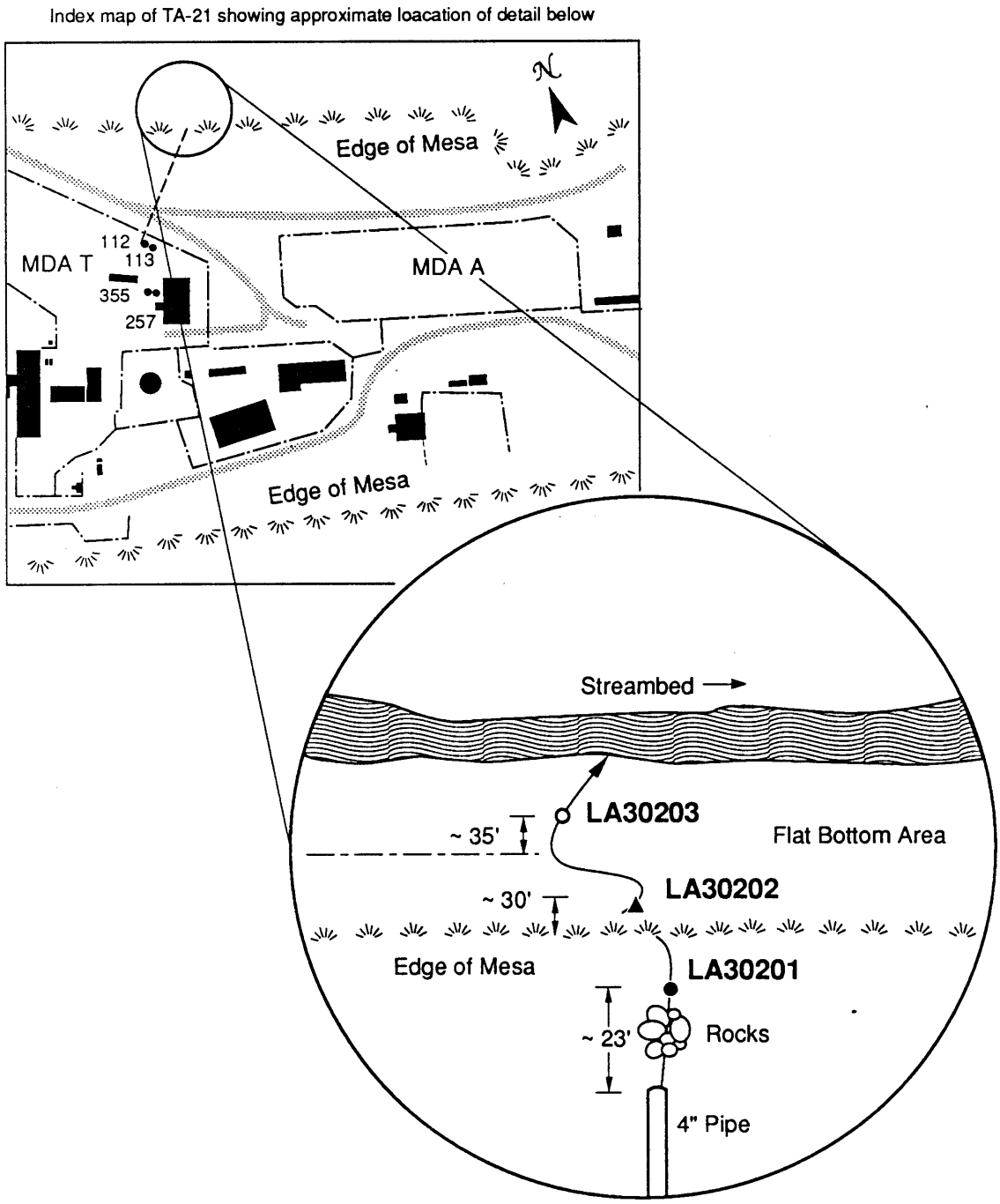


Fig. 15.4-6 DOE HQ Environmental Survey Problem #6 sampling locations at TA-21 inactive NPDES 50 outfall.

TABLE I5.4-II
ENVIRONMENTAL PROBLEM 6 ANALYTICAL DATA

AREA	TA-21-257	TA-21-257	TA-21-257	
LOCATION	OUTFALL	OUTFALL	OUTFALL	
TYPE OF LOCATION	NPDES 50	NPDES 50	NPDES 50	
SAMPLE NUMBER	LA30201XW	LA30202XW	LA30203XW	
MEDIA	SED	SED	SED	Upper Limit[d]
UNITS	mg/kg	mg/kg	mg/kg	of Background
SDG NUMBER	LA30201XW	LA30201XW	LA30201XW	$\bar{x} + 2s$
Field Measurements				
Depth (ft)	0-0.25	0-0.25	0-0.25	
Analytes				
Antimony	—	—	—	—
Arsenic	—	—	—	7.1
Barium	33.3B	41.4B	69.1	850
Beryllium	1.2	—	—	2.9
Cadmium	24.7	—	—	0.37
Chromium	8.8	—	—	75
Copper	45.8	—	—	19
Lead	26.1	6.2	10.1	54
Mercury	—	—	—	0.03
Nickel	64.3	—	—	18.5
Selenium	—	—	—	—
Silver	—	—	—	—
Thallium	—	—	—	—
Zinc	60.5	22.4	20.3	78
% Solids	87.0	80.7	85.6	
Total (allowed) Hold Time[a]	8(182)	8(182)	8(182)	
Total (allowed) Hold Time[b]	29(28)	29(28)	29(28)	
Total (allowed) Hold Time[c]	162(182)	162(182)	162(182)	

[a]ICP
[b]CVAAS
[c]GFAAS
[d]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$, as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} + 2s$ as calculated from the data given in Table. 4.2-XV.

TABLE 15.4-II (continued)

AREA	TA-21-257	TA-21-257	TA-21-257	TA-21-257	TA-21-257	TA-21-257	
LOCATION	OUTFALL	OUTFALL	OUTFALL	OUTFALL	OUTFALL	OUTFALL	
TYPE OF LOCATION	NPDES 50	NPDES 50	NPDES 50	NPDES 50	NPDES 50	NPDES 50	Upper Limit
SAMPLE NUMBER	LA30201D	LA30201W	LA30202D	LA30202W	LA30203D	LA30203W	of Background
MEDIA	SED	SED	SED	SED	SED	SED	$\bar{x} + 2s$
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	pCi/kgW	pCi/kgD	pCi/kgW	(pCi/g)
Alpha Emitters							
Thorium-230	1200 ±400	na	1800 ± 400	na	1000 ± 400	na	—
Thorium-232[e]	na	<16200 ±1200	na	<16900 ± 1200	na	<12140 ± 860	1.8
Uranium-235	na	1660 ±340	na	211 ± 71.0	na	64.0 ± 17.0	—
Uranium-238[e]	na	<14300 ±1300	na	<16400 ± 1300	na	<11670 ± 910	1.7
Uranium (all isotopes)[f]	8000 ±800	—	9000 ± 900	na	12000 ± 1200	na	—
Plutonium-238	105000 ±7000	—	336 ± 42	na	46 ± 27	na	0.005
Plutonium-239, 240	377000 ±19000	—	1880 ± 150	na	247 ±48.0	na	0.025
Americium-241	na	1440 ±140	na	2560 ± 450	na	520 ± 120	—
Beta Emitters							
Strontium-90	414000 ±38000	na	17000 ± 1400	na	<1100	na	0.88
Protactinium-233	na	340 ±110	na	—	na	—	—
Gamma Emitters							
Potassium-40	na	27000 ±3400	na	30700 ± 3000	na	22600 ± 2000	—
Cesium-137	na	144 ±13.0	na	51800 ± 3500	na	1080 ± 90.0	0.44
Samarium-153	na	<1130	na	—	na	—	—

[e]Total unbroken chain activity in equilibrium.
[f] Units are µg (/L, /kgW, or /kgD) instead of pCi (/L, /kgW, or /kgD).

are plutonium, uranium, mercury, lead, organics, and various acids that were associated with the plutonium purification process.

SWMU 21-024(n) may potentially be contaminated with petroleum products in addition to the contaminants found in the previous sampling listed above. This is because TA-21-155 currently houses the furnace for DP East.

SWMU 21-024(o) will likely be contaminated with organics, such as petroleum products related to the diesel plant. Other contaminants in the source term are Arochlor 1260 (PCBs), and tritium, which were found in the previous sampling.

SWMU 21-026(d) could potentially contain small amounts of any contaminant present at TA-21 that potentially could have entered the septic system. Most would have been removed by the waste treatment plant prior to discharge. However, tritium and other radionuclides would not be removed by any of the treatment processes.

15.4.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contaminants at the previously unsampled outfalls and the remaining outfalls. The specific data required to assess contamination in each of these areas include the following:

1. Identify the contaminants present using Level II and III data for the previously unsampled outfalls and the remaining outfalls. Radionuclides, metals, and organic constituents were previously identified in three SWMUs.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.4.3. Sampling/Investigation Rationale

This chapter contains outfalls for which drainage patterns can be identified. Therefore, if Strategy A cannot be used to identify sampling locations based on radiological surveys, Strategy C will be used (for sampling Strategies A and C see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.4.4. Sampling Plan

All field radiological surveys will be performed in a band 10 ft wide running from the outfall to the mesa edge (for method see Sec. 11.4.1.2). The screening and analytics to be performed on the soil samples taken in this investigation are presented in Table 15.4-III.

SWMU 21-011(k) will have five samples taken at three locations. Strategy A will be used if possible. Under Strategy C, the first sample location will be in a small pooling area 13 ft north of the outfall marker stake. This will be a surface soil sample (for method see Sec. 11.5.2.1), and soil is expected to be shallow at this location. The remaining two sampling locations will be 52 ft north of the outfall marker in a pooling area on the canyon slope and 120 ft north of the stake in the gully at the canyon bottom. Near-surface soil samples will be taken to a 12-in. depth at each location (two 6-in. increments at each location) (see Sec. 11.5.2.4 for method).

SWMU 21-022(h) is very close to the mesa edge. It will be sampled at the outfall mouth and at the effluent collection point on the bench directly below. Field radiological surveys will be used to identify sampling points if possible. Three near-surface samples will be collected (three 6-in. intervals, total depth of 18 in.) at each location (for method see Sec. 11.5.2.4).

SWMU 21-024(n) will have field radiological surveys in an area 20-ft wide between the outfall and the north perimeter road because the evidence of the outfall channel has been removed by construction of the road. Three locations will be sampled to a depth of 18 in. by the near-surface soil sampling method (Sec. 11.5.2.4). If patterns of contamination can be found that indicate the effluent channel, Strategy A will be used. Otherwise, sampling will be accomplished according to Strategy C by sampling at the outfall mouth and at two locations in the ditch 55 ft north of the outfall marker. The two locations in the ditch will be 10 ft apart and downstream from the outfall.

SWMU 21-024(o) will have a radiological survey between the outfall and the mesa edge. The investigations will consist of near-surface soil samples (for method see Sec. in 11.5.2.4) to a depth of 18 in. (three 6-in. intervals) to be taken from two locations. Under Strategy C, samples will be taken from the center of the broad channel at two locations. The first location will be 2 ft east of the outfall marker, and the second will be 15 ft southeast of the outfall marker.

SWMU 21-026(d) will have field radiological sampling performed as part of the investigation over the well-defined channel from the outfall mouth to the base of the cliff. Three surface soil samples will be taken of sediments in the drainage channel using results from the radiological survey. If it is necessary to use Strategy C, the three samples will be taken in pooling areas at

Table 15.4-III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT DIRECT DISCHARGE OUTFALLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
21-011(k)																																	
Radiological Survey				X	X																												
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
21-022(h)																																	
Radiological Survey				X	X																												
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
Field Duplicate																						X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
21-024(n)																																	
Radiological Survey				X	X																												
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
Rinsate Blank																						X	X	X	X		X	X	X	X			X
Field Blank																												X	X	X			
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X

Table 15.4–III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT DIRECT DISCHARGE OUTFALLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
21-024(o)																																			
Radiological Survey				X	X																														
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Field Duplicate																						X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
21-026(d)																																			
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X					
	2	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	3	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Trip Blank																												X							

the outfall mouth, at 24 ft north of the outfall marker, and at 43 ft north of the marker (see Sec. 11.5.2.1 for method). Three near-surface soil samples will be taken to a total depth of 18 in. at the base of the cliff (for method see Sec. 11.5.2.4).

15.5. Surface Drainage South of TA-21-3

15.5.1. Site Description

This section addresses a drainage that includes four drain lines from Building TA-21-3.

15.5.1.1. Site History

SWMU 21-027(a) is a complex drainage system in the area between equipment room 3A in TA-21-3 and the south rim of DP Mesa (Fig. 15.5-1). It includes CEARP outfalls 3d, 3p (NPDES No. EPA03A031), 3ae, and 3af. The system originates at the southwest corner of Building TA-21-3 (LASL 1958c) with floor drains from equipment room 3A that connect to two 3-in. lines. Those lines connect to a 4-in. line, which empties into a 12-in. storm drain (LASL 1950). This drain line extends from the southwest corner of TA-21-3 almost to the southwest corner of the cooling tower TA-21-143 (LANL 1990) where it empties into a ponding area. This area also receives NPDES-permitted discharges of treated cooling water from the cooling tower. The combined effluents from the pond flow east along the south side of the cooling tower to a 24-in. CMP culvert, which carries them to the mesa edge.

15.5.1.2. Existing Information

This SWMU was sampled as part of DOE Headquarters Environmental Survey Problem 19 (DOE 1989b). Three samples were taken as shown in Fig. 15.5-1. Table 15.5-I identifies the analyses and presents the results. The analytical methods for these samples were not included in the reference and cannot be identified. Therefore, this data is used solely to guide future sampling.

This area was also sampled as part of the 1988 ER Program reconnaissance sampling (DOE 1989b). Two samples were taken from the ponding area, and the results are given in Table 15.5-II. The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory.

Comparing the results of these two sampling efforts with data given in Sec. 4.2.4 indicates above background level concentrations of cadmium, chromium, copper, lead, zinc, mercury, ^{241}Am,

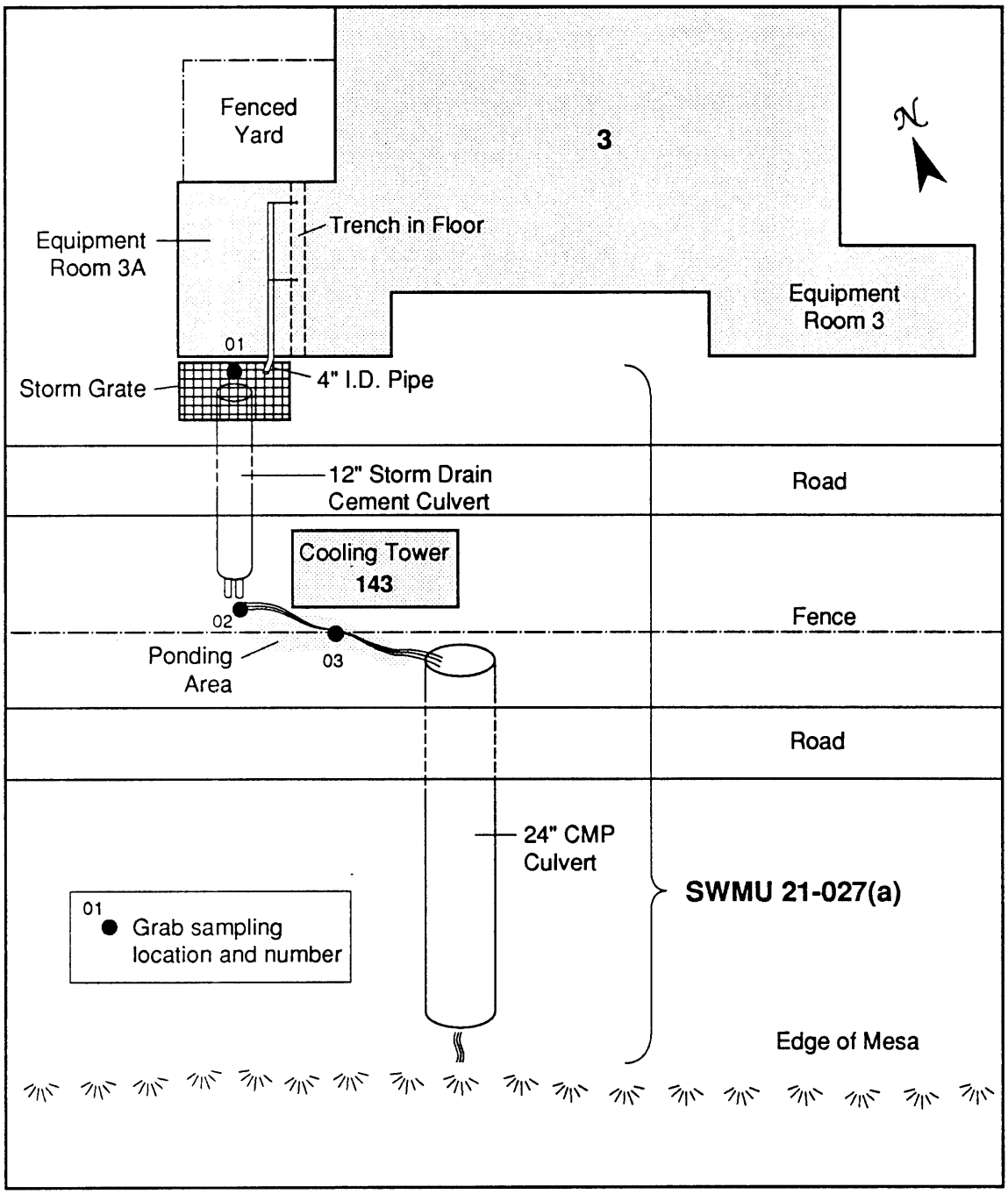


Fig. 15.5-1 Configuration of SWMU 21-027(a) and DOE HQ Environmental Survey Problem #19 sampling locations.

TABLE 15.5-I
DOE ENVIRONMENTAL SURVEY PROBLEM 19 ANALYTICAL DATA
(FROM TABLE 4.19. - LOS ALAMOS NATIONAL LABORATORY - INORGANIC DATA - ENVIRONMENTAL PROBLEM 19 APRIL 1989)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60401XW	LA60402XW	LA60403XW	
MEDIA	Soil	Soil	Soil	Upper Limit
UNITS	ug/kg	ug/kg	ug/kg	of Background
SDG NUMBER	LA60403XV	LA60403XV	LA60403XV	$\bar{x}$ + 2s
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS				
alpha-BHC	—	—	—	--a
Endosulfan I	—	—	—	--a
Endosulfan II	—	—	—	--a
4,4'-DDD	—	—	—	--a
4,4'-DDT	—	—	—	--a
gamma-chlordane	—	—	—	--a
Aroclor-1221	—	—	—	--a
Aroclor-1248	—	—	—	--a
Aroclor-1254	2600 J	3200 J	7700 J	--a
Total (Allowed) Hold Time	7(14)d	7(14)d	7(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor				

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	Upper Limit
SAMPLE NUMBER	LA60401D	LA60401W	LA60402D	of Background
MEDIA	Soil	Soil	Soil	$\bar{x} + 2s$
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	(pCi/g)
Alpha Emitters				
Thorium - 232[b]	na	<4430 ±390	na	1.8
Uranium - 234	na	—	na	—
Uranium - 235	na	469 ±47.0	na	—
Uranium - 238[b]	na	<6510 ±520	na	1.7
Uranium (all isotopes)[c]	2000 ±200	na	5000 ±500	—
Plutonium - 238	4000 ±1000	na	86000 ±6000	0.005
Plutonium - 239, 240	22300 ±2300	na	216000 ±13000	0.025
Americium - 241	na	4200 ±320	na	—
Beta Emitters				
Strontium - 90	<550	na	<760	0.88
Gamma Emitters				
Beryllium - 7	na	340 ±80.0	na	—
Potassium - 40	na	12340 ±990	na	—
Cesium - 137	na	210 ±50.0	na	0.44

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	Upper Limit
SAMPLE NUMBER	LA60402W	LA60403D	LA60403W	of Background
MEDIA	Soil	Soil	Soil	$\bar{x} + 2s$
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	(pCi/g)
Alpha Emitters				
Thorium - 232[b]	<9220 ±730	na	<8280 ±650	1.8
Uranium - 234	—	na	267000 ±47000	—
Uranium - 235	290 ±53.0	na	14840 ±980	—
Uranium - 238[b]	<10020 ±860	na	<7790 ±630	1.7
Uranium (all isotopes)[c]	na	6000 ±600	na	—
Plutonium - 238	na	14400 ±1800	na	0.005
Plutonium - 239, 240	na	84500 ±5400	na	0.025
Americium - 241	27400 ±2600	na	9300 ±1200	—
Beta Emitters				
Strontium - 90	na	<840	na	0.88
Gamma Emitters				
Beryllium - 7	—	na	600 ±260	—
Potassium - 40	17800 ±1800	na	17700 ±1300	—
Cesium - 137	642 ±76.0	na	1373 ±99.0	0.44

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60401XV	LA60402XV	LA60403XV	Upper Limit
MEDIA	Soil	Soil	Soil	of Background
UNITS	ug/kg	ug/kg	ug/kg	$\bar{x} + 2s$
SDG NUMBER	LA60401XV	LA60401XV	LA60401XV	
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS[d]				
Acenaphthene	—	—	320 J	—[a]
Phenanthrene	720 J	680 J	3200 J	—[a]
Anthracene	180 J	—	740 J	—[a]
Fluoranthene	970 J	1000 J	6400	—[a]
Pyrene	1300 J	960 J	4400	—[a]
Benzo(a)anthracene	—	1200 J	2700 J	—[a]
Chrysene	1100 JB	1500 JB	3200 JB	—[a]
Benzo(b)fluoranthene	—	2600 J	—	—[a]
Benzo(k)fluoranthene	940 JB	2800 JB	3500 JB	—
Benzo(a)pyrene	—	3100 JB	1900 JB	—[a]
Indeno(1,2,3 - cd)pyrene	—	3900	2500 J	—[a]
Dibenz(a,h)anthracene	—	2800 J	—	—[a]
Benzo(g,h,i)perylene	—	3100 J	1500 J	—[a]
TENTATIVELY IDENTIFIED COMPOUNDS				
Chlorinated Hydrocarbon	—	—	1600 J	—[a]
Total (Allowed) hold time	3(14)d	3(14)d	3(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor	0.100	0.100	0.100	

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60402XX	LA60403XX	LA60401XX	
MEDIA	Soil	Soil	Soil	Upper limit
UNITS	ug/kg	ug/kg	ug/kg	of Background
SDG NUMBER	LA60203XX	LA60203XX	LA60203XX	$\bar{x} + 2s$
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS				
Acetone	100 B	260 B	—	--a
1,1,1-Trichloroethane	—	—	—	--a
Trichloroethene	—	—	73	--a
Toluene	—	—	44	--a
Ethylbenzene	—	—	20 J	--a
Xylene (total)	—	—	18 J	--a
TENTATIVELY IDENTIFIED COMPOUNDS				
Prob T-Butyl Phenol	41 J	—	—	--a
Prob Terpene	56 J	1600 J	—	--a
Prob Terpene	110 J	110 J	—	--a
Prob Terpene	—	2000 J	—	--a
Total (Allowed) hold time	9(14)d	9(14)d	9(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor	1.000	1.000	1.000	
AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60401XW	LA60402XW	LA60403XW	Upper limit[e]
MEDIA	Soil	Soil	Soil	of Background
UNITS	mg/kg	mg/kg	mg/kg	$\bar{x} + 2s$

TABLE 15.5-I (continued)

SDG NUMBER	LA50006XW	LA50006XW	LA50006XW	(mg/kg)
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
ANALYTES				
Antimony	—	—	—	—
Arsenic	—	—	—	7.1
Barium	195	103	131	850
Beryllium	—	0.53 B	0.39 B	2.9
Cadmium	—	—	4.9	0.37
Chromium	16.5	38.1	90.6	75
Copper	50.1	110	103	19
Lead	63.5	52.4	77.2	54
Mercury	NR	NR	NR	0.03
Nickel	12.4	7.3 B	10.6	18.5
Selenium	—	—	—	—
Silver	—	—	—	—
Thallium	—	—	—	—
Zinc	296	286	379	78
% Soils	90.8	87.1	86.3	
Total (Allowed) Hold Time[f]	7(182)d	7(182)d	7(182)d	
Total (Allowed) Hold Time[g]	7(182)d	7(182)d	7(182)d	

[a]Background assumed to be zero.
[b]Total unbroken chain activity in equilibrium.
[c]Units are µg (/L, /kgW, or /kgD) instead of pCi ((/L, /kgW, or /kgD).
[d]All the polynuclear aromatic hydrocarbons (PAHs) listed here are common constituents of asphalt, and are listed here for completeness. They are not contaminants of concern.
[e]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$ as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metal is $\bar{x} + 2s$ as calculated from the data given in Table 4.2-XV.
[f]ICP.
[g]GFAAS.

TABLE 15.5-II
1988 RECONNAISSANCE SAMPLING RESULTS FROM
SWMU 21-027(a)[a]

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x} + 2s$
	Volatiles				
Sample #1	DICHLOROMETHANE-METHYLENE	75	UG/KG	65	—[c]
	CHLORIDE				
	Semi-Volatiles				
	FLUORANTHENE	3000	UG/KG	2200	—[c]
	PHENANTHRENE	2400	UG/KG	2200	—[c]
	PYRENE[b]	2300	UG/KG	2200	—[c]
	Metals				
	ALUMINUM, TOTAL	1490	MG/KG	39.1	65,000
	ARSENIC, TOTAL	3.3	MG/KG	2.0	7.1
	CADMIUM, TOTAL	1.1	MG/KG	0.98	0.37
	CALCIUM, TOTAL	1790	MG/KG	978	—
	CHROMIUM, TOTAL	48.9	MG/KG	2.0	75
	COPPER, TOTAL	35.4	MG/KG	4.9	19
	IRON, TOTAL	10200	MG/KG	19.6	26,600
	LEAD, TOTAL	46.6	MG/KG	19.6	54
	MANGANESE, TOTAL	87.7	MG/KG	2.9	770
	MERCURY, TOTAL	0.29	MG/KG	0.12	0.03
	NICKEL, TOTAL	12.8	MG/KG	7.8	18.5
	OIL & GREASE BY GRAVIMETRIC[b]	4630	MG/KG	58.2	—[c]
	VANADIUM, TOTAL	13.5	MG/KG	9.8	—
	ZINC, TOTAL	226	MG/KG	3.9	78
	Radionuclides				
	AMERICIUM	4.6	PCI/G	0.6	—
	CESIUM-137	0.5	PCI/G	0.1	0.44
	PLUTONIUM-238	1.9	PCI/G	0.2	0.005
	PLUTONIUM-239	28	PCI/G	1.0	0.025
	RADIUM-226	0.7	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.2	0.88
	THORIUM 232	0.9	PCI/G	0.1	1.8
	TRITIUM	1600	PCI/ML	100	0.0072

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x} + 2s$
	URANIUM-234	290	PCI/G	20	—
	URANIUM-235	10	PCI/G	1	—
	URANIUM-238	1.9	PCI/G	0.4	1.7
	Radionuclides				
Sample #2	AMERICIUM	7.6	PCI/G	0.5	—
	CESIUM-137	0.3	PCI/G	0.1	0.44
	PLUTONIUM-238	8.5	PCI/G	0.5	0.005
	PLUTONIUM-239	6.8	PCI/G	2.0	0.025
	RADIUM-226	1.2	PCI/G	0.1	2.5
	THORIUM 232	0.4	PCI/G	0.2	1.8
	TRITIUM	68	PCI/ML	3.0	0.0072
	URANIUM-234	4.0	PCI/G	0.4	—
	URANIUM-235	0.2	PCI/G	0.1	—
	URANIUM-238	0.7	PCI/G	0.2	1.7
	Metals				
Sample #2	ALUMINUM, TOTAL	1290	MG/KG	31.7	65,000

[a]Sample #1 was from CEARP Outfall 3d; Sample #2 from 3ae.
[b]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$ as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} + 2s$ as calculated from the data given in Table 4.2-XV.
[c]Background assumed to be zero.

^{238}Pu, $^{239/240}Pu$, ^{234}U, ^{235}U, ^{238}U, ^{232}Th, ^{90}Sr, and ^{137}Cs. In addition, toluene and trichloroethene were found in concentrations above the detection limit. All the polynuclear aromatic hydrocarbons (PAHs) found are common constituents of asphalt and, therefore, are not considered further.

15.5.1.3. Source Term

The source term for this discharge system includes all the contaminants found in the previous sampling efforts, These contaminants will likely be found throughout the discharge system, at the final outfall point on the south edge of DP Mesa and on the bench directly below the mesa.

15.5.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contaminants at SWMU 21-017(a). The specific data required to assess contamination of SWMU 21-017(a) include the following:

1. Identify the contaminants present using Level III data from the discharge and below the ponding area. Contaminants may be driven downward into the tuff by the constant water head available at the ponding area. Contaminants may include radionuclides, organic and inorganic constituents.

2. If contamination is identified, determine the lateral and vertical extent of contaminant migration by additional subsurface sampling and Level III/IV analyses.

15.5.3. Sampling/Investigation Rationale

Surface soil sampling will be used to address contaminant levels at various points along the drainage system on DP Mesa and on the bench below the south rim of the mesa. Vertical boreholes will be used to assess the migration of contaminants into subsurface soil and tuff in the ponding area.

Because sampling locations are evident on the mesa top, sampling Strategy C will be used. On the bench, appropriate locations are not as evident, and Strategy B will be used (for Strategies B and C, see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from the outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly

to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.5.4. Sampling Plan

Five surface soil samples (for method see Sec. 11.5.2.1) will be taken along the drainage system: one from beneath the storm drain at the corner of Room 3A, three from the ponding area, and one from the end of the 24-in. CMP, about 2 ft from the mesa edge (see Fig. 15.5-2). Radiological surveys may be used to refine the sampling locations (for method see Sec. 11.4.1.2).

Two boreholes will be drilled to a nominal depth of 20 ft in the ponding area (for method see Sec. 11.5.3.2). The boreholes will be placed at opposite ends of the ponding area as shown in Fig. 15.5-2. Four samples will be acquired from each borehole (5-ft core intervals).

The bench below the mesa edge will be sampled according to Strategy B. Three groups of three sampling locations will be placed at 5-ft intervals outward from the base of the cliff on the bench. Surface soil samples will be taken at each location (see Sec. 11.5.2.4 for method), resulting in nine samples from the bench. The screening and analytics to be performed on the soil samples taken in this investigation are presented in Table 15.5-III.

Table 15.5-III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS OF THE SURFACE DRAINAGE SOUTH OF TA-21-3.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
21-027(a)																																	
Radiological Survey				X	X																												
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
	2	0.0 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
Field Duplicate																						X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	6	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	7	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	8	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	9	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X

Table 15.5-III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS OF THE SURFACE DRAINAGE SOUTH OF TA-21-3.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X				
Trip Blank																												X						

15.6. Septic Tanks

15.6.1. Site Description

This chapter addresses two abandoned septic tanks, a leach field, and the associated lines and outfalls at DP East, SWMU 21-024(j) and (k). They have been grouped together because of similarities in contaminants and configuration.

15.6.1.1. Site History

SWMU 21-024(j) consists of septic tank TA-21-194 and associated drain lines. The septic tank received sewage from TA-21-155 (warehouse/laboratory), but it is not known where (or if) the septic tank discharged overflow to the environment (LANL 1990; LANL 1989a). The function and operation of the laboratory in Building TA-21-155 cannot be determined. The reinforced concrete tank is located off the southwest corner of TA-21-155 near the south edge of the perimeter road (Fig. 15.6-1). It was constructed in December 1961 and has dimensions of 5-ft long by 3-ft wide and 6-ft deep. In October 1966, the septic system was abandoned by pumping out the septic tank and filling it with earth (LANL 1989a).

SWMU 21-024(k) consists of septic tank TA-21-219, associated drain lines, and a leach field (Fig. 15.6-2). Sewage discharged from TA-21-209 (high-temperature chemistry building) was carried south to manhole TA-21-217 via a 6-in. cast iron line. Six-inch VCPs carried the sewage south to manhole TA-21-228 and on southwest to septic tank TA-21-219. The septic tank, which has two chambers, was constructed in September 1965 from reinforced concrete (LANL 1989a). The outside dimensions are 18-ft 6-in. long by 6-ft 4-in. wide and 8-ft 10-in. deep (LASL 1964). Overflow from the septic tank went to a leach field which was 30-ft long by 20-ft wide and 5-ft 6-in. deep (Fig. 15.6-2). Also, two 4-in. VCP lines are shown to extend from the downslope edge of the leach field as shown in Fig. 15.6-2. The two drain lines daylighted somewhere between the leach field and the mesa edge; however, the exact location is not known. In October 1966, the septic system was abandoned by pumping out the tank and filling it with earth.

Currently two manholes and two vent pipes can be observed south of TA-21-155 just outside the security fence above the location of septic tank TA-21-219. No evidence of the two leach field drain lines is evident, although pieces of VCP can be seen in the area. The leach field may have been removed because there is evidence of backfill in the area suspected of containing the leach field. However, there is no documentation that states any portion of the septic system was removed.

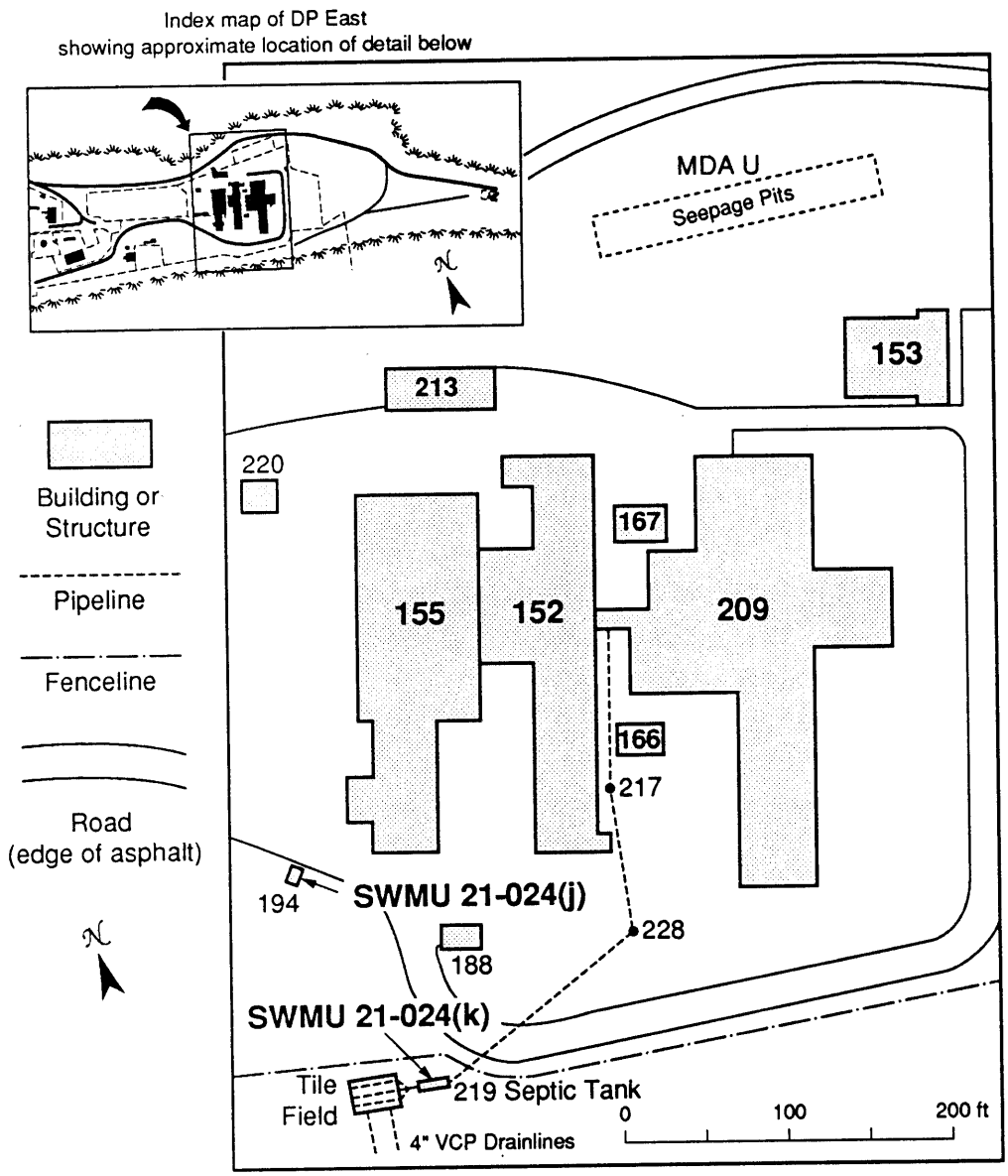


Fig. 15.6-1 Location of SWMUs 21-024(j) and -024(k). (LASL 1964)

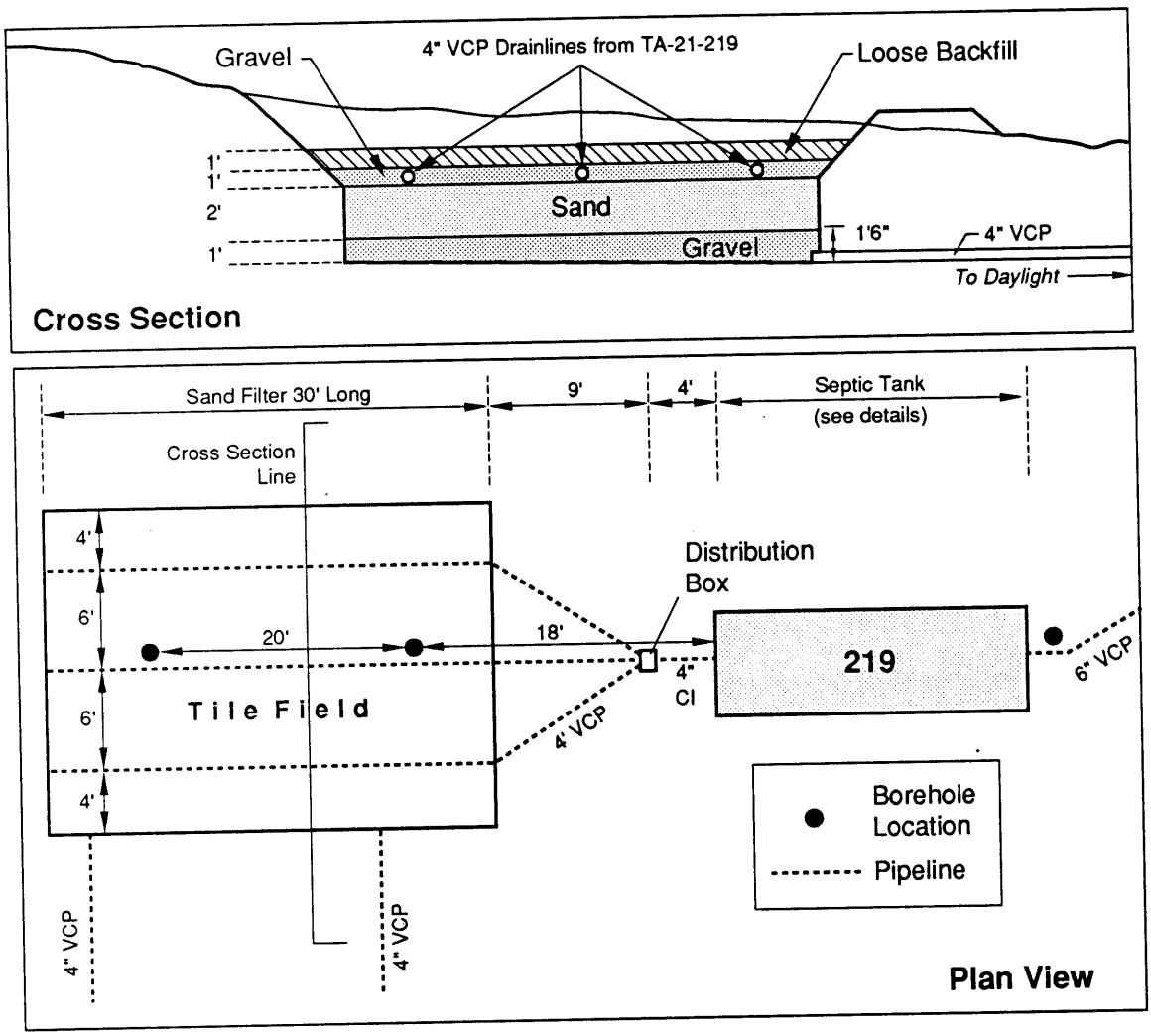


Fig. 15.6-2 Leach field details and borehole sampling locations. (LASL 1964)

15.6.1.2. Existing Information

No quantitative information exists on potential contaminants.

15.6.1.3. Source Term

SWMU 21-024(j) can potentially contain radionuclides, organics, metals, and inorganic lab chemicals.

SWMU 21-024(k) may have radionuclides, organics, metals, and common laboratory chemical present in the septic tank, the leach field, and the outfall.

15.6.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-024 (j) and (k). The specific data required to assess contamination at SWMU 21-024 (j) and (k) include the following:

1. Determine the location of septic tank TA-21-194. This system has been abandoned, and its exact location is not known.
2. Identify contaminants present using Level II and III data. Potential contaminants in these areas may include radionuclides, organic and inorganic constituents.
3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.6.3. Sampling/Investigation Rationale

The location of SWMU 21-024(j) will be marked in the field by surveys based on an engineering drawing. Geophysical surveys will be used to confirm the exact location of the tanks, assuming a response to the rebar in the concrete. Excavation will be necessary to uncover the top of the septic tanks in order to provide positive locations of the tanks and drain lines before drilling begins.

Subsurface soil sampling will be performed at each septic tank to identify the presence of contaminants released by overflow or leaks. This single borehole will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal. Subsurface samples will also be taken in the leach field to determine whether the liquid distribution system has carried contaminants into the soil and tuff beneath the field.

15.6.4. Sampling Plan

SWMU 21-024(j). The location of septic tank TA-21-194 will be determined by surveying from an engineering drawing (LASL 1964) and will be marked in the field. A geophysical survey (for method see Sec. 11.4.2.1) will be used to confirm the location if a response to the rebar in the reinforced concrete can be obtained. A vertical borehole will be sampled to a nominal depth of 20 ft near the drain line inlet of the septic tank (see Sec. 11.5.3.2 for method). A total of four samples will result (5-ft core intervals).

Table 15.6-I lists the screening and analyses to be performed on the samples.

SWMU 21-024(k) sampling will be performed by drilling three vertical boreholes to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The first borehole will be placed on the inlet side of the septic tank as close to the tank as possible (Fig. 15.6-2). The remaining two boreholes will be drilled within the area occupied by the leach field. These two boreholes will be 18 ft and 38 ft from the west end of the septic tank (Fig. 15.6-2).

If contamination is found to be present in the leach field, then a radiologic survey and sampling may be required downslope from the leach field to the mesa edge to identify any contamination that may be associated with the two 4-in. VCP drain lines shown to extend from the leach field south towards the mesa edge.

Table 15.6-I lists the screening and analyses to be performed on the samples.

Table 15.6-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
21-024(j)						X	X																										
Survey								X	X		X	X	X								X	X	X	X		X	X	X	X			X
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
21-024(k)				X	X	X	X																										
Survey								X	X		X	X	X								X	X	X	X		X	X	X	X			X
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
Trip Blank																												X					
	2	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
Field Duplicate																					X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
	3	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X			X
Rinsate Blank																												X	X	X			
Field Blank																												X					
Trip Blank																																	

15.7. Surface Drainage South of TA-21-155

15.7.1. Site Description

This section contains two SWMUs that have separate histories and origins but drain in the same area, resulting in a common sampling plan. Their histories will be discussed separately, but in the remainder of the section, they will be discussed together.

15.7.1.1. Site History

SWMU 21-024(m) (CEARP identifier 3z) is reported to be an 8-in. VCP that exits TA-21-209, the high-temperature chemistry lab, and leads south toward Los Alamos Canyon. The outfall cannot be located in the field. The former location, as indicated on engineering drawing ENGR-4821, is shown on Fig. 15.7-1.

At the approximate site where the outfall should be, there is an 8-in. CMP discharging water. This pipe appears to come from a storm drain below the lawn area of TA-21-209. Adjacent to the pipe is an NPDES-type stake, but no placard. The construction of this pipe may have destroyed the SWMU 21-024(m) outfall pipe. Immediately adjacent to the flowing outfall is a dry, 12-in. CMP with no labeling. It is unlikely that either of these pipes represents SWMU 21-024(m), although the location appears correct. The area around the outfall is gently sloping and is drained by the channel associated with the SWMU 21-027(b) outfall.

SWMU 21-027(b) consists of two outfalls with CEARP identifiers 3q and 3r. CEARP outfall 3r is an active NPDES outfall (No. EPA03A034). It discharges treated cooling water from cooling towers TA-21-166 and TA-21-167 on the south edge of DP Mesa (Fig. 15.7-1). Formerly, these cooling towers discharged through SWMU 21-024(i) (see Sec. 15.3).

CEARP outfall 3q is identified as discharging south into Los Alamos Canyon from a cooling tower associated with TA-21-152. The outfall could not be located during the site reconnaissance. A LANL report on NPDES outfalls (LANL 1989c) states that this outfall was eliminated. In addition, no engineering drawings showing a line discharging southward from TA-21-152 have been found other than those showing the line considered to be CEARP outfall 3r. It is probable that this outfall is the same as CEARP outfall 3r, and they will be considered to be the same under SWMU 21-027(b).

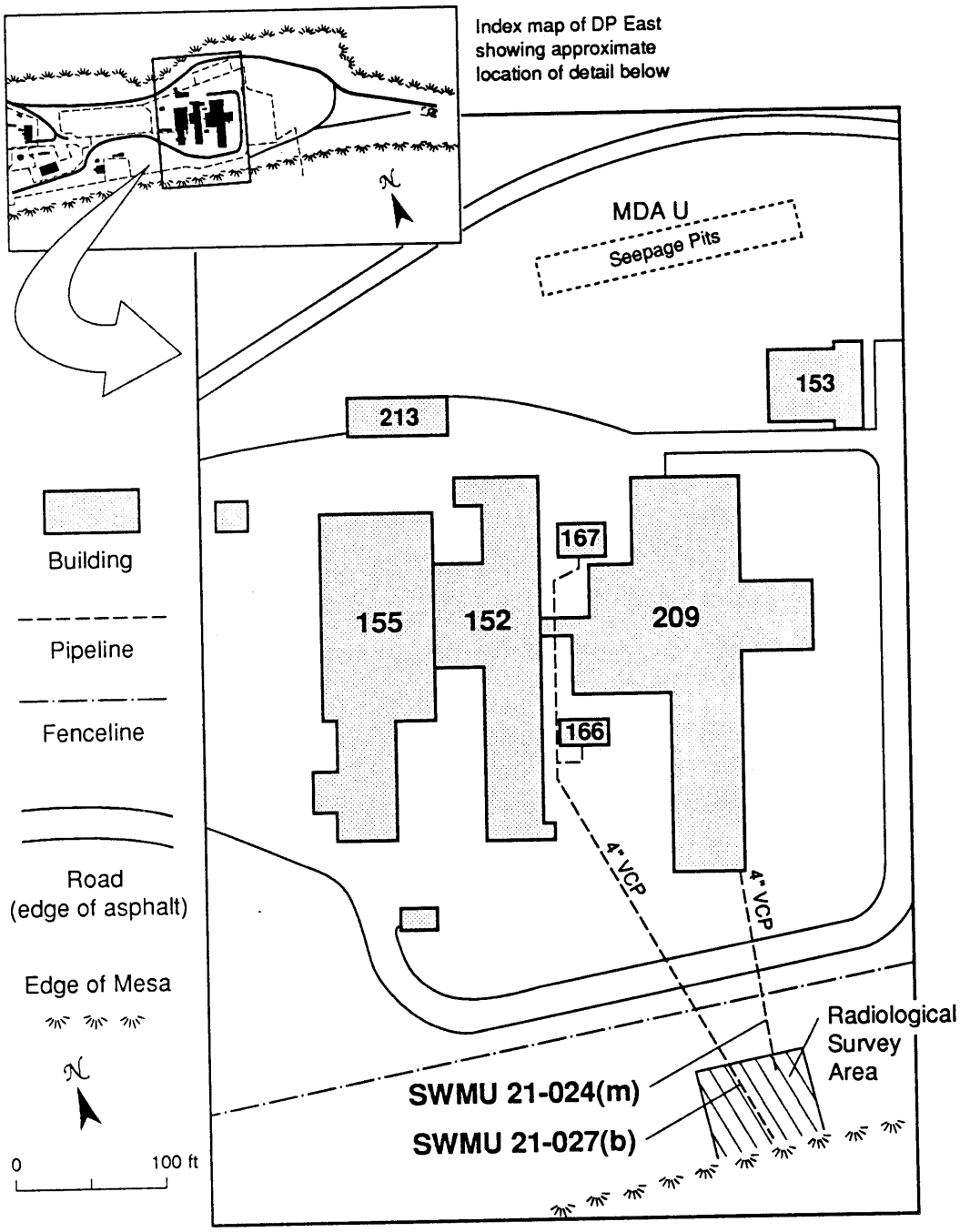


Fig. 15.7-1 Location of SWMU 21-024(m) and -027(b). (LASL 1976a)

15.7.1.2. Existing Information

The drainage serving these SWMUs has not previously been sampled and no quantitative contaminant information is available.

15.7.1.3. Source Term

The source term for the channel serving both SWMUs includes radionuclides and organic and inorganic lab chemicals from the high-temperature chemistry lab, TA-21-209.

15.7.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-024(m) and 21-027(b). Specific data required to assess contamination at SWMUs 21-024(m) and 21-027(b) include the following:

1. Identify the contaminants present using Level II and III data. These outfalls discharge what appears to be stormwater and cooling tower water; no contamination has been previously identified.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.7.3. Sampling/Investigation Rationale

Field radiological surveys will be used, if possible, to identify sampling locations within the well defined drainage serving SWMUs 21-024(m) and 21-027(b). Surface soil samples collected a part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.7.4. Sampling Plan

A field radiological survey will be performed in the entire area around the channel, including both outfall locations as shown in Fig. 15.7-1 (see Sec. 11.4.1.2 for method).

Near-surface soil samples (for method see Sec. 11.5.2.2) will be taken to an 18-in. depth (three 6-in. intervals) from two locations according to Strategy A, if possible, or Strategy C if not. Under

Strategy C, the sampling locations will be the mouth of outfall SWMU 21-027(b) and the small pooling area at the mesa edge, 15 ft south of the outfall.

Table 15.7-I lists the screening and analyses to be performed in this investigation.

Table 15.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR THE SURFACE DRAINAGE SOUTH OF TA-21-155.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Surface Drainage South of TA-21-155																																
Survey				X	X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Field Duplicate																					X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Rinsate Blank																					X	X	X	X		X	X	X	X			X	
Field Blank																											X	X	X				
Trip Blank																											X						

15.8. Surface Drainage North of TA-21-155

15.8.1. Site Description

This section discusses two outfall systems, SWMUs 21-004(d) and 21-024(h), whose effluents are drained by the same channel. Both systems have distinct histories and contaminant information, but their sampling plans are related and will overlap.

15.8.1.1. Site History

SWMU 21-004(d) was an overflow line (CEARP identifier 3n) from an acid waste pumping station, structure TA-21-223, that carried waste from DP East to TA-21-257 at DP West for treatment. It ran north from the pump station and discharged at a concrete bulkhead approximately 15 ft north of the perimeter road (Fig. 15.8-1). This outfall would discharge in the event that the pumps failed. The discharged wastes generally consisted of diluted laboratory wastes and liquids from chilled water systems originating from operations at DP East. The wastes may have also been contaminated with tritium (Buchholz 1991), polonium and actinium (Merrill 1990), and mercury and $^{239/240}Pu$ (DOE 1989). Engineering drawings indicate that between 1968 and 1979, a 14-ft extension line was added to the bulkhead to discharge effluents further downslope (LASL 1968a; LASL 1979). In 1979, two holding tanks were added approximately 50 ft downslope from the bulkhead to store overflow (LASL 1979). These tanks are discussed in Sec. 14.3 as part of SWMU 21-004(d). Prior to 1979, the station would at times overflow to the canyon (LANL 1987). When the tanks were installed, the pipe was extended from the bulkhead into the tanks, which were erected roughly where effluent from the outfall would have gone. The area was extensively reworked to construct the pad for the tanks.

Effluent discharging from the bulkhead, and later from the 14 ft extension, would have flowed approximately 75 ft northwest to a deep channel that also drains SWMU 21-024(h). This channel leads to a drainage ditch for the east-west road on the north side of the tanks. Effluent in the ditch is discharged northward through a CMP under the road and thence to DP Canyon.

SWMU 21-024(h) (CEARP outfall 3i) discharged sewage from TA-21-151 through septic tank TA-21-163 (abandoned in place in 1966) to the surface on the north rim of DP Mesa (Fig. 15.8-1). The septic tank is constructed of reinforced concrete with dimensions of 6 ft by 14 ft by 5-ft deep. Six-in. VCP lines carry effluent from TA-21-151 to the septic tank and then to the outfall.

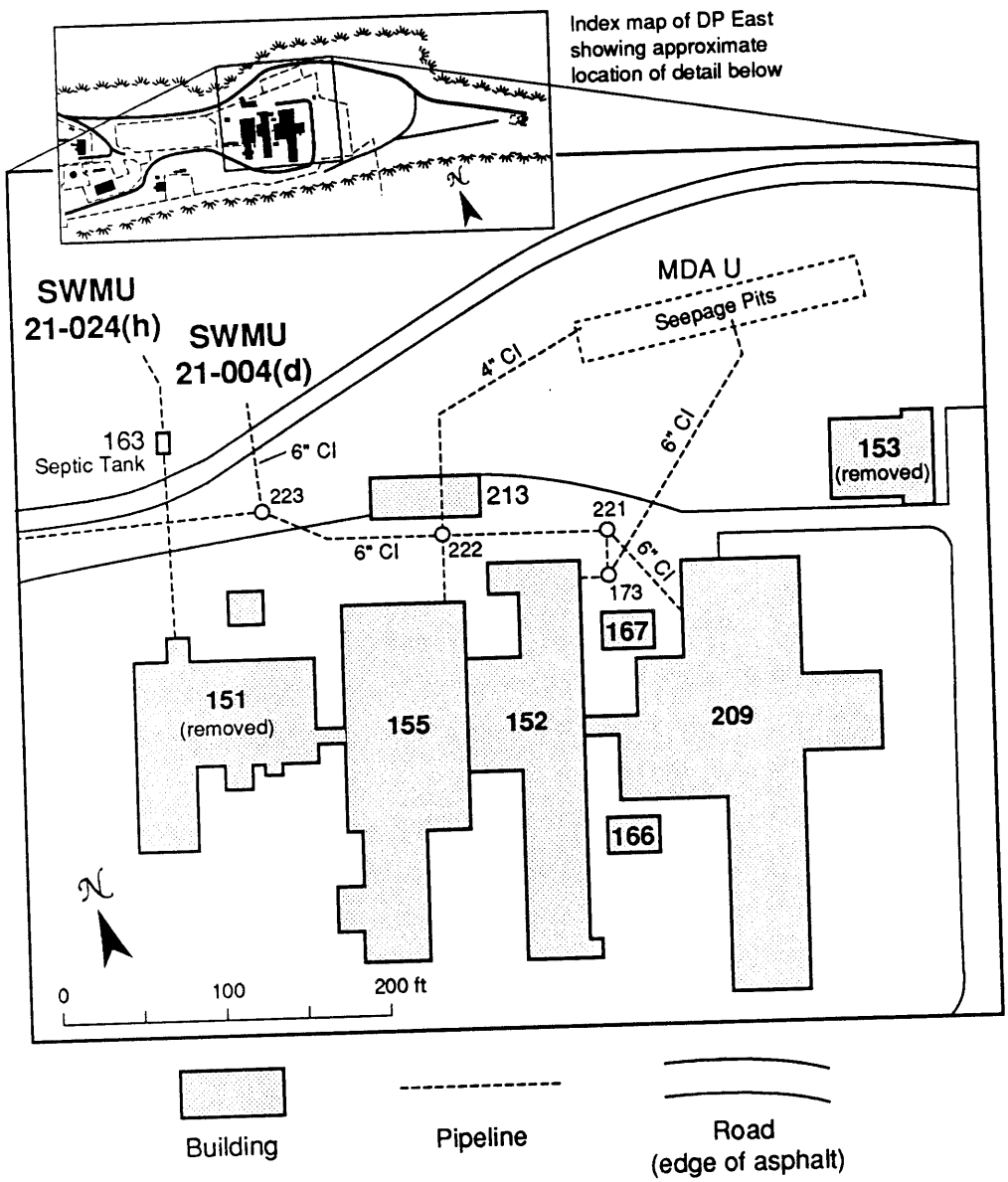


Fig. 15.8-1 Location of SWMUs 21-004(d) and 21-024(h). (LASL 1958d, 1976a)

An engineering drawing bears the notation "field check could not locate end of pipe" (LASL 1958d). And no surface expression of the pipe can be found at present. A CEARP marker was placed in the channel mentioned above, at the location LASL investigators felt was the most likely site of the outfall. This marker should be considered as only an approximate location.

15.8.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. The analytical results are presented in Table 15.8-I.

SWMU 21-004(d). A sample was taken from beneath the pipe extending from the bulkhead, approximately 2 ft downslope of the bulkhead. Comparing the results with the background data presented in Sec. 4.2.4 indicates above-background levels of mercury, $^{239/240}Pu$, and tritium. Also, oil and grease by gravimetric analyses were found in concentrations above the detection limit.

SWMU 21-024(h) had a grab sample taken at the junction of two channels leading away from the CEARP marker. The results show above-background level readings of ^{241}Am, tritium, and $^{239/240}Pu$, as well as oil and grease in concentrations above the detection limit.

15.8.1.3. Source Term

SWMU 21-004(d). This SWMU is associated with waste at DP East because the pipeline replaced the outfall. Therefore, the source term for this SWMU includes ^{227}Ac and organic and inorganic laboratory chemicals, as well as the contaminants identified in the sample described above.

SWMU 21-024(h) may be contaminated with tritium because of the fusion fuel research conducted at DP East, in addition to the contaminants identified in the sample described above.

15.8.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-004(d) and 21-024(b). The specific data required to assess contamination at SWMUs 21-004(d) and 21-024(h) include the following:

1. Determine the location of the septic tank TA-21-163. The location of this tank is unclear and has not been previously located.

TABLE 15.8-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS 21-004(d) and 21-024(h)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-004(d)	ALUMINUM, TOTAL	7790	MG/KG	31	65,000
	BARIUM, TOTAL	95.5	MG/KG	31	850
	CALCIUM, TOTAL	2760	MG/KG	777	—
	CHROMIUM, TOTAL	6.1	MG/KG	2.0	75
	COPPER, TOTAL	7.0	MG/KG	4.0	19
	IRON, TOTAL	7330	MG/KG	16	26,600
	LEAD, TOTAL	13.1	MG/KG	10	54
	MAGNESIUM, TOTAL	1400	MG/KG	777	4,700
	MANGANESE, TOTAL	246	MG/KG	2.0	770
	MERCURY, TOTAL	0.17	MG/KG	0	0.03
	NICKEL, TOTAL	6.6	MG/KG	6.0	18.5
	OIL & GREASE BY GRAVIMETRIC	596	MG/KG	54	—[b]
	POTASSIUM, TOTAL	1200	MG/KG	777	—
	SILVER, TOTAL	2.1	MG/KG	2.0	—
	VANADIUM, TOTAL	14.2	MG/KG	8.0	—
	ZINC, TOTAL	35.1	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	0.3	PCI/G	0.1	0.44
	PLUTONIUM-239	3.5	PCI/G	0.3	0.025
	RADIUM-226	1.3	PCI/G	0.2	2.5
	THORIUM-232	0.9	PCI/G	0.3	1.8
	TRITIUM	260	PCI/ML	10	0.0072
	URANIUM-234	1.4	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.2	1.7
	Metals				
SWMU 21-024 (h)	ALUMINUM, TOTAL	2230	MG/KG	35	65,000
	CHROMIUM, TOTAL	2.4	MG/KG	2.0	75
	IRON, TOTAL	3170	MG/KG	18	26,600
	LEAD, TOTAL	8.5	MG/KG	6.0	54
	MANGANESE, TOTAL	194	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	272	MG/KG	53	—[b]
	ZINC, TOTAL	26.8	MG/KG	4.0	78

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Radionuclides				
	AMERICIUM	0.2	PCI/G	0.1	—
	PLUTONIUM-239	1.5	PCI/G	0.2	0.025
	RADIUM-226	1.0	PCI/G	0.1	2.5
	STRONTIUM-90	0.6	PCI/G	0.3	0.88
	THORIUM-232	0.6	PCI/G	0.2	1.8
	TRITIUM	7.0	PCI/ML	2.0	0.0072
	URANIUM-234	0.5	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7

[a] The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b] Background assumed to be zero.

2. Identify the contaminants present using Level II and III analyses at the SWMU 21-004(d) outfall area, the SWMU 21-024(h) septic tank and outfall, and the area where both systems commingle.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analysis.

15.8.3. Sampling/Investigation Rationale

Before sampling begins, the location of TA-21-163 will be marked by surveying from old engineering drawings. The location of the end of the outfall line cannot be determined in this way because its location on the engineering drawings has been marked as unknown.

Appropriate soil sampling locations for both SWMUs and the commingling area will be determined using Strategy A. If Strategy A does not identify radioactively contaminated areas for sampling, Strategy B will be employed at SWMU 21-004(d), and Strategy C will be used at SWMU 21-024(h) and in the commingling area (for explanation of these strategies see Sec. 15.1.4).

The area of septic tank will be sampled by borehole coring to identify subsurface contamination resulting from leaks or overflows. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.8.4. Sampling Plan

SWMU 21-004(d) will have a field radiological survey (see method in Sec. 11.4.2.1) performed in an area approximately 20-ft wide between the bulkhead and the roadside ditch to the north where the effluent commingles with SWMU 21-024(h) (Fig. 15.8-2).

Near-surface soil samples (see Sec. 11.5.2.4 for method) will be taken at six locations in the drainage between the bulkhead and the point where it merges with the main channel. If a definite drainage path can be established by the radiation surveys, Strategy A will be used to select sampling locations. Otherwise, Strategy B will be used with one three-location group placed below the opening of the concrete bulkhead and a second group placed halfway between the bulkhead and the roadside ditch. Each near-surface soil sampling location will be sampled to a depth of 18 in. (three 6-in. intervals), resulting in a total of 18 samples by either strategy.

Screening and analyses to be performed on the 18 samples gathered in this plan are presented in Table 15.8-II.

SWMU 21-024(h). A field radiological survey will be performed in the channel from the septic tank to the roadside ditch to the north.

Near-surface soil samples (for method see Sec. 11.5.2.4) will be taken from three locations: two in the channel and one at the commingling area in the roadside ditch. Each location will be sampled to a total depth of 18 in. (three 6-in. intervals), giving nine samples. If areas of radioactive contamination are detected, Strategy A will be used to select sampling locations. Otherwise, Strategy C sampling locations will be: a large pooling area 30 ft upstream (south) of the CEARP marker, a pooling area around the CEARP marker, and 40 ft north of the CEARP marker in the roadside ditch.

The borehole at the septic tank will be located on the south (influent) side and drilled to a nominal depth of 20 ft (see Sec. 11.5.3.2 for method), resulting in four samples (5-ft core intervals). It will be necessary to remove soil from the upper portion of the septic tank in order to provide positive identification of the drilling location (Fig. 15.8-2).

Screening and analyses to be performed on the 13 samples gathered in this plan are presented in Table 15.8-II.

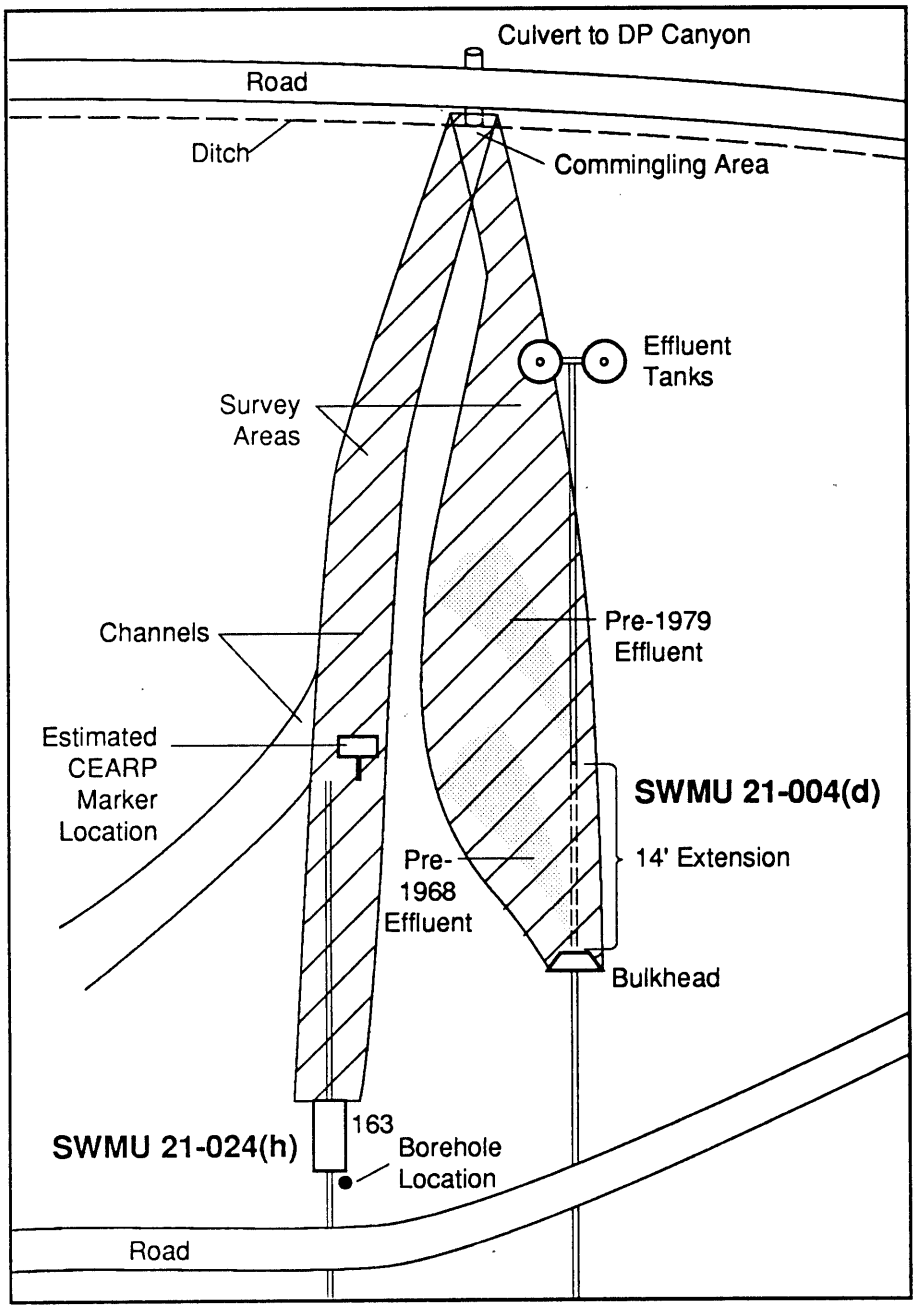


Fig. 15.8-2 SWMU 21-004(d) and SWMU 21-024(h) survey and sampling locations.

Table 15.8-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT THE SURFACE DRAINAGE NORTH OF TA-21-155.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-004(d)																																			
Survey				X	X																														
Near Surface Soil	1	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
	2	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
Field Duplicate																							X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
	3	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
	4	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
	5	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
	6	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X												X	X	X	X		X	X	X	X			X	
Rinsate Blank																							X	X	X	X		X	X	X	X			X	
Field Blank																													X	X	X				
21-024(h)																																			
Survey				X	X																														

Table 15.8-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT THE SURFACE DRAINAGE NORTH OF TA-21-155.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
Field Duplicate																						X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X
TA-21-163 Septic Tank																																	
Trench Excavation							X				X	X																					
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		10.0 - 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X
Rinsate Blank																												X	X	X			
Field Blank																												X					
Trip Blank																																	

15.9. Special Cases

15.9.1. Site Description

15.9.1.1. Site History

SWMU 21-006(b) (CEARP identifier 3u) originates in TA-21-2 as a 3-in. acid drain line. It passes southward through sump (settling tank, acid pit) TA-21-118 and thence to Los Alamos Canyon (Fig. 15.9-1). A 2-in. steel vapor line extends southward from the sump over the canyon rim and partially down the cliff face. It ends approximately 8 ft above the land surface on the bench below.

This sump and outfall system was built to receive ether waste from the ethyl ether extraction process, which was part of the original design of the TA-21 plutonium purification process (LASL 1969). The sump is being investigated in Sec 17.2 as part of SWMU 21-006(b).

SWMU 21-024(f) (CEARP identifier 3k) discharged sewage from TA-21-45 (the safety training building) through septic tank 124 (abandoned in place in 1966) to the surface on the north rim of DP Mesa (Fig. 15.9-2). The septic tank is a 1000-gal. steel tank with 4-in.-diameter VCP lines serving it.

Currently, there is no surface expression of the septic tank. A 4-in. VCP outfalls into a shallow pit with dimensions approximately 3 ft by 3 ft by 2-ft deep. This pit may have held all discharges when the septic tank was in operation because it shows no signs of effluent ever flowing out of it. There is a broad, moderate slope to the north edge of the mesa, then a steep slope to the bottom of DP Canyon.

15.9.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results are presented in Table 15.9-I.

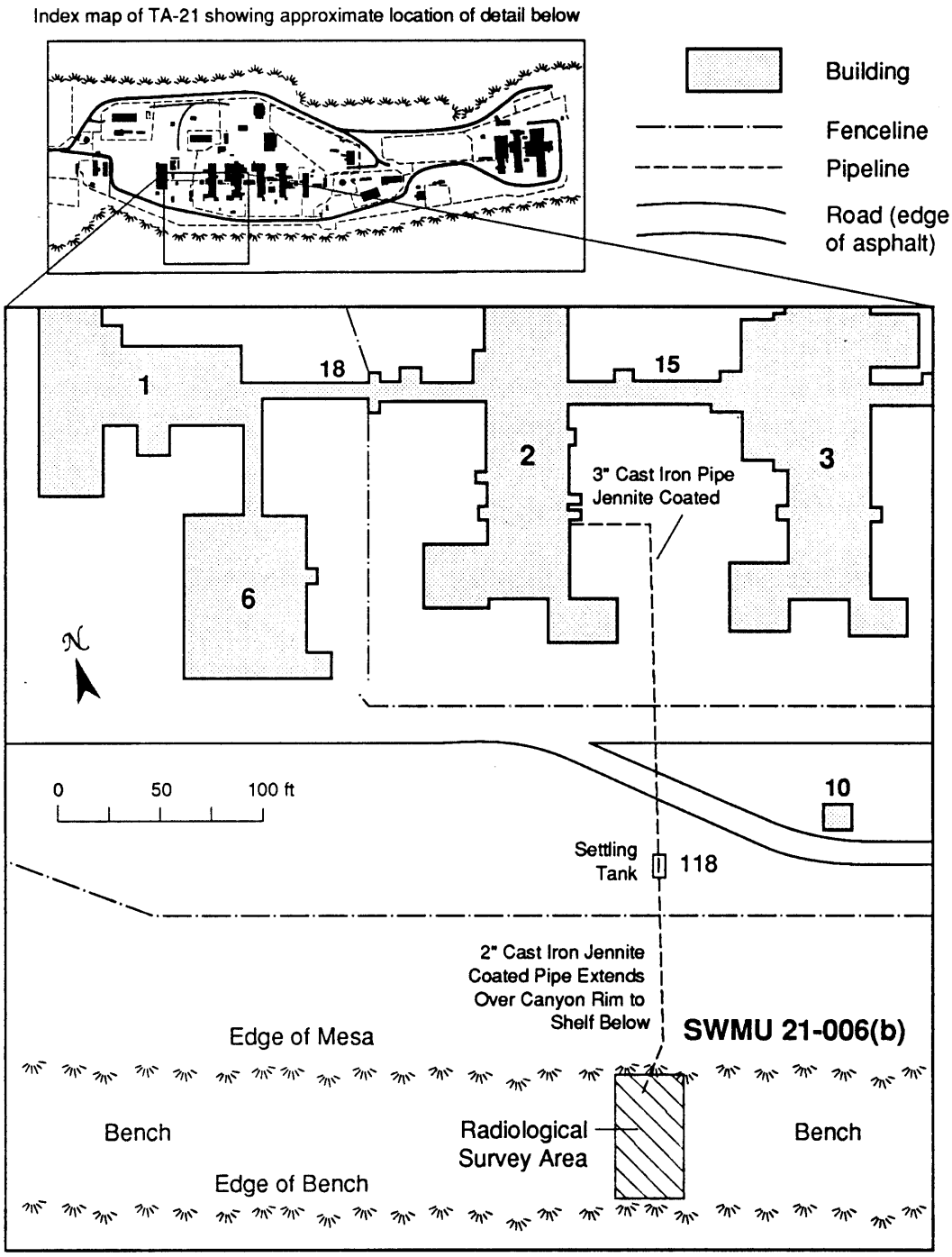


Fig. 15.9-1 Location of SWMU 21-006(b) as it appeared on the south side of Building 2 in 1961. (LASL 1961)

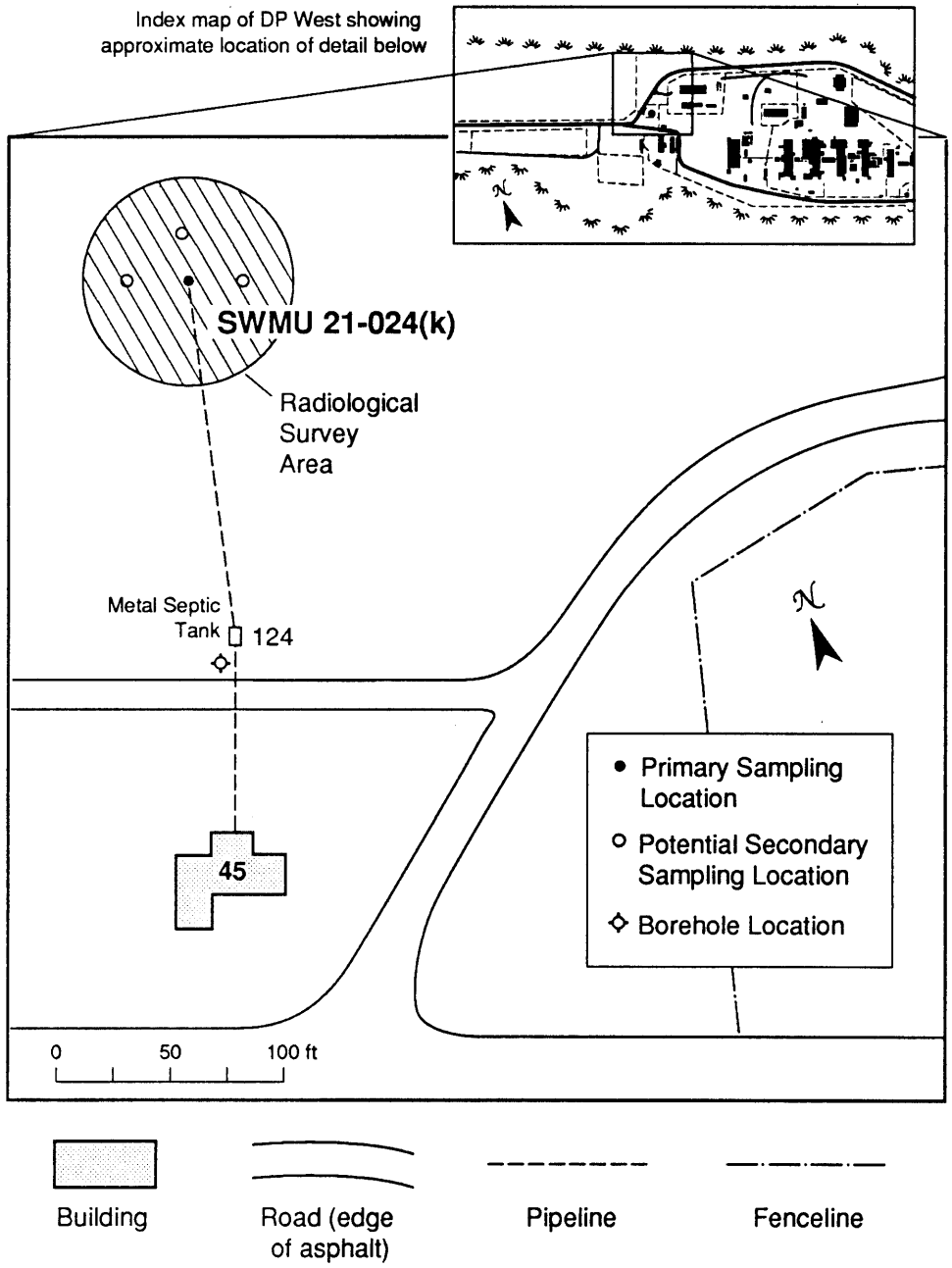


Fig. 15.9-2 Location of SWMU 21-024(k), sampling points, and radiological survey area. (LASL 1958a)

TABLE 15.9-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS 21-006(b) and 21-024(f)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x} + 2s$
	Metals				
SWMU 21-006(b)	ALUMINUM, TOTAL	3990	MG/KG	37	65,000
	BARIUM, TOTAL	48.8	MG/KG	37	850
	CALCIUM, TOTAL	1340	MG/KG	932	—
	CHROMIUM, TOTAL	6.2	MG/KG	2.0	75
	COPPER, TOTAL	7.1	MG/KG	6.0	19
	IRON, TOTAL	3560	MG/KG	19	26,600
	LEAD, TOTAL	191	MG/KG	93	54
	MANGANESE, TOTAL	137	MG/KG	4.0	770
	NICKEL, TOTAL	9.1	MG/KG	8.0	18.5
	ZINC, TOTAL	44.8	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	1.5	PCI/G	0.2	0.44
	PLUTONIUM-239	1.3	PCI/G	0.3	0.025
	RADIUM-226	1.2	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	31	PCI/ML	3.0	0.0072
	URANIUM-234	1.8	PCI/G	0.3	—
	URANIUM-238	1.0	PCI/G	0.2	1.7
	Volatile Organics				
	TOLUENE	9.9	UG/KG	6	—[b]
	Metals				
SWMU 21-024 (f)	ALUMINUM, TOTAL	9750	MG/KG	37	65,000
	ARSENIC	2.2	MG/KG	2.0	7.1
	BARIUM, TOTAL	131	MG/KG	37	850
	CALCIUM, TOTAL	2130	MG/KG	914	—
	CHROMIUM, TOTAL	8.9	MG/KG	2.0	75
	COPPER, TOTAL	9.0	MG/KG	6.0	19
	IRON, TOTAL	9920	MG/KG	18	26,600
	LEAD, TOTAL	34.5	MG/KG	10	54
	MAGNESIUM, TOTAL	2150	MG/KG	914	4,700
	MERCURY, TOTAL	0.22	MG/KG	0	0.03
	NICKEL, TOTAL	12.4	MG/KG	8.0	18.5
	OIL & GREASE BY GRAVIMETRIC	257	MG/KG	56	—[b]
	POTASSIUM, TOTAL	1330	MG/KG	914	—
	VANADIUM, TOTAL	23.5	MG/KG	10	—
	ZINC, TOTAL	44.2	MG/KG	4.0	78

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x} + 2s$
	Radionuclides				
	CESIUM-137	1.0	PCI/G	0.1	0.44
	PLUTONIUM-239	1.6	PCI/G	0.2	0.025
	RADIUM-226	1.8	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	15	PCI/ML	2.0	0.0072
	URANIUM-234	1.7	PCI/G	0.4	—
	URANIUM-238	1.3	PCI/G	0.3	1.7

aThe upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$ as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} + 2s$ as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

SWMU 21-006(b) was sampled on the bench immediately below the outfall (DOE 1989a) (Table 15.9-I). Comparison of these results with background level data given in Sec. 4.2.4 indicates above background levels of lead, ^{137}Cs, $^{239/240}Pu$, and tritium. Toluene was found in concentrations above the detection limit.

SWMU 21-024(f). A sample was taken from the center of the pit, 4 ft 6 in. north of the CEARP marker (DOE 1989a) (Table 15.9-I). The results indicate that mercury, ^{137}Cs, $^{239/240}Pu$, and tritium are present in concentrations above background level, as well as oil and grease in concentrations greater than the detection limit.

15.9.1.3. Source Term

SWMU 21-006(b) will likely contain organics, both volatile and semivolatile, in addition to the contaminants identified in the previous sampling above, because it was originally built to receive ether waste.

SWMU 21-024(f). No evidence is available to support the selection of contaminants for the source term other than those indicated above.

15.9.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination of SWMUs 21-006(b) and 21-024(f). The specific data required to assess contamination at SWMUs 21-006(b) and 21-01-24(f) include the following:

1. Identify the contaminants present using Level II and Level III data. This area below the vapor line at SWMU 21-006(b) may contain lead, radionuclides, and organic constituents. The pit as well as subsurface soils beneath septic tank 124 area [SWMU 21-024(f)], may contain metals, radionuclides, and organic constituents.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.9.3. Sampling/Investigation Rationale

SWMU 21-006(b) will be investigated by soil sampling on the bench beneath the outfall of the vapor line. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

SWMU 21-024(f). The location of septic tank TA-21-124 will be marked by surveying from old engineering drawings. A borehole will be drilled adjacent to the tank to determine if it has leaked contaminants into the subsurface soil. A shallow borehole will be placed in the pit at the outfall from tank TA-21-124 to determine if contaminants are present in subsurface soils. The area around the pit will be surveyed for radioactive contamination and sampled to identify contaminants in any drainage path leading from the pit. This approach will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

15.9.4. Sampling Plan

SWMU 21-006(b). Field radiological surveys (for method see Sec. 11.4.1.2) will be performed in a 20-ft-wide area, starting directly below the vapor line and running to the edge of the bench (Fig. 15.9-1).

If Strategy A (see Sec. 15.1.4) identifies radioactively contaminated areas, six surface soil samples will be biased to those locations (for method see Sec. 11.5.2.1). Otherwise, Strategy B will be used, with one three-sample group of surface soil samples taken from directly below the

Table 15.9-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SPECIAL CASE SWMU'S.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium
21-006(b)																														
Survey				X	X																									
Surface Soil Samples	1	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	2	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	3	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	4	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	5	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	6	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
21-024(f)																														
Survey				X	X																									
Near Surface Soil	1	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X								X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	2	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
Field Duplicate																			X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X								X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X								X	X	X	X		X	X	X	X			X
	3	0.0 - 6.0 in						X	X		X								X	X	X	X		X	X	X	X			X
		6.0 - 12.0 in						X	X		X								X	X	X	X		X	X	X	X			X
		12.0 - 18.0 in						X	X		X								X	X	X	X		X	X	X	X			X
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X						X	X	X	X		X	X	X	X			X
Rinsate Blank																			X	X	X	X		X	X	X	X			X
Field Blank																									X	X	X			
		2.5 - 5.0 ft						X	X		X	X	X						X	X	X	X		X	X	X	X			X
		5.0 - 7.5 ft						X	X		X	X	X						X	X	X	X		X	X	X	X			X
		7.5 - 10.0 ft						X	X		X	X	X						X	X	X	X		X	X	X	X			X

Table 15.9-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SPECIAL CASE SWMU'S.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
Field Duplicate																						X	X	X	X		X	X	X	X			X	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X				
Trip Blank																												X						

end of the vapor line, and a second group taken in a small channel near the southern edge of the bench.

Table 15.9-II lists the screening and analyses to be performed on the six samples collected.

SWMU 21-024(f). Field radiological surveys will be performed throughout a 50-ft radius centered on the outfall pit (see Fig. 15.9-2). If a pattern of radioactive contamination is found that indicates a drainage channel, Strategy A will be used, and near-surface soil samples (for method see Sec. 11.5.2.4) will be collected at three sampling locations. If a flow pattern is not found, the three near-surface soil sampling locations will be on the east, north, and west sides of the outfall pit at a distance of 10 ft from the center (Fig. 15.9-2). In either case, each near-surface sampling location will be sampled to an 18-in. depth (three 6-in. intervals), resulting in a total of nine samples.

At the outfall pit, a shallow borehole (for method see Sec. 11.5.3.1) will be drilled to a nominal depth of 10 feet, resulting in six samples (2.5-ft core interval).

At the septic tank, a vertical borehole (see method in Sec. 11.5.3.2.) will be drilled to a nominal depth of 20 ft on the south (inlet) side, resulting in four samples (5-ft core intervals).

Table 15.9-II lists the screening and analyses to be performed on the 19 samples to be collected.

15.10. NPDES Discharge Systems

15.10.1. Site Description

There are five outfalls in this section. All are NPDES discharge systems, which have not been assigned a SWMU number. The reason for sampling these outfalls, even though they are permitted discharges, is that prior to being permitted, they may have discharged contaminants. The majority of them have not been sampled before.

15.10.1.1. Site History

EPA 02A129 (CEARP identifier 3ag) discharges from the steam plant, TA-21-357. It exits southward from the building and discharges onto DP Mesa (Fig. 15.10-1). A channel carries the effluent over the south rim of DP Mesa and into Los Alamos Canyon. According to the NPDES description (EPA 1987), it discharges boiler blowdown.

EPA 03A035 (CEARP identifier 3t) exits southward from a cooling tower in TA-21-210, the plutonium research support building. It discharges treated cooling water (EPA 1987) approximately 4 ft inside the security fence (Fig. 15.10-1). The outfall consists of an 8-in. CMP located in a bank above the interior perimeter road and flowing a small quantity of water (less that 1 gal. per minute).

Water from the outfall ponds and flows to a storm drain and then south toward the rim of DP Mesa, seeping into the ground before reaching the mesa edge. The area surrounding the outfall is a steep slope to the mesa rim, approximately 75-ft distant.

EPA 03A036 (CEARP outfall 3s) discharges to the north from cooling tower TA-21-220. The discharge point is at the security fence in a heavily vegetated channel leading down to the north perimeter road (Fig. 15.10-1). The effluent passes through a culvert into DP Canyon. A Laboratory report (LANL 1989b) indicates that the cooling tower may have been replaced by Building 151. However, an actively flowing outfall exists at the site, appearing to originate at TA-21-220. The discharge is treated cooling water (EPA 1987).

EPA 03A037 (CEARP identifiers 3b and 3v) runs south from the corridor (TA-21-314) between Buildings TA-21-3 and TA-21-4. It discharges from the bank above the interior perimeter road, inside the south security fence (Fig. 15.10-1). Effluent from the outfall pools on the north side of the road and flows through a culvert to the south rim of DP Mesa and over the cliff onto the bench above Los Alamos Canyon.

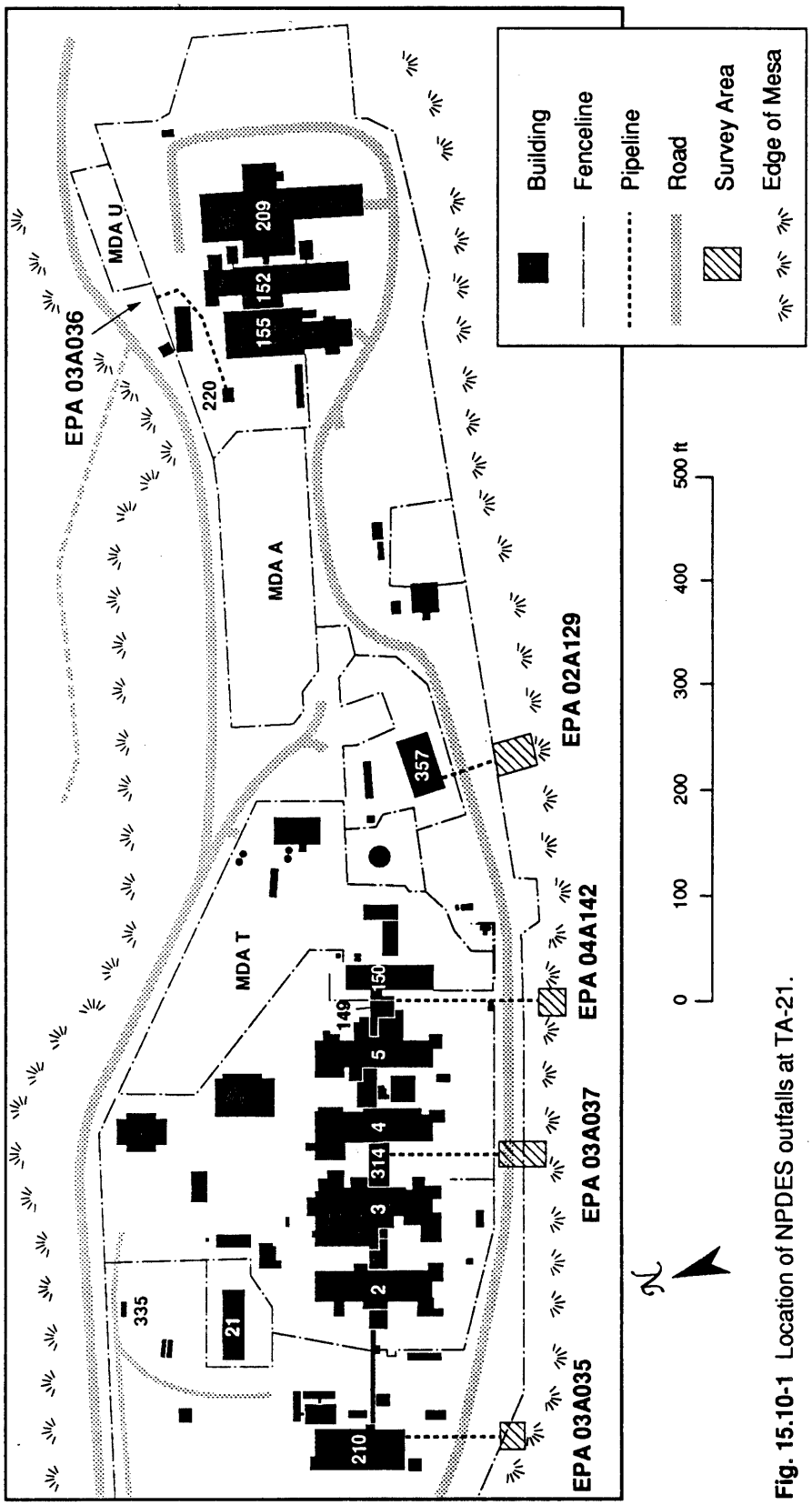


Fig. 15.10-1 Location of NPDES outfalls at TA-21.

EPA 04A142 consists of noncontact cooling water from TA-21-149, the corridor between Buildings TA-21-5 and TA-21-150. The outfall consists of an 8-in. CMP discharging to the south edge of DP Mesa with effluent running over the cliff onto the bench above Los Alamos Canyon.

15.10.1.2. Existing Information

EPA 02A129 is the only outfall in this section to have previous soil sampling performed. It was sampled as part of the 1988 reconnaissance sampling (DOE 1989a). A grab sample was taken from a precipitate-stained pool below the canyon rim. Results of analyses are shown in Table 15.10-I. Comparing these results to Sec. 4.2.4 indicates above background levels of $^{239/240}Pu$, tritium, and ^{235}U.

15.10.1.3. Source Term

EPA 02A129 may be contaminated with fuel oil from the boiler and common boiler blowdown constituents, such as sulfite and copper salts in addition to the plutonium, tritium, and uranium previously identified.

EPA 03A035 could potentially be contaminated with plutonium, uranium, various metals, and organic and inorganic lab chemicals because it is associated with the plutonium research support building.

EPA 03A036. No information is available to support the selection of a source term.

EPA 03A037 has a potential source term, which includes plutonium, uranium, mercury, lead, and organic solvents because it is connected to a corridor that is associated with plutonium processing.

EPA 04A142 may potentially be contaminated with plutonium, uranium, mercury, lead, and organics because it is connected to a structure that is associated with plutonium processing.

15.10.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminants from previous discharges at NPDES discharge systems. The specific data required to assess contamination at the NPDES discharge systems include the following:

1. Identify the contaminants present using Level II and III data for the NPDES discharge system sites. Only EPA 02A129 indicates radionuclide contamination.

TABLE 15.10-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR
NPDES OUTFALL EPA 02A129

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
EPA 02A129	ALUMINUM, TOTAL	1530	MG/KG	43	65,000
	IRON, TOTAL	1520	MG/KG	22	26,000
	LEAD, TOTAL	11.6	MG/KG	10	54
	MANGANESE, TOTAL	89.2	MG/KG	4.0	770
	NICKEL, TOTAL	14.0	MG/KG	10	18.5
	OIL & GREASE BY GRAVIMETRIC	82.1	MG/KG	55	—[b]
	SODIUM, TOTAL	1600	MG/KG	1070	—
	ZINC, TOTAL	39.6	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	0.4	PCI/G	0.1	0.44
	PLUTONIUM-239	0.2	PCI/G	0.1	0.025
	RADIUM-226	1.6	PCI/G	0.2	2.5
	STRONTIUM-90	0.2	PCI/G	0.1	0.88
	THORIUM-232	1.5	PCI/G	0.2	1.8
	TRITIUM	8	PCI/ML	3.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	1.0	PCI/G	0.2	1.7

[a]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2 -XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.10.3. Sampling/Investigation Rationale

Field radiological surveys will be performed at each outfall. If these surveys detect contaminants in the channel, Strategy A will be used to determine biased soil sampling locations. Otherwise, Strategy C will be used to sample the channels. For a complete description of these strategies, see Sec. 15.1.4. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.10.4. Sampling Plan

Field radiological surveys will be performed according to the method in Sec. 11.4.1.2. Table 15.10-II lists the analytical procedures to be performed at each of the outfalls.

EPA 02A129 will be surveyed for radioactivity in an area 10-ft wide, along the channel, between the outfall and the mesa edge.

Near-surface soil samples will be taken from two locations according to Strategy A, if possible (see Sec. 11.5.2.4 for method). Otherwise, Strategy C will be used, with one location at the pool under the outfall mouth and the second 15 ft south of the security fence in the effluent channel. The near-surface soil samples will be taken to an 18-in. depth (three 6-in. intervals), resulting in six samples by either strategy.

EPA 03A035 will be surveyed for radioactivity along the effluent channel between the outfall and the mesa edge.

Near-surface sampling will be performed to a depth of 18 in. (three 6-in. intervals) at two locations for a total of six samples (see Sec. 11.5.2.4 for method). Strategy A will be used if the field radiological survey identifies contaminated areas. Under Strategy C, sampling locations will be at the outfall mouth and at a pool 6 ft south of the security fence.

EPA 03A036 will be surveyed for radioactivity along the channel. Sampling location will be selected based on Strategy A if possible, although the generally wet conditions in this channel will reduce the effectiveness of these surveys. Otherwise, Strategy C will be used to obtain near-surface samples from two locations (for method see Sec. 11.5.2.4). A depth of 18 in. will be sampled at each location (three 6-in. intervals), resulting in a total of six samples. Under Strategy

Table 15.10-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT NPDES DISCHARGE SYSTEMS.

				Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
EPA 02A129																																	
Survey				X	X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
Field Duplicate																					X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				
EPA 03A035																																	
Survey				X	X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
Rinsate Blank																					X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				
EPA 03A036																																	
Near Surface Soil	1	0.0 - 6.0 in		X	X			X	X		X										X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X										X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X										X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X										X	X	X	X		X	X	X	X				

Table 15.10-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT NPDES DISCHARGE SYSTEMS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
EPA 03A037																																	
Survey				X	X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
EPA 04A142																																	
Survey				X	X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
Trip Blank																												X					

C, the first sample location will be at the outfall mouth and the second will be at the culvert entrance on the south side of the perimeter road.

EPA 03A037. A field radiological survey will be conducted in an area 10-ft wide along the channel between the outfall and the mesa edge.

Using Strategy A, near-surface samples will be taken at two locations selected on the basis of radioactive contamination (for method see Sec. 11.5.2.4). A depth of 18 in. will be sampled at each location (three 6-in. intervals), giving a total of six samples. If Strategy A cannot be used, these samples will be taken from the pool at the outfall mouth and at the small pooling area near the mesa edge, according to Strategy C.

EPA 04A142 will be surveyed for radioactivity at the outfall and on the bench directly below the outfall.

Eighteen-inch deep near-surface soil sampling will be performed at two locations, producing six samples (see Sec. 11.5.2.4 for method). Strategy A will be used, if possible. If Strategy C is used, the first location will be from below the outfall mouth, and the second will be on the bench directly below the outfall.

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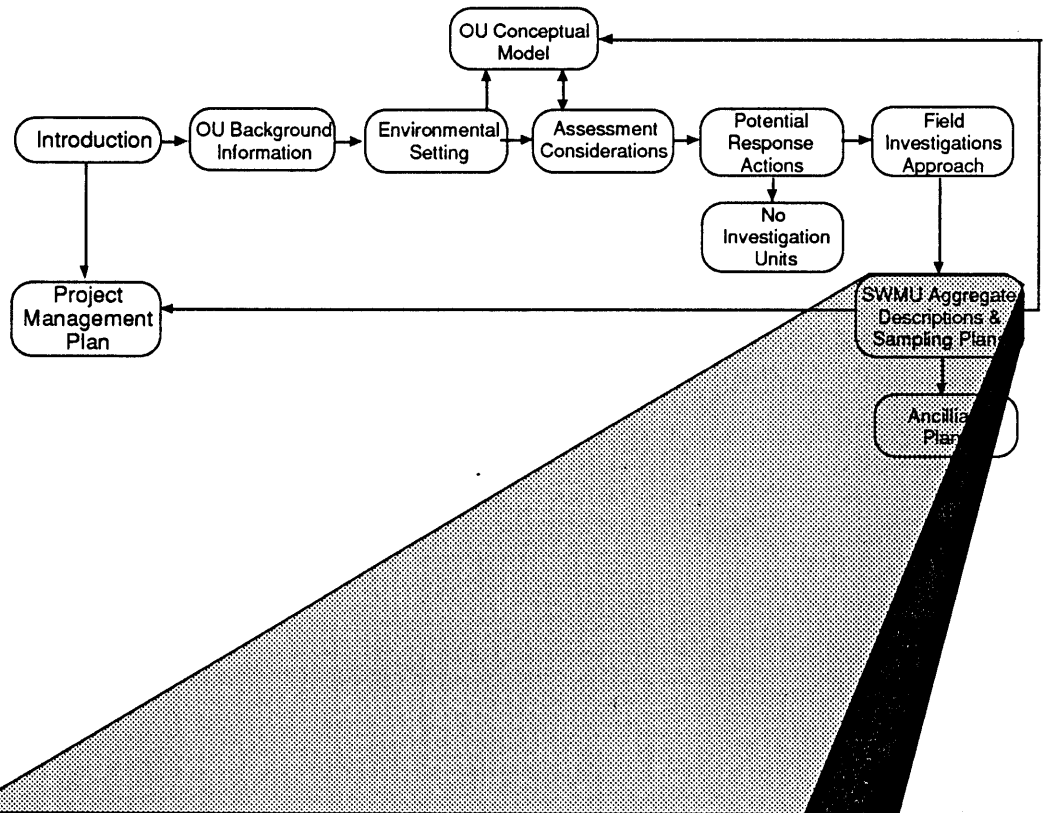
CHAPTER 16



SWMU Aggregate Descriptions & Sampling Plans

• Material Disposal Areas

16.1 INTRODUCTION

This chapter addresses the five material disposal areas at TA-21 (MDAs A, B, T, U, and V) and associated structures (see Fig. 16.1-1). In this chapter, tables and figures are located at the end of each section. Initially, these MDAs were used for disposal of solid and liquid wastes generated from plutonium-processing operations at DP West and initiator production at DP East (see Table 3.2-I). Later, the nature of waste disposal activities at certain MDAs, such as MDAs T and A, changed dramatically, as detailed in Table 16.1-I. For example, early waste disposal at MDA A was of plutonium-processing liquid wastes in below-ground tanks; however, in the late 1960s, a pit at MDA A was used for solid waste disposal of radioactively contaminated building D&D waste.

Two treatment plants used to treat effluent prior to its release to MDA T, Buildings 35 and 257, are addressed in conjunction with MDA T. They are included with MDA T because of their proximity and their effect on waste disposal at MDA T. Table 16.1-II briefly describes the regulated units addressed in this chapter.

Also in this chapter, a detailed surface and subsurface field sampling plan is described for each MDA. This introduction summarizes the rationale guiding the development of the sampling plans and describes the sampling approaches for surface, geomorphic, and subsurface sampling. Sampling to be repeated for each MDA is described in this section and not repeated in the sampling plan for each MDA.

Potential migration pathways at TA-21 SWMUs are discussed in Chapter 5. Surface and subsurface soil are the contaminated media for all of the MDAs. The identified potential contaminant migration pathway for all of the MDAs include infiltration, vapor phase movement, and erosive exposure of waste. Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for potential response actions at TA-21 SWMUs are discussed in Chapter 10. Preliminary remedial alternatives that are identified for all of the MDAs include monitoring, capping-in-place, treatment, removal and disposal, and removal and treatment.

The strategy for the field investigations at the MDAs is summarized in flow charts and tables. Figure 16.1-2 presents a summary of the field investigations for the solid waste MDAs (A and B), and Fig. 16.1-3 presents a summary of the field investigations for the liquid waste MDAs (MDA T, U, and V). Field measurements and laboratory analyses for each MDA are summarized in Tables

16.1-III through 16.1-VI. Methods for field measurements and laboratory analyses are presented in Chapter 11. Table 16.1-VII summarizes the geohydrological analyses for Chapter 16 and Table 16.1-VIII summarizes all investigation types by borehole sampling interval.

16.1.1 Sampling Rationale

Because one of the primary potential remedial alternatives to be evaluated for all MDAs is passive remediation through *in situ* stabilization with capping-in-place, the emphasis of all MDA characterization is on whether and how waste is migrating and not on source term definition. However, source term characterization will occur for those MDAs that received liquid waste because contaminant transport has been demonstrated at these sites.

Both because the major activity at most MDAs occurred in the 1940s (see Table 16.1-I) and because previous surface and subsurface studies have been conducted at most MDAs, we can confirm previous findings and evaluate the migration that has occurred over time to the present. For example, MDA B has not been used since 1952; therefore, we can evaluate if any waste has migrated beyond the site in the past 40 years. We can place boreholes near boreholes drilled in 1966 to evaluate migration away from MDA B, to find out whether results have changed in time. At MDA T, by placing boreholes near the 30-m boreholes that were drilled into absorption beds in 1978, we can evaluate if any migration has occurred in the past 13 years.

Because most MDAs were stabilized and capped in the mid-1980s, comparison of contamination data from past surveys with current data may show if migration of contaminants via surface run-off is taking place.

16.1.2 Surface and Subsurface Sampling Objectives

The primary objective for surface and subsurface characterization for all five MDAs is to determine if contaminants are migrating from the MDAs. The resulting data needs are described for each SWMU later in this chapter. Transport mechanisms and pathways for migration include surface erosion and lateral and vertical subsurface migration. The characterization objective yields the following sampling objectives:

1. Detect and identify contaminants.
2. Determine the vertical and lateral distribution of contaminants.
3. Identify potential contaminant transport pathways on the surface and in the upper part of the vadose zone.

4. Identify the lithologic, chemical, and mineralogic properties of rock that may affect contaminant migration.

5. Determine the geologic stability of each MDA, particularly with respect to erosion.

6. Collect geologic and hydrologic data to support transport model calculations.

16.1.3. Surface Sampling Approach

MDA surface sampling will be evaluated in conjunction with two OU-wide investigations, surface sampling on a 40- by 40-m grid, and erosional drainage channel evaluation. Both are discussed in Chapter 12. MDA surface sampling results will also be evaluated in the context of MDA-specific erosion-feature sampling discussed in Sec. 16.1.4.

Sequential surface sampling plans will be used in conjunction with spatial prediction techniques such as kriging to achieve surface sampling goals of

- detecting and identifying contaminants;
- determining the lateral distribution of contaminants; and
- identifying potential contaminant transport pathways on the surface.

Sequential sampling involves selecting two or more samples in stages. The results of measurements on the initial investigation sample are used to guide the selection of the second-stage sample. The rationale and advantages of sequential sampling are discussed in Appendix H of the IWP.

Because spatial prediction surfaces such as kriging surfaces will be used for characterization of the MDAs, the goals of the initial investigation samples are to collect data for

- constructing a model relating the observed outcome variables to the outcomes for unobserved units;
- predicting the unobserved units using the model; and
- estimating the prediction errors for these units.

In general, the model will consist of a trend component and a correlation component. The usual method for using this model for prediction is called best linear unbiased prediction (BLUP), but in much of the geostatistical literature this method is called "kriging."

If preliminary predictions and/or prediction uncertainties are deemed inadequate for the site characterization, then a second-stage sample will be taken. Adequacy will be based on the level of uncertainty acceptable for adequately characterizing migration (including transport parameters and their uncertainty) and erosion patterns, making comparisons to action levels, or evaluating impacts such as human health risks (see Chapter 11).

The number and locations of additional samples to be taken will depend on the results of the initial investigation sample predictions. For example, if it is apparent that some areas of the site will require remediation, the subsequent investigation(s) can be devoted to confirming low predictions, so that unnecessary remediation can be avoided with sufficient confidence for the risk assessment. On the other hand, if the bulk of the site appears to be in satisfactory condition, the subsequent investigation may be devoted largely to more detailed characterization of apparent "hot spots" to determine precisely the extent of remediation required. Another possibility is that in the subsequent investigation, it will only be necessary to take a systematic "infill" sample to reduce prediction errors.

Developing appropriate spatial prediction surfaces requires understanding the nonsampling component of variability (measurement error), as well as the naturally occurring local variability. This requirement motivates split and replicate sampling. Split samples are duplicates, two or more samples taken from the same sampling point. These split samples allow estimation of measurement error. Replicate samples are taken at closely spaced points and permit estimation of local variability thus providing better estimation of the spatial correlation needed for the prediction model.

The initial investigation samples for all MDAs will consist of grid samples augmented with off-grid samples to allow an estimate of spatial variability and radiation surveys between grid points. The surface sampling will be conducted inside and outside the fence at each MDA to the mesa edge. The objective of sampling inside the MDA fence is to evaluate the effectiveness of past MDA capping efforts and to confirm the absence of surface contamination at the present time. The sampling outside the MDA fence will identify the presence of contaminants which may be subject to continuing dispersal. The objective of radioactive screening using Level I/II instruments within the gridded area is to identify any areas of elevated radioactivity between grid points. Additional samples will be taken to characterize any such areas detected.

MDAs A, B, and V were sampled in October 1990. Samples were taken on 10-m grids with replicates 3 m apart inside the fence of each MDA. These data will be evaluated in combination with the general surface grid sampling data (Sec. 12.4) and with the sampling of sediment

deposition areas (Sec. 16.1.4). MDAs A and B will be sampled on 20- by 20-m grids outside the MDA fences. MDA V will not be sampled in the initial investigation.

Because MDAs T and U have not been extensively surface-sampled recently, the initial investigation samples for MDAs T and U consist of 20- by 20-m and 10- by 10-m grids, respectively, both inside the MDAs and outside the fence extending to DP canyon. The sample points outside the MDAs will be coordinated with the surface grid sampling plan (Sec. 12.4) and the sampling of sediment deposition areas (Sec. 16.1.4). Ten replicate samples will be taken at each MDA.

16.1.3.1 Contaminant Analysis on Soil Samples

Generally, all surface samples will be analyzed for the full suite of contaminants, except volatile organic compounds. The analytical laboratory analyses will include radionuclide, metals, and semivolatiles, as detailed in analytical tables in field sampling plans in later sections of this chapter. In any subsequent sampling, a reduced analytical suite may be used, based on the initial results.

16.1.4. Detailed Drainage Sampling

Geomorphic characterization of each MDA (following the Geomorphic Characterization SOP) will involve preparation of a 1:500 scale map of surficial deposits and landforms extending from the site downslope into the adjacent canyon. The mapping will identify erosional features including rills, gullies, major drainage channels, sites of seepage erosion, rockfall, and landsliding. In conjunction with results of surface grid sampling inside and outside MDA fences to the edge of the mesa top, geomorphic mapping will be used both to evaluate the erosional stability of the ground surface in each MDA and to evaluate potential compromise to the integrity of each site by erosional and mass-wasting processes. The geomorphic studies described in this section are not repeated in the sampling plans for each MDA given later in this chapter.

As a complement to the surface sampling in grids, more detailed sampling of sediment along drainage channels will be undertaken because the drainage channels are the most probable offsite transport pathway for contaminants. This topographically based surface sampling will follow identification of drainage channels and local sediment storage sites in the geomorphic characterization activities (Sec. 12.3.3) and MDA-specific geomorphic characterization described in the above paragraph. The initial investigation of this sampling will be along the primary drainage channels on canyon walls on each side of DP Mesa and along minor channels directly

draining the MDAs. Subsequent sampling, if needed, will be focused on upslope branches of the channels in an attempt to identify the source and define the extent of contamination.

Near-surface soil samples will be collected from the first 18 in. of sediment. At sites where the geomorphic characterization suggests significant recent deposition of sediment, additional samples may be collected at depth to determine if sediments with a higher level of contamination have been buried. The appropriate depth and number of samples needed to characterize sites of active sediment accumulation will be based on local site characteristics.

It is assumed that five drainages will be sampled at each MDA, at three 6-in. depth increments for a total of 15 samples per MDA. These samples will be analyzed in an analytical laboratory for radionuclides, semivolatiles, and metals as detailed in Table 16.1-IX. The drainage sample analyses are not repeated in the sampling plans for each MDA given later in this chapter.

16.1.5 Subsurface Sampling Approach

A staged drilling approach will be used to characterize subsurface contamination at the MDAs. The configuration and number of drill holes for the initial investigation differ significantly between solid waste MDAs (A and B) and liquid waste MDAs (T, U, and V) because of the different contaminant characteristics for these two types of sites. This section also describes borehole geophysics, geochemical parameter determination and mineralogic data that will be collected from boreholes at MDAs.

16.1.5.1 Solid Waste MDAs

The solid waste MDAs (A and B) are landfills where the nature of the solid waste is highly heterogeneous and where the addition of liquid waste was minimal. Existing data suggest that contaminant migration is not a significant problem at the solid waste MDAs because of the dry conditions in these landfills and because of the arid conditions of the site. Therefore, source term characterization may not be necessary at these MDAs if drilling beside and beneath the site demonstrates that contaminants are not migrating from the landfill pits. If contaminants are not migrating, the most likely remedial action will be to cap the site and monitor for future releases. Based on these objectives, the initial phase of drilling at the solid waste MDAs is designed to systematically survey the site for the presence of contamination adjacent to and beneath the solid waste pits. Sample locations were chosen based on existing information. The sample locations were those locations determined to have the greatest probability of detecting a migration plume if such a plume exists. Hydrogeological data, including vertical fracture information, will also be collected

from these shallow angle holes. This information will be used in conjunction with computer transport models to determine the potential for preferential pathway transport.

Subsequent investigations, including the need to collect source term information for the solid waste disposal beds, will be based on results from the initial investigation. For example, at solid waste areas, if initial drilling shows that waste has migrated away from the MDA, subsequent holes may be required for source term characterization and to determine the lateral and vertical extent of contaminant migration. Should such holes be necessary at MDA A, previous geophysics studies (Gerety et al. 1989) can guide borehole placement. However, as detailed in Sec. 16.3, the number of pits and trenches at MDA B is uncertain. Therefore, a geophysical investigation may be required prior to placement of any source term characterization boreholes.

16.1.5.2 Liquid Waste MDAs

The approach for characterizing contaminants at the liquid waste MDAs T, U, and V is based on previous studies that indicate that contaminant transport occurred in the past at these three sites. Source term characterization is necessary for the transport modelling required for these sites. The initial investigation is limited to drilling source term characterization holes in the absorption beds. These drill holes are intended to fully penetrate the contaminant plume. Because they penetrate the zones of greatest contamination, these source term holes will be analyzed for a full analytical suite in an effort to identify contaminants of concern. Additionally, one hole at each liquid MDA (T,U, and V), will be extended 50 ft below the contamination plume. Samples from the additional 50 ft will document conditions below the contaminant plume and may allow a comparison to rock properties within the plume to determine if the passage of the plume has altered rock properties.

A subsequent investigation will be required to define the extent of migration from each liquid MDA. The initial investigation results will be used to define the location and appropriate drilling angle for subsequent investigation core holes beneath each MDA. Evaluation of analytical results from the initial sampling may allow a reduced analytical suite to be used in subsequent holes.

16.1.5.3 Borehole Drilling Method

Drilling equipment used to characterize the MDAs may include both hollow-stem augers and rotary core drills (using Hollow-Stem Auger and Air Rotary Drilling SOPs). Core samples collected during the drilling operation will be used to detect contaminant migration away from absorption beds, disposal pits, and buried storage tanks. Continuous coring will provide samples

for characterizing contaminant plumes and for conducting characterization of physical and chemical transport mechanisms. These holes will be dry-cored to minimize possible mobilization of contaminants by drilling fluids and to minimize disturbance of the natural saturation conditions in the tuff. The borehole depth stopping criteria (see Sec. 11.5.3) will be defined by the depth of contaminant plumes as determined by field laboratory sample analysis. As described in Sec. 11.5.3, coring will continue for two 5-ft intervals once field laboratory measurements cease to detect contaminants. Drill core not used for analytical samples will be archived for the duration of the RFI. Holes will be completed and abandoned according to the drilling SOP.

16.1.5.4 Borehole Lithologic Logging

Logs describing lithologic changes with depth, stratigraphic contacts, alteration features, welding characteristics, color, and phenocryst and lithic contents will be prepared for all MDA drill holes. The lithologic log will include descriptions of fracture density, the occurrence of fracture-lining minerals, and the dip of fractures. Following the immediate removal of samples for volatile compounds, lithologic logs will be prepared and the drill core photographed in color before cores are sampled for remaining contaminant analysis. This will ensure that a complete lithologic description of the drill core is available for characterization of the site and for the permanent record of studies at TA-21. The geophysical and lithologic logging described in this section is not repeated in individual MDA sampling plans given later in this chapter.

16.1.5.5 Liquid Waste MDA Hydrogeological Characterization and Geophysical Logging Boreholes

In addition to the five general hydrogeologic characterization boreholes detailed in Sec. 12.5, one 300-ft vertical borehole will be drilled at each liquid waste MDA (T,U, and V) for similar characterization. Investigations in each borehole will include hydrogeological and geochemical analyses, pore gas sampling, and geophysical logging using the methods detailed in Sec. 12.5.1. Tables detailing these investigations and the radiological and chemical analytical requirements for each borehole are given in Sec. 12.5.1.

16.1.5.6 Soil Moisture Determination

Characterization of the vertical variation in moisture content is an important parameter for evaluating transport of contaminants. Other investigations at the Laboratory have determined that moisture content can vary greatly over a short vertical distance. Therefore, core samples for

gravimetric moisture content determination will be collected at 5-ft intervals on all initial investigation MDA boreholes.

16.1.5.7 Geochemical and Mineralogic Characterization of Core Samples

For all MDA initial investigation boreholes, mineralogic and geochemical data will be collected, using established SOPs for laboratory tests, as detailed in Sec. 12.5.1.5 and in hydrogeological tables for each MDA in this chapter. Specific sampling locations will be guided by lithological logging, so all hydrostratigraphic units present in a borehole are sampled. Additionally, contaminated zones will be sampled. Both systematic sampling at 20-ft intervals and selective sampling in contaminated zones to define the geochemical parameters associated with particular contaminants will be conducted.

Mineralogic data will be collected for matrix and fracture-lining minerals; emphasis will be placed on characterizing mineralogic controls on contaminant distribution and on identifying zones of smectites, zeolites, and iron-manganese oxides. These samples will be used to map vertical and lateral changes in mineralogy as a function of lithology and to characterize zones of contaminant accumulation. Data from mineralogic studies at the MDAs will also be used to identify potential migration pathways and to assess the natural retardation potential of tuffs.

Fracture-lining minerals commonly differ significantly from those found in the rock matrix and provide direct evidence of groundwater flow in fractures in the vadose zone. The number and distribution of samples for the characterization of fracture-lining minerals are dependent on the number and nature of fractures encountered during drilling; samples appropriate for characterization will be identified after inspection of the drill core. A contingency of five fracture samples per borehole is detailed in the geohydrologic tables for each MDA.

16.1.5.8 Contaminant Analysis on Core

Generally, in all initial investigations, the full suite of analyses (radionuclides, metals, VOAs, semivolatiles) will be conducted on all core samples. If a fracture is encountered within a 5-ft sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for rock and the fractured material.

In any subsequent sampling, a reduced analytical suite will be used, based on an assessment of the results from the initial investigation.

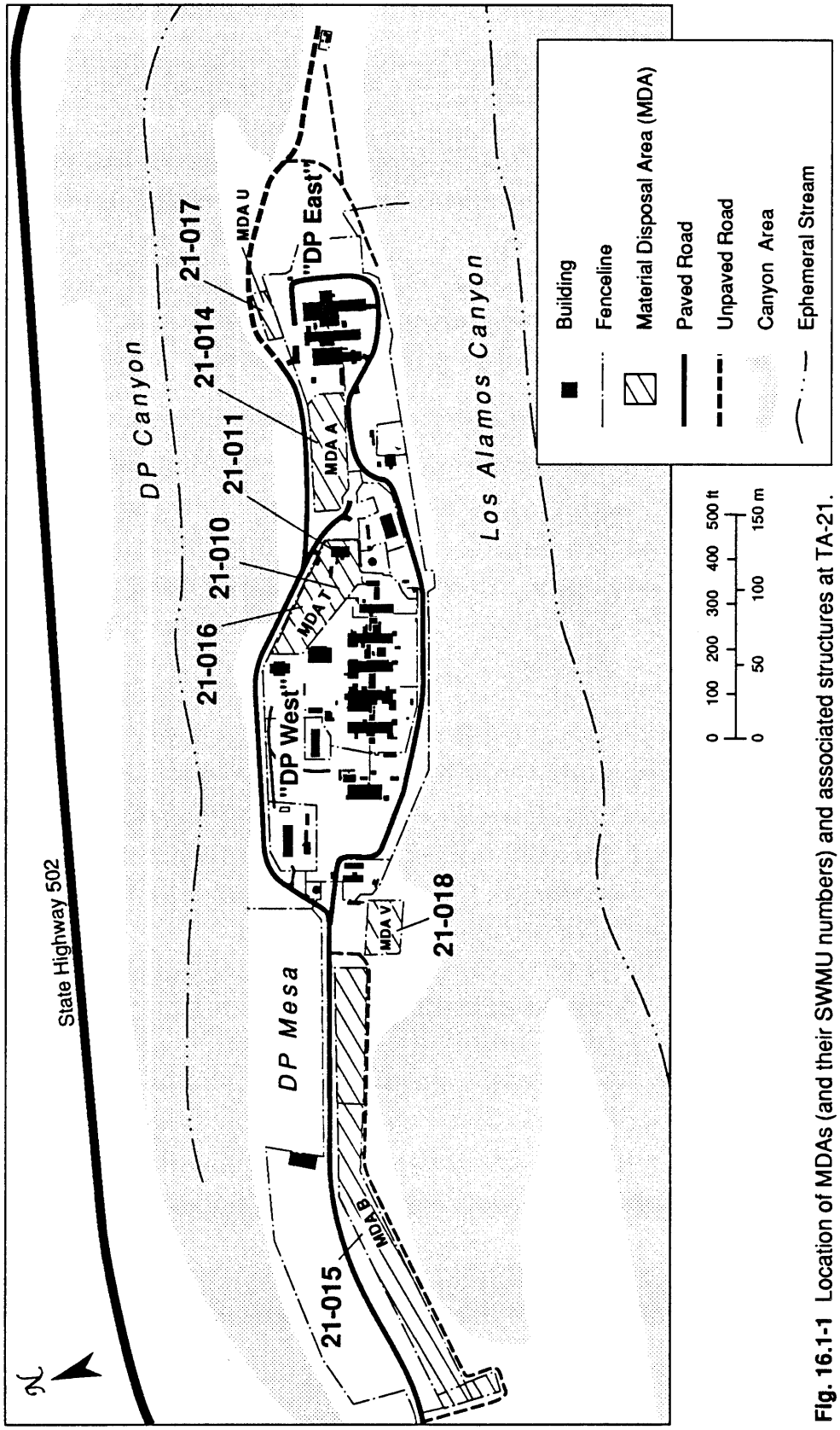


Fig. 16.1-1 Location of MDAs (and their SWMU numbers) and associated structures at TA-21.

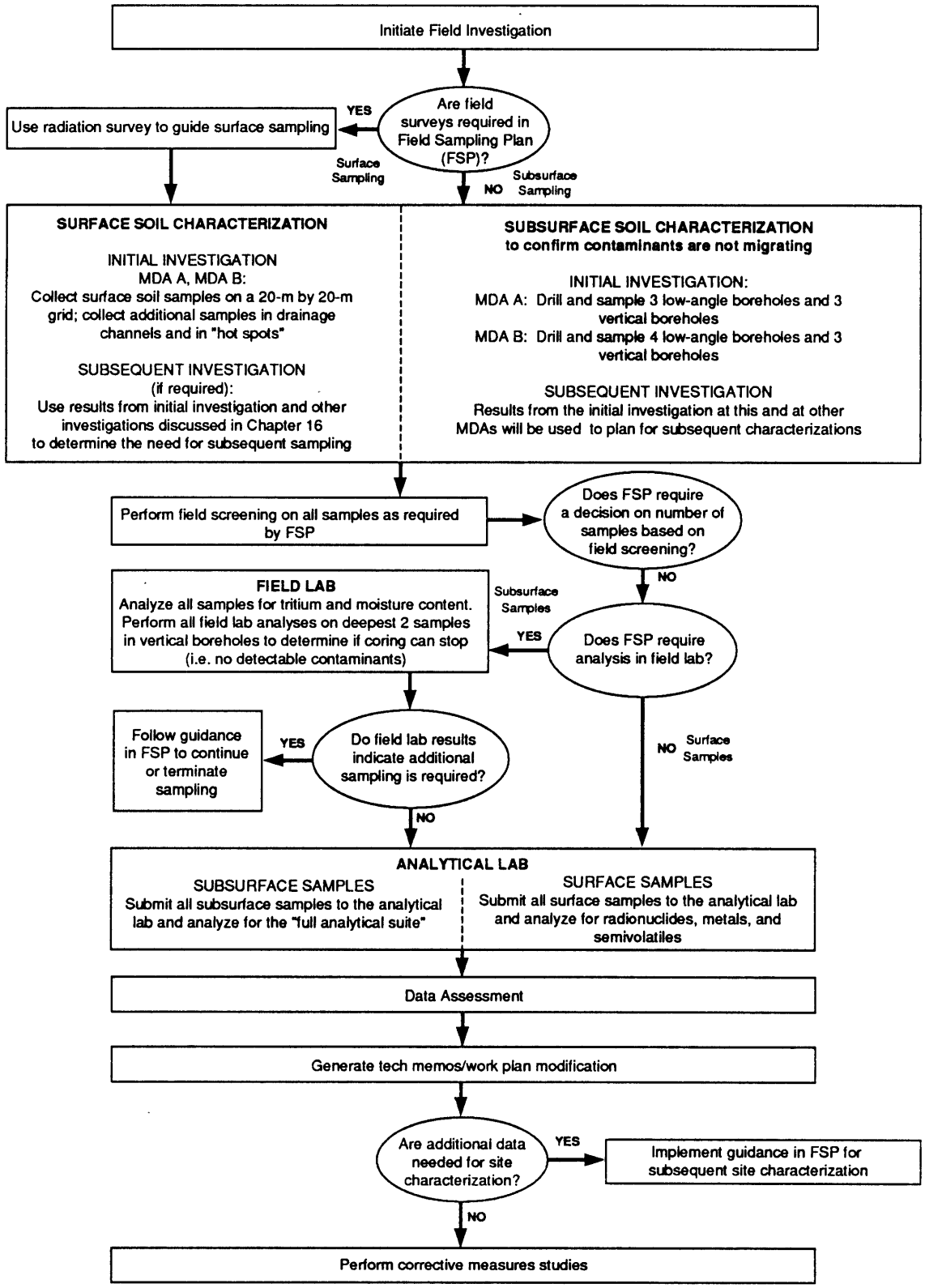


Fig. 16.1-2 Logic flow for the field investigation at the solid waste MDAs (MDA A and MDA B).

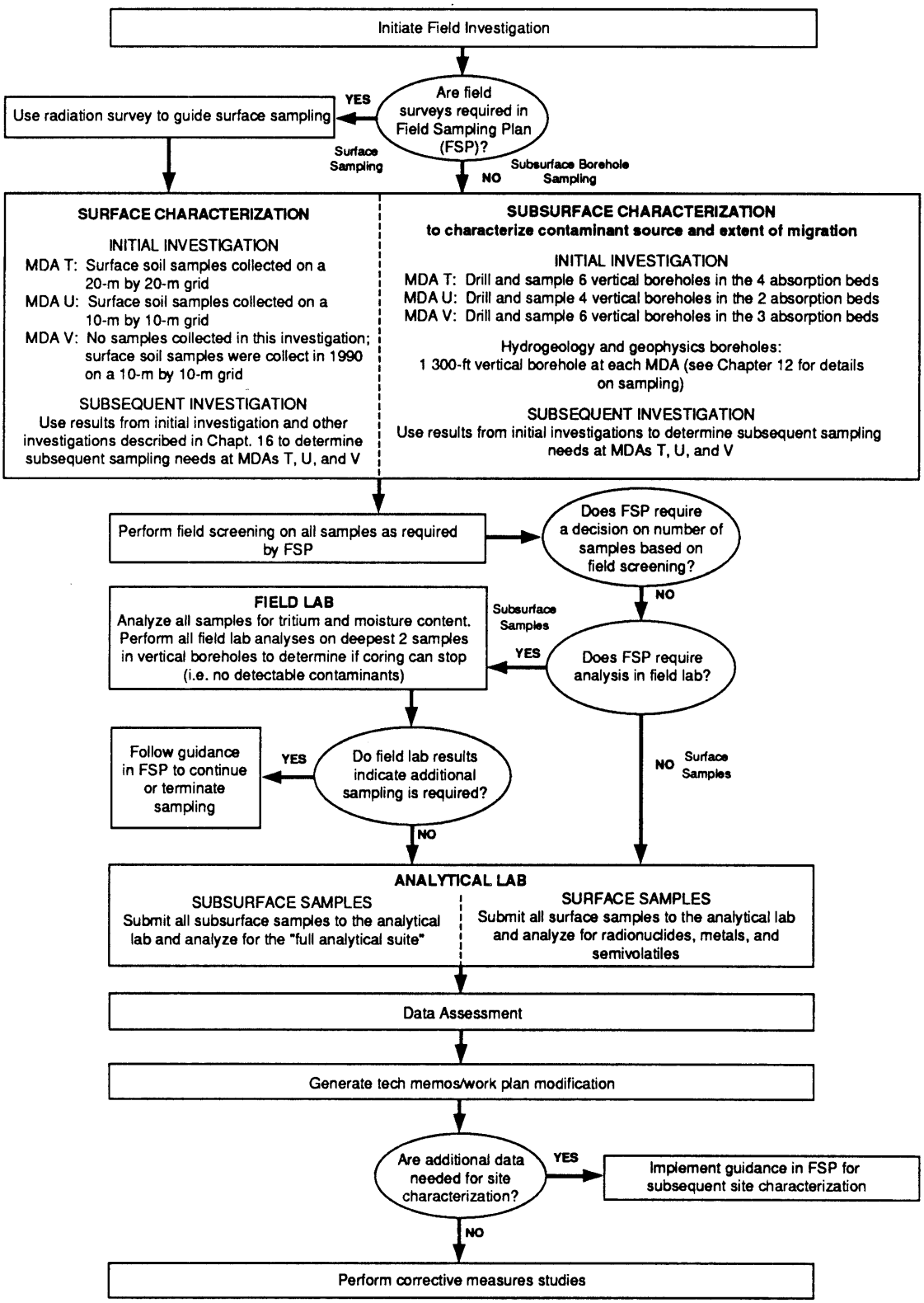


Fig. 16.1-3 Logic flow for the field investigation at the liquid waste MDAs (MDA T, MDA U, and MDA V).

TABLE 16.1-I. BRIEF MDA DESCRIPTIONS

MDA	Area (acres)	Solid/Liquid Waste Disposal	Brief Description	Date Became Inactive
A	1.25	Solid	• Four pits used 1944-1947 • Large pit used 1969-1978 for building D&D • Below ground General's tanks used 1945-1949	1978
B	6.03	Solid	• Unknown number of pits/trenches used 1945-1948 • Western 2/3 of site paved 1966 • Eastern 1/3 of site used for trench cover studies 1982-present	1952
T	2.21	Liquid	• Four absorption beds used 1945-1967 • 62 shafts for ^{241}Am cement paste disposal used 1968-1976 • TRU cement paste storage 1975-1983	1983
U	0.20	Liquid	• Two absorption beds used 1948-1968	1968
V	0.88	Liquid	• Three absorption beds used 1945-1961	1961

TABLE 16.1-II. SWMUS AND AREAS OF CONCERN ADDRESSED IN CHAPTER 16

MDA/Associated Structure	SWMU No.	Area of Concern	Brief Description
A	21-014	—	Five pits and two underground tanks for solid waste disposal
B	21-015	—	Unknown number of pits or trenches for solid waste disposal
T	21-016(a)	—	Four absorption beds
T	21-016(b)	—	Experimental caisson at NW corner absorption bed 1
T	21-011(c)	—	An acid holding tank and an acid sump located within MDA T
T	21-016(c)	—	62 Shafts between absorption beds 2 and 4
T	21-028(a)	—	Satellite container storage area for alcohol, acetone, and freon inactive as of January 1990
T	—	C-21-009	1978 spill of ^{241}Am in cement paste at Area T shafts. Paste was removed and area was decontaminated
T	—	C-21-012	1976 spill of ^{241}Am and plutonium in a cement paste
TA-21-35	21-010(a)–(h)	—	Old industrial liquid waste treatment facility and associated structures
TA-21-257	21-011(a)–(j)	—	New industrial waste treatment plant and associated structures
TA-21-257	21-001	—	Radioactive container storage area at SW corner of TA-21-257
TA-21-257	—	C-21-005	Release of ^{241}Am and plutonium on west side of building; soil was decontaminated
TA-21-257	—	C-21-007	Release of Pu, Am, U from tank vent
TA-21-257	—	C-21-033	1976 TRU cement paste spill
U	21-017(a) and (b)	—	Two absorption beds
U	21-017(c)	—	Sump, TA-21-164, between two absorption beds
V	21-018(a)	—	Three absorption beds
TA-21-20	21-018(b)	—	Laundry building

TABLE 16.1-III SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 16.

		Survey Areas			Surface	Near Surface Soil Samples	
Section	Description	Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples
16.1	MDA Drainages		10			15	45
16.2	MDA B	1	2		80		
16.3	MDA T	1	2		60		
16.4	TA-21-35	3		3			
16.5	TA-21-257	1	2			5	25
16.6	MDA U	1	2		60		
16.7	MDA V						
16.8	MDA A	1	2		55		
	Total	8	10	3	255	5	25

		Boreholes									Q A
		Shallow			Vertical			Angled			
Section	Description	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
16.1	MDA Drainages										15
16.2	MDA B				3	90	33	5	940	213	70
16.3	MDA T				6	650	178				38
16.4	TA-21-35	10	75	28	5	100	20				12
16.5	TA-21-257	7	70	28				4	80	16	15
16.6	MDA U				4	250	70				26
16.7	MDA V				6	500	145				24
16.8	MDA A				3	175	51	3	440	103	43
	Total	17	145	56	27	1765	497	12	1460	332	243

TABLE 16.1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 16.

	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8			Total
Field Sample Screening											
Gross Gamma	45	326	228	50	69	100	118	168			1104
Gross Alpha	45	326	228	50	69	100	118	168			1104
Organic Vapor		246	178	50	69	50	118	123			834
Combustible Gas/Oxygen		246	178	50	44	50	118	123			809
Lithological Logging		246	178	50	44	50	118	123			809
Field Laboratory Measurements											
Gross Alpha		6		50	69	8	12	6			151
Gamma Spectrometry		6		50	69	8	12	6			151
Tritium			10	50	69	18	22	6			175
Volatile Organics		6		50	69	8	12	6			151
PCB											
Soil Moisture		246	178			50	118	123			715
Laboratory Analysis											
Gamma Spectrometry	55	365	248	21	30	134	150	232			1235
Tritium	55	365	248	21	30	134	150	232			1235
Total Uranium	55	365	248	21	30	134	150	232			1235
Isotopic Plutonium	55	365	248	21	30	134	150	232			1235
Isotopic Uranium											
Strontium 90	55	365	248	21	30	134	150	232			1235
VOA (SW 8240)		311	207	28	39	87	162	198			1032
Semivolatiles (SW 8270)	60	382	257	24	34	141	156	243			1297
Metals (SW 6010)	60	382	257		34	141	156	243			1273
PCB (SW 8080)											
TCLP Metals											

TABLE 16.1-V SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 16.

		Survey Areas			Surface	Near Surface Soil Samples	
Section	Description	Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples
16.2	MDA B		2		30		
16.3	MDA T		2		40		
16.4	TA-21-35						
16.5	TA-21-257						
16.6	MDA U		2		30		
16.7	MDA V	1	2		30		
16.8	MDA A		2		30		
	Total	1	10		160		

		Boreholes									Q A
		Shallow			Vertical			Angled			
Section	Description	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
16.2	MDA B				5	375	75				28
16.3	MDA T				8	900	220	11	1690	393	141
16.4	TA-21-35	8	80	32	5	100	20				12
16.5	TA-21-257	10	100	40				4	80	16	12
16.6	MDA U				2	150	40	4	300	80	33
16.7	MDA V				4	300	80	5	925	210	72
16.8	MDA A				5	375	100				27
	Total	18	180	72	29	2200	535	24	2995	699	325

TABLE 16.1-VI SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 16

	16.2	16.3	16.4	16.5	16.6	16.7	16.8				Total
Field Sample Screening											
Gross Gamma	105	553	52	56	110	265	95				1236
Gross Alpha	105	553	52	56	110	265	95				1236
Organic Vapor	75	523	52	56	90	245	75				1116
Combustible Gas/Oxygen	75	523	52	56	90	245	75				1116
Lithological Logging	75	523	52	56	90	245	75				1116
Field Laboratory Measurements											
Gross Alpha		30	52	56	4	8	10				160
Gamma Spectrometry		30	52	56	4	8	10				160
Tritium		26	52	56	4	8	10				156
Volatile Organics		30	52	56	4	8	10				160
PCB											
Soil Moisture	75	523			90	245	75				1008
Laboratory Analysis											
Gamma Spectrometry	120	633	17	18	168	361	144				1461
Tritium	120	633	17	18	168	361	144				1461
Total Uranium	120	633	17	18	168	361	144				1461
Isotopic Plutonium	120	633	17	18	168	361	144				1461
Isotopic Uranium											
Strontium 90	120	633	17	18	168	361	144				1461
VOA (SW 8240)	95	650	25	21	157	366	131				1445
Semivolatiles (SW 8270)	128	661	20	26	176	377	151				1539
Metals (SW 6010)	128	661		21	176	377	151				1514
PCB (SW 8080)											
TCLP Metals											
Sum of Laboratory Analysis by Table	951	5137	130	158	1349	2925	1153				

TABLE 16.1-VII SUMMARY OF GEOHYDROLOGICAL ANALYSES BY SECTION FOR CHAPTER 16.

	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8			Total
Hydrogeological and Geochemical											
Gravimetric Water Content											
Bulk Density											
Dry Density											
Porosity											
Porosity (He injection)											
Saturated Hydraulic Conductivity											
Air Water Relative Permeability											
Moisture Characteristic Curve											
Clay Mineral Content		93	67			37	59	62			318
Zeolite Mineralogy		93	67			37	59	62			318
Sulfate Mineral Content		93	67			37	59	62			318
Carbonate Mineral Content		93	67			37	59	62			318
Fe and Mn Content		93	67			37	59	62			318
Total Organic Compound		93	67			37	59	62			318
Cation Exchange Capacity		93	67			37	59	62			318
Slurry Ph		93	67			37	59	62			318
Environmental Isotopes											
Chloride-35/Chloride-37											
Carbon-12/Carbon-13											
Strontium-86/Strontium -87											
Hydrogen/Deuterium											
Oxygen-16/Oxygen-18											
Tritium											
Carbon-14											
Chloride-36											
Pore Gas Sample											
Straddle Packer Tests											
Volatile Organic Coumpounds											
Carbon Dioxide											
Methane											
Carbon-12/Carbon-13											
Relative Humidity											
SF6											

TABLE 16.1-VIII
SUMMARY OF CHAPTER 16 INVESTIGATIONS BY BOREHOLE PURPOSE

Investigation	Liquid Waste MDA 300-ft Hydrogeological Characterization Borehole	Liquid Waste MDA Source Term Borehole Borehole	Solid Waste MDA Migration Characterization
Soil moisture/Tritium (Sec. 16.1.5.6)	every 5-ft interval	every 5-ft interval	every 5-ft interval
Geochemical/Mineralogy (Sec. 16.1.5.7 using Sec. 12.5.1.5 methods)	every 20-ft interval, plus fracture zones	every 20-ft interval, plus fracture zones	every 20-ft interval, plus fracture zones
Contaminant Analysis (Sec. 16.1.5.8)	None	every 5-ft interval, plus fracture zones	every 5-ft interval, plus fracture zones
Lithological Logging (Sec. 16.1.5.4)	Continuous	Continuous	Continuous
Hydrogeological Parameters (Sec. 12.5.1.4)	every 20-ft interval except moisture content and associated calculations (e.g., porosity, bulk, density, K_s) every 5 ft	None	None
Geophysical Logging (Sec. 12.5.1.6)	Continuous	None	None
Stable Isotopes (Sec. 12.5.1.7)	Every 20 ft for first 100 ft; 40-ft intervals thereafter	None	None
Straddle Packer (Sec. 12.5.1.8)	Every 20 ft for first 100 ft; 40-ft intervals thereafter	None	None
Rock properties below contaminant plume for geochemical/mineralogy (Sec. 16.1.5.2 using Sec. 12.5.1.5. methods)	None	Every 10 ft for 50 ft below contaminant plume	None

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
MDA B																																		
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				
MDA T																																		
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
MDA U																																		
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				
MDA V																																		
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X													X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
MDA A																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
Field Duplicate																							X	X	X	X		X		X	X				
Rinsate Blank																							X	X	X	X		X		X	X				
Field Blank																														X	X				

16.2 SWMU 21-015 Material Disposal Area (MDA) B

16.2.1 Site Description

MDA B is the largest solid waste disposal site at TA-21 (SWMU 21-015), with an approximate area of 6.03 acres (24,000 m^2) (Engineering Department 1965). Buried waste pits occupy about 4,650 m^2 with an estimated volume of 21,240 m^3. The location of MDA B at TA 21 is shown in Fig. 16.2-1.

MDA B consists of two areas, an unpaved eastern area and a paved, fenced western area as shown in Fig. 16.2-1. The number of pits in MDA B is unknown; however, Rogers (1977) states that there were at, a minimum, five pits located there.

16.2.1.1 Site History

A chronological sequence of events and data pertaining to MDA B is given in Table 16.2-I. The following discussion of this information provides the basis for identifying information needed to complete characterization and assessment.

In 1945, pits at MDA A were being filled at such a rate that additional waste disposal pits were necessary. MDA B was a favorable location because sufficient space was available. Tyler (1945) suggested that a trench 15-ft wide by 300-ft long be dug at the eastern end of MDA B. Dow (1945) suggested that the excavation of this waste pit was to be continued until a depth of 12 ft was reached or until September 1, 1945, whichever came sooner. It is not known if the completed pit achieved the dimensions of 15 by 300 ft by 12-ft deep or precisely where it was located.

Other memos indicated there were additional pits. Meyer (1952) said that four pits were dug in MDA B by 1945 and that space was exhausted by 1948. The locations of these pits are not precisely known; however, their dimensions and orientations to fence lines are known. Personal testimony and reference to common Laboratory practice at the time suggested that four disposal pits 300-ft long, 15-ft wide, and 12-ft deep were located parallel to the fence line along DP road and that two pits of uncertain length were located in the north-south leg of MDA B at the western end of the site (Rodgers 1977).

Several sources indicated that additional trenches were located at the easternmost part of MDA B for chemical disposal. A 1964 memo (Safety Office 1964) stated that a covered shallow trench 2-

ft wide by 40-ft long by 3-ft deep was located at the extreme eastern end of MDA B. Another source indicated several small slit trenches, 3-ft to 4-ft deep, 2-ft wide, and less than 40-ft long were reportedly dug in this area for chemical disposal (DOE 1987).

The exact number of pits cannot be ascertained with available information. However, one can assume that there were a minimum of four disposal pits parallel to the fence along DP road and at least one trench for chemical disposal at the easternmost end of MDA B.

A fire occurred at MDA B in 1948 (Buckland 1948). The fire was estimated to have lasted two hours, had great intensity, and covered a waste area of 2,500 ft^2 (McCurdy 1973). The probable cause was spontaneous combustion of mixed chemicals in waste probably containing plutonium, americium, and fission products. The location of this fire is not well known. Buckland and Enders had different recollections regarding where the fire occurred (Rogers 1978).

Because of the seriousness of the fire at MDA B and its close proximity to living and working areas, another disposal site location was selected near Ten Site (Rogers 1977). After the fire in 1948, MDA B was no longer used for waste disposal. Shortly after MDA B was closed, subsidence occurred. This was remedied by using the area for disposal of uncontaminated concrete and soil from construction sites (Rogers 1977).

MDA B was probably fenced as early as 1944 as indicated by the Meyer's memo (1952). In 1966, another request was made to replace the then-current fence with an 8-ft chain link fence (The Zia Company 1966).

The western two-thirds of MDA B was fenced and compacted in 1966 per instructions in Hilton (1966) and leased by DOE to Los Alamos County for trailer storage. The storage area is indicated by the paved area in Fig. 16.2-1. Los Alamos County has been asked to vacate use of this site as a trailer storage area by September 30, 1990 (Bohannan 1990).

Surface stabilization of the east end of MDA B began on July 6, 1982 (Emelity 1982a) and was completed by October 15, 1982 (Emelity 1982b). The fence was moved outward by 10 ft, surfaces were decontaminated, vegetation was removed, and the area was covered with soil, compacted, and reseeded. Capping studies were initiated on the east end of Area B in 1987 to evaluate alternative cover designs.

16.2.1.2 Existing Information

16.2.1.2.1 Waste Disposal Information

Nonradioactive Waste. There are some indications that hazardous chemicals may be present at MDA B. For example, Drager (1948), commenting on the 1948 fire, reported that there was some evidence that chemicals had been disposed of in the dump in an unauthorized manner; i.e., in cardboard containers used for the regular disposal of common laboratory waste. In the fire, several cartons of waste caused minor explosions, and on one occasion, a cloud of pink smoke arose from the debris in the dump.

Documented employee interviews (DOE 1987) stated that chemical disposal occurred at the east end of MDA B. Chemicals disposed of included old bottles of organics, perchlorates, ethers, and solvents. A DOE (1987) document also stated that lecture bottles of mixtures, spent chemicals, old chemicals, and corrosive gases may be in the trench(es) at the east end of MDA B.

Radioactive Waste. MDA B contains solid wastes. The principal radioactive contaminants consist of the types of radioactive materials used at the time: plutonium, polonium, uranium, americium, curium, radioactive lanthanum (RaLa), actinium, and waste products from the water boiler (Meyer 1952). However, approximately 90% of the waste consisted of radioactively contaminated paper, rags, rubber gloves, glassware, and small metal apparatus placed in cardboard boxes by the waste originator and sealed with masking tape. The remainder of the material consisted of metal, including air ducts and large metal apparatus. The latter type of material was placed in wood boxes or wrapped with paper (Meyer 1952).

At least one truck contaminated with fission products from the Trinity test is buried in MDA B (DOE 1987).

Generally, the pits contain little plutonium. Meyer (1971) estimated that MDA B contains no more than 100 grams of $^{239/240}Pu$. MDA B probably contains no transuranic waste, in which transuranic waste is defined as waste with a concentration of $^{239/240}Pu$ greater than 100 nCi/g of waste (Walker 1983).

16.2.1.2.2 Historical Surface Sampling Data

Numerous surface soil sampling studies have been undertaken at MDA B, beginning in 1966, and have continued periodically to the present.

1966 Beta-gamma Survey. In 1966, a beta gamma survey conducted 20 in. above the black top in the paved area showed readings above instrument background levels.

1971 Alpha- and Beta-gamma Survey. In November 1971, the asphalt of the DP trailer park was surveyed with an alpha counter, Ludlum Model 139, and a beta-gamma counter Model E-112-B. The results showed no alpha contamination and only background beta counts (Workman 1971).

1977 Soil and Vegetation Sampling. Soil and vegetation samples were collected from the unpaved area from September 1976 through October 1977 (Booth 1978). Sample analyses included radionuclide and gross alpha and beta measurements. The sampling locations are shown in Fig. 16.2-2 and are denoted 1977 Trocki Gamma Survey Soil Samples and 1977 Trocki Transect Soil Samples. The results of soil and vegetation sampling are given in Table 16.2-II. In 1978, additional analyses were performed on these soil samples (Booth 1978). Those data are given in Table 16.2-III.

Tritium results for the soil samples are given in Figs. 16.2-3 and 16.2-4 The tritium concentrations were above background levels of 7,200 pCi/L (Purtymun 1987) but were generally less than 20,000 pCi/L (Gunderson 1981). Several of the samples had higher levels; the maximum observed level was 983,000 pCi/L. The $^{239/240}Pu$ concentrations were generally above 1 pCi/g, which is considerably higher than the maximum worldwide fallout levels of 0.025 pCi/g given by Purtymun et al. (1987). Samples from several locations showed concentrations in the 20-to-40 pCi/g range. Additionally, elevated levels of ^{241}Am, ^{238}Pu, and ^{137}Cs were found (Table 16.2-II).

Tritium and $^{239/240}Pu$ data were used to predict a continuous concentration surface for the total unpaved area using kriging predictors. The resulting contours (Fig. 16.2-5) show elevated concentrations of tritium and $^{239/240}Pu$ in the center of the sampled area. In addition, $^{239/240}Pu$ contours also show several "hot spots" dispersed across the sampling area.

It was Trocki's opinion that contamination in the middle and southern portion of the area was most likely because of late 1940s burial practices. Pieces of contaminated equipment were sometimes stored on the surface until a suitable pit location was available. Lack of adequate pit cover probably accounted for the above-background contamination over the "apparent pit surface."

1979 Perimeter Soil Sampling. Perimeter soils at five locations on the southern edge of MDA B were sampled in November 1979. The locations and data are shown in Figs. 16.2-6 and 16.2-7.

The sample analysis results for selected radionuclides are given in Table 16.2-IV. Contamination above background levels of ^{238}Pu, $^{239/240}Pu$, uranium, tritium, ^{137}Cs, and ^{90}Sr were observed at one or more depths. Only $^{239/240}Pu$ and uranium appeared above background levels at all locations. The degree of contamination was greater for $^{239/240}Pu$. Location B-5 showed the highest levels of contamination. A sample intended to document background concentrations near MDA B was taken approximately 200 ft west of the area. Plutonium-239/240 levels in this sample were eight times the background level.

1980 Vegetation Sampling. Vegetation was sampled in 1980 at the same locations as soil sampled in 1979. Those results are given in Table 16.2-V The plutonium data for control samples collected in Guaje Canyon are also given in Table 16.2-V. In general, higher levels of radionuclides were found in vegetation collected at locations at the eastern unpaved area. However, not all samples at those locations showed elevated levels of contamination. This variability suggests that either contamination was not uniform in the environs of the root systems or that contaminated dust deposition on leaves was not uniform.

The fruit of a peach tree located at the west end of MDA B (see Fig. 16.2-2) was sampled in 1981 and analyzed for tritium, ^{238}Pu, $^{239/240}Pu$, and ^{90}Sr. The fruit was classified into peels, pulp, and pits from the lower, middle, and upper parts of the tree for analysis. The laboratory analysis results are given in Table 16.2-VI. The tritium concentrations were similar to those found in background soil water. Both ^{238}Pu and $^{239/240}Pu$ were detected in the fruit. However, no obvious trend was observed among fruit from the lower, middle, and upper parts of the tree. Strontium-90 was below detectable levels.

1982 Vegetation Sampling. MDA B was scheduled for renovation in the Fall of 1982. Restabilization of the soil surface required the removal of all plants. Therefore, an intense sampling scheme was formulated to collect and analyze samples from various layers within that ecosystem: soil, litter, roots, stems, and leaves (Wenzel et al. 1987). The purpose of the study was to determine whether any trees or shrubs were rooting directly in waste material, to examine rooting patterns in a shallow land burial site, and to study the distribution patterns of different radionuclides by dissecting vegetative samples into representative compartments. Analysis included ^{137}Cs, $^{239/240}Pu$, uranium, and scandium. Sampling locations are given in Fig. 16.2-2 and include some subsurface samples (1982 Excavated Plants and Soils and 1982 Sampled Plants and Soils). The data are given in Table 16.2-VII and are expressed as a mean with a standard deviation and a coefficient of variation (COV). The ratios of soil to wood for the various radionuclides ranged from a high of 8 for plutonium to a low of 5 for cesium indicating that the vegetation is not taking up the elements rapidly. As would be expected, for all elements, both

root and bark measurements generally showed greater concentrations than their corresponding wood measurement. The small number of samples and the variability of the data make statistically significant comparisons impossible.

1982 Soil Sampling. In addition to this intensive ecosystem sampling effort, prior to renovation soil samples were collected along diagonal transects (Fig. 16.2-2). Sample analysis results are given in Table 16.2-VIII are shown in Figs. 16.2-8 and 16.2-9. Samples were collected at depths of 0 -1 cm, 1 - 10 cm, and 10 - 30 cm.

At the 0-1-cm depth, there were 35 samples analyzed for tritium, all having values above background. The values ranged from 13,400 pCi/l up to 25,600,000 pCi/l (Fig. 16.2-8). At sampling depths of 1-10 cm and 10-30 cm, the tritium was also above-background, with high values of 7,050,000 pCi/l and 4,740,000 pCi/l, respectively. Within the top foot, the levels decreased with depth . The 1982 tritium levels were much higher than those observed in 1977, possibly indicating a tritium source external to MDA B. At 0-1 cm, there were 40 samples analyzed for $^{239/240}Pu$, 97% of which were above background level. They ranged from background to 58 pCi/l (Fig. 16.2-9). At 1-10 cm, all results were above the background level , while at 10-30 cm, 87% were above the background level. The extreme values for $^{239/240}Pu$ at both of these depths were comparable to the extreme values at the 0-1-cm depth.

For all three sampling depths, concentration contours derived from prediction surfaces using kriging show high tritium levels at the center of MDA B along the southern fence (Fig. 16.2-10) . The concentration of $^{239/240}Pu$ is predicted to be high in several regions (Fig. 16.2-11), showing a pattern of high concentration similar to that of the 1977 data. The different depths show slightly different patterns, but the general pattern of the highest values occurring along a line from the northeastern corner to the southwestern corner is evident in all three depths. Due to the uncertainties involved in predicting these concentration surfaces, the patterns at the different depths should be regarded as quite similar.

1982 Post Renovation Soil Sampling. After MDA B was renovated in 1982, soil samples were taken at four locations on the perimeter of MDA B in October 1982. The first three locations are shown in Fig. 16.2-12. The location of a fourth sample (B-4) is not known. These samples were taken outside the area of renovation. The results (tritium, uranium, and plutonium) are given in Table 16.2-IX and, while above background levels, they are typical of local contaminant levels at TA-21.

1983 Baseline Soil Sampling. In 1983, surface soil samples were collected for radionuclide analysis. The data from these samples were to serve as baseline data (Mayfield 1985b). The

baseline data are given in terms of north (N), south (S), and east (E) coordinates. However, it should be noted that the reference location was not documented in the field notebook (Mayfield 1985b). This set of data is important in that it serves as a baseline for monitoring future contamination after bringing in new soil as part of the MDA B renovation. The coordinates of the location of collected soil samples appear to fit the unpaved eastern portion of MDA B, if it is assumed that the reference location is the southwest corner and that each coordinate unit represents 10 meters (Fig. 16.2-13) (Mayfield 1985b). If those assumptions are correct, then not only is the fenced area covered (N0, E_ to N3, E_) but also the north (N4, E_) and south (S1, E_) unfenced areas. Although the documentation of the reference location of the coordinate system could not be found, the baseline data are recorded here with the apparent reference location because of their importance to future monitoring.

Three sampling depths were again used, 0 -1 cm, 1 - 10 cm, and 10 - 30 cm. The laboratory results are given in Table 16.2-X and shown in Figs. 16.2-13 through 16.2-16 (Mayfield 1985b). Within the fenced area, tritium concentrations were 35,000 pCi/L or less, with most locations being less than 20,000 pCi/L. In a number of cases the concentrations at or outside the fence line were higher than the concentrations inside the fence. The predicted concentration contours for tritium showed the highest concentrations at the corners of the area, especially the southwestern corner beyond the fence line (Fig. 16.2-17).

Plutonium-239/240 concentrations are generally within background levels (<0.025 pCi/g) inside the fenced area with several exceptions. However, the concentrations on or outside the fence line are above background levels. The concentrations outside the fenced area are similar to concentrations observed in previous sampling. The predicted concentration contours for $^{239/240}Pu$ (Fig. 16.2-18) also show the highest concentrations at the corners of the area beyond the fence.

Uranium concentrations slightly exceed the maximum background level of 3.4 µg/g. These concentrations are essentially background levels. Plutonium-238 concentrations are undetectable below background level with only a few exceptions. Those exceptions are either on the fence line or outside the fence line.

Radionuclide concentrations are low inside the fence because MDA B was covered with clean soil in 1982 prior to this sampling. However, new cover soil was not put outside the fence. Elevated levels outside the MDA B fence may be typical of local contaminant levels at the TA-21 OU.

1984 Soil Sampling. Soil samples were collected in May 1984 at three locations. These locations were described in a field notebook (Mayfield 1985b) as follows: B-1, southern end of the western-fenced unpaved area; B-2, southern end of MDA B near the western corner of the unpaved eastern area; and B-3, north side near DP Road at the northwestern corner of the eastern unpaved area of MDA B. Without additional information, these locations cannot be accurately placed on a site map. The laboratory results are given in Table 16.2-XI. Tritium concentrations are within background levels. Plutonium-238 concentrations are very low at the three locations, exceeding background level only at location B-3. Plutonium-239/240 exceeded background levels and ranged from 0.4 to 7.4 pCi/g. These plutonium concentrations may be indicative of local contaminant levels in the vicinity of TA-21.

16.2.1.2.3 Historical Subsurface Sampling Data

1966 Borehole Sampling. In 1966, 13 boreholes 25- to 50-ft deep were drilled in the vicinity of the outer edges of the waste pit at MDA B (Kennedy 1966; Purtymun and Kennedy 1966). See Fig. 16.2-19 for borehole locations. This study was conducted jointly by LANL and the USGS to determine if seepage of water from precipitation had caused migration of radioactive contamination from the pit into the adjacent land and tuff because the surface of the pit and adjacent land were being considered for commercial use. The depth of soil varied from 1 to 4 ft, and the holes showed no evidence of previously disturbed material, indicating that the pit was not penetrated. Samples of drill cuttings of soil and tuff were analyzed for gross alpha and gross beta-gamma radioactivity, plutonium, and uranium. These data are given in Tables 16.2-XII through 16.2-XVI. The data indicate no radioactive contamination when compared with the following upper background limit of these constituents: 16 dpm/g gross alpha, 20 dpm/g gross beta, and 3.4 µg/g total uranium. Plutonium analysis results were below the detection limit of 0.4 dpm/g.

The moisture content in the soil and tuff adjacent to the walls of the boreholes was determined with a neutron moisture probe. The results are given in Figs. 16.2-20 and 16.2-21. A report from Rogers contains the following:

> Distribution of moisture in five test holes indicated some lateral movement of water, probably from the contaminated waste pit. The amount of water moving through the tuff was well below the estimated effective porosity of the tuff. Radiochemical analyses of the soil and tuff from the test holes showed no indication of radioactive contamination. A much larger amount of water than occurs from precipitation would be required to move radioactive contaminants from the water pit into the adjacent soil and tuff. An asphalt covering on the

pit with adequate drainage could prevent any movement of radioactive contaminants from the waste pit.

1982 Subsurface Soil Samples. The 1982 intensive ecological study (Table 16.2-VII) included soil samples to a depth of 160 cm. These data show a possible decrease in soil contamination with depth for plutonium and cesium. The variability for plutonium is too great for a statistically significant result. However, uranium and scandium show no apparent decrease in concentration with depth.

1983 Borehole Sampling. In 1983, subsurface soil samples were collected at two locations outside the fenced area (Fig. 16.2-12) to a depth of 58 ft. Samples were analyzed for tritium, uranium, ^{238}Pu, $^{239/240}Pu$, and ^{137}Cs. Sample analysis results are given in Table 16.2-XVII. Cesium and ^{238}Pu, $^{239/240}Pu$ concentrations were all within background levels. Uranium was slightly higher than the background range. Two exceptions were the $^{239/240}Pu$ levels in the 0-ft to 3-ft interval of hole B-1 (0.21 pCi/g) and the 3-ft-to-8-ft interval for hole B-2 (0.25 pCi/g). However, those concentrations were within the range of surface contamination levels observed at TA-21.

Tritium concentrations, on the other hand, generally increased with depth (Table 16.2-XVII; Fig. 16.2-22). Tritium data are available only to a depth of 23 ft. The concentrations range from 7,500 pCi/L to 36,000 pCi/L.

16.2.1.2.4 Summary of Historical Data

Considerable sampling data are available indicating that the surface soil at MDA B was contaminated with radionuclides (e.g., tritium, $^{239/240}Pu$). Data from subsurface soil sampling indicate elevated tritium concentrations. These concentrations appeared to increase with depth. The source of this contamination (e.g., soil surface, trench waste at MDA B, waste from other areas such as MDA V) is not known.

In 1982, the surface soil inside the MDA B fence was replaced with clean cover. Subsequent sampling has indicated background levels of contaminants with a few exceptions. The data show that the elevated levels of contaminants are located on and outside the fence line where clean soil was not placed. Elevated levels of contaminants outside the MDA B fence may be more typical of local contaminant levels at the TA-21 OU.

16.2.1.3 Source Term

MDA B contains principally radioactively contaminated solid waste, with the exception of chemical disposal that has occurred in at least one trench at the eastern end of MDA B. No data exist on source concentrations.

No subsurface sampling within the MDA B fence has been done. In boreholes outside of MDA B, most radionuclides were at background concentrations, indicating minimal lateral migration. However, in one borehole, tritium concentration increased with depth to 23 ft, the maximum depth of available data. The source of tritium is unknown. No nonradionuclide data are available.

16.2.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminant migration from MDA B. Specific data required to evaluate contaminant migration at MDA B include the following:

1. Confirm the absence of contaminant migration by identifying the contaminants present both in the surface and subsurface. Analyses for contaminants other than radionuclides are required, because it is known that chemical disposal occurred at the eastern end of MDA B. Since the objective is to confirm the absence of contamination, Level III/IV analyses are required.

2. Determine the vertical and lateral distribution of surface and subsurface contaminants both within and beyond the MDA B fence, as necessary, using Level II/III data.

3. If contaminant migration is identified, determine the geologic stability of the site, particularly with respect to erosion because MDA B is adjacent to an auxiliary canyon to Los Alamos Canyon.

4. If contaminant migration is identified, determine the primary migration pathways through evaluation of sample analysis results.

16.2.3 Sampling/Investigation rationale

MDA B surface sampling on a 10- by 10-m grid within the fenced area was conducted in October 1990. At this time, analytical results are unavailable. Additional sampling from the MDA B fence to the canyon rim will be conducted to identify contaminant levels and evidence of surface run-off driven migration. This sampling will be coordinated with the TA-21 OU surface sampling (see Chapters 12 and 13). In addition, detailed sampling of the drainages as described in Sec. 16.1.4 will be conducted. Whether additional surface sampling at MDA B is required will be determined by evaluating these combined data.

These data will be used to determine spatial prediction surfaces such as kriging surfaces for MDA B and the surrounding area. These surfaces will be used to determine radionuclide contaminant levels and study migration patterns and erosion effects. Requirements for additional radionuclide sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Because MDA B was a solid waste disposal area, subsurface sampling will focus on identifying migration beneath the site and not on source term definition. The rationale for this approach is discussed in Sec. 16.1.1. Emphasis will be on angle drill holes reaching beneath MDA B. However, vertical drill holes on the south side of the site will assess possible lateral migration of contaminants toward the canyon. These holes will be placed near holes drilled for the same purpose in 1966. A comparison to the earlier data may allow an evaluation of changes over time. Depending on the results of initial sampling, this approach to subsurface contaminant migration characterization may need to be modified to include source term definition or expanded to include a larger area.

Because contaminant species present in MDA B are unknown, a full analytical suite will be specified for initial sampling. However, in any necessary additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.2.4 Sampling Plan

Detailed tables identifying the sample screening and analysis required for each investigation planned at MDA B have been prepared. However, due to the large number of pages these tables have been placed in Section F.2 of Appendix F, Analytical Tables.

16.2.4.1 Surface Sampling Plan

16.2.4.1.1 1990 Surface Sampling

MDA B was sampled intensively for surface radionuclide contamination in October 1990. Soil samples are being analyzed for the following radionuclides: $^{239/240}Pu$, ^{238}Pu, ^{137}Cs, ^{90}Sr, tritium, ^{241}Am, and total uranium. No vegetation samples were taken. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste sites. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.2-23, two areas

have additional sample locations based on a 3- by 3-m grid, and the samples around the perimeter are more closely spaced. These additional samples allow for characterization of the local variability, increasing the precision for the prediction of contaminant concentration distributions. Phoswich and gamma exposure rates (μR) counts will be determined for each sample location, and samples will be analyzed in the analytical laboratory for radionuclide contamination.

In 1982, MDA B underwent site stabilization activities, removing surface contamination, adding cover material, recontouring, and reseeding. The data collected in 1990 should help determine the effectiveness of this stabilization activity.

16.2.4.1.2 Initial Investigation

Sixty-four samples will be collected from the MDA B fence to the canyon rim. These samples will be spaced approximately 20-m apart. Six off-grid samples will also be collected approximately 5 m from the original sampling location as shown in Fig. 16.2-24. In addition, samples in drainages will be collected as described in Sec. 16.1.4. Radiation survey instruments will be used within the 20- by 20-m gridded area to confirm that no areas of elevated radioactivity are present between the grid points. Up to 10 samples will be taken to further characterize any such areas detected.

Samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. The exception is that all surface samples taken near the approximate location of the chemical waste disposal pit at the southwestern end of MDA B will also be analyzed for volatile organics in an analytical laboratory. Table F.2-I (see Appendix F) presents the sample screening and analysis requirements.

16.2.4.1.3 Subsequent Investigation

For planning purposes, it is assumed that 30 surface samples on a 10- by 10-m grid surrounding MDA B will be required in the subsequent investigation. As much as possible, a reduced analytical suite will be used, based on results of the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.2-II (see Appendix F) presents the assumed sample screening and analysis requirements for the subsequent investigations.

16.2.4.2 Subsurface Sampling Plan

16.2.4.2.1 Initial Investigation

Because MDA B was a solid waste disposal site, drilling initially will be around the perimeter; no holes will be drilled into the site. Sample locations for MDA B are those locations determined to have the greatest probability of detecting a migration plume if such a plume exists. Five drill holes inclined 10 to 20° from horizontal beneath the site will show with higher confidence whether the hypothesis that wastes have not migrated is correct (Figs. 16.2-25 and 16.2-26). Three vertical drill holes are located on the south side of the site to detect possible lateral migration of contaminants towards the adjacent canyon. Two of the vertical drill holes will be drilled next to boreholes drilled by the USGS in 1966 to determine if contaminant transport has occurred during the 25 years since the earlier holes were drilled. A third vertical hole will be drilled adjacent to the small pit used to dispose of hazardous chemicals.

The nominal depth of the drill holes is given in Fig. 16.2-25. The borehole stopping criteria in Sec. 11.5.3 will be applied only to vertical boreholes and the field laboratory will be used to make these determinations. Samples for contaminant characterization in initial investigation holes along with samples for soil moisture determination will be collected at 5-ft intervals. In the initial investigation, the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table F.2-III (see Appendix F).

An important objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways; therefore, if fractures are encountered (particularly in shallow angle boreholes), they will be preferentially sampled. If a fracture is encountered over a 5-ft sampling interval, two samples will be taken from that sampling interval to compare analytical results for fracture and nonfracture intervals. A five-sample contingency is allowed for each borehole in Table F.2-III (see Appendix F) for fracture sampling.

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5.1) will be characterized systematically on 20-ft intervals of core, and in contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis are detailed in Table F.2-IV (see Appendix F).

16.2.4.2.2 Subsequent Investigation

If the hypothesis is correct that no migration is occurring, then no subsequent investigation is expected. However, if initial boreholes and/or modeling suggest migration is occurring, then additional boreholes may be required.

The necessity for additional characterization will be determined after results from the initial drilling program are evaluated in conjunction with modeling predictions. Placement of additional drill holes will be based on these results from the initial drill holes. If initial drilling results indicate a need for more detailed source term characterization, surface geophysics will be used to locate the buried solid waste disposal pits, employing methods previously used at MDA A (Gerety et al. 1989).

For planning purposes, it is assumed that five 75-ft vertical boreholes will be required to further define the source term and its lateral and vertical extent. Additionally, three additional 30-ft boreholes are assumed to be necessary around the chemical disposal pit (see Fig. 16.2-27). In any subsequent sampling, a reduced analytical suite will be used based on results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.2-V (see Appendix F) details the assumed screening and analysis requirements for the subsequent investigations.

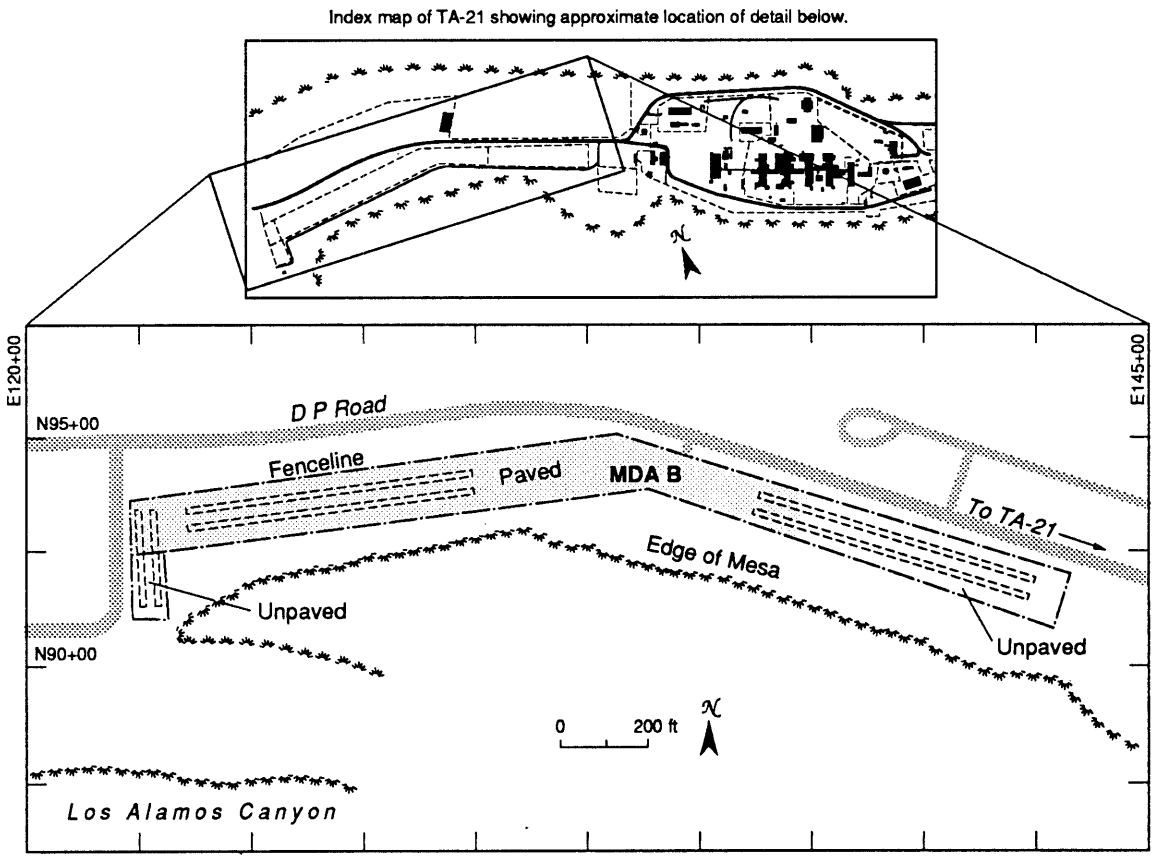


Fig. 16.2-1 Base map of MDA B showing estimated locations (from Rodgers 1977) of pits and trenches.

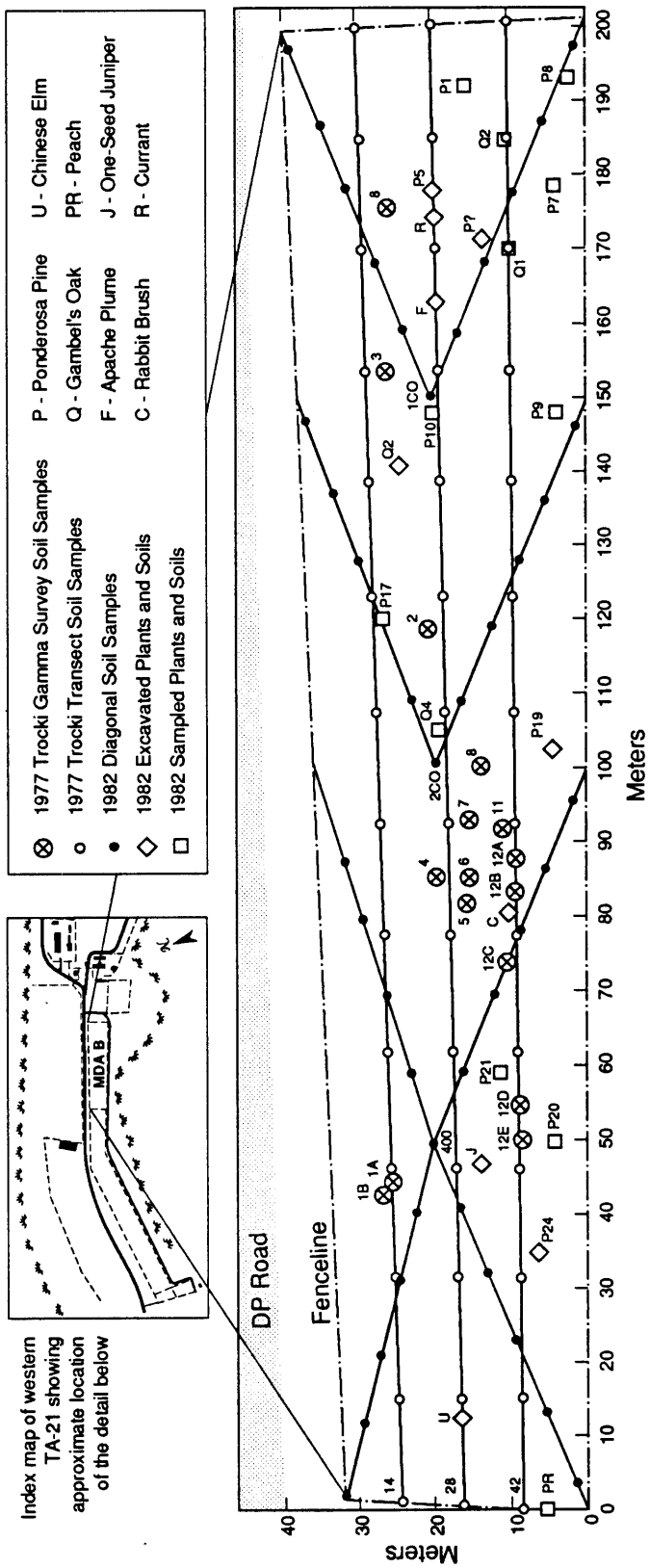


Fig. 16.2-2 MDA B sampling and excavation sites.

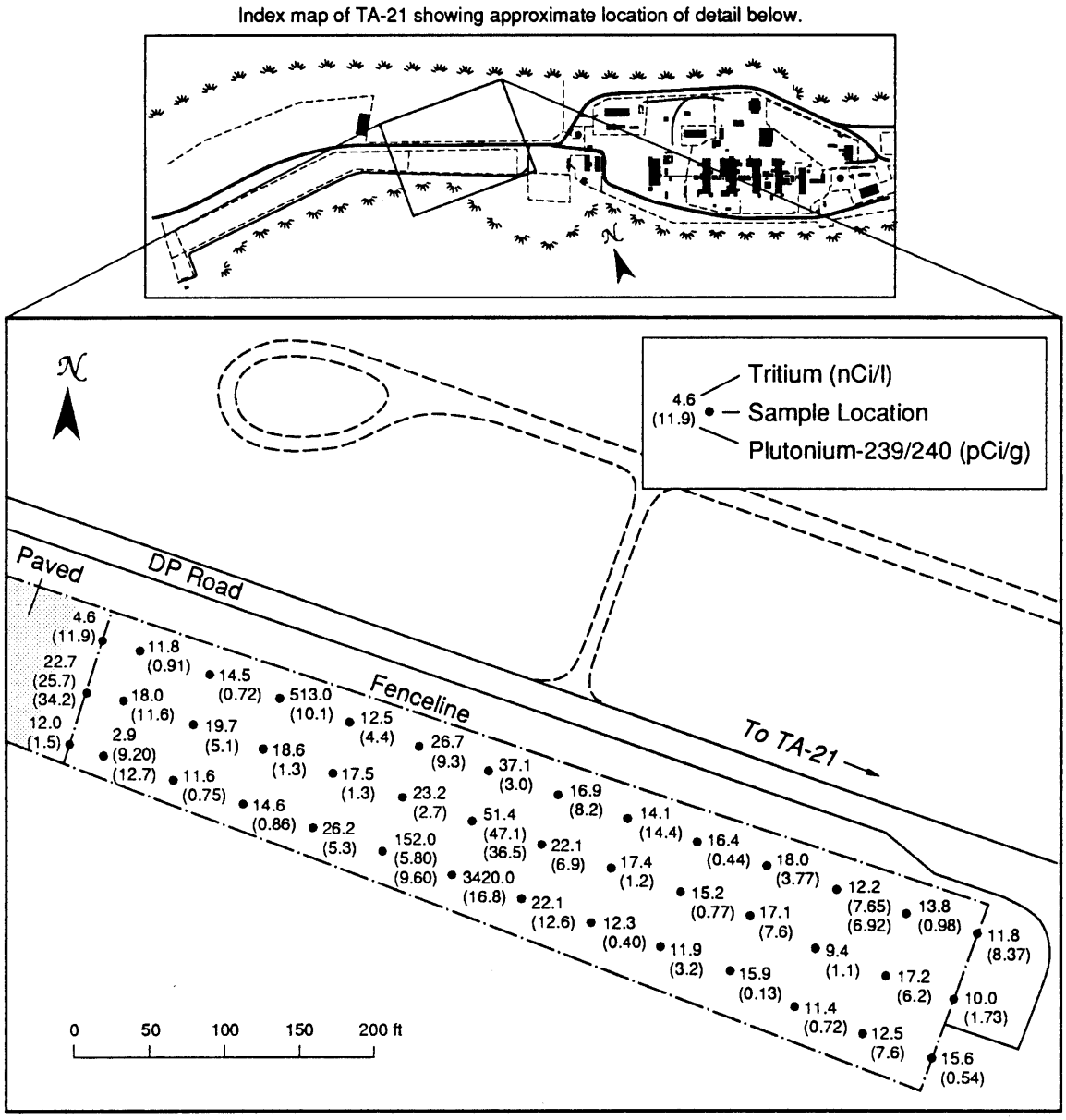


Fig. 16.2-3 Surface soil sampling locations for 1977 Trocki transect sample at MDA B.

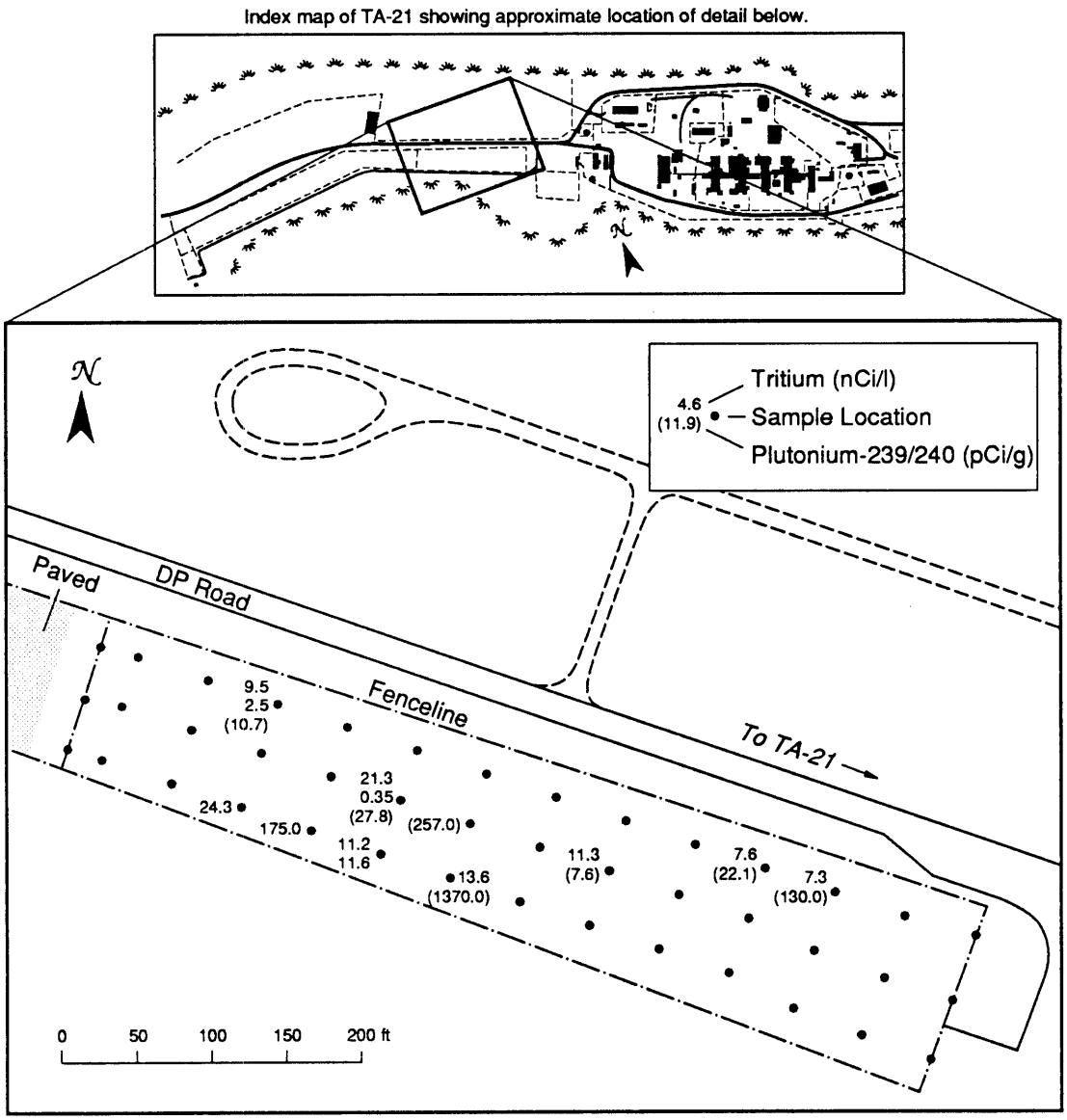


Fig. 16.2-4 Surface soil sampling locations from 1977 Trocki gamma survey at MDA B.

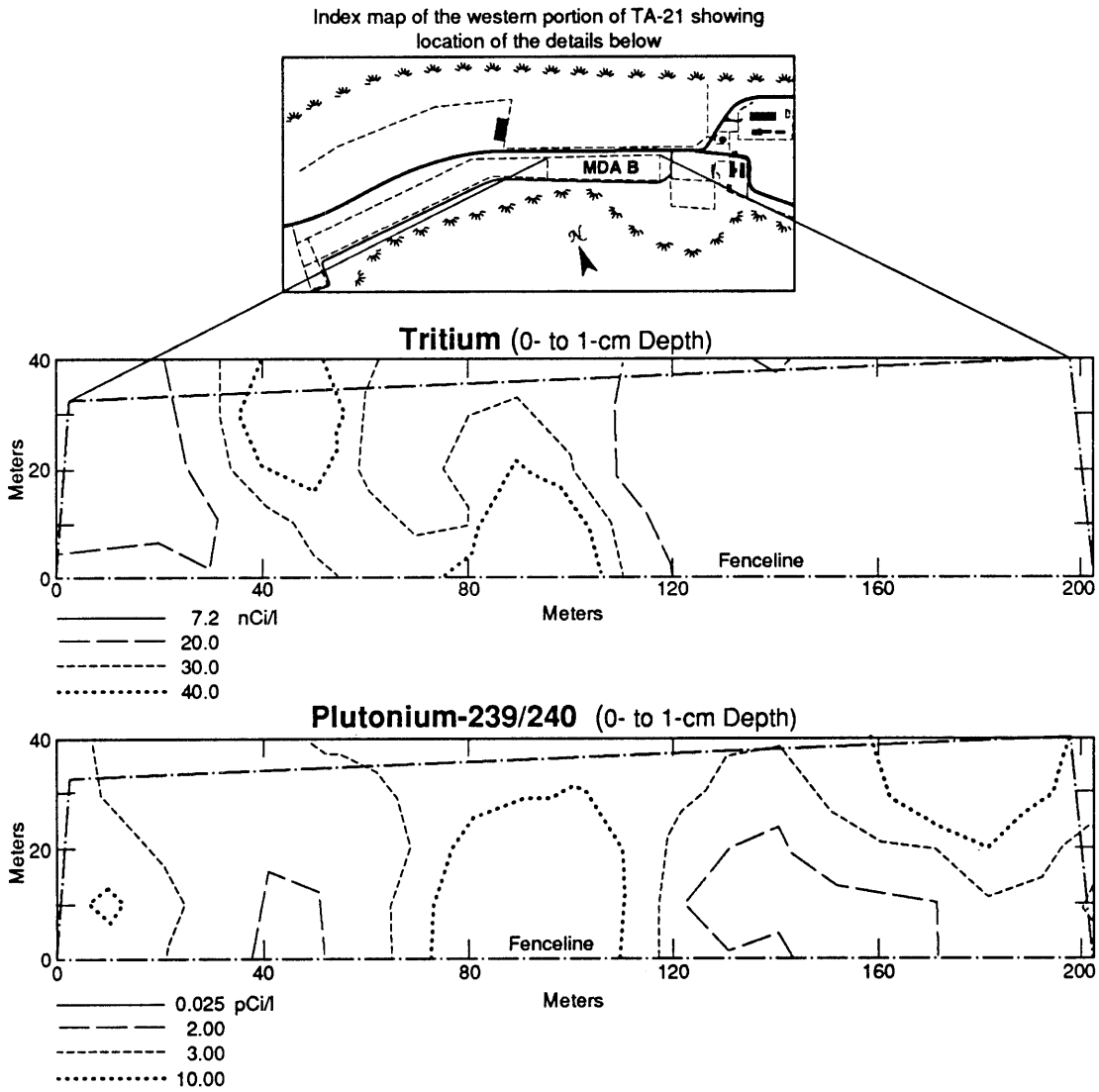


Fig. 16.2-5 Concentration contours for tritium and plutonium-239/240 from the 1977 soil samples on the unpaved section of MDA B.

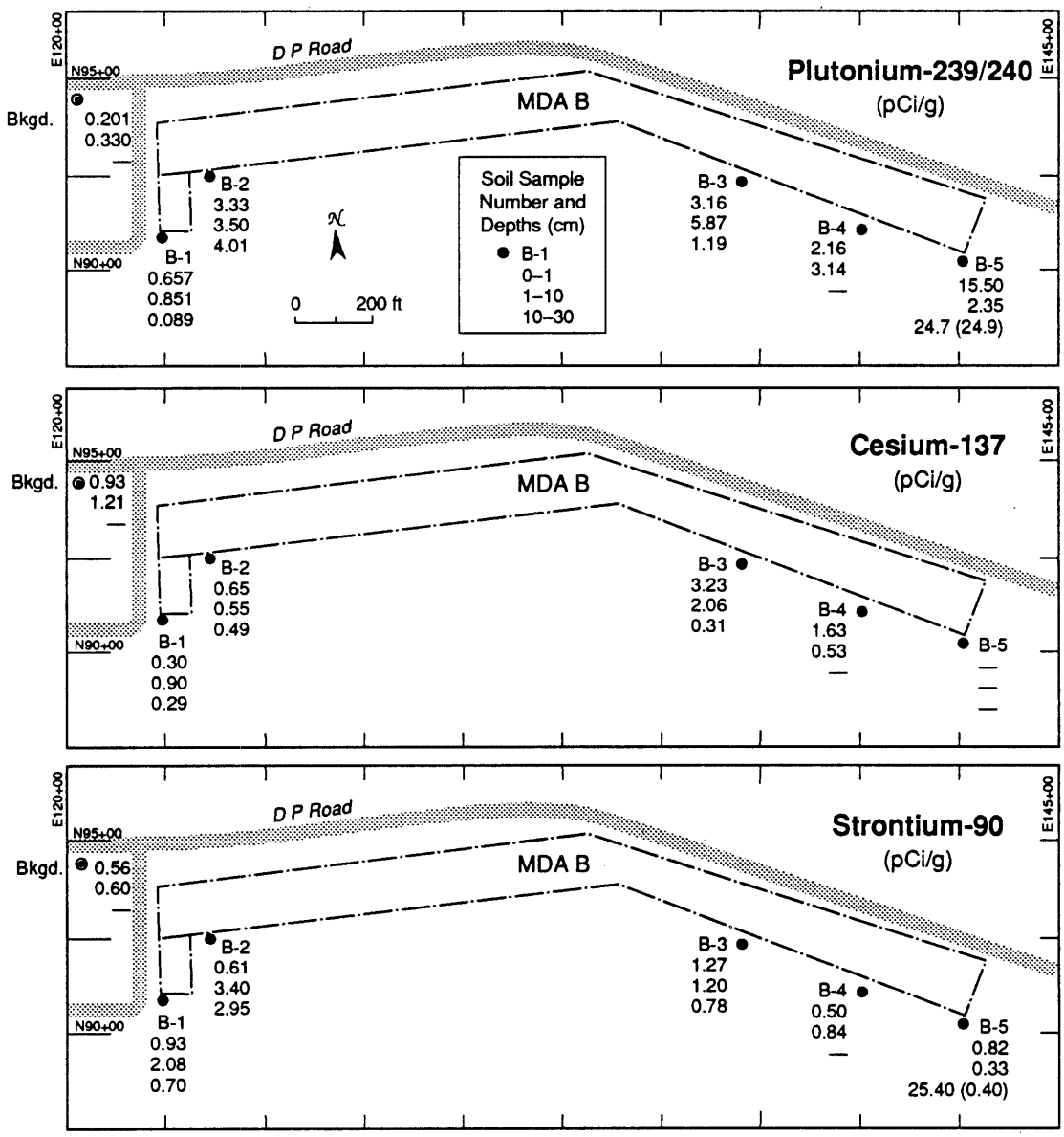


Fig. 16.2-6 Concentrations of plutonium-239/240, cesium-137, and strontium-90 in soils sampled in MDA B in 1979. (Background location not to scale)

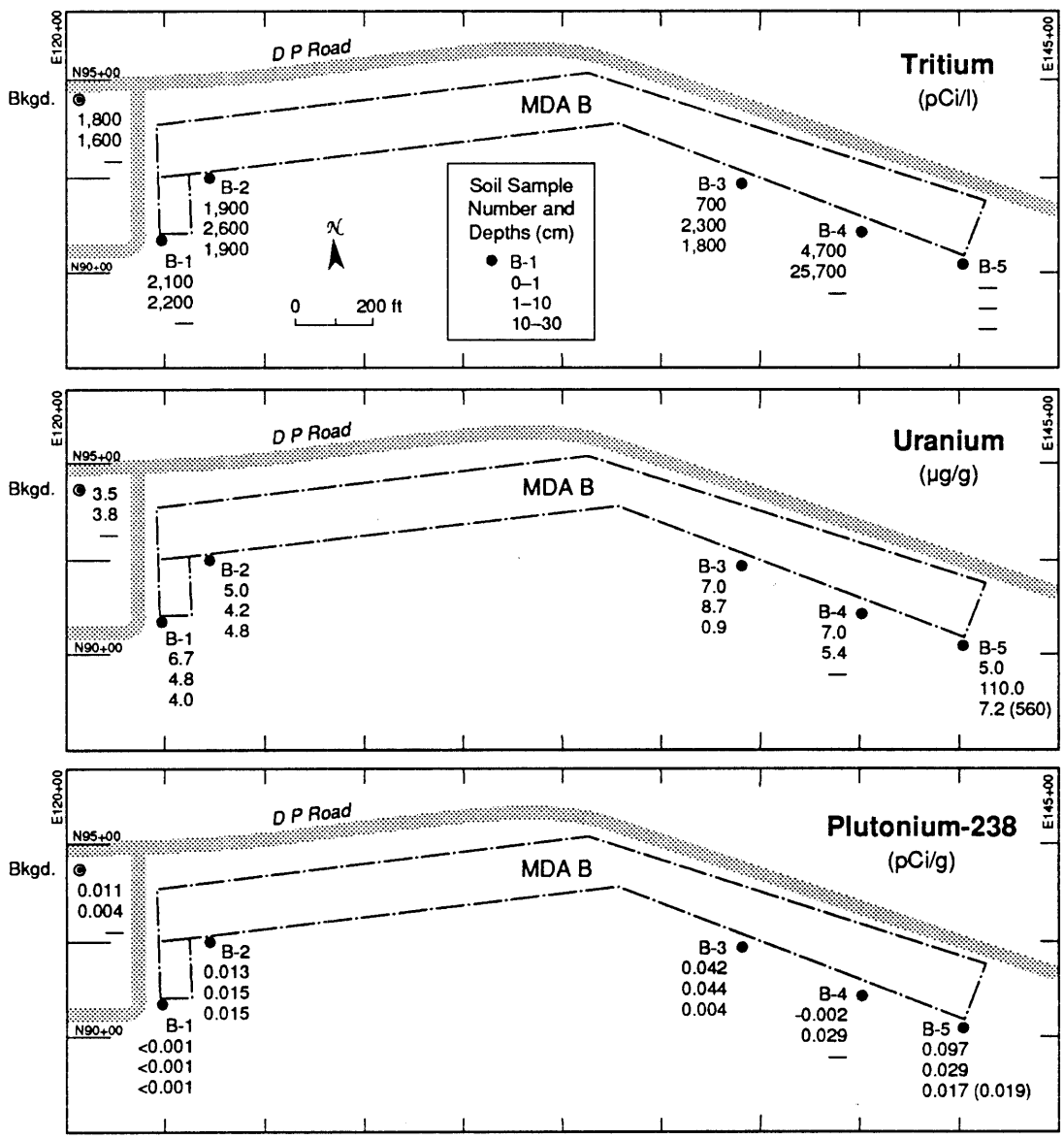


Fig. 16.2-7 Concentrations of tritium, uranium, and plutonium-238 in soils sampled in MDA B in 1979.

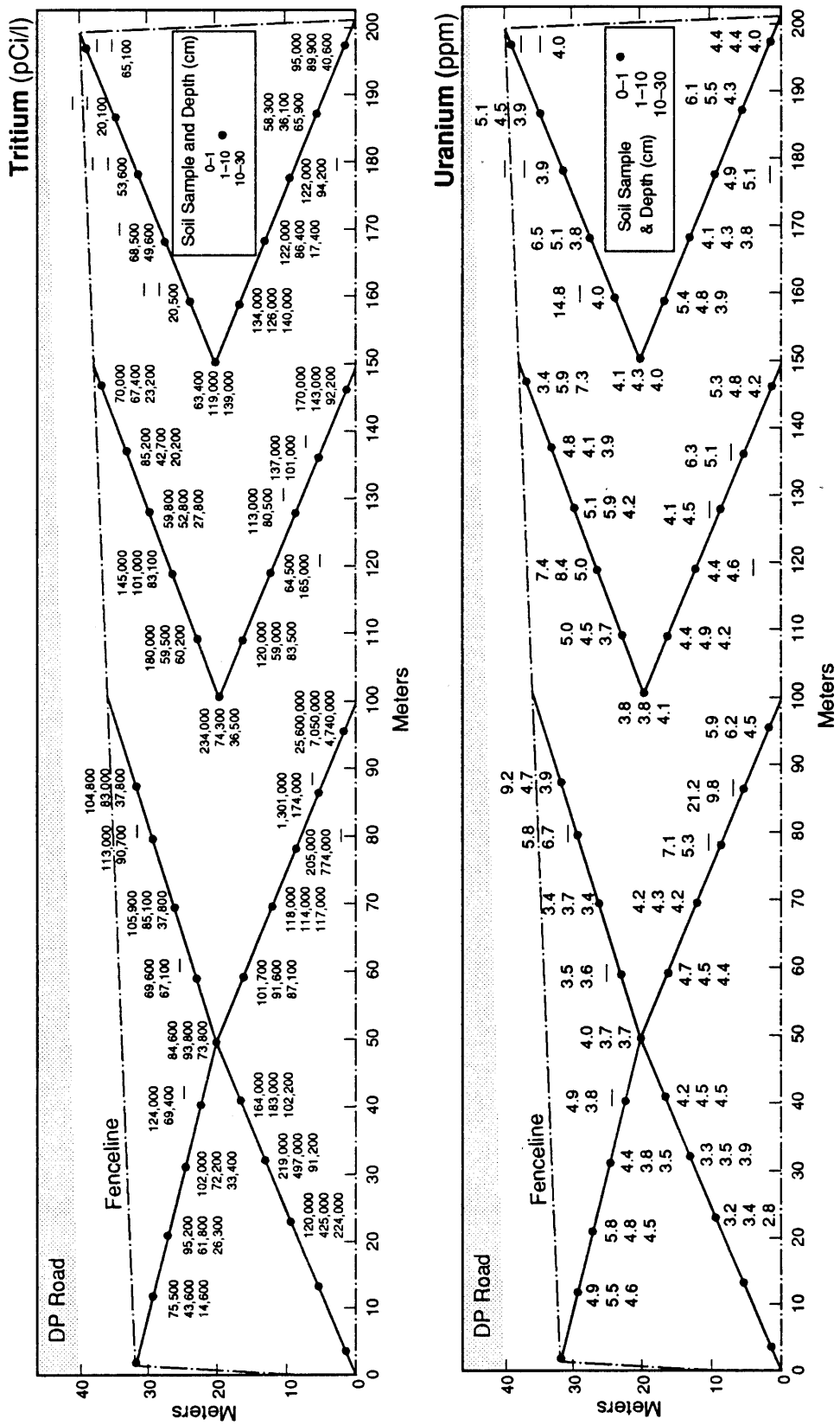


Fig. 16.2-8 Tritium and uranium concentrations in surface soils sampled in 1982 at MDA B before renovation.

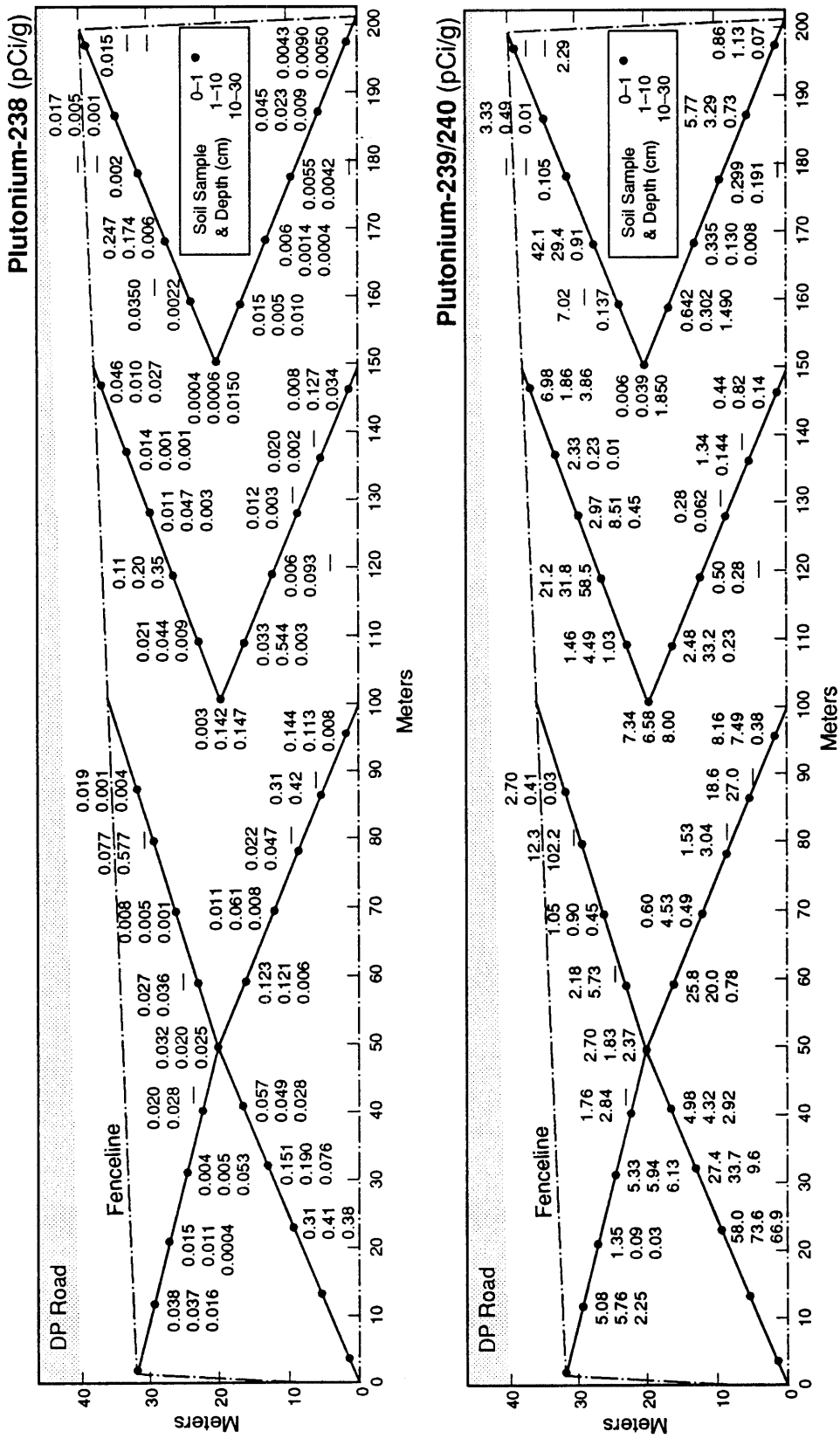


Fig. 16.2-9 Plutonium-238 and -239/240 concentrations in surface soils sampled in 1982 at MDA B before renovation.

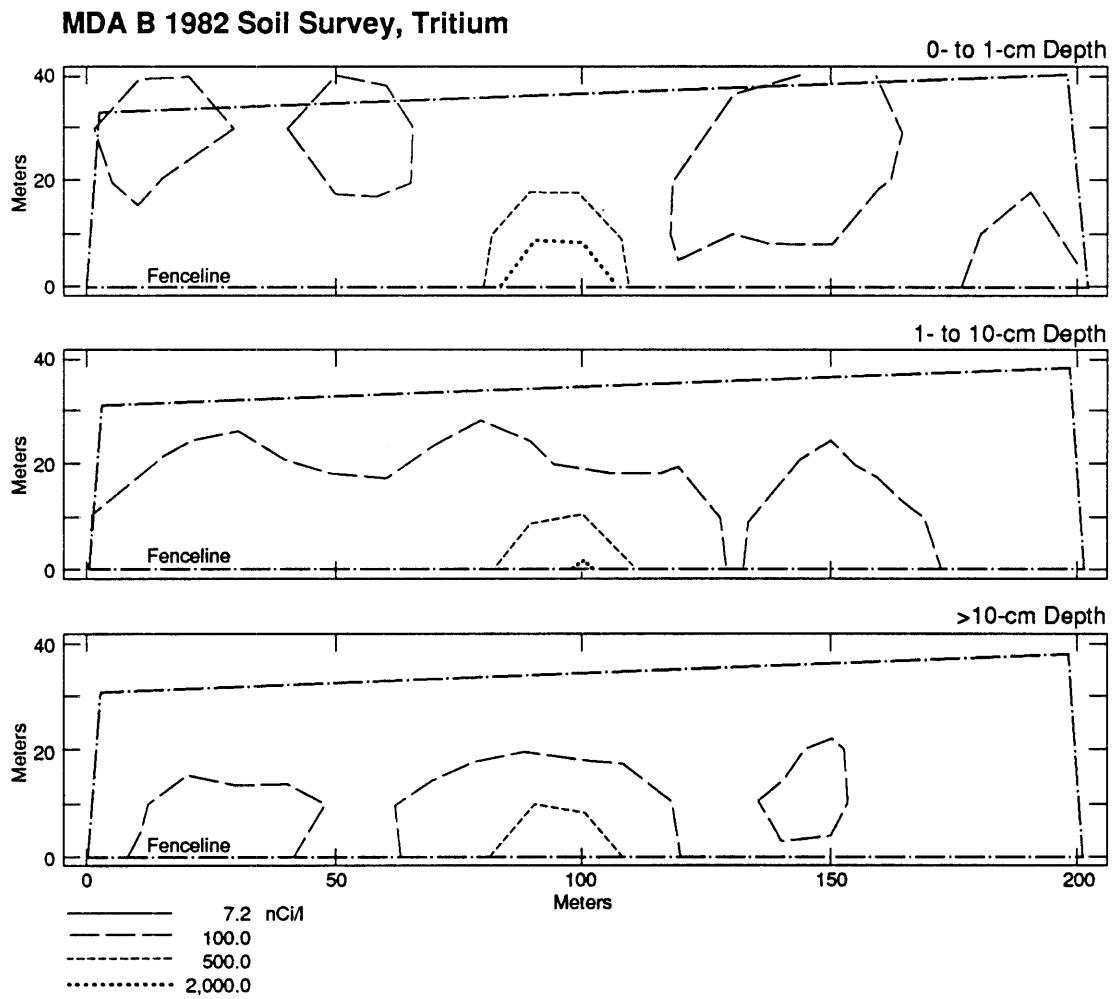


Fig. 16.2-10 Concentration contours for tritium from 1982 soil samples at MDA B.

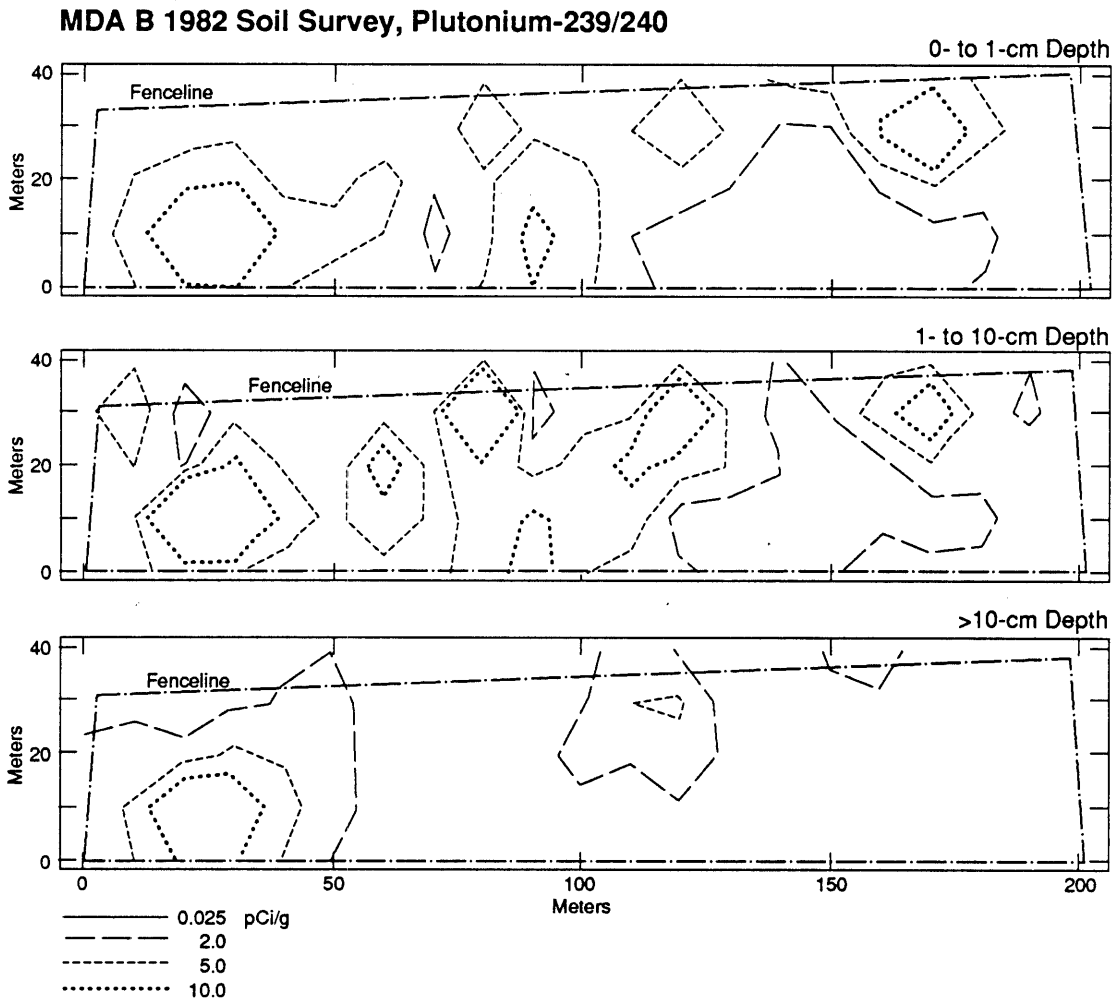


Fig. 16.2-11 Concentration contours for plutonium-239/240 from 1982 soil samples at MDA B.

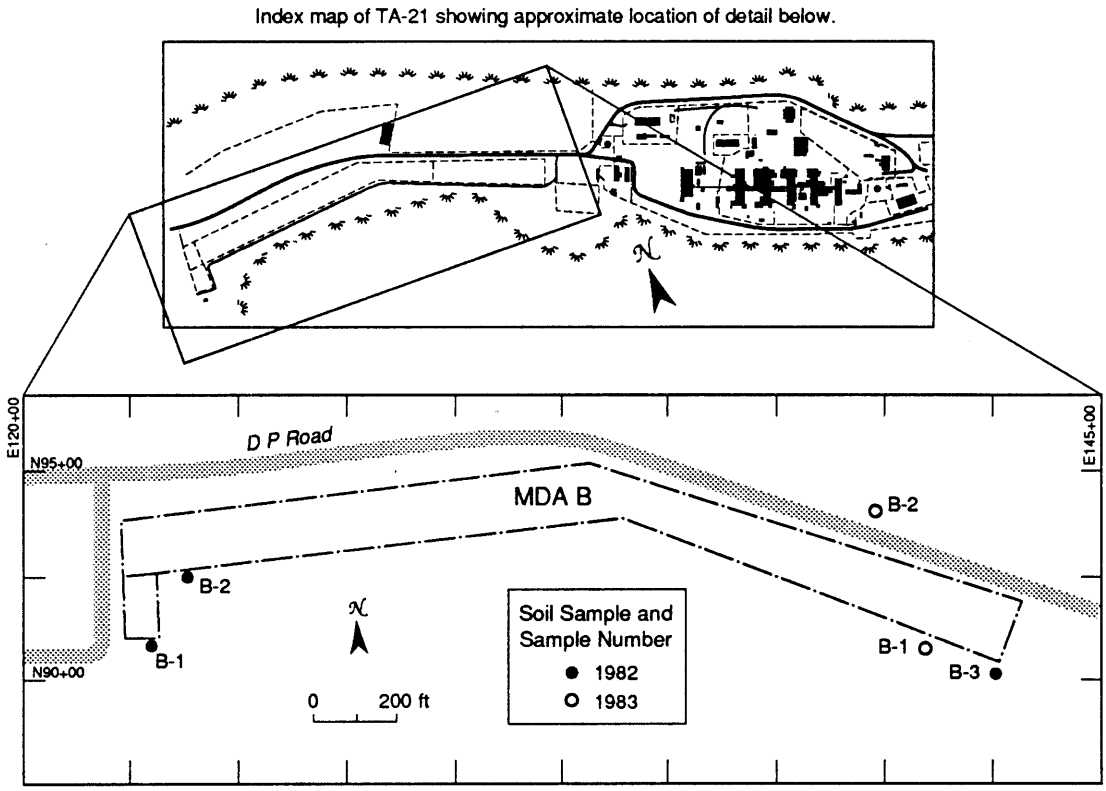


Fig. 16.2-12 Location of perimeter soil sampling in 1982 and 1983 at MDA B.

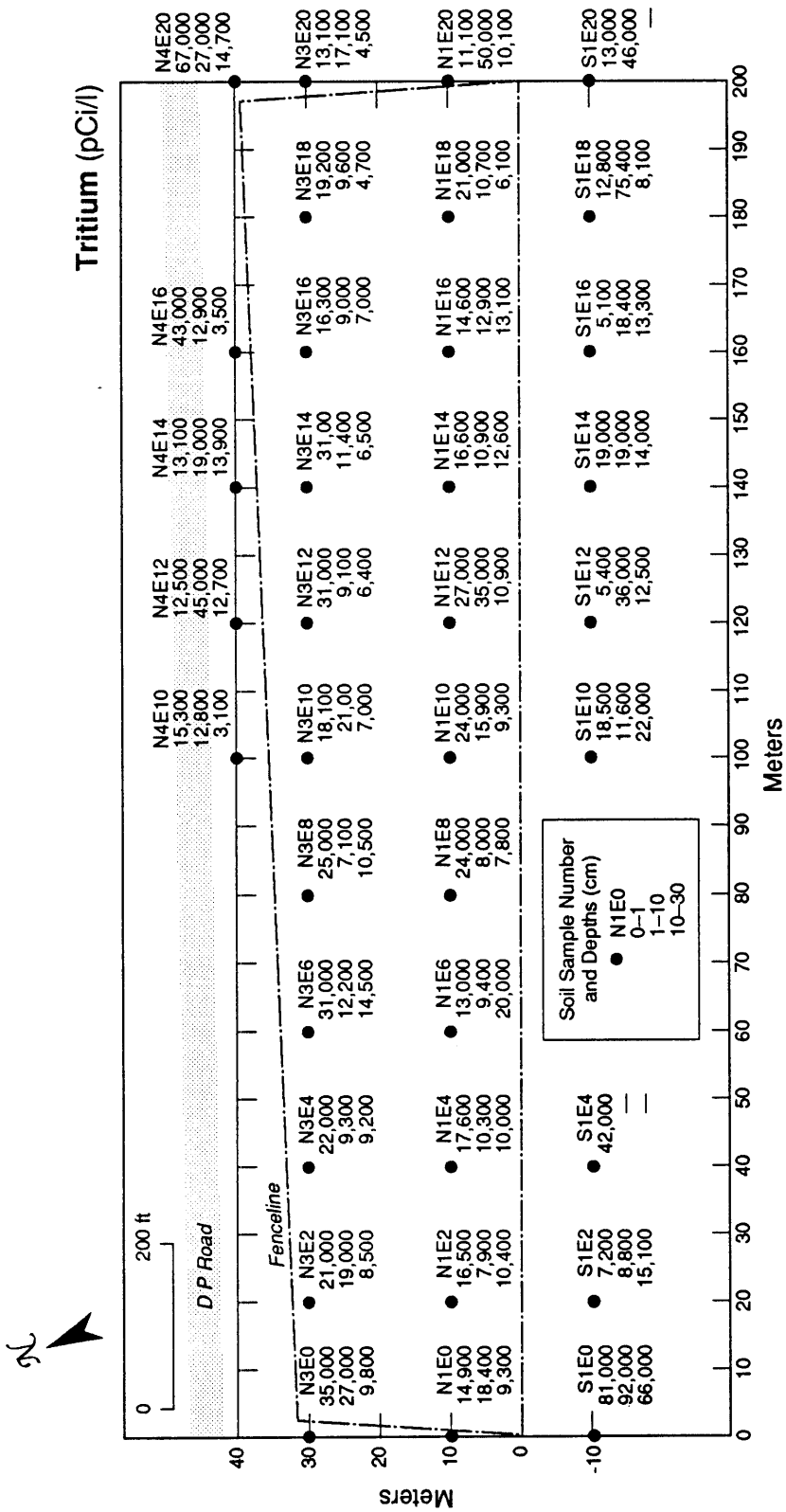


Fig. 16.2-13 Tritium concentrations for MDA B surface soil samples. (Mayfield 1985b)

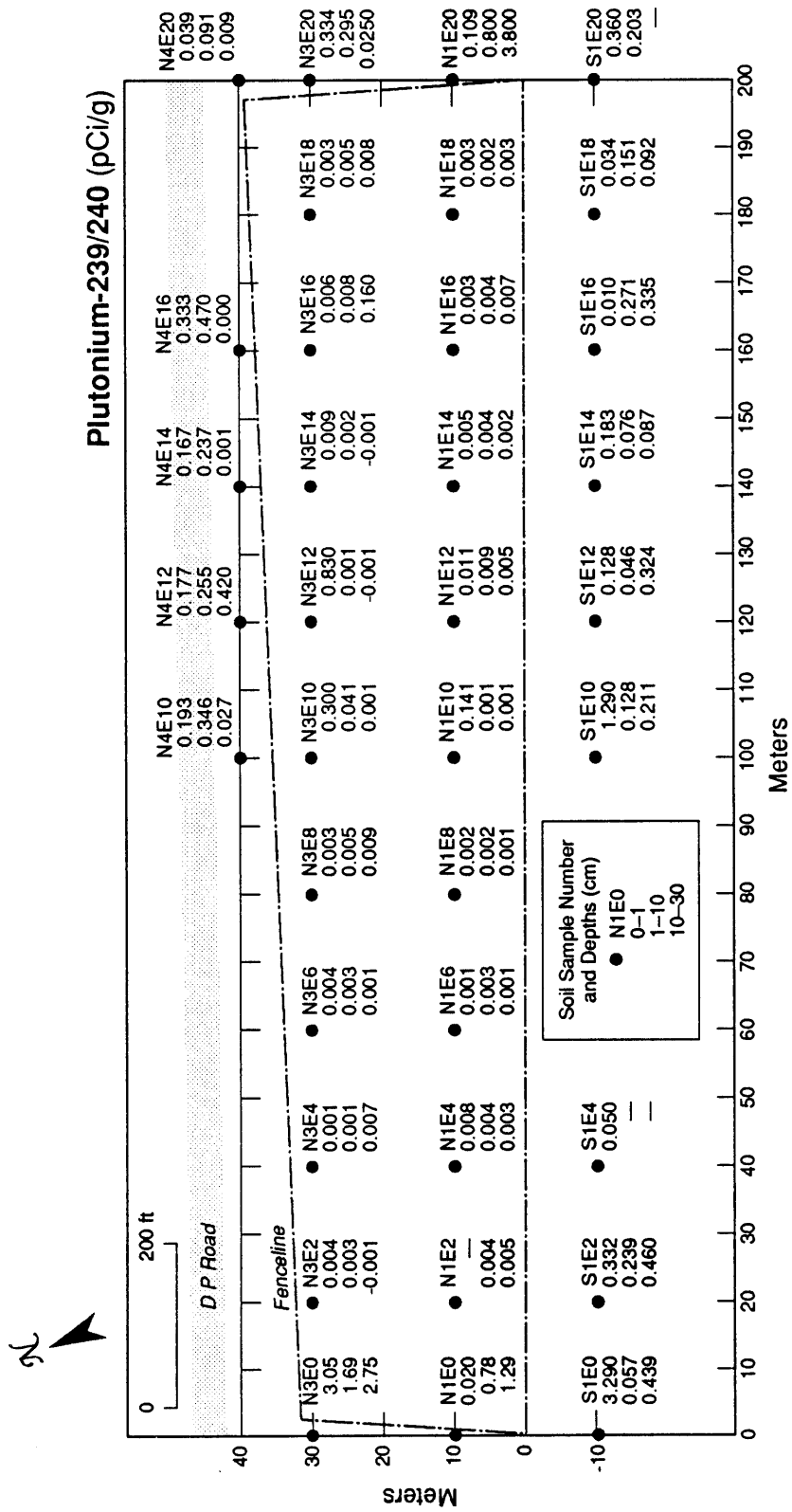


Fig. 16.2-14 Plutonium-239/240 concentrations for MDA B surface soil samples. (Mayfield 1985b)

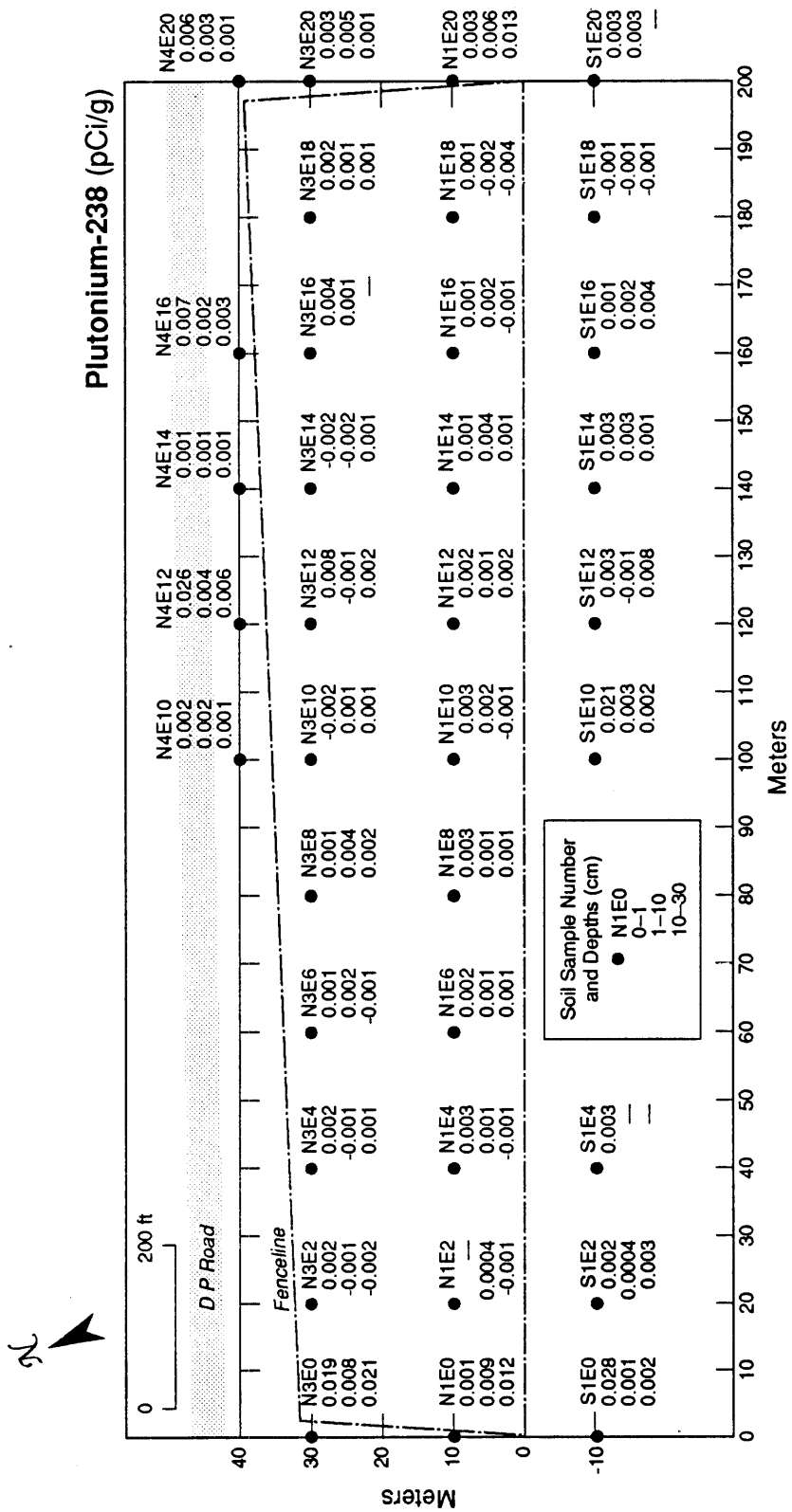


Fig. 16.2-15 Plutonium-238 concentrations for MDA B surface soil samples. (Mayfield 1985b)

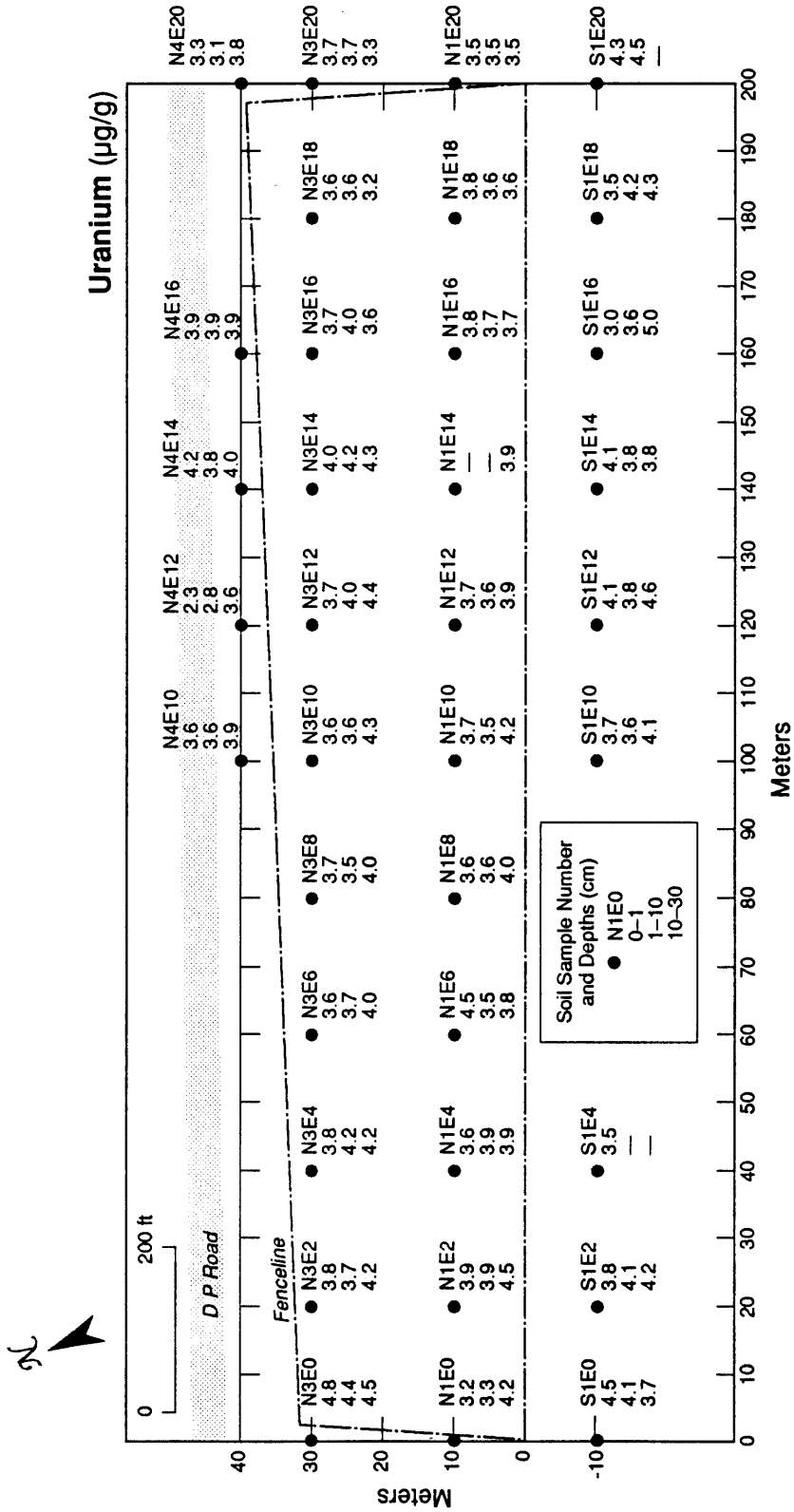


Fig. 16.2-16 Uranium concentrations for MDA B surface soil samples. (Mayfield 1985b)

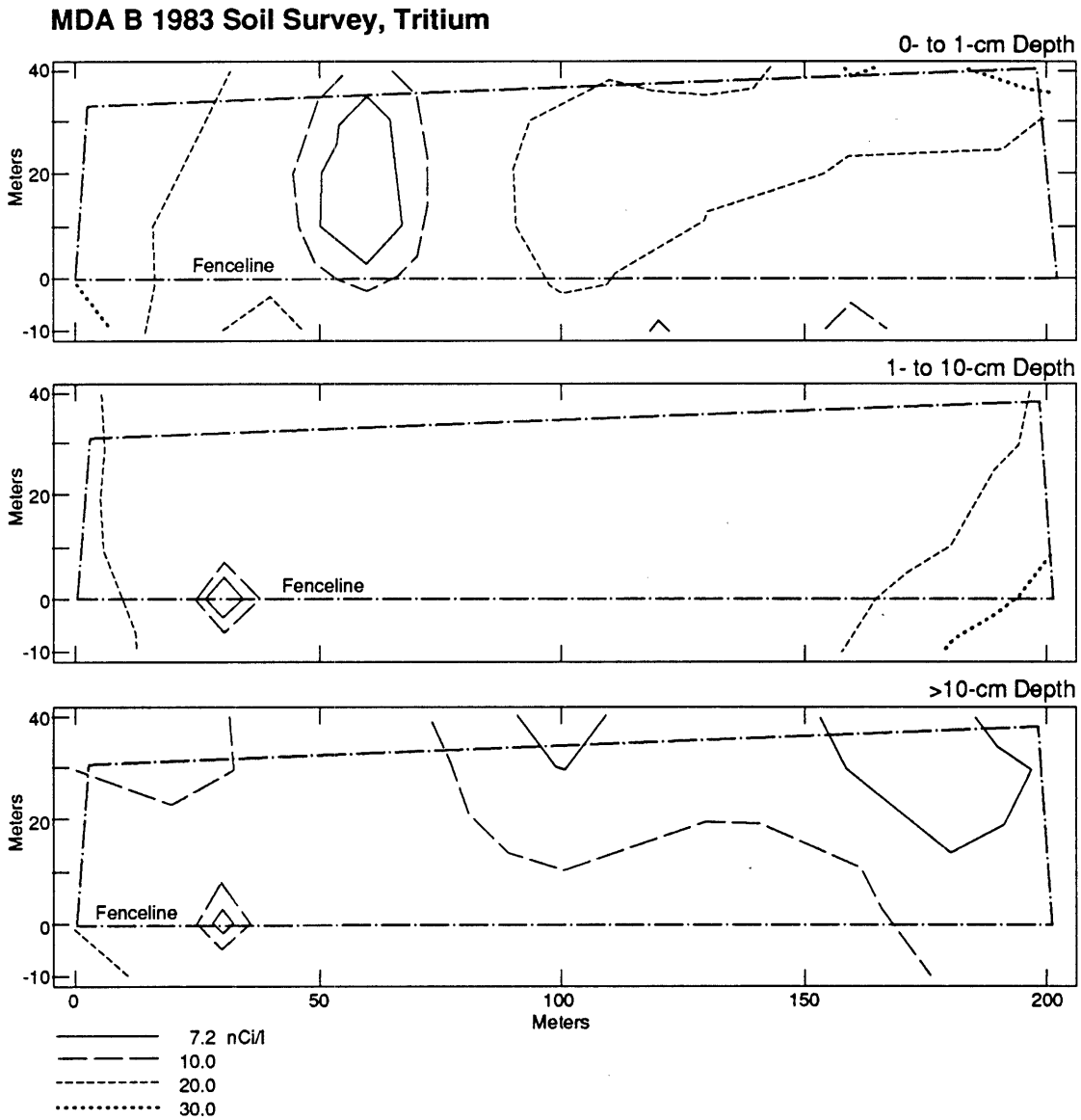


Fig. 16.2-17 Concentration contours for tritium from 1983 soil samples at MDA B. These samples were collected after the area was renovated.

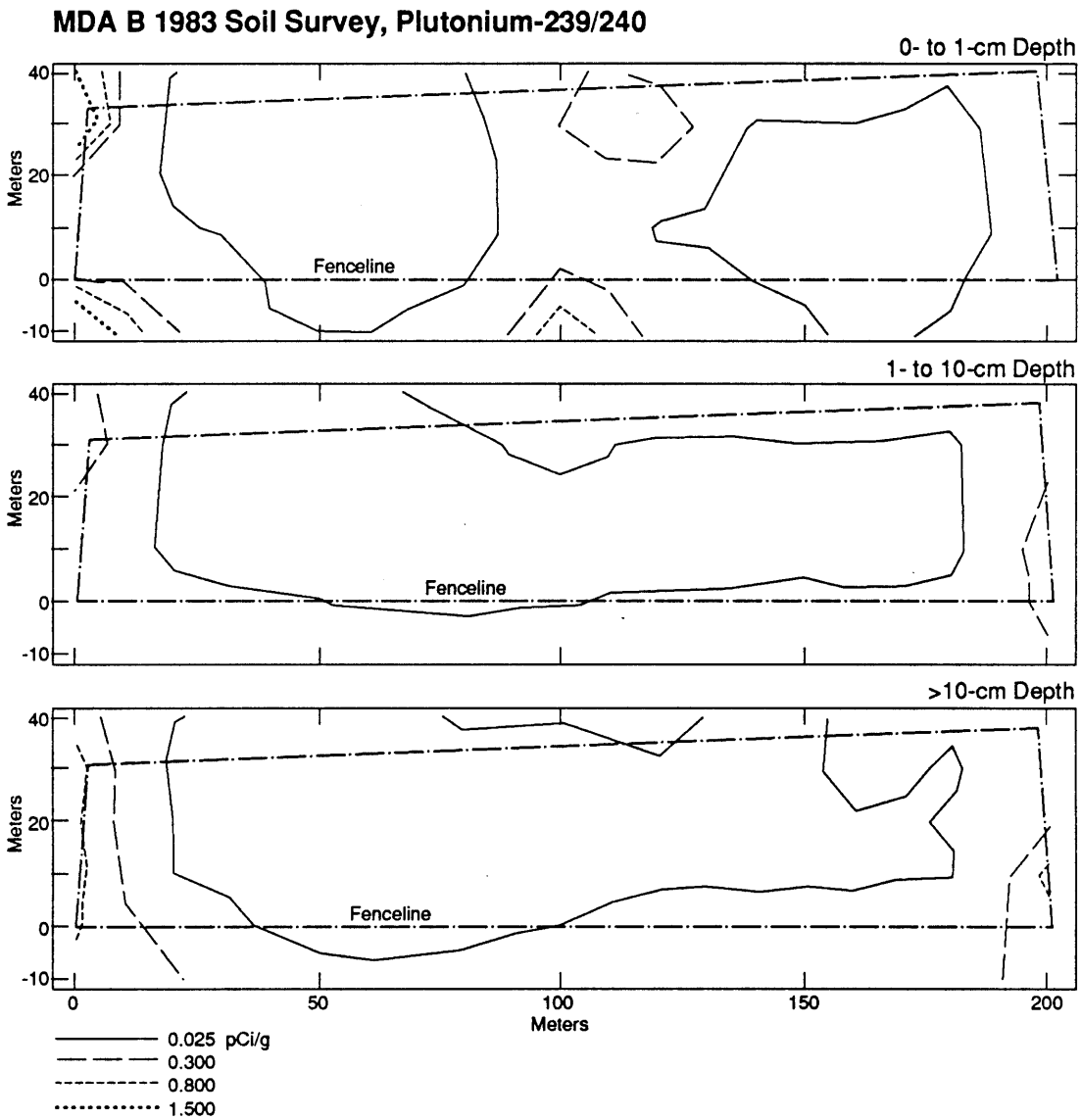


Fig. 16.2-18 Concentration contours for plutonium-239/240 from 1983 soil samples at MDA B. These samples were collected after the area was renovated.

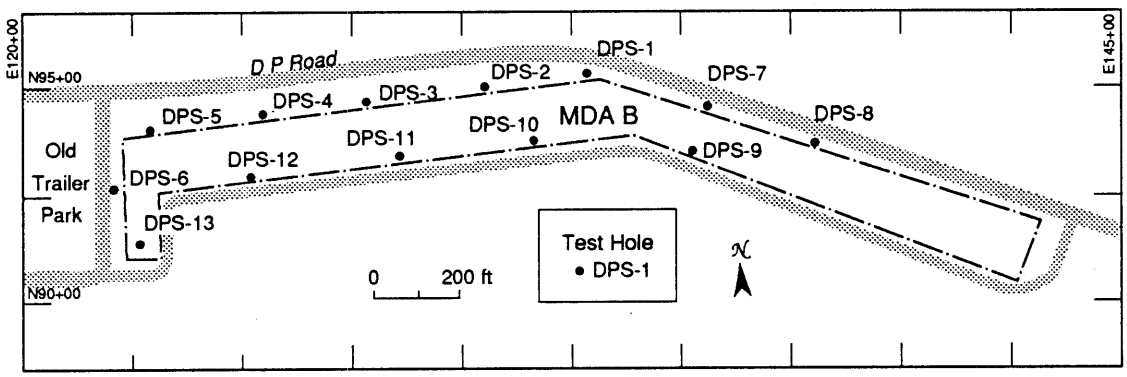


Fig. 16.2-19 Map of MDA B showing location of test holes drilled in 1966.

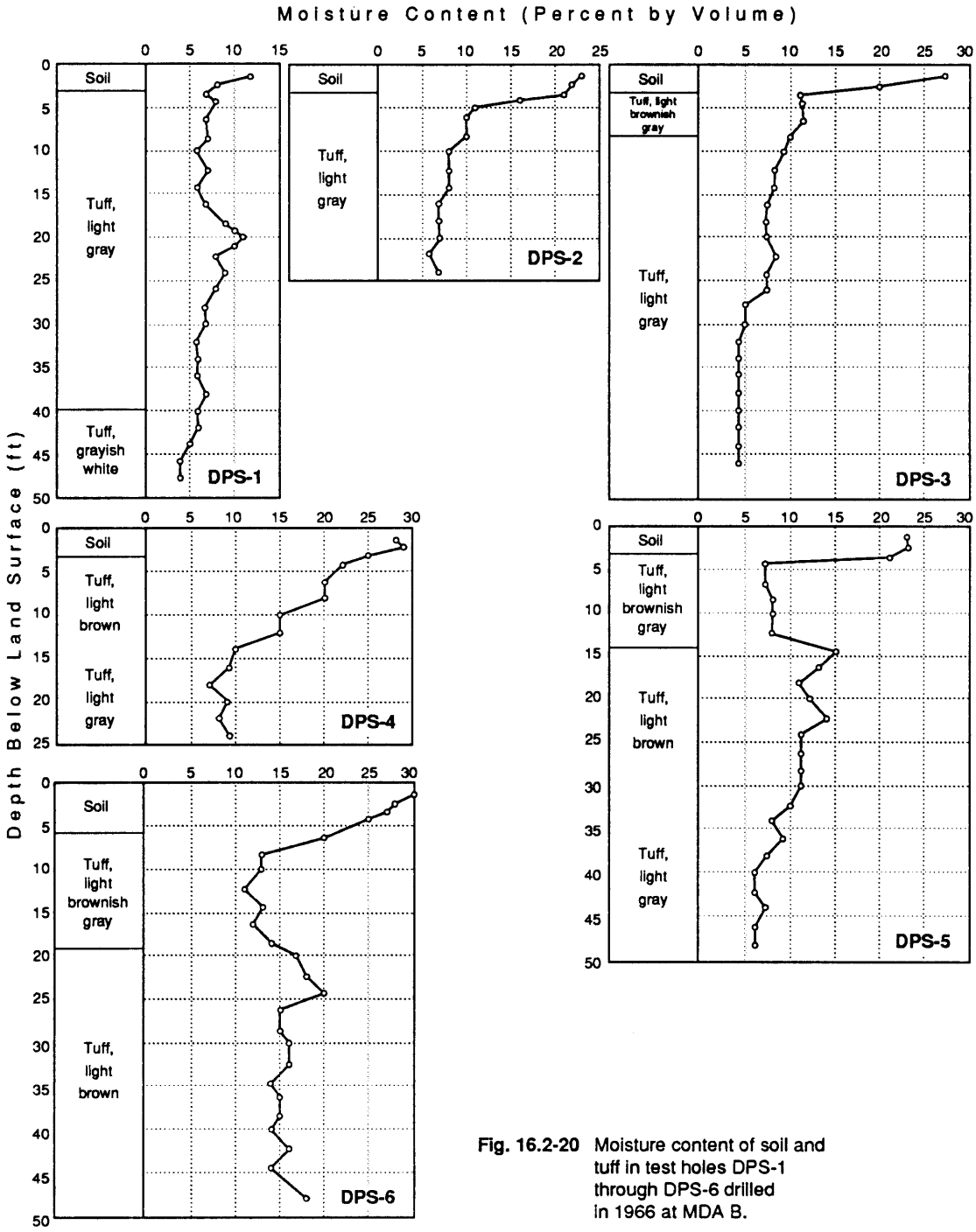


Fig. 16.2-20 Moisture content of soil and tuff in test holes DPS-1 through DPS-6 drilled in 1966 at MDA B.

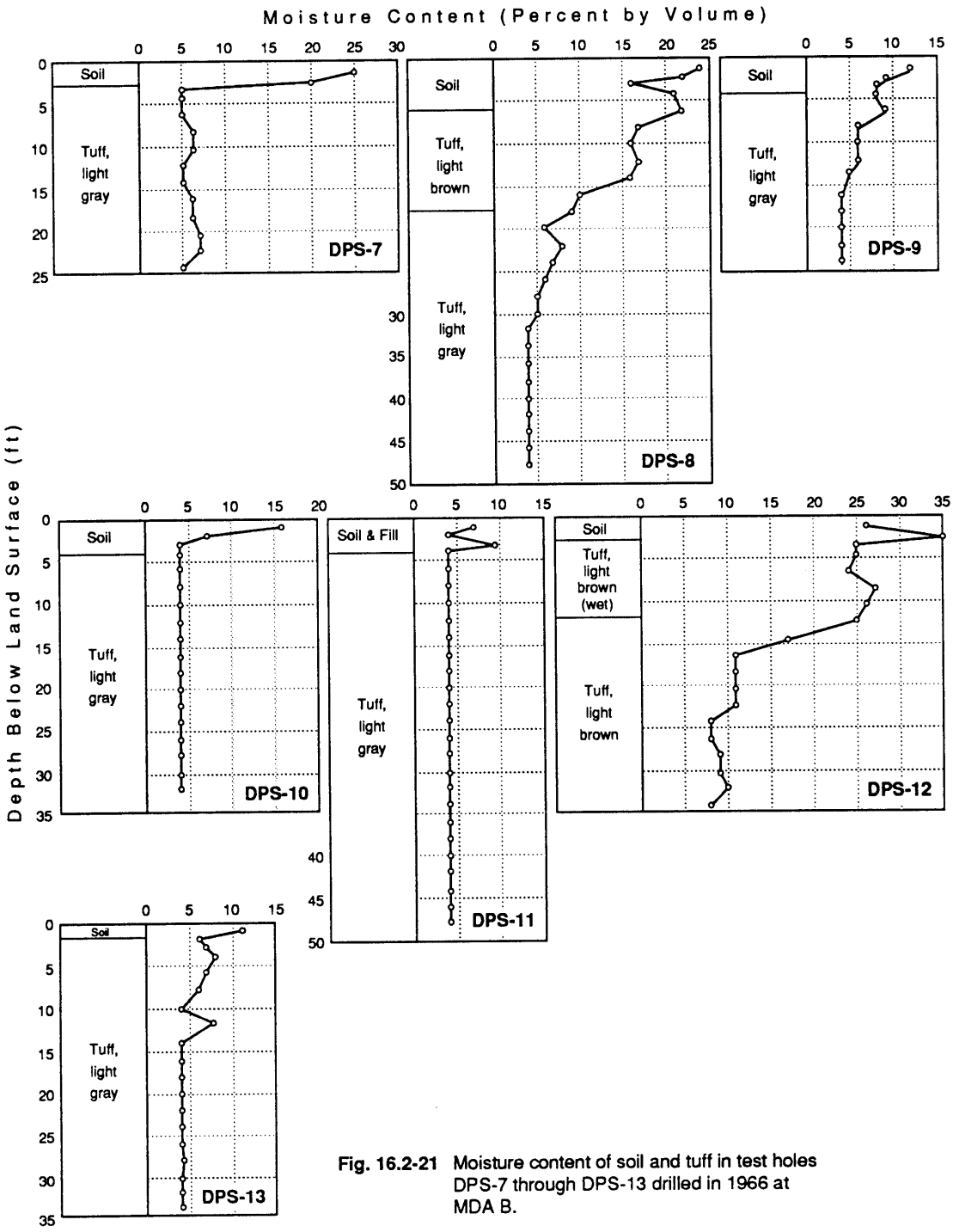


Fig. 16.2-21 Moisture content of soil and tuff in test holes DPS-7 through DPS-13 drilled in 1966 at MDA B.

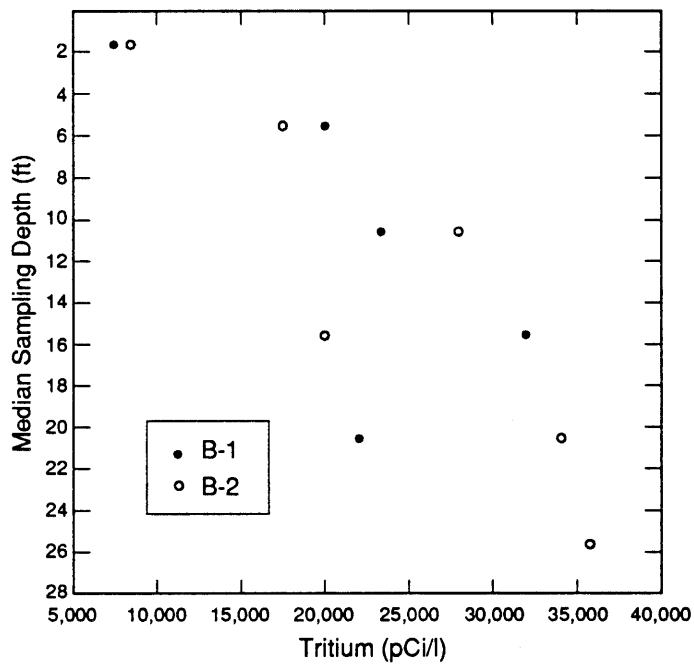


Fig. 16.2-22 Depth vs. tritium concentration in soils sampled at MDA B during 1983. Note that tritium concentrations increase with depth.

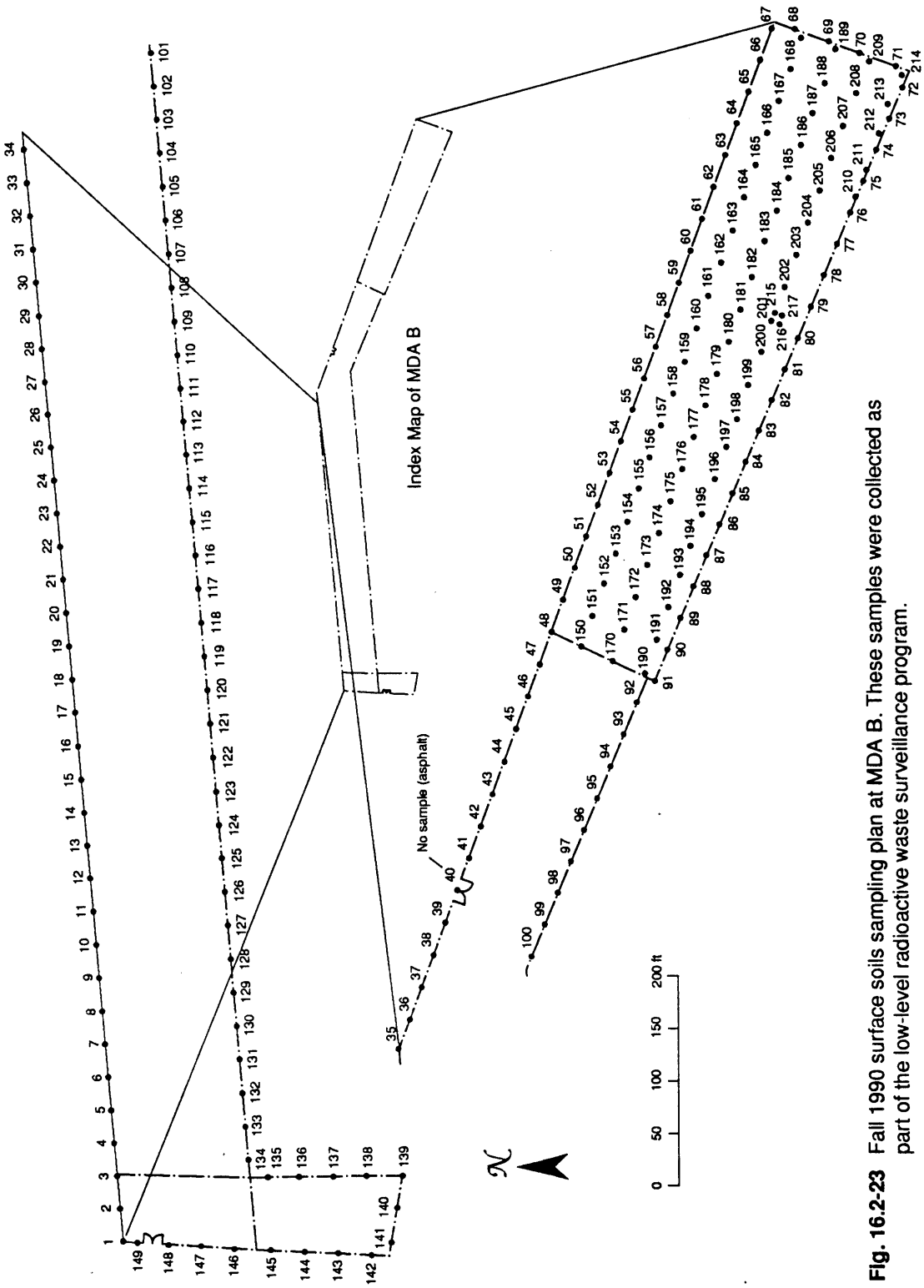


Fig. 16.2-23 Fall 1990 surface soils sampling plan at MDA B. These samples were collected as part of the low-level radioactive waste surveillance program.

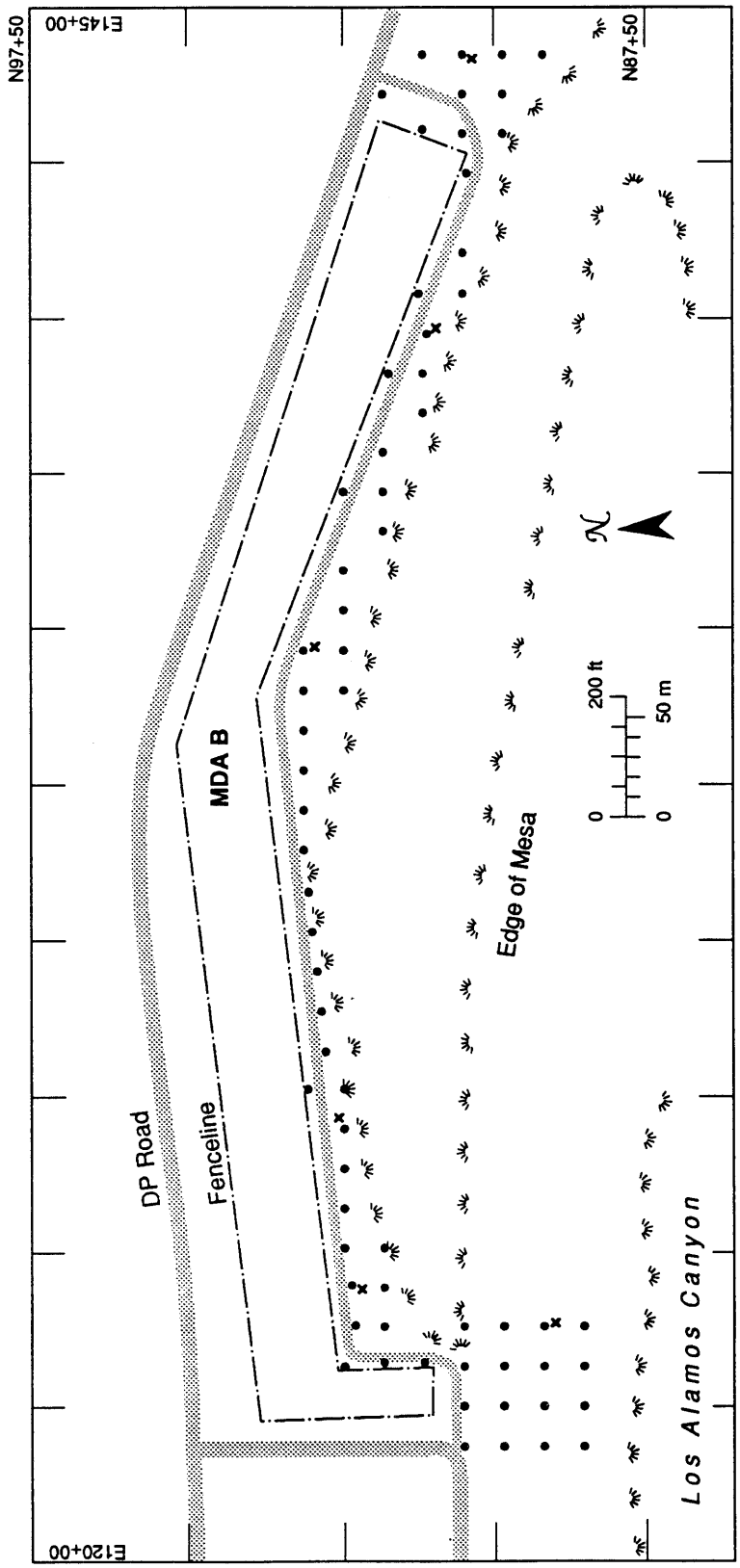


Fig. 16.2-24 Approximate 20-m by 20-m spacing of surface samples from fence to canyon rim for MDA B. The x's indicate possible replicate samples.

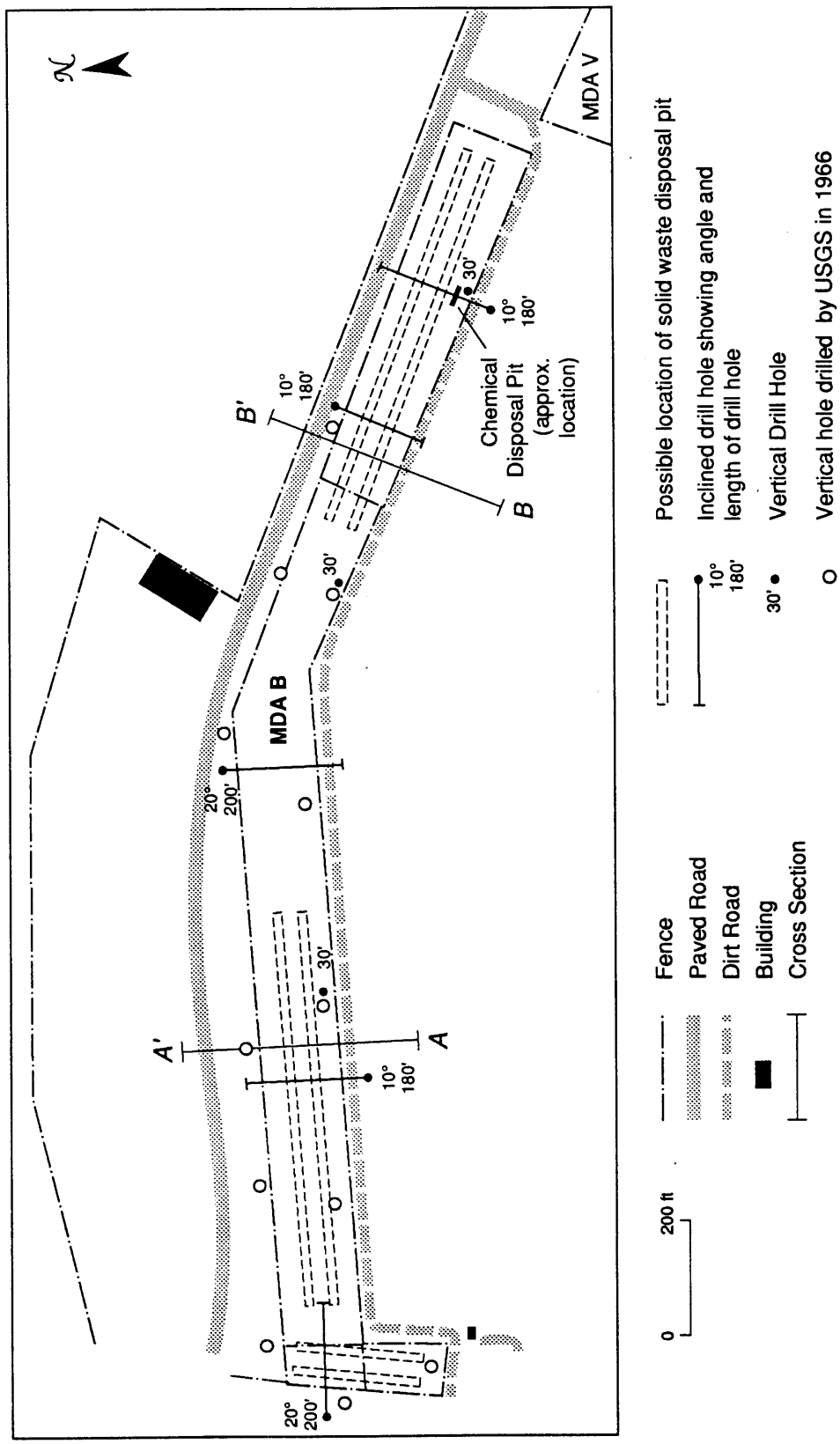


Fig. 16.2-25 Map of MDA B showing possible layout of disposal beds and locations of initial investigation drill holes.

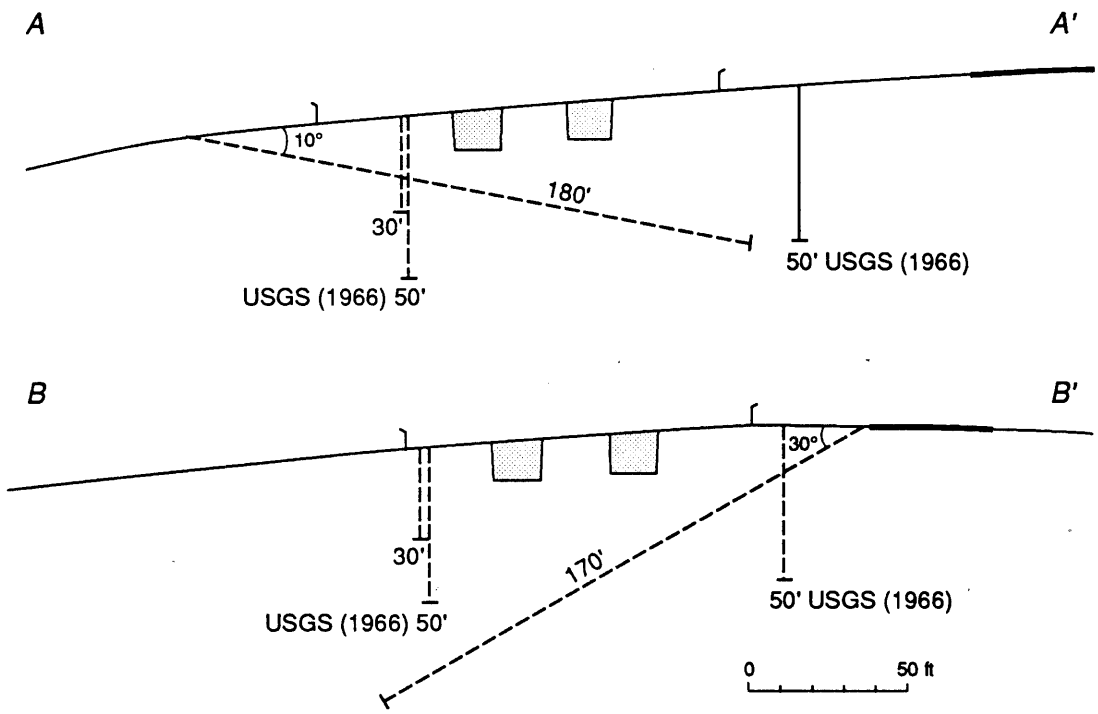


Fig. 16.2-26 Cross sections for MDA B showing schematic layout of the disposal beds and locations of initial characterization drill holes. Drill holes outside the plane of the section are dashed.

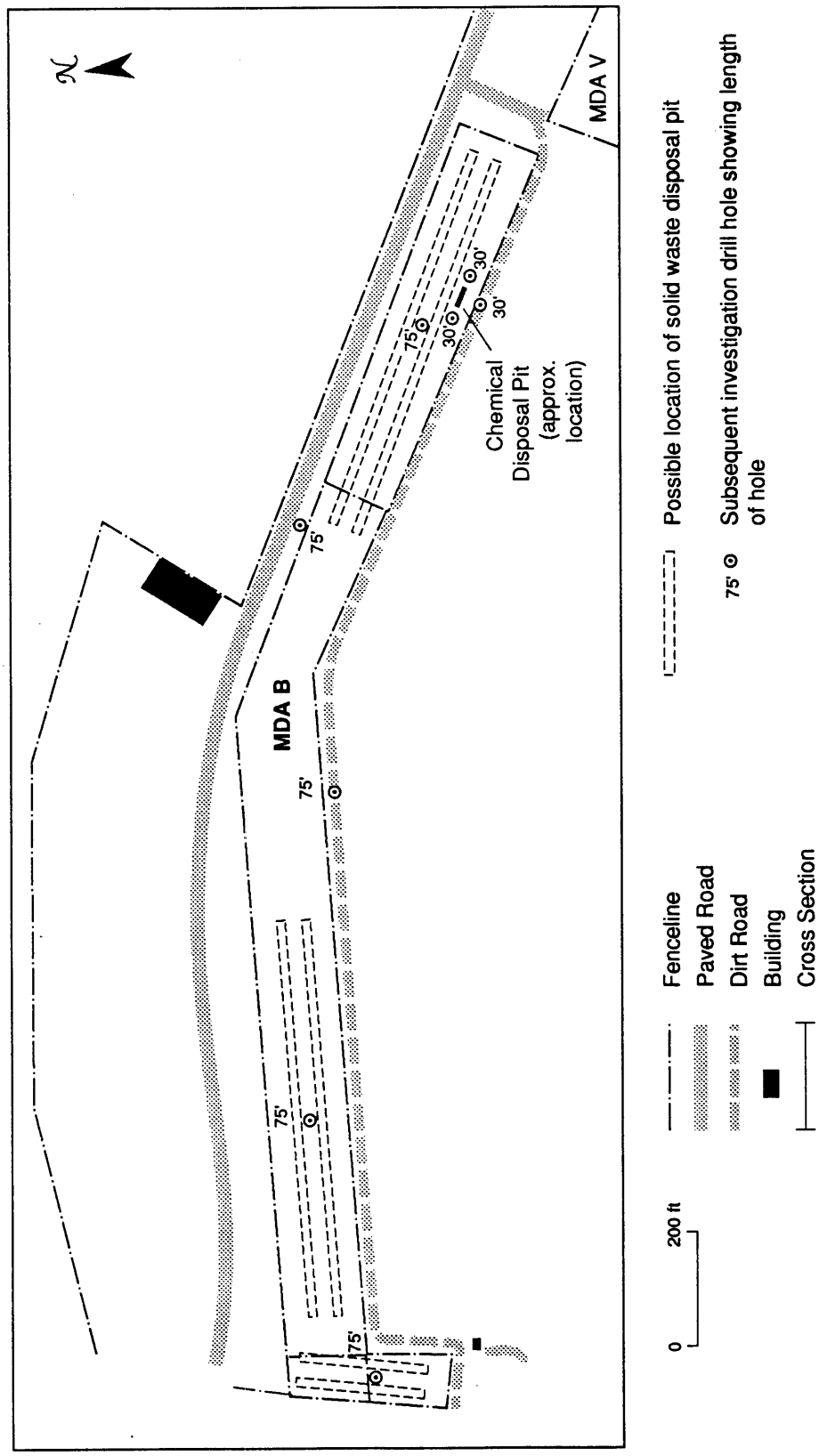


Fig. 16.2-27 Map of MDA B showing possible layout of disposal beds and locations of subsequent investigation drill holes.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1944-1952	MDA B	N/A	Construction of pit(s) and disposal of solid waste. Exact dimensions and number of pits not known.
1948	MDA B	N/A	On May 3, fire occurred in 60% of the open pit. Fire extinguished within two hours.
1948 (?) fence.	MDA B	N/A	Hog wire fence was replaced with chain link
1953 (June)	MDA B In caisson down-gradient of MDA B	LA-6848-MS Vol. I, 1963 USGS Administrative Release	Gross alpha in soil.
1966 asphalt	MDA B	N/A	Western two-thirds of the area paved with and then leased to the County of Los Alamos for the storage of RV-type vehicles.
1966 Alpha, (February)	MDA B	USGS Open File Report	Moisture content, Uranium, Plutonium, Gross
		LA-6848-MS Vol. I	Gross Alpha, Gross Beta-Gamma.
1966 September (?)	MDA B	LA-6848-MS Vol. I	Beta-Gamma Survey (Geiger counter).
1971 (November)	MDA B	LA-6848-MS Vol. I	Gross alpha (alpha counter) Gross beta-gamma (beta-gamma counter).
1976 (August)	MDA B (asphalt portion)	LA-6848-MS Vol. I	Visual observation for maintenance and repair measures.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1977	MDA B (unpaved portion)	Unpublished data (Discussed in report that is in preparation)	Surface Phoswich gamma survey surface soil samples (Uranium, Plutonium, Gross alpha, Gross beta, and tritium).
1979 ^{90}Sr,	MDA B.	Los Alamos Notebook	^{3}H, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{137}Cs, ^{226}Ac,
	5 sampling locations plus background Depth: 0-1, 1-10, and 10-30 cm	A411 Files	^{226}Ra, and total U in soils (surface).
1980	MDA B. 5 sampling locations	Los Alamos Notebook A411 Files	^{3}H, ^{235}U, $^{235}U/^{238}U$, ^{238}Pu, ^{239}Pu in plants.
1980	One location at MDA B Depth: 0-1, 1-10, and 10-30 cm	Los Alamos Notebook A411 Files	Gross gamma in soil.
1981 and	MDA B.	N/A	A decontamination crew removed some U-233
			Pu-239 contaminated soil to an active waste disposal site.
1981	MDA B. Peaches (1 location) location not identified	Los Alamos Notebook A411 Files	^{3}H, ^{238}Pu, ^{239}Pu, and ^{90}Sr in peels, pulp, and pits of peaches.
1981	MDA B, exact location not identified (excavation samples) new sewer ditch Depth: 110-120; 100-130; 90-113 etc.	Los Alamos Notebook A411 Files	Moisture content, U, and ^{239}Pu, in soil from new sewer ditch.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1981	MDA B, 12 locations. Depths not identified nor location identified		^{3}H, ^{238}Pu, ^{239}Pu and Gross gamma in soil.
1982-1987 evaluate	MDA B	N/A	A series of experiments was initiated and implemented on the unpaved portion to trench cap design on moisture and vegetative penetration into buried waste.
1982	MDA B	N/A	The surface of the unpaved eastern area was renovated because of the presence of exposed waste and of surface contamination. The fence was moved outward ten feet. All vegetation was removed, a soil cover added, compacted and reseeded.
1982	MDA B. 4 locations for soil Depths: 0-1, 1-10, 10-30 cm	Los Alamos Notebook A411 Files	^{3}H, U, ^{238}Pu, ^{239}Pu in soil (surface).
1982	MDA B, location not identified	Los Alamos Notebook	Gamma spectrum analysis in peels, pulp, and pits of peaches.
1982	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1982	MDA B, research plots	LA-10573-MS	Soil Moisture.
1983	MDA B. Sampling depths: 0-1, 1-10, and 10-30cm; Sampling location: special grid	Los Alamos Notebook A411 Files	Soil, Special grid, ^{3}H, U, ^{238}Pu, ^{239}Pu and Sc.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1983	MDA B. Locations: B2 and B2 subsurface, Depths: 0-3, 3-8, 8-13, 13-18, etc. ft)	Los Alamos Notebook	Soil (B1 and B2) ^{3}H, total U, $^{235}U/^{238}U$, ^{238}Pu, ^{239}Pu, ^{137}Cs.
1983	MDA B. Location: Baseline Depths: 0-1, 1-10, 10-30 cm	Los Alamos Notebook A411 Files	Soil ^{3}H, U, ^{238}Pu, ^{239}Pu, ^{137}Cs.
1983	MDA B	N/A	Animal pelt and shelter ^{238}Pu, ^{239}Pu.
1983	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1983	MDA B, research plots	LA-10573-MS	Soil moisture.
1984	MDA B, 3 locations B1, B2, B3, soil depths 01-, 1-10, 10-14, 10-18, 10-25 cm	Los Alamos Notebook A411 Files	Vegetation ^{3}H, U, ^{238}Pu, gamma spectrum. Soil (surface) ^{3}H, ^{238}Pu, ^{239}Pu gamma spectrum. Field survey: Gamma uR-meter, Phoswich.
1984	MDA B, research plots	LA-10573-MS	Soil moisture.
1984	MDA B, 21 locations, soil subsurface	Los Alamos Notebook A4ll Files	Soil (subsurface) (Bl and B2), ^{238}Pu, ^{239}Pu.
1984	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1985	MDA B.	Los Alamos Notebook A411 Files	Annual site inspection: breach of confinement, condition of cap, intrusion, other.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1985	MDA B, research plots	LA-10573-MS	Soil moisture.
1985	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1986	MDA B	Los Alamos Notebook	Surface Reconnaissance.
1986	MDA B, 23 Locations	Los Alamos Report LA-10992-ENV	TLD data.

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	^{241}Am pCi/g	^{238}Pu pCi/g	$^{239/240}Pu$ pCi/g	^{137}Cs pCi/g
	BKGD.[a,b]			7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06540	BS-1	4.40	3.70	11.80[c]					
77.06541	BS-2	4.30	4.30	13.80[c]					
77.06542	BS-3	16.00[c]	5.70	12.20[c]					7.65[c]
77.06543	BS-4	8.60	8.60c	18.00[c]					
77.06544	BS-5	5.10	3.20	16.40[c]					
77.06545	BS-6	8.80	6.40	14.10[c]					
77.06546	BS-7	9.10	5.40	16.90[c]					
77.06547	BS-8	7.30	7.30	37.10[c]					
77.06548	BS-9	11.00[c]	6.50	26.70[c]					
77.06549	BS-10	6.20	4.30	12.50[c]					
77.06550	BS-11	46.00[c]	5.40	513.00[c]			1.40[c]	0.01	10.10[c]
77.06551	BS-12	4.40	5.10	14.50[c]					
77.06552	BS-13	11.00[c]	4.30	11.80[c]					
77.06553	BS-14	5.80	7.00	4.60					
77.06554	BS-15	5.30	4.50	10.00[c]					
77.06555	BS-16	5.10	4.60	17.20[c]					
77.06556	BS-17	6.40	6.60	9.40[c]					
77.06557	BS-18	3.00	4.10	17.10[c]					
77.06558	BS-19	5.80	6.10	15.20[c]					
77.06559	BS-20	6.10	5.70	17.40[c]					
77.06560	BS-21	5.70	6.50	22.10[c]					
77.06561	BS-22	27.00c	6.50	51.40[c]	7.70c		0.63c	47.60[c]	0.07
77.06562	BS-23	6.20	3.80	23.20[c]					
77.06563	BS-24	3.80	3.80	17.50[c]					
77.06564	BS-25	4.50	5.40	18.60[c]					
77.06565	BS-26	6.20	4.20	19.70[c]					

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	^{241}Am pCi/g	^{238}Pu pCi/g	$^{239/240}Pu$ pCi/g	^{137}Cs pCi/g
	BKGD.[a,b]			7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06566	BS-27	15.00c	2.70	18.00[c]	2.70	1.12[c]			0.11
77.06567	BS-28	30.00c	3.90	22.70[c]	2.70	0.90[c]	0.06c	25.70[c]	0.53
77.06568	BS-29	3.90	4.40	15.40[c]	5.00[c]				0.87
77.06569	BS-30	8.40	31.00[c]	12.50[c]	5.70[c]	0.45[c]			1.31[c]
77.06570	BS-31	3.80	3.40	11.40[c]					
77.06571	BS-32	1.30	2.80	15.90[c]					
77.06572	BS-33	8.50	9.00[c]	11.90[c]	0.01				2.04[c]
77.06573	BS-34	5.90	5.50	12.30[c]					
77.06574	BS-35	13.00c	8.60[c]	22.10[c]	14.00c	2.10[c]			1.45[c]
77.06575	BS-36	26.00c	7.70	3420.00[c]	0.00	1.76c	0.14c	16.80[c]	1.11[c]
77.06576	BS-37	15.00c	7.40	152.00[c]	4.60[c]	3.70[c]		5.80[c]	1.60[c]
77.06577	BS-38	9.20	7.00	26.20[c]					
77.06578	BS-39	4.00	4.50	14.60[c]					
77.06579	BS-40	2.90	4.30	11.60[c]					
77.06580	BS-41	12.00c	3.30	2.89	3.40	1.40[c]	0.00	9.20[c]	0.42
77.06581	BS-42	3.30	4.60	12.00[c]					
77.08455	BS-43			12.10[c]	5.10[c]				0.60
77.08456	BS-44			13.80[c]	4.30[c]				0.89
77.08457	BS-45			13.40[c]	8.80[c]				1.59[c]
77.08458	BS-46			11.20[c]	7.40[c]				2.50[c]
77.08459	BS-47			.780	4.00[c]				0.56
77.08460	BS-48			.880	5.10[c]				1.65[c]
77.08461	BS-49			18.60[c]	7.90[c]				1.38[c]
77.08462	BS-50			14.50[c]	8.30[c]				0.37
77.08463	BS-51			8.50	6.60[c]				1.49[c]
77.06582	BPS-1A	6.30	4.30	10.70					
77.06583	BPS-1B	240.00[c]	350.00[c]	9.50				-0.04	2.50[c]
77.07684	BPS-2	1600.00[c]	137.00[c]	11.30[c]	79.00[c]		0.02[c]	7.61[c]	0.80

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	^{241}Am pCi/g	^{238}Pu pCi/g	$^{239/240}Pu$ pCi/g	^{137}Cs pCi/g
	BKGD.[a,b]			7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06585	BPS-3	370.00[c]	560.00[c]	7.7	835.00[c]		0.03[c]	22.10[c]	0.89
77.06586	BPS-4	7.10	6.40	983.00[c]					
77.06587	BPS-5	10.00[c]	152.00[c]	21.30[c]	13.00[c]		-0.03	27.80[c]	127.00[c]
77.06588	BPS-6	3.10	99.00[c]	.345			0.79[c]		
77.06589	BPS-7	200.00[c]	5.60	24.80[c]	5.40[c]	71.00[c]	5.00[c]	257.00[c]	0.48
77.06590	BPS-8	6200.00[c]	-15.00	7.30	9.70[c]	233.00[c]		130.00[c]	1.03
77.06591	BPS-9	17.00[c]	8.50[c]	24.80[c]	6.30[c]	52.20[c]	0.78[c]	51.90[c]	0.92
77.06592	BPS-11	2000.00[c]	18.00[c]	31.70[c]	8.10[c]		27.10[c]	1370.00[c]	0.71
	BPS-12A			43.60[c]			20.00[c]	0.00	0.00
	BPS-12B			11.62[c]	100.00[c]	0.00	0.00	0.00	6.00[c]
	BPS-12C			11.20[c]			0.00	0.00	0.00
	BPS-12D			175.00[c]	1.90		0.00	0.00	0.43
	BPS-12E			24.30[c]				0.00	0.00
	BPS-13			58.20[c]					

[a]Upper limit background levels from Purtymun (1987).
[b]Upper limit background levels from The Environmental & Surveillance Group (1980).
[c]Above background activity.

TABLE 16.2-III
MDA B SOIL SURVEY SAMPLES (1978)

Loc.	$^{239,240}Pu$ pCi/g	^{90}Sr pCi/g	^{226}Ra pCi/g	Th mg/g	Other
BKGD.[a]	.025[a]	.88[a]	.005[b]		
BS-1	8.37±0.03	0.72±0.08	1.2±0.3	10.8±.6	0.53±0.07 ^{137}Cs -0.3±0.4 ^{227}Ac
BS-2	0.975±0.017		0.9±0.5	10.8±6	0.71±0.10 ^{137}Cs -0.9±0.4 ^{227}Ac
BS-3	6.92±0.07	0.53±0.07	0.9±0.3	11.3±.6	1.30±0.13 ^{137}Cs 0.1±0.9 ^{227}Ac
BS-4	3.77±0.05		1.4±0.3	11.7±.6	1.06±0.08 ^{137}Cs 0.0±0.2 ^{227}Ac
BS-5	0.438±0.013	1.66±0.11	1.3±0.2	11.6±.6	0.20±0.05 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-6	14.36±0.12		1.19±0.17	10.2±.6	0.92±0.08 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-7	8.19±0.08	1.27±0.11	0.73±0.13	11.8±.6	0.80±0.08 ^{137}Cs 0.1±0.5 ^{227}Ac
BS-8	3.03±0.04		1.3±0.3	13.0±6	1.39±0.14 ^{137}Cs 0.3±0.9 ^{227}Ac
BS-9	9.34±0.10	0.70±0.09	1.7±0.4	11.3±.6	1.14±0.14 ^{137}Cs -2.0±1.1 ^{227}Ac
BS-10	4.42±0.04		1.7-0.4	10.3±.6	0.49±0.07 ^{137}Cs 0.8±0.5 ^{227}Ac
BS-11			1.6±0.2		1.03±0.07 ^{137}Cs pci/g 0.80±0.20 ^{241}Am pci/g
BS-12	0.718±0.015	1.54±0.10	1.54±0.18	13.4±.6	1.25±0.14 ^{137}Cs -0.8±1.0 ^{227}Ac
BS-13	0.908±0.018		1.23±0.11	12.4±.6	0.78±0.05 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-14	11.91±0.12	1.73±0.11	1.07±0.10	10.2±.6	1.06±0.08 ^{137}Cs -0.1±0.4 ^{227}Ac
BS-15	1.73±0.03		1.09±0.14	13.2±.6	0.84±0.07 ^{137}Cs 0.0±0.4 ^{227}Ac
BS-16	6.19±0.06	0.55±0.13	1.39±0.12	13.3±.6	1.06±0.06 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-17	1.12±0.03		1.34±0.10	12.0±.6	1.87±0.11 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-18	7.59±0.08	0.78±1.2	1.15±0.14	13.3±.6	0.79±0.06 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-19	0.765±0.018		1.30±0.11	12.5±.6	0.85±0.07 ^{137}Cs -0.7±0.6 ^{227}Ac
BS-20	1.16±0.03		1.0±0.3	11.9±.6	1.00±0.08 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-21	6.9±0.1		1.1±0.3	12.4±.6	1.69±0.10 ^{137}Cs 0.4±0.3 ^{227}Ac
BS-22	36.5±0.8		1.2±0.4	10.8±.6	0.27±0.05 ^{137}Cs -0.5±0.4 ^{227}Ac
BS-23	2.69±0.04		1.25±0.13	11.3±.6	0.49±0.06 ^{137}Cs -0.2±0.5 ^{227}Ac
BS-24	1.27±0.03		1.7±0.4	12.4±.6	0.80±0.08 ^{137}Cs 0.1±0.6 ^{227}Ac
BS-25	1.27±0.02		1.2±0.3	10.9±.6	0.94±0.07 ^{137}Cs 0.3±0.3 ^{227}Ac
BS-26	5.09±0.06		1.3±0.3	12.8±.6	0.53±0.07 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-27	11.64±0.11	0.7±0.1	0.5±0.3	9.8±.6	0.29±0.05 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-28	34.2±0.6		1.0±0.3	8.1±.6	0.49±0.06 ^{137}Cs -0.6±0.6 ^{227}Ac
BS-29	0.536±0.018		0.85±0.11	15.1±.6	1.01±0.10 ^{137}Cs -0.4±0.6 ^{227}Ac
BS-30	7.60±0.07		1.7±0.3	14.2±.6	1.30±0.08 ^{137}Cs 0.1±0.3 ^{227}Ac
BS-31	0.718±0.017	2.24±0.13	1.06±0.10	13.0±.6	1.31±0.09 ^{137}Cs -0.5±0.6 ^{227}Ac
BS-32	0.131±0.008		1.9±0.3	13.1±.6	0.45±0.05 ^{137}Cs 0.7±0.4 ^{227}Ac
BS-33	3.21±0.04	0.74±0.09	1.4±0.3	14.3±.6	2.29±0.13 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-34	0.399±0.013		0.6±0.2	11.3±.6	1.24±0.10 ^{137}Cs 0.2±0.3 ^{227}Ac
BS-35	12.6±0.3		1.8±0.4	10.3±.6	1.82±0.11 ^{137}Cs -0.7±0.6 ^{227}Ac
BS-36	16.9±0.2		1.1±0.4	12.4±.6	1.13±0.07 ^{137}Cs 0.0±0.3 ^{227}Ac
BS-37	9.56±0.19		1.17±0.13	10.9±.6	1.65±0.12 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-38	5.25±0.07		1.13±0.14	12.0±.6	0.72±0.06 ^{137}Cs -0.3±0.5 ^{227}Ac
BS-39	0.86±0.02	1.51±0.12	1.33±1.5	23.0±.6	0.68±0.07 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-40	0.751±0.018		1.6±0.3	14.8±.6	0.43±0.05 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-41	12.67±0.12	1.5±0.1	1.19±0.14	10.1±.6	0.57±0.04 ^{137}Cs 0.1±0.2 ^{227}Ac

TABLE 16.2-III
MDA B SOIL SURVEY SAMPLES (1978)

Loc.	$^{239,240}Pu$ pCi/g	^{90}Sr pCi/g	^{226}Ra pCi/g	Th mg/g	Other
BKGD.[a]	.025[a]	.88[a]	.005[b]		
BS-42	1.50±0.03		0.8±0.2	11.0±.6	0.83±0.06 ^{137}Cs 0.3±0.4 ^{227}Ac
BS-43	0.751±0.019	0.77±0.1	1.0±0.3	11.7±.6	0.71±0.07 ^{137}Cs 0.1±0.5 ^{227}Ac
BS-44	0.089±0.006		0.46±0.11	8.7±.6	0.91±0.06 ^{137}Cs -0.3±0.4 ^{227}Ac
BS-45	1.051±0.018	1.0±0.1	1.4±0.4	12.1±.6	1.95±0.12 ^{137}Cs -0.2±0.4 ^{227}Ac
BS-46	2.874±0.018		0.2±0.6	10.9±.6	2.80±0.19 ^{137}Cs -0.4±0.7 ^{227}Ac
BS-47	0.189±0.008	0.5±0.1	0.8±0.2	10.8±.6	0.52±0.08 ^{137}Cs -0.2±0.6 ^{227}Ac
BS-48	0.198±0.007		1.4±0.3	12.2±.6	1.67±0.10 ^{137}Cs 0.7±0.5 ^{227}Ac
BS-49	1.65±0.02	1.68±0.14	0.99±0.06	10.0±.6	1.56±0.09 ^{137}Cs -0.2±0.3 ^{227}Ac
BS-50	3.60±0.05		1.30±0.14	12.8±.6	0.42±0.05 ^{137}Cs 0.3±0.3 ^{227}Ac
BS-51	1.64±0.03	2.04±0.17	1.2±0.4	12.7±.6	1.67±0.10 ^{137}Cs -0.5±0.5 ^{227}Ac
BPS 2			12.9±.08		0.60±0.05 ^{137}Cs pci/g 0.00±0.50 ^{241}Am pci/g
BPS 5			17.5±1.3		131 ±9.00 ^{137}Cs pci/g 0.40±0.20 ^{241}Am pci/g
BPS 8			1.4±0.3		0.98±0.08 ^{137}Cs pci/g 240.0±12.0 ^{241}Am pci/g

[a]Upper limit background levels from Purtymun (1987).
[b]The upper limit background level for ^{226}Ra is the same as that for ^{238}U which is from Purtymun (1987).

TABLE 16.2-IV
MDA B PERIMETER SOIL SURVEY SAMPLES (1979)[a]

Sample Number (cm)	Sample Location	Sample Depth	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-	^{227}Ac Value (pCi/g)	+/-
BKGD.[b,c]			720[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]		0.04[c]	
79.04417	BKGD.[d]	0-1	800	300	3.5	0.4	0.0110	0.0020	0.201	0.008	0.93	0.06	-0.3	0.3
79.04418	BKGD.[d]	1-10	1600	400	3.8	0.4	0.0037	0.0014	0.330	0.010	1.21	0.08	0.1	0.3
79.04419	BS-1	0-1	2100	400	6.7	0.7	-0.0007	0.0015	0.657	0.015	0.30	0.07	-1.5	0.7
79.04420	BS-1	1-10	2200	400	4.8	0.5	0.0005	0.0014	0.851	0.019	0.90	0.09	0.1	0.7
79.04421	BS-1	10-30	0	300	4.0	0.4	0.0007	0.0011	0.089	0.005	0.29	0.09	1.4	0.8
79.04422	BS-2	0-1	1900	400	5.0	0.5	0.0130	0.0020	3.330	0.040	0.65	0.05	-0.1	0.4
79.04423	BS-2	1-10	2600	400	4.2	0.4	0.0150	0.0030	3.500	0.040	0.55	0.06	0.1	0.4
79.04424	BS-2	10-30	1900	400	4.8	0.5	0.0150	0.0020	4.010	0.040	0.49	0.06	-0.7	0.8
79.04425	BS-3	0-1	700	300	7.0	0.7	0.0420	0.0040	3.160	0.040	3.23	0.19	-0.3	0.9
79.04426	BS-3	1-10	2300	400	8.7	0.9	0.0440	0.0040	5.870	0.070	2.06	0.13	-0.4	0.6
79.04427	BS-3	10-30	1800	400	3.9	0.4	0.0040	0.0015	1.188	0.019	0.31	0.16	-1.0	1.5
79.04428	BS-4	0-1	4700	400	7.0	0.7	-0.0019	0.0009	2.160	0.030	1.63	0.12	-0.1	0.8
79.04429	BS-4	1-10	25700	600	5.4	0.5	0.0290	0.0030	3.140	0.040	0.53	0.06	0.0	0.5
79.04430	BS-5	0-1			5.0	0.5	0.0970	0.0050	15.500	0.130				
79.04431	BS-5	1-10			110.0	10.0	0.0290	0.0030	2.350	0.030				
79.04432	BS-5	10-30			7.2	0.7	0.0170	0.0030	24.700	0.200				
79.04433	BS-5	10-30			56.0	6.0	0.0190	0.0030	24.900	0.200				

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper limit background levels from Purtymun (1987).
[c]The upper limit background level for Actinium 227 is the same as Uranium 235. The upper limit background level for ^{235}U was derived from Purtymun's upper limit background level for total Uranium.
[d]These samples, taken approximately 200 ft west of MDA B, were intended to document background concentrations near MDA B; however, $^{239/240}Pu$ levels in these samples were eight times the background level.

TABLE 16.2-V
1980 MDA B AND GUAJE CANYON VEGETATION SURVEY SAMPLES[a]

Sample Number BKGD.[b,c]	Sample Location	Species	Tritium Value (pCi/l) 800[b]	+/-	^{235}U Value (ppb) 156[c]	+/-	^{238}Pu Value (pCi/g) 0.00015[b]	+/-	$^{239/240}Pu$ Value (pCi/g) 0.00023[b]	+/-
	MDA B									
80.05340	1	Yucca	1400	300	160	50	-0.0040	0.0040	0.0160	0.0060
80.05341	1	Artemesia	-1800	300	1310	130	-0.0040	0.0030	0.1170	0.0150
80.05342	2	Juniper	600	300	930	100	0.0013	0.0005	0.0640	0.0030
80.05343	3	Melilotus	2900	300	390	50	0.0030	0.0030	0.2290	0.0130
80.05344	3	Andropagon	7300	400	390	50	0.0075	0.0018	0.3170	0.0130
80.05345	3	Quercus	809000	13000	1230	130	0.0043	0.0012	0.0490	0.0030
80.05346	4	Cercocarpus	2400	300	790	80	0.0023	0.0007	0.0930	0.0040
80.05347	4	Quercus	3000	300	1020	100	0.0104	0.0014	0.5100	0.0150
80.05348	4	Andropagon	2300	300	590	60	0.0019	0.0012	0.0770	0.0060
80.05349	5	Guttieriezia	543000	9000	930	100	0.0580	0.0030	0.1160	0.0040
80.05350	5	Bouteloua	29900	700	9950	1000	0.0020	0.0030	0.5200	0.0200
80.05351	5	Verbascum	374000	6000	1740	180	0.0044	0.0014	0.2500	0.0100
	Guaje Controls									
80.06867		Hochia Scoparia					-0.0005	0.0013	0.0070	0.0030
80.06868		Mylilotur					-0.0010	0.0020	0.0070	0.0030
80.06869		Quercus Gambelli					0.0021	0.0019	0.0030	0.0040
80.06870		Artemesia					0.0004	0.0013	0.0120	0.0020
80.06871		Bramus tectorium (dead)					0.0004	0.0003	0.0140	0.0010
80.06872		Bouteloua gracilis					0.0012	0.0014	0.0190	0.0030
80.06873		Pinus ponderosa					0.0020	0.0030	0.0680	0.0080
80.06874							0.0102	0.0018	0.2840	0.0100
80.06875		Pinus edulis					0.0034	0.0014	0.0500	0.0050
80.06876		Juniperus monosperma					-0.0003	0.0010	0.0370	0.0030

aThe ± values reported for each radionuclide are analytical laboratory uncertainty.
bUpper limit background levels from The Environmental & Surveillance Group (1987).
cUpper limit background level for U-235 calculated from the upper limit background level for total uranium provided by The Environmental & Surveillance Group (1987).

TABLE 16.2-VI
MDA B VEGETATION SURVEY SAMPLE: PEACHES[a]

Sample Number BKGD.[b]	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l) 800[b]	+/-	^{238}Pu Value (pCi/g) 0.00015[b]	+/-	$^{239/240}Pu$ Value (pCi/g) .00023[b]	+/-	^{90}Sr Value (pCi/g)	+/-
81.07118	PEELS	LOWER	1400	500	0.0220	0.0080	0.0740	0.0130	-0.0400	0.0800
81.07119	PEELS	MIDDLE	1400	900	0.1200	0.0120	0.0750	0.0100	0.0900	0.1000
81.07120	PEELS	TOP	7800	700	0.0380	0.0080	0.0350	0.0080	0.1000	0.0800
81.07121	PULP	LOWER	4200	400	0.0110	0.0030	0.0210	0.0040	-0.0700	0.0500
81.07122	PULP	MIDDLE	7200	1000	0.0110	0.0020	0.0100	0.0020	0.0400	0.0600
81.07123	PULP	TOP	1700	400	0.0080	0.0030	0.0210	0.0040	-0.0900	0.0800
81.07124	PITS	LOWER	3600	400	0.0230	0.0060	0.0350	0.0080	-0.0100	0.1000
81.07125	PITS	MIDDLE	2900	400	0.0630	0.0150	0.0750	0.0160	0.1000	0.2000
81.07126	PITS	TOP	800	400	0.0600	0.0140	0.0270	0.0100	-0.1700	0.1100

aThe ± values reported for each radionuclide are analytical laboratory uncertainty.
b Upper background levels from The Environmental & Surveillance Group (1987).

TABLE 16.2-VII
ARITHMETIC MEAN, STANDARD DEVIATION, AND COEFFICIENT OF VARIATION FOR RADIONUCLIDE RESULTS

Sample Type	N	Sc (ppb dry)		U (ppb dry)		^{137}CS (fCi/g dry)		$^{239/240}Pu$ (fCi/g dry)	
		$\bar{X} \pm 1\sigma$	COV	$\bar{X} \pm 1\sigma$	COV	$\bar{X} \pm 1\sigma$	COV	$\bar{X} \pm 1\sigma$	COV
BKGD.°				.0096°		2060°		.23°	
Ponderosa Pine 5 - growing in waste									
Soil around waste debris (>100 cm)	6	2660±434	0.16	5070±581	0.11	168±267	1.6	578000±323000	0.56
Litter - pine needles	2	111±11.3	0.10	430±20.5	0.048	385±28.3	0.074	3570±764	0.21
Litter - misc.	1	262		585		423		7210	
Unbagged needles	3	10.4±.912	0.088	63.3±8.61	0.14	23.1±13.4	0.58	21.6±5.84	0.27
Bole bark	2	9.94±8.86	0.89	70.1±49.4	0.70	28.2±36.8	1.3	10400±5830	0.56
Bole wood	5	0.631±.0524	0.083	0.385±.195	0.51	8.50±11.21	1.3	5.27±1.59	0.30
Root wood	5	3.78±7.22	1.9	10.1±14.5	1.4	-0.699±1.96	2.8	250±328	1.3
Root bark	4	141±96.0	0.68	314±199	0.63	3.80±6.56	1.7	23900±31000	1.3
Ponderosa Pine - all remaining									
Soil 2 cm	3	2510±382	0.15	5630±793	0.14	1075±389	0.36	5650±7340	1.3
Soil 10 cm	3	2540±366	0.14	5290±497	0.094	289±266	0.92	4720±6180	1.3
Soil 25 cm, 30 cm	4	3070±760	0.25	4430±1030	0.23	110±96.3	0.88	1230±1270	1.0
Soil 45-55, 80 cm	2	2840±368	0.13	4415±827	0.19	186±335	1.8	884±702	0.79
Soil 150-160 cm	1	2450		4180		-46.9		1020	
Litter - pine needles	7	164±72.2	0.44	426±229	0.54	459±161	0.35	217±102	0.47
Litter - misc.	4	454±322	0.71	867±528	0.61	628±356	0.57	816±741	0.91
Unbagged needles	14	20.0±9.48	0.47	76.7±93.2	1.2	77.9±39.6	0.51	13.0±12.1	0.93
Bole bark	11	43.3±35.6	0.82	74.4±60.7	0.82	30.4±35.7	1.2	557±875	1.6
Bole wood	16	0.391±.538	1.4	0.996±1.36	1.4	3.71±6.52	1.8	1.52±2.25	1.5
Root wood	2	14.3±18.1	1.3	36.3±28.7	0.79	-1.62±6.92	4.3	164±211	1.3
Root bark	4	2.80±5.20	1.9	412±445	1.1	15.5±25.4	1.6	997±1940	1.9

TABLE 16.2-VII (continued)

Sample Type	N	Sc (ppb dry) X ± 1σ	COV	U (ppb dry) X± 1σ	COV	^{137}CS (fCi/g dry) X± 1σ	COV	$^{239/240}Pu$ (fCi/g dry) X± 1σ	COV
BKGD.[o]				.0096[o]		2060[o]		.23[o]	
Peach and Elm (Deciduous trees)									
Soil 2 cm	1	4000		3730		476		18100	
Soil 10 cm	1	4300		3240		383		29500	
Soil 25 cm, 30 cm	1	3770		3720		189		7850	
Soil 80 cm	1	3210		3800		72.7		12100	
Unbagged leaves	4	26.5±15.5	0.58	47.9±18.2	0.38	-34.2		2.63	
Bagged leaves	3	5.18±1.56	0.30	14.4±9.65	0.67	148		4.87	
Bole bark	2	22.5±24.3	1.1	40.0±46.7	1.2	96.0±63.6	0.66	15.3±3.25	0.21
Bole wood	2	0.200±0.0290	0.15	7.68±.488	0.064	1.33±5.43	4.1	4.10±0.431	0.11
Root wood	1	4.77		14.3		-4.27		62.1	
Root bark	1	0.530		602		83.8		4160	
Oak, Chamisa, Ribes, Fallugia (Shrubs)									
Soil 2 cm	3	2850±613	0.22	5900±1850	0.31	1200±560	0.47	14600±9330	0.64
Soil 10 cm	3	3390±1500	0.44	5660±1750	0.31	664±110	0.17	5320±1850	0.35
Soils 25, 30 cm	3	3510±1500	0.43	4170±748	0.18	163±64.0	0.39	1670±759	0.45
Soils 45-55, 80 cm	2	2260±651	0.29	4020±141	0.035	-13.3±35.4	2.7	4140±5310	1.30
Soil 150, 160 cm	1	2730		3770		-35.8		729	
Soil no depth, around waste debris area (>100 cm)	2	3630±2690	0.74	15800±11900	0.75	75.5±7.42	0.098	159000±219000	1.4
Litter - pine needles	1	56.5		96.8		6570		255	
Litter - misc.	2	1100±1190	1.1	1720±1800	1.0	572±366	0.64	14300±18100	1.3
Unbagged leaves	6	23.3±3.67	0.16	62.1±33.3	0.54	28.3±20.6	0.73	36.7±8.15	0.22
Bagged leaves	12	4.86±.848	0.17	21.0±12.8	0.61	26.9±31.4	1.2	5.27±3.76	0.71
Bole bark	3	85.4±73.9	0.87	650±746	1.1	252±219	0.87	98.4±12.4	0.13
Bole wood	3	2.05±2.22	1.1	13.8±7.44	0.54	12.0±9.49	0.79	21.6±3.44	0.16
Root wood	1	39.6		210		-10.4		5.21	
Root bark	1	1.90		6250		121		113	

[a]Table from Wenzel et al. (1987).
[o]Upper limit background levels from The Environmental & Surveillance Group (1987).

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02900	1L-10m	0-1	(nCi/l) 134	3	5.40	0.50	0.0150	0.0030	0.6420	0.0170
83.02901	1L-10m	1-10	(nCi/l) 126	3	4.80	0.50	0.0050	0.0030	0.3020	0.0120
83.02902	1L-10m	10-30	(nCi/l) 140	3	3.90	0.40	0.0100	0.0020	1.4900	0.0300
83.02903	1L-20m	0-1	(nCi/l) 112	2	4.10	0.40	0.0060	0.0010	0.3350	0.0100
83.02904	1L-20m	1-10	86400	1400	4.30	0.40	0.0014	0.0000	0.1300	0.0060
83.02905	1L-20m	10-30	17400	400	3.80	0.40	0.0004	0.0010	0.0080	0.0020
83.02906	1L-30m	0-1	(nCi/l) 122	2	4.9	0.50	0.0055	0.0010	0.2990	0.0100
83.02907	1L-30m	1-10	94200	1800	5.1	0.50	0.0042	0.0010	0.1910	0.0090
83.02908	1L-30m	10-30								
83.02909	1L-40m	0-1	58300	1100	6.1	0.60	0.0450	0.0040	5.7700	0.0700
83.02910	1L-40m	1-10	36100	700	5.5	0.60	0.0230	0.0030	3.2900	0.0400
83.02911	1L-40m	10-30	65900	1200	4.3	0.40	0.0090	0.0040	0.7300	0.0200
83.02912	1L-50m	0-1	95000	2000	4.4	0.40	0.0043	0.0010	0.8600	0.0200
83.02913	1L-50m	1-10	89900	1700	4.4	0.40	0.0090	0.0020	1.1300	0.0200
83.02914	1L-50m	10-30	40600	700	4.0	0.40	0.0050	0.0010	0.0700	0.0060
83.02915	1U-10m	0-1			14.8	1.50	0.0350	0.0040	7.0200	0.0100
83.02916	1U-10m	1-10								
83.02917	1U-10m	10-30	20500	500	4.0	0.40	0.0022	0.0010	0.1370	0.0090
83.02918	1U-20m	0-1			6.5	0.70	0.2470	0.0120	42.100	0.5000
83.02919	1U-20m	1-10	68500	1400	5.1	0.50	0.1740	0.0100	29.400	0.3000
83.02920	1U-20m	10-30	49600	1000	3.8	0.40	0.0060	0.0020	0.9100	0.0200
83.02921	1U-30m	0-1								
83.02922	1U-30m	1-10								
83.02923	1U-30m	10-30	53600	900	3.9	0.40	0.0021	0.0010	0.1050	0.0080
83.02924	1U-40m	0-1			5.1	0.50	0.0170	0.0030	3.3300	0.0600
83.02925	1U-40m	1-10			4.5	0.40	0.0051	0.0010	0.4890	0.0170
83.02926	1U-40m	10-30	20100	500	3.9	0.40	0.0010	0.0010	0.0100	0.0020
83.02927	1U-50m	10-30	65100	1100	4.0	0.40	0.0150	0.0030	2.2900	0.0400
83.02928	2C-0m	0-1	(nCi/l) 234	4	3.8	0.40	0.0032	0.0010	7.3400	0.1000
83.02929	2C-0m	1-10	74300	1200	3.8	0.40	0.1420	0.0080	6.5800	0.0900
83.02930	2C-0m	10-30	36500	700	4.1	0.40	0.1470	0.0090	8.0000	0.1000
83.02931	2L-10m	0-1	(nCi/l) 120	2	4.4	0.40	0.0330	0.0040	2.4800	0.0400

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02932	2L-10m	1-10	59000	1000	4.9	0.50	0.5440	0.0180	33.200	0.0400
83.02933	2L-10m	10-30	83500	1300	4.2	0.40	0.0029	0.0010	0.2320	0.0100
83.02934	2L-20m	0-1	64500	1100	4.4	0.40	0.0057	0.0010	0.5000	0.0170
83.02935	2L-20m	1-10	(nCi/l) 165	3	4.6	0.50	0.0930	0.0070	0.2800	0.0120
83.02937	2L-30m	0-1	(nCi/l) 113	1.9	4.1	0.40	0.0120	0.0070	0.2800	0.0300
83.02938	2L-30m	1-10	80500	1300	4.5	0.40	0.0029	0.0010	0.0620	0.0050
83.02940	2L-40m	0-1	(nCi/l) 137	2	6.3	0.60	0.0200	0.0030	1.3400	0.0300
83.02941	2L-40m	1-10	(nCi/l) 101	1.7	5.1	0.50	0.0017	0.0010	0.1440	0.0070
83.02943	2L-50m	0-1	(nCi/l) 170	3	5.3	0.50	0.0084	0.0010	0.4350	0.0130
83.02944	2L-50m	1-10	(nCi/l) 143	4	4.8	0.50	0.1270	0.0070	0.8200	0.0200
83.02945	2L-50m	10-30	92200	1700	4.2	0.40	0.0340	0.0030	0.0140	0.0020
83.02946	2U-10m	0-1	(nCi/l) 180	3	5.0	0.50	0.0210	0.0040	1.4600	0.0300
83.02947	2U-10m	1-10	59500	1000	4.5	0.50	0.0440	0.0050	4.4900	0.0600
83.02948	2U-10m	10-30	60200	1000	3.7	0.40	0.0090	0.0030	1.0300	0.0200
83.02949	2U-20m	0-1	(nCi/l) 145	3	7.4	0.70	0.1100	0.0200	21.200	2.0000
83.02950	2U-20m	1-10	(nCi/l) 101	1.6	8.4	0.80	0.2010	0.0200	31.800	3.0000
83.02951	2U-20m	10-30	83100	1300	5.0	0.50	0.3460	0.0400	58.500	5.0000
83.02952	2U-30m	0-2	59800	1100	5.1	0.50	0.0110	0.0080	2.9700	0.0500
83.02953	2U-30m	2-10	52800	900	5.9	0.60	0.0470	0.0050	8.5100	0.1100
83.02954	2U-30m	10-30	27800	600	4.2	0.40	0.0031	0.0010	0.4520	0.0160
83.02955	2U-40m	0-1	85200	1500	4.80	0.50	0.0140	0.0030	2.3300	0.0400
83.02956	2U-40m	1-10	42700	800	4.10	0.40	0.0006	0.0010	0.2310	0.0120
83.02957	2U-40m	10-30	20200	500	3.90	0.40	0.0005	0.0010	0.0140	0.0030
83.02958	2U-50m	0-1	70000	1300	3.40	0.30	0.0460	0.0050	6.9800	0.0900
83.02959	2U-50m	1-10	67400	1100	5.90	0.60	0.0100	0.0020	1.8600	0.0300
83.02960	2U-50m	10-30	23200	500	7.30	0.70	0.0270	0.0040	3.8600	0.0600
83.02961	3L-10m	0-1	(nCi/l) 101.7	1.9	4.70	0.50	0.1230	0.0070	25.800	0.3000
83.02962	3L-10m	1-10	91600	1600	4.50	0.50	0.1210	0.0070	20.000	0.2000
83.02963	3L-10m	10-30	87100	1500	4.40	0.40	0.0055	0.0010	0.7840	0.0170
83.02964	3L-20m	0-1	(nCi/l) 118	2	4.20	0.40	0.0113	0.0010	0.6010	0.0130
83.02965	3L-20m	1-10	(nCi/l) 114	3	4.30	0.40	0.0610	0.0040	4.5300	0.0500
83.02966	3L-20m	10-30	(nCi/l) 117	2	4.20	0.40	0.0080	0.0020	0.4910	0.0160

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02967	3L-30m	0-1	(nCi/l) 205	4	7.10	0.70	0.0220	0.0030	1.5300	0.0300
83.02968	3L-30m	1-10	(nCi/l) 774	11	5.30	0.50	0.0470	0.0040	3.0400	0.0400
83.02969	3L-30m	10-30								
83.02970	3L-40m	0-1	(nCi/l) 1301	19	21.20	2.10	0.3060	0.0100	18.600	0.1700
83.02971	3L-40m	1-10	(nCi/l) 174	3	9.80	1.00	0.4220	0.0120	27.000	0.2000
83.02972	3L-40m	10-30								
83.02973	3L-50m	0-1	(nCi/l) 25600	400	5.90	0.60	0.1440	0.0070	8.1600	0.0900
83.02974	3L-50m	1-10	(nCi/l) 7050	100	6.20	0.60	0.1130	0.0070	7.4900	0.0900
83.02975	3L-50m	10-30	(nCi/l) 4740	70	4.50	0.50	0.0080	0.0010	0.3830	0.0130
83.02976	3U-10m	0-1	69600	1200	3.50	0.40	0.0270	0.0040	2.1800	0.0400
83.02977	3U-10m	1-10	67100	1100	3.60	0.40	0.0360	0.0040	5.7300	0.0800
83.02978	3U-10m	10-30								
83.02979	3U-20m	0-1	(nCi/l) 105.9	1.7	3.40	0.40	0.0080	0.0080	1.0500	0.0300
83.02980	3U-20m	1-10	85100	1400	3.70	0.40	0.0050	0.0020	0.9000	0.0300
83.02981	3U-20m	10-30	37800	700	3.40	0.40	0.0006	0.0010	0.4510	0.0170
83.02982	3U-30m	0-1	(nCi/l) 113	1.8	5.80	0.60	0.0770	0.0070	12.310	0.1500
83.02983	3U-30m	1-10	90700	1400	6.70	0.70	0.5770	0.0500	102.20	10.000
83.02985	3U-40m	0-1	(nCi/l) 104.8	1.6	9.20	0.90	0.0190	0.0030	2.7000	0.0500
83.02986	3U-40m	1-10	83000	2000	4.70	0.50	0.0011	0.0010	0.4120	0.0160
83.02987	3U-40m	10-30	37800	700	3.90	0.40	0.0042	0.0010	0.0250	0.0030
83.02991	4C-0m	0-1	84600	1400	4.00	0.40	0.0320	0.0040	2.7000	0.0500
83.02992	4C-0m	1-10	93800	1500	3.70	0.40	0.0200	0.0040	1.8300	0.0400
83.02993	4C-0m	10-30	73800	1300	3.70	0.40	0.0250	0.0030	2.3700	0.0400
83.02994	4L-10m	0-1	(nCi/l) 164	3	4.20	0.40	0.0570	0.0050	4.9800	0.0700
83.02995	4L-10m	1-10	(nCi/l) 183	3	4.50	0.40	0.0490	0.0040	4.3200	0.0600
83.02996	4L-10m	10-30	(nCi/l) 102.2	1.6	4.50	0.40	0.0280	0.0030	2.9200	0.0400
83.02997	4L-20m	0-1	(nCi/l) 219	4	3.30	0.30	0.1510	0.0090	27.400	0.3000
83.02998	4L-20m	1-10	(nCi/l) 497	7	3.50	0.40	0.1900	0.0090	33.700	0.3000
83.02999	4L-20m	10-30	91200	1500	3.90	0.40	0.0760	0.0080	9.5900	0.9000
83.03000	4L-30m	0-1	(nCi/l) 120	14	3.20	0.30	0.3100	0.0300	58.000	6.0000
83.03001	4L-30m	1-10	(nCi/l) 425	7	3.40	0.30	0.4120	0.0160	73.600	0.8000
83.03002	4L-30m	10-30	(nCi/l) 224	4	2.80	0.30	0.3830	0.0130	66.900	0.6000

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.03009	4U-10m	0-1	(nCi/l) 124	3	4.90	0.50	0.0200	0.0030	1.7600	0.0300
83.03010	4U-10m	1-10	69400	1100	3.80	0.50	0.0280	0.0040	2.8400	0.0400
83.03012	4U-20m	0-1	(nCi/l) 102	1.7	4.40	0.40	0.0035	0.0010	5.3300	0.0700
83.03013	4U-20m	1-10	72200	1200	3.80	0.40	0.0048	0.0050	5.9400	0.0800
83.03014	4U-20m	10-30	33400	700	3.50	0.40	0.0530	0.0050	6.1300	0.0900
83.03015	4U-30m	0-1	95200	1800	5.80	0.60	0.0150	0.0080	1.3500	0.0300
83.03016	4U-30m	1-10	61800	1000	4.80	0.50	0.0110	0.0020	0.9000	0.0200
83.03017	4U-30m	10-30	26300	600	4.50	0.50	0.0004	0.0010	0.0280	0.0040
83.03018	4U-40m	0-1	75500	1500	4.90	0.50	0.0380	0.0040	5.0800	0.0700
83.03019	4U-40m	1-10	43600	800	5.50	0.60	0.0370	0.0050	5.7600	0.0800
83.03020	4U-40m	10-30	14600	400	4.60	0.50	0.0160	0.0030	2.2500	0.0300
83.03024	1C-0m	0-1	63400	1100	4.10	0.40	0.0004	0.0010	0.0060	0.0010
83.03025	1C-0m	1-10	(nC/l) 119	14	4.30	0.40	0.0006	0.0000	0.0390	0.0030
83.03026	1C-0m	10-30	(nCi/l) 139	3	4.00	0.40	0.0150	0.0030	1.8500	0.0300

[a] The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b] Upper limit background levels from Purtymun (1987).

TABLE 16.2-IX
1982 MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (ppm)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
82.09371	B-1	0-1	18900	500	4.80	0.50	0.0005	0.0000	0.1160	0.0080
82.09372	B-1	1-6	25800	500	4.60	0.50	0.0022	0.0010	0.1170	0.0080
82.09373	B-2	0-1	31200	600	5.10	0.50	0.0100	0.0020	1.1800	0.0300
82.09374	B-2	1-10	33400	600	4.80	0.50	0.0140	0.0020	2.5900	0.0400
82.09375	B-2	10-30	13000	400	3.80	0.40	0.0012	0.0010	0.2840	0.0110
82.09376	B-3	0-1	53100	1000	3.60	0.40	0.0080	0.0020	0.2290	0.0100
82.09377	B-3	1-10	13200	400	3.10	0.30	0.0070	0.0020	0.2400	0.0400
82.09378	B-3	10-30	10100	300	5.20	0.50	0.0110	0.0020	0.6300	0.0160
82.09379	B-4	0-1	45700	900	3.00	0.30	0.0007	0.0000	0.4830	0.0140
82.09380	B-4	1-10	12900	400	4.80	0.50	0.0100	0.0020	0.5750	0.0160

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper limit background levels from Purtymun (1987).

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.04582	N1E0	0-1	14900	1600	3.19	0.16	0.0005	0.0014	0.0200	0.0030
83.04583	N1E0	1-10	18400	1900	3.25	0.23	0.0090	0.0030	0.7800	0.0300
83.04584	N1E0	10-30	9300	1000	4.16	0.21	0.0120	0.0030	1.2900	0.0500
83.04585	N1E2	0-1	16500	1700	3.87	0.19				
83.04586	N1E2	1-10	7900	900	3.86	0.19	0.0004	0.0015	0.0035	0.0018
83.04587	N1E2	10-30	10400	1100	4.45	0.22	-0.0011	0.0014	0.0049	0.0017
83.04588	N1E4	0-1	17600	1800	3.63	0.18	0.0029	0.0017	0.0080	0.0020
83.04589	N1E4	1-10	10300	1300	3.90	0.20	0.0005	0.0015	0.0040	0.0020
83.04590	N1E4	10-30	10000	1100	3.90	0.20	-0.0007	0.0014	0.0029	0.0014
83.04591	N1E6	0-1	13000	1400	4.52	0.23	0.0015	0.0009	0.0007	0.0009
83.04592	N1E6	1-10	9400	1000	3.52	0.25	0.0005	0.0015	0.0032	0.0018
83.04593	N1E6	10-30	20000	2000	3.76	0.19	0.0006	0.0016	0.0010	0.0020
83.04594	N1E8	0-1	24000	2000	3.61	0.18	0.0027	0.0018	0.0021	0.0016
83.04595	N1E8	1-10	8000	900	3.64	0.18	0.0010	0.0016	0.0021	0.0014
83.04596	N1E8	10-30	7800	900	3.98	0.20	0.0006	0.0017	0.0011	0.0018
83.04597	N1E10	0-1	24000	2000	3.71	0.19	0.0029	0.0019	0.1410	0.0100
83.04598	N1E10	1-10	15900	1700	3.54	0.18	0.0021	0.0017	0.0011	0.0017
83.04599	N1E10	10-30	9300	1000	4.16	0.21	-0.0005	0.0017	0.0005	0.0014
83.04600	N1E12	0-1	27000	3000	3.70	0.19	0.0016	0.0014	0.0110	0.0030
83.04601	N1E12	1-10	35000	4000	3.63	0.25	0.0010	0.0030	0.0090	0.0030
83.04602	N1E12	10-30	10900	1200	3.87	0.19	0.0023	0.0013	0.0053	0.0017
83.05615	N1E14	0-1	16600	1700			0.0010	0.0020	0.0050	0.0020
83.05616	N1E14	1-10	10900	1200			0.0004	0.0013	0.0042	0.0018
83.05617	N1E14	10-30	12600	1300	3.89	0.20	0.0013	0.0011	0.0020	0.0011
83.05618	N1E16	0-1	14600	1500	3.77	0.19	0.0009	0.0013	0.0027	0.0015
83.05619	N1E16	1-10	12900	1400	3.74	0.19	0.0018	0.0019	0.0040	0.0020
83.05620	N1E16	10-30	13100	1400	3.72	0.19	-0.0006	0.0016	0.0070	0.0020
83.05621	N1E18	0-1	21000	2000	3.82	0.19	0.0011	0.0017	0.0027	0.0019
83.05622	N1E18	1-10	10700	1100	3.58	0.18	-0.0017	0.0016	0.0022	0.0019
83.05623	N1E18	10-30	6100	700	3.64	0.18	-0.0004	0.0006	0.0027	0.0017

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05624	N1E20	0-1	11100	1200	3.49	0.18	0.0027	0.0013	0.1090	0.0080
83.05625	N1E20	1-10	50000	5000	3.49	0.18	0.0060	0.0020	0.8000	0.0300
83.05626	N1E20	10-30	10100	1100	3.52	0.18	0.0130	0.0030	3.8000	0.1300
83.05627	N3E0	0-1	3500	4000	4.81	0.24	0.0190	0.0040	3.0500	0.1100
83.05628	N3E0	1-10	27000	3000	4.41	0.22	0.0080	0.0030	1.6900	0.0700
83.05629	N3E0	10-30	9800	1100	4.51	0.23	0.0210	0.0040	2.7500	0.1100
83.05630	N3E2	0-1	21000	2000	3.75	0.19	0.0018	0.0019	0.0040	0.0020
83.05631	N3E2	1-10	19000	2000	3.65	0.18	-0.0010	0.0020	0.0030	0.0030
83.05632	N3E2	10-30	8500	900	4.16	0.21	-0.0015	0.0017	-0.0010	0.0020
83.05633	N3E4	0-1	22000	2000	3.76	0.19	0.0020	0.0020	0.0010	0.0020
83.05634	N3E4	1-10	9300	1000	4.24	0.21	-0.0012	0.0015	0.0006	0.0012
83.05635	N3E4	10-30	9200	1000	4.20	0.21	0.0010	0.0030	0.0070	0.0030
83.05636	N3E6	0-1	31000	3000	3.63	0.18	0.0008	0.0016	0.0040	0.0030
83.05637	N3E6	1-10	12200	1300	3.68	0.18	0.0017	0.0019	0.0030	0.0030
83.05638	N3E6	10-30	14500	1500	4.03	0.20	-0.0005	0.0015	0.0010	0.0015
83.05639	N3E8	0-1	25000	3000	3.73	0.19	0.0008	0.0017	0.0030	0.0030
83.05640	N3E8	1-10	7100	800	3.48	0.17	0.0037	0.0019	0.0053	0.0018
83.05641	N3E8	10-30	10500	1100	4.01	0.20	0.0015	0.0011	0.0090	0.0030
83.05642	N3E10	0-1	18100	1900	3.56	0.25	-0.0020	0.0020	0.3000	0.0300
83.05643	N3E10	1-10	21000	2000	3.61	0.18	0.0009	0.0017	0.0410	0.0070
83.05644	N3E10	10-30	7000	800	4.29	0.22	0.0010	0.0020	0.0010	0.0020
83.05645	N3E12	0-1	31000	3000	3.72	0.26	0.0080	0.0040	0.8300	0.0400
83.05646	N3E12	1-10	9100	1000	3.98	0.20	-0.0010	0.0020	0.0010	0.0020
83.05647	N3E12	10-30	6400	700	4.37	0.22	0.0020	0.0020	-0.0010	0.0030
83.05648	N3E14	0-1	31000	3000	3.98	0.20	-0.0020	0.0020	0.0090	0.0030
83.05649	N3E14	1-10	11400	1200	4.19	0.21	-0.0018	0.0018	0.0020	0.0020
83.05650	N3E14	10-30	6500	800	4.31	0.22	0.0007	0.0016	-0.0010	0.0030
83.05651	N3E16	0-1	16300	1700	3.70	0.26	0.0040	0.0020	0.0060	0.0030
83.05652	N3E16	1-10	9000	1000	4.04	0.20	0.0010	0.0020	0.0080	0.0020
83.05653	N3E16	10-30	7000	800	3.55	0.25			0.1600	0.0200

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05654	N3E18	0-1	19200	2000	3.64	0.26	0.0021	0.0017	0.0026	0.0016
83.05655	N3E18	1-10	9600	1000	3.59	0.18	0.0005	0.0015	0.0050	0.0020
83.05656	N3E18	10-30	4700	600	3.20	0.22	0.0012	0.0017	0.0080	0.0030
83.05657	N3E20	0-1	13100	1400	3.67	0.18	0.0030	0.0020	0.3340	0.0170
83.05658	N3E20	1-10	17100	1800	3.69	0.26	0.0045	0.0019	0.2950	0.0150
83.05659	N3E20	10-30	4500	600	3.29	0.23	0.0005	0.0015	0.0250	0.0040
83.05660	N4E10	0-1	15300	1600	3.61	0.18	0.0017	0.0014	0.1930	0.0130
83.05661	N4E10	1-10	12800	1400	3.58	0.25	0.0015	0.0018	0.3460	0.0170
83.05662	N4E10	10-30	3100	500	3.94	0.28	0.0005	0.0012	0.0270	0.0040
83.05663	N4E12	0-1	12500	1300	2.32	0.16	0.0260	0.0040	0.1770	0.0100
83.05664	N4E12	1-10	45000	5000	2.80	0.20	0.0039	0.0017	0.2550	0.0150
83.05665	N4E12	10-30	12700	1300	3.57	0.25	0.0057	0.0019	0.4200	0.0200
83.05666	N4E14	0-1	13100	1400	4.24	0.21	0.0010	0.0020	0.1670	0.0130
83.05667	N4E14	1-10	19000	2000	3.79	0.19	0.0010	0.0016	0.2370	0.0130
83.05668	N4E14	10-30	13900	1500	3.98	0.20	0.0010	0.0030	0.0009	0.0030
83.05669	N4E16	0-1	43000	4000	3.91	0.20	0.0070	0.0030	0.3330	0.0190
83.05670	N4E16	1-10	12900	1400	3.86	0.27	0.0020	0.0020	0.4700	0.0200
83.05671	N4E16	10-30	3500	500	3.91	0.20	0.0030	0.0020	0.0670	0.0070
83.05672	N4E20	0-1	67000	7000	3.27	0.16	0.0060	0.0020	0.0390	0.0050
83.05673	N4E20	1-10	27000	3000	3.08	0.22	0.0028	0.0017	0.0910	0.0080
83.05674	N4E20	10-30	14700	1500	3.80	0.19	0.0012	0.0017	0.0090	0.0020
83.05675	S1E0	0-1	81000	8000	4.54	0.23	0.0280	0.0050	3.2900	0.1300
83.05676	S1E0	1-10	92000	9000	4.11	0.21	0.0014	0.0016	0.0570	0.0060
83.05677	S1E0	10-30	66000	7000	3.74	0.19	0.0017	0.0014	0.4390	0.0190
83.05678	S1E2	0-1	7200	800	3.83	0.19	0.0018	0.0015	0.3320	0.0160
83.05679	S1E2	1-10	8800	1000	4.09	0.21	0.0004	0.0012	0.2390	0.0120
83.05680	S1E2	10-30	15100	1600	4.19	0.21	0.0031	0.0017	0.4600	0.0200
83.05681	S1E4	0-1	42000	4000	3.51	0.18	0.0030	0.0020	0.0500	0.0060
83.05682	S1E10	0-1	18500	1900	3.73	0.19	0.0210	0.0030	1.2900	0.0500
83.05683	S1E10	1-10	11600	1200	3.59	0.18	0.0026	0.0013	0.1280	0.0080

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05684	S1E10	10-20	22000	2000	4.05	0.20	0.0024	0.0014	0.2110	0.0110
83.05685	S1E12	0-1	5400	700	4.13	0.21	0.0026	0.0014	0.1280	0.0080
83.05686	S1E12	1-10	36000	4000	3.77	0.19	-0.0013	0.0016	0.0460	0.0050
83.05687	S1E12	10-30	12500	1300	4.56	0.23	0.0080	0.0020	0.3240	0.0180
83.05688	S1E14	0-1	19000	2000	4.07	0.20	0.0030	0.0017	0.1830	0.0110
83.05689	S1E14	1-10	19000	2000	3.81	0.19	0.0032	0.0012	0.0760	0.0060
83.05690	S1E14	10-30	14000	1500	3.83	0.19	0.0009	0.0015	0.0870	0.0070
83.05691	S1E16	0-1	5100	600	2.96	0.21	0.0010	0.0020	0.0100	0.0030
83.05692	S1E16	1-10	18400	1900	3.60	0.18	0.0024	0.0018	0.2710	0.0140
83.05693	S1E16	10-30	13300	1400	4.96	0.25	0.0038	0.0019	0.3350	0.0180
83.05694	S1E18	0-1	12800	1400	3.53	0.25	-0.0010	0.0020	0.0340	0.0050
83.05695	S1E18	1-10	15400	1600	4.24	0.21	-0.0011	0.0017	0.1510	0.0110
83.05696	S1E18	10-30	8100	900	4.33	0.22	0.0005	0.0013	0.0920	0.0080
83.05697	S1E20	0-1	13000	1400	4.27	0.21	0.0030	0.0020	0.3600	0.0200
83.05698	S1E20	1-10	46000	5000	4.45	0.22	0.0029	0.0015	0.2030	0.0100

[a]Mayfield (1983).
[b]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[c]Upper limit background levels from Purtymun (1987).

TABLE 16.2-XI
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (ppm)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
84.04056	B-1	0-1	4800	600			0.0009	0.0018	0.5200	0.0200
84.04057	B-1	1-10	2700	400			0.0054	0.0017	0.6000	0.0200
84.04058	B-1	10-14	2400	300			0.0008	0.0017	0.3900	0.0200
84.04059	B-2	0-1	2400	300			0.0043	0.0016	1.4800	0.0500
84.04060	B-2	1-10	1800	300			0.0080	0.0020	1.0700	0.0400
84.04061	B-2	10-18	1800	300			0.0070	0.0020	1.1800	0.0400
84.04062	B-3	0-1	2500	300			0.0220	0.0040	3.0700	0.1100
84.04063	B-3	1-10	2300	300			0.0228	0.0098	7.3900	0.3100
84.04064	B-3	10-25	2400	300			0.0017	0.0014	0.3900	0.0180

[a]Mayfield (1984).
[b]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[c]Upper limit background levels from Purtymun (1987).

TABLE 16.2-XII
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-1, 3, & 5
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-1 DPS-1, 3, 5		DPS-3 DPS-1, 3, 5	DPS-5		DPS-1	DPS-3	DPS-5
0-1	Soil	0.4	1.2	0.5	3.1	12.6	4.5	<0.4	<0.5
1-2	Soil	0.5	0.3	0.9	3.0	4.3	4.8	<0.4	<0.5
2-3	Soil	0.7	0.1	0.3	3.6	1.6	2.7	<0.4	<0.5
3-5	Tuff	0.3	0.1	0.1	2.4	1.5	3.4	<0.4	<0.5
5-10	Tuff	0.3	0.6	0.1	6.0	1.3	1.5	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.4	2.7	0.0	3.6	<0.4	<0.5
15-20	Tuff	0.7	0.1	0.3	3.6	0.0	1.3	<0.4	<0.5
20-25	Tuff	0.4	0.1	0.3	2.2	0.1	1.6	<0.4	<0.5
25-30	Tuff	0.3	0.1	1.0	1.0	0.1	7.6	<0.4	<0.5
30-35	Tuff	0.2	0.5	0.5	1.2	1.6	3.1	<0.4	<0.5
35-40	Tuff	0.3	0.4	0.2	0.6	0.7	0.9	<0.4	<0.5
40-45	Tuff	0.4	0.0	0.2	1.2	0.1	2.5	<0.4	<0.5
45-50	Tuff	0.4	0.1	0.3	0.0	0.7	4.6	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XIII
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-2 & 4
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]		Gross beta-gamma (d/m/g)[a]		Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-2	DPS-4	DPS-2	DPS-4	DPS-2 & 4	DPS-2 & 4
0-1	Soil	0.9	0.3	9.1	4.3	<0.4	<0.5
1-2	Soil	0.5	1.1	2.8	4.9	<0.4	<0.5
2-3	Soil	0.8	0.0	0.6	0.0	<0.4	<0.5
3-5	Tuff	0.6	0.2	0.3	0.0	<0.4	<0.5
5-10	Tuff	0.3	0.3	1.8	1.9	<0.4	<0.5
10-15	Tuff	0.6	0.1	2.5	1.3	<0.4	<0.5
15-20	Tuff	0.6	0.5	3.3	0.6	<0.4	<0.5
20-25	Tuff	0.5	0.9	2.1	4.6	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XIV
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-6, 8, & 11
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-6 DPS-6, 8, 11		DPS-8 DPS-6, 8, 11	DPS-11		DPS-6	DPS-8	DPS-11
0-2	Soil	0.8	0.6	0.3	6.1	3.3	2.1	<0.4	<0.5
2-5	Soil	0.7	0.5	0.6	4.6	4.9	4.0	<0.4	<0.5
5-10	Soil & tuff	0.8	0.4	0.4	4.0	5.8	1.3	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.5	3.3	3.6	1.9	<0.4	<0.5
15-20	Tuff	0.8	0.4	0.5	5.2	2.2	2.8	<0.4	<0.5
20-25	Tuff	1.2	0.4	0.5	5.7	1.3	1.2	<0.4	<0.5
25-30	Tuff	0.8	0.1	0.7	3.4	1.0	3.0	<0.4	<0.5
30-35	Tuff	0.5	0.6		2.7	3.4		<0.4	<0.5
35-40	Tuff	0.3	0.2	0.6	3.6	4.9	1.9	<0.4	<0.5
40-45	Tuff	0.2	0.4	0.9	2.8	4.6	2.7	<0.4	<0.5
45-50	Tuff	0.2	0.4	0.5	3.0	3.0	1.8	<0.4	<0.5

[a]Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XV
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-7&9
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]		Gross beta-gamma (d/m/g)[a]		Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-7	DPS-9	DPS-7	DPS-9	DPS-7 & 9	DPS-7 & 9
0-2	Soil	1.2	0.7	3.9	2.4	<0.4	<0.5
2-5	Soil & Tuff	0.6	0.5	3.9	2.1	<0.4	<0.5
5-10	Tuff	0.2	0.4	1.3	3.7	<0.4	<0.5
10-15	Tuff	0.3	0.5	1.5	1.8	<0.4	<0.5
15-20	Tuff	0.5	0.5	2.4	3.7	<0.4	<0.5
20-25	Tuff	0.4	0.3	2.7	1.0	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XVI
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS10, 12, & 13
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-10	DPS-12	DPS-13	DPS-10	DPS-12	DPS-13	DPS-10, 12, 13	DPS-10, 12, 13
0-2	Soil	0.4	0.8	1.0	3.1	1.2	4.3	<0.4	<0.5
2-5	Soil & tuff	0.3	0.4	0.7	3.0	1.6	0.0	<0.4	<0.5
5-10	Tuff	0.8	0.4	0.4	2.5	0.4	2.1	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.7	2.7	1.0	2.8	<0.4	<0.5
15-20	Tuff	0.6	0.4	0.6	4.3	0.0	0.0	<0.4	<0.5
20-25	Tuff	0.5	0.5	0.8	2.7	3.0	0.9	<0.4	<0.5
25-30	Tuff	0.2	0.8	0.9	2.1	0.9	1.9	<0.4	<0.5
30-35	Tuff	1.0	0.4	0.4	0.7	0.6	0.4	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XVII
1983 PERIMETER SUBSURFACE SOIL SAMPLES

Sample Number	Sample Location	Sample Depth (ft)	Tritium Value (pCi/l)	+/-	Uranium Value (ppm)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
BKGD.[a]			7200[a]		3.40[a]		0.0050[a]		0.0250[a]		1.0900[a]	
83.04341	B-1	0-3	7500	800	3.62	0.18	0.0018	0.0012	0.2060	0.0100	0.0628	0.0368
83.04342	B-1	3-8	20000	2000	3.56	0.18	-0.0006	0.0009	0.0029	0.0013	0.0162	0.0207
83.04343	B-1	8-13	23000	2000	3.59	0.18	0.0003	0.0006	0.0024	0.0011	0.0525	0.0271
83.04344	B-1	13-18	32000	3000	3.34	0.18	0.0004	0.0000	0.0011	0.0010	-0.0547	0.0357
83.04345	B-1	18-23	22000	2000	3.35	0.18	0.0006	0.0010	0.0050	0.0010	0.0382	0.0667
83.04353	B-2	0-3	8500	900	3.56	0.18	0.0018	0.0009			-0.0580	0.0362
83.04354	B-2	3-8	17700	1800	3.52	0.18	0.0007	0.0010	0.2540	0.0110	-0.7230	0.0770
83.04355	B-2	8-13	28000	3000	3.24	0.18					0.0530	0.0687
83.04356	B-2	13-18	20000	2000	3.50	0.18	0.0005	0.0010	0.0070	0.0020	0.0463	0.0556
83.04357	B-2	18-23	34000	4000	3.68	0.18	0.0026	0.0010	0.0020	0.0010	0.0330	0.0664
83.04358	B-2	23-28	36000	4000	3.71	0.18	-0.0014	0.0000	0.0003	0.0000	0.0975	0.0474
	(cm)											
83.04346	B-1	23-28			3.34	0.18	0.0010	0.0000	0.0017	0.0010	0.0647	0.0415
83.04347	B-1	28-33			3.68	0.18	0.0003	0.0010	0.0023	0.0010	0.0665	0.0529
83.04348	B-1	33-38			3.61	0.18	0.0004	0.0000	0.0014	0.0000	0.0457	0.0721
83.04349	B-1	38-43			3.80	0.18	0.0007	0.0000	0.0007	0.0000	-0.4170	0.0372
83.04350	B-1	43-48			3.34	0.18	0.0004	0.0010	0.0009	0.0010	-0.2400	0.0345
83.04351	B-1	48-53			3.71	0.18	0.0009	0.0000	0.0003	0.0000	0.0357	0.0261
83.04352	B-1	53-58			3.51	0.18	0.0019	0.0010	0.0110	0.0020	-0.0012	0.0323
83.04359	B-2	28-33			3.63	0.18	0.0007	0.0010	0.0036	0.0010	-0.2060	0.0213
83.04360	B-2	33-38			3.70	0.18	0.0010	0.0010			0.0305	0.0305
83.04361	B-2	38-43			3.49	0.18	-0.0008	0.0010			-0.1590	0.0385
83.04362	B-2	43-48			3.53	0.18	-0.0003	0.0010			-0.0017	0.0332
83.04363	B-2	48-53			3.39	0.18	-0.0004	0.0000			-0.0027	0.0571
83.04364	B-2	53-58			3.53	0.18	-0.0007	0.0000			-0.7170	0.0355

[a]Upper limit background levels from Purtymun (1987).

16.3 SWMU 21-016 Material Disposal Area (MDA) T

16.3.1 Site Description

Material Disposal Area T (MDA T) is located at DP West as shown in Fig. 16.3-1 (LASL 1976c). The area of MDA T is approximately 0.89 ha (2.21 ac). MDA T consists of four absorption beds used to dispose of liquid wastes, a retrievable waste storage area, and a series of disposal shafts used to dispose of wastes mixed with cement.

Several SWMU subunits and areas of concern resulted from the activities conducted at this MDA. They are described in Table 16.3-I. This field sampling plan addresses potential contamination from all of these subunits.

The first disposal units at MDA T were four absorption beds. These absorption beds were approximately 36.6-m long (120-ft) x 6.1-m wide (20-ft) x 1.8-m (6-ft) deep. A cross section of the beds (Nyhan et al. 1984) is shown in Fig. 16.3-2. The two sources of liquid waste for the absorption beds in 1946 were

- sumps collecting effluent from Buildings 2, 3, 4, and 5 at DP West that discharged effluent to the distribution box located between beds 1 and 2; and
- the floor drain leading directly from Building 12 at DP West to bed 1 (Fig. 16.3-3).

In 1952, Building 35, which was located to the south of the absorption beds, began liquid waste treatment operations, and afterwards the beds were used for waste disposal on an intermittent basis until 1967.

The next disposal units at MDA T were a series of shafts located mainly between beds 2 and 4 (Fig. 16.3-1). The shafts were augered starting on May 1, 1968, and were used to dispose of cement paste wastes from liquid waste treatment processes at Building 257. Forty-nine of the shafts were 2.4 m (8 ft) in diameter with a 1.2-m (4-ft) pilot hole to determine suitability of the geologic material. Thirteen of the shafts were 1.8 m (6 ft) in diameter. These solid waste disposal shafts were initially expected to go to a depth of 18.3 m (60 ft), but, as shown in Table 16.3-II, their depth varied because of the presence of a boulder zone encountered between 15- to 32-ft depths in some shafts. The shafts were lined with asphalt prior to disposal of wastes.

The final disposal activity was a retrievable waste storage facility excavated in 1974 between absorption beds 1 and 3 (Fig. 16.3-1). A pit, 9-m (30-ft) wide by 18-m (60-ft) long and 6-m (20-ft)

deep, was used to store corrugated metal pipes that were 0.75 m (2.5 ft) in diameter and 6-m (20-ft) long. During 1984 and 1986, these pipes were removed from MDA T and relocated to MDA G.

16.3.1.1 Site History

MDA T is one of the oldest disposal areas at the Laboratory. Table 16.3-III is based on archival information dating back to 1945 and provides a chronological sequence of events and data that pertain to MDA T. A brief history is given below for each disposal unit.

16.3.1.1.1 Absorption beds.

There are two references (Abrahams 1962 and Purtymun 1967) that state MDA T was receiving wastes as early as 1943, but the earliest record of any disposal activity is 1945. Fowler (1964) indicated that the absorption beds were constructed "about 1945." The absorption beds were used until 1952 when Building 35, the industrial liquid waste treatment facility (SWMU 21-010, see Sec. 16.4), was constructed to treat the wastes "because the tuff in the beds had become clogged with suspended solids" (Christenson and Thomas 1962).

Christenson and Thomas (1962), reported that 39.56 m3 (10450 gal.) of ammonium citrate waste were discharged to the absorption beds in 1951 and 1952. The nature of the waste effluent is discussed further in Sec. 16.3.1-3.

Although after 1952 effluent from the liquid waste treatment at Building 35 was discharged to DP Canyon north of the absorption beds, records indicate that some wastes from DP West continued to be discharged to the beds from 1952 to 1965 (Table 16.3.IV).

From 1965 to 1967, wastes from DP-East were discharged to the absorption beds (Table 16.3-IV). The composition of these wastes is unknown.

16.3.1.1.2 Disposal Shafts

The filling of the disposal shafts was started in May 1968 (Christenson 1969). The term shaft is used here, rather than pits cited in the original memorandums. Figure 16.3-1 shows the shafts are mainly located between absorption beds 2 and 4. Depths of the shafts are given in Table 16.3-II. The operation of filling these shafts involved mixing wastes such as "neutralized americium," "strip," alkaline fluoride, and plant sludge with cement in a pug mill operation at Building 257 and discharging the slurry to the asphalt-lined shafts. In addition, some shafts during certain intervals received unspecified volumes of wash water. In a memorandum dated January 6, 1971,

Christenson (1971a) indicated that the wash water contained unaccounted activity. Also, five shafts (numbers 3, 17, 18, 19, and 26) had bathyspheres containing $^{239/240}Pu$ buried at various depths within the cement-filled shafts. The shaft-filling sequence is partially recorded in memorandums from Christenson (1969, 1970a, 1970b, 1971a, 1971b, 1972a, 1972b, 1973a, 1973b) and Emelity (1974). This operation was discontinued in April 1983.

16.3.1.1.3 Retrievable Waste Storage Area

In 1974, a retrievable waste storage area was excavated between Pits No. 1 and 3 (Fig. 16.3-1). The retrievable wastes contained either 10 nCi/g transuranic radionuclides or 100 nCi/g ^{238}Pu and were to be stored in a retrievable manner for a minimum of 20 years (H Division 1975). The retrievable waste was pumped from the pug mill into corrugated metal pipes (CMP) 0.75 m (2.5 ft) in diameter and 6 m (20 ft) in length. The bottom of each CMP was capped with a 0.3 m (1 ft) plug of "cold cement," and the top was capped with another 0.3 m (1 ft) plug after the pipe was filled. Operations ended in 1983, and beginning in August 1984, CMPs were relocated to MDA G (Becker et al. 1985). Nyhan and Drennon (1990) reported that 69 CMPs were removed in 1984, and 158 CMPs were removed in 1986. Following the removal of the CMPs, the site was reclaimed, and no further waste storage activities occurred at MDA T.

16.3.1.1.4 Surface Spills

Two surface spills of ^{241}Am paste at MDA T are identified as areas of concern C-21-009 and C-21-012 (Table 16.3-I). Additionally, potential surface releases may have occurred from SWMU 21-028(a).

Area of concern C-21-009. A 1978 spill of ^{241}Am in a cement paste occurred at MDA T while filling asphalt lined shafts. The paste was removed and the area was decontaminated (LANL 1990). Since no records exist of the location of this 1978 cement paste spill, any contamination found around the asphalt-lined shafts at MDA T could not be directly attributed to this 1978 spill. However, since the surface and subsurface characterization activities detailed in this chapter address the area occupied by the asphalt-lined shafts, if any residual contamination exists from this 1978 spill it will be detected as part of MDA T characterization.

Area of concern C-21-012. This area of concern resulted from a 1976 spill of cement paste contaminated with ^{241}Am and plutonium that spilled during the filling of a corrugated metal pipe (LANL 1990). The location of this particular spill is unknown; therefore any contamination between absorption beds 1 and 3 could not be directly attributed to this spill. However, the surface

and subsurface field sampling described in this section will characterize this part of MDA T, and any residual contamination remaining from this spill will be addressed.

SWMU 21-028(a). This was a satellite container storage area for alcohol, acetone, and freon located within the MDA T fence that has been inactive since January 1990. Under RCRA generator guidance, when a storage area is removed by the Environmental Surveillance Group (HSE-8), all materials stored and any visually present stained soil from spills is removed. If any surface contamination remains from surface spills that may have occurred from this area, they will be detected as part of the general surface sampling for MDA T (see Sec. 16.3.4.1.2).

16.3.1.1.5 Surface Stabilization

In 1987, the surface of MDA T inside the fenced area was stabilized. Runoff from developed areas of TA-21 south of MDA T was routed around the northwest end of MDA T in an asphalt-lined ditch (Hansen and Tillery 1987). The run-off had previously been channeled across MDA T, resulting in gully formation on the northeast corner of absorption bed number 2. MDA T was regraded to a slope of approximately 5% towards DP Canyon. A large mound of tuff on the south end of MDA T near adsorption beds 2 and 4 and also an earthen berm running east-west along the north boundary of the site were used as fill in regrading the area (Hansen and Tillery 1987). The thickness of this fill after regrading is unknown. It was covered with approximately 6 to 12 in. of topsoil prior to reseeding and mulching.

16.3.1.2 Existing Information

16.3.1.2.1 Waste Discharge Information

16.3.1.2.1.1 Radioactive contaminants

Early records for the amount and composition of effluents to the absorption beds are not available. Christenson (1973) estimated that an average of 1.4035 Ci per year of plutonium was discharged to the MDA T absorption beds between 1945 and 1951 for a total source of 9.8 Ci. This estimate was based on experience after the liquid waste treatment plant (Building 35) was established. In the same memorandum, Christenson estimated 2 Ci per year of tritium were discharged to the beds for a total of 14 Ci. Citrate wastes were disposed from June 1951 to July 1952 with a plutonium count of 7,000 c/min/ml. Nyhan and Drennon (in preparation) reported a concentration of 6,300 pCi Pu/ml for the citrate wastes. Assuming that these wastes were $^{239/240}Pu$, the activity of plutonium added in these wastes was 0.245 Ci. The total known discharge

to the beds is given in Table 16.3-IV, but no information is available on the composition of the low-level wastes from DP East.

The shafts between pits 2 and 4 were used for disposal of cement paste from the new waste treatment facility, Building 257. Warren (1979) listed the americium and $^{239/240}Pu$ content of these shafts (See Table 16.3-V). Included in the fourth column of Table 16.3-V is the amount of $^{239/240}Pu$ buried in the 0.91-m (3-ft) diameter bathyspheres. In addition to the americium and plutonium isotopes listed above, there was some ^{238}Pu (approximately 2.5 g) and mixed-fission products including strontium and cesium (approximately 14.8 Ci) that were disposed in the shafts (Warren 1979). All corrugated metal pipes have been removed from the retrievable storage area; therefore, it is assumed that only residual contamination remains, if any.

Table 16.3-VI summarizes available radioactivity data for known radionuclides at MDA T. As can be seen in this table, the disposal shafts represent a large source of radionuclides, especially when compared to the absorption beds.

16.3.1.2.1.2 Nonradioactive contaminants

Little data are available on other chemicals in the waste stream at MDA T. Table 16.3-VII was taken from Christenson and Thomas (1962) and gives approximate ranges as well as averages. Table 16.3-VIII describes the citrate wastes disposed between June 1951 to July 1952 (Christenson and Thomas 1962). An indication of the composition of the waste stream going into Building 257 for the period January through May 1973 can be seen in Table 16.3-IX. These wastes were not necessarily disposed in MDA T because different operations at Building 257 split the waste stream into different modes of disposal.

16.3.1.2.2 Historical Surface Sampling Data

Although data have been collected from 1946 through 1986, two detailed surface soil surveys taken in 1984 and 1986 as part of the environmental surveillance of low-level radioactive waste management areas are the most thorough and appropriate for assessing radionuclide contamination and determining data needs (Nyhan and Drennon in preparation). The 1986 data were also reported and analyzed in the "Environmental Surveillance of Low-Level Radioactive Waste Management Areas at Los Alamos During 1986" (Environmental Science Group et al. 1987).

1984 Soil Sampling. The 1984 survey sampled at grid points on a 20- by 20-m grid at depths of 0 to 1 cm, 1 to 10 cm, and 10 to 30 cm. The samples were analyzed for tritium, $^{239/240}Pu$, and

^{238}Pu. This survey showed very few elevated tritium levels, that is, levels above the 7200 pCi/L used as an upper limit for background (Purtymun et al. 1987). These elevated levels occurred in samples from the deeper depth intervals in the area between the northern fence and Absorption Bed 4. Figure 16.3-4 shows the 1984 sample locations and the tritium concentration contours developed by Nyhan and Drennon (in preparation) for samples taken at a depth of 10-30 cm. Other depths showed similar patterns, however, the maximum levels were lower. In contrast to the tritium levels, ^{238}Pu and $^{239/240}Pu$ were above the background level at all sampling locations. These upper limits are 0.005 pCi/g for ^{238}Pu and 0.025 pCi/g for $^{239/240}Pu$ (Purtymun et al. 1987). The sample locations included areas outside the fence, on the north rim of DP Mesa (Fig. 16.3-4).

1986 Soil Sampling. The 1986 survey used a 10- by 10-m grid consisting of 75 sampling locations inside the fenced area, 16 locations along the fence, and 16 locations outside the fence across the road on the north rim of DP Mesa (Fig. 16.3.5). Samples were taken at the surface (0-5 cm). Phoswich and RASCAL survey measurements were done at all grid points. Samples from 71 of these grid points were analyzed in the laboratory for ^{238}Pu, $^{239/240}Pu$, and ^{241}Am, and ^{137}Cs. The 1986 data (Figs. 16.3-5 to 16.3-10) showed the same trends as the 1984 data and, because there were more sampling locations in 1986, we focused on this more current data.

Kriged prediction surfaces (Cressie 1988) were used to study the spatial distributions of the contaminants from the 1986 data. Figures 16.3-5 - 16.3-10 show the data, the kriged surfaces, and the corresponding uncertainty regions for Phoswich, RASCAL, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, and ^{137}Cs.

Most of the Phoswich counts exceeded Laboratory background counts (Fig. 16.3-5). Also included in Fig. 16.3-5 is the contour map of kriged phoswich levels and the corresponding uncertainty regions. These data indicate that there were elevated levels throughout the sampling region. The RASCAL data (Fig. 16.3-6) also show elevated levels. However, areas with elevated readings for phoswich and RASCAL data do not correspond, indicative of the different radiation responses of the two instruments.

Plutonium-238, $^{239/240}Pu$, and ^{241}Am levels generally exceeded their background levels (Figs. 16.3-7 and 16.3-8). These elevated levels reflect a widespread source of these nuclides on the surface of MDA T. [Note that the Laboratory's upper limit "background" level for $^{239/240}Pu$, reported by the Environmental Science Group et al. (1987) is 0.054 pCi/g, over twice that of the worldwide fallout levels reported by Purtymun (1987)]. Concentrations in soil ranged from background levels to 35 pCi/g ^{238}Pu, 70 pCi/g $^{239/240}Pu$, and 260 pCi/g ^{241}Am. These

maxima all occurred within the fenced area. However, as with previous data, contamination existed outside the fenced area adjacent to DP Canyon. Most of the ^{137}Cs concentrations (Fig. 16.3-10) that exceeded the upper background limit were outside the fence of MDA T to the north. A maximum of 42 pCi/g of cesium was observed down slope just inside the north east section of the fence.

The kriged surfaces for all three transuranics (^{238}Pu, $^{239/240}Pu$, and ^{241}Am) suggest elevated levels may persist along the southern boundary of the sampled area into the center and southern part of MDA T inside the fence (Figs. 16.3-7, 16.3-8, and 16.3-9). A region of high Phoswich predictions (Fig. 16.3-5) in the southern section of the fenced region, which was not covered by the soil samples, also suggests elevated levels may be present. However, this cannot be confirmed without additional soil sampling.

All kriged surfaces (Figs. 16.3-7, 16.3-8, 16.3-9, and 16.3-10) show that the northern perimeter of the 1986 sampling area to DP canyon deserves much more investigation. These contaminant contours also indicate a central area of elevated radioactivity that may be very local but which was not bounded by the data.

The 1986 survey also included analysis of vegetation for ^{137}Cs, ^{238}Pu (Fig. 16.3-11), $^{239/240}Pu$, and americium (Fig. 16.3-12). These data are discussed in the report, Environmental Surveillance of Low-level Radioactive Waste Management Areas at Los Alamos During 1986 (Environmental Science Group et al. 1987). This report states that ^{137}Cs concentrations in vegetation often exceeded those measured in soil from corresponding locations. Exactly what the corresponding locations were or what levels would be observed at such locations, is not clear. The maximum ^{137}Cs concentration was about 65 pCi/g, well above worldwide fallout levels. Elevated ^{137}Cs levels in vegetation were observed outside the fenced area as they were in the soil samples. Plutonium-238, $^{239/240}Pu$, and ^{241}Am also showed elevated levels and followed patterns similar to the soil samples. The report states that "all of the radionuclides were transported into the vegetation component of the system at levels predictable based on concentration ratio data in the published literature."

16.3.1.2.3 Historical Subsurface Sampling Data

Many studies have been done to evaluate subsurface radionuclide movement beneath MDA T. Most of these studies have emphasized the four absorption beds and radionuclide movement beneath them. In particular, absorption bed 1 has been studied several times, beginning in 1953.

1953 Borehole Sampling. In 1953, Herman (1954), of the United States Geological Survey (USGS), initiated a study to investigate the distribution of plutonium discharged into the beds. Five holes were drilled into and around the absorption beds (Fig. 16.3-13). Two of the holes, DPW-1 and DPW-2, were drilled between absorption beds 1 and 3 and absorption beds 2 and 4, respectively. Plutonium concentrations from all five holes are given in Table 16.3-X. Data were also collected on the mineralogy and ion exchange capacity of the tuff, and these are given in Table 16.3-XI.

These 1953 data showed that, at that time, little movement of radionuclides had occurred between the absorption beds. Higher radionuclide concentrations were present for the holes located in the beds and an obvious increase in plutonium concentration occurred in the slant hole, DPW-3, where it intersected bed 1 (Table 16.3-X).

In 1959, a caisson was constructed at the northwest corner of absorption bed 1 to study subsurface plutonium distribution. The caisson was 9.14-m (30-ft) deep, 1.83-m (6-ft) wide, and 3.66-m (12-ft) long. Two horizontal holes at 2-ft depth intervals to a 28-ft depth were drilled into the center of the absorption bed (midpoint in terms of width not geometric center of the bed). Each pair of horizontal holes was instrumented, one for soil moisture and one for gross alpha measurement. Generally, these studies showed that alpha activity had percolated into the tuff and that its concentration decreased with increasing depth (Table 16.3-XII). An increase in activity at the 12-ft depth coincides with high moisture readings at that depth (Christenson and Thomas 1962). Of primary interest are infiltration studies conducted in 1960 and 1961 in which water was added to absorption bed 1. The effect of this additional water on subsurface moisture and plutonium distribution was studied as described below.

The 1960 Infiltration experiment. In 1960, as part of the infiltration experiment, wastes from DP west were diverted into bed 1 during the period July 6 to July 31, 1960 (Abrahams 1963). Christenson and Thomas (1962) indicated that the average daily rate of this diversion was 32.93 m^3/d (8,700 gpd), and Abrahams (1963) listed a value of 30.27 m^3/d (8,000 gpd). From August 1 to September 7, 1960, Los Alamos tap water was added to bed 1 (Abrahams 1963). The tap water was added at a rate of 24.98 m^3/d (6,600 gpd) according to Christenson and Thomas (1962) and 24.61 m^3/d (6,500 gpd) according to Abrahams (1963).

To study the effect of this additional water, six holes were drilled around the periphery of bed 1 in late 1960 at locations shown in Fig. 16.3-14. These holes were air drilled and ranged in depth from 23.16 to 30.18 m (76 to 99 ft); all holes were 6.35 cm (2.5 in) in diameter. Cuttings were collected from each hole at 1.5-m (5-ft) intervals and analyzed for gross alpha (Table 16.3-XIII).

The highest gross alpha content was obtained from the hole designated DPW-2. This hole was drilled at 19° from vertical and angled under absorption bed 1. Christenson and Thomas (1962) indicated that these readings were found at depths of 9.1 m (30 ft) to 16.7 m (45 ft) below the surface. They attributed these high values to a vertical fissure.

Plastic pipe was inserted into each hole for moisture monitoring with a neutron probe (Christenson and Thomas 1962). Moisture data collected during and after the 1960 water additions are unavailable. However, Christenson and Thomas (1962) stated these data showed similar results as those obtained from the 1961 infiltration study discussed below.

The 1961 Infiltration experiment. In the 1961 infiltration experiment, 24.23 m^3/d (6400 gpd) of DP raw waste was diverted to absorption bed 1 during the period June 30 to August 1, 1961 (Christenson and Thomas 1962; Abrahams 1963). This was followed by adding tap water to bed 1 from August 2 to August 26, 1961, at the rate of 26.88 m^3/d (7,100 gpd) (Christenson and Thomas 1962; Abrahams 1963). Moisture distribution in the tuff for the 1961 experiment from the five holes drilled in 1960 can be seen in Figs. 16.3-15 and 16.3-16. (Christenson and Thomas 1962). The moisture distribution plots show that there was relatively little change in the moisture content for holes 3, 4, and 5 despite the large volume of water added during this time. This indicates that the bed had a high infiltration capacity and there was little lateral movement of water in the tuff. The limited lateral movement is further supported by the lack of contamination in the holes drilled adjacent to the absorption beds as shown in Table 16.3-XIII (Herman 1954). However, the irregular moisture curves for holes 1, A-1, and 2 suggest that percolating water may either perch (note peaks in curves) or travel rapidly along fissures. Abrupt decreases in moisture indicate rapid drainage that may be caused by fissures. Christenson and Thomas (1962) acknowledged that these factors will influence radionuclide accumulation and sorption, but exactly how they influence these events is unknown.

In 1974, a hole was cored to a depth of 4.3 m (14 ft) into absorption bed 3 (Fried et al. 1977). The ^{241}Am and $^{239/240}$Pu distributions are shown in Fig. 16.3-17. All samples were above worldwide fallout background levels. The highest levels of americium were at the surface and between 8.5 and 10 ft; and the highest levels of plutonium were at the surface and between 12.5 and 14 ft.

In 1978, holes were cored into both beds 1 and 2, and these results were reported in Nyhan et al. (1984; 1985). (See Fig. 16.3-2) Results for plutonium and americium are reproduced in Figs. 16.3-18 and 16.3-19, respectively. These data indicated that both plutonium and americium have

moved to depths of 30.5 m (100 ft) beneath bed 1. Bed 2 received only overflow effluent, and both plutonium and americium migrated a shorter distance beneath this bed than in bed 1.

16.3.1.2.4 Summary of historical data

The historical surface soil data in 1984 and 1986 indicate that MDA T and the down slope area to the north rim of DP Mesa contain elevated levels of plutonium, americium, and cesium on or near the ground surface. Levels are high at the borders of the sampling locations along DP canyon and within MDA T. The vegetation data indicate that transport of radionuclides into vegetation both within and outside MDA T has occurred. The surface of MDA T inside the fence was stabilized in 1987, and fill was added. Whether elevated surface contamination currently exists within or outside the fence is not known.

The subsurface data indicate that transport of plutonium and americium into the tuff has occurred to at least 28 to 30 m. Data beyond that depth are unavailable; therefore, the total vertical depth of the plume is unknown. The lateral extent of contamination is also unknown.

Data on contaminants other than radionuclides, such as organics, (volatile and semivolatile) and inorganics are unavailable for either surface or subsurface. However, available information on the composition of the waste stream applied to the absorption beds (Tables 16.3-VII through 16.3-IX), in addition to plutonium processing knowledge (Sec. 3.2), will provide useful information to guide future sampling (see Sec. 16.3.2).

16.3.1.2.5 Subsurface modeling of radionuclides

Attempts at simulating the subsurface pathway were conducted by Travis and Nuttall (1984) and HydroGeoLogic (1989). The study by Travis and Nuttall (1984) compared a porous media continuum approach using a linear K_d or retardation factor, a separate K_d for the tuff and clay layer, and a colloid transport model. Travis and Nuttall compared their results for plutonium with the data from Nyhan et al. (1984) for hole 1 in absorption bed 1. Their results indicated that the constant K_d values did not reproduce the observed data very well but that the variable K_d did allow plutonium transport down to the depths where plutonium was observed. The colloid transport simulation matched a peak in plutonium concentration found near 10 m in depth, but the curve quickly tailed off and was essentially below detection limits by 17 m in depth. The HydroGeoLogic simulation (HydroGeoLogic 1989) used a porous media continuum approach for water flow and contaminant transport. One aspect of this study was to use a spatially variable K_d in a layered system that reproduced the serrated concentration profile that was observed. Both of

these modeling studies were limited by available hydrologic and geochemical data.

The two modeling studies demonstrated how different conceptual views of the subsurface pathway can be applied to available data to recreate site history. In fact, both the colloid transport and distributed K_D are potential mechanisms that can occur simultaneously or over different phases during the history of the waste site. A feature of the Bandelier tuff noted by HydroGeoLogic (1989) was the rapid damping of input pulses. Abrahams(1963) reported on two infiltration studies showing that in locations where water was ponded for several months, the soil water content returned to pretest levels within a year after water application was discontinued. This is important in deciphering the behavior observed in the absorption beds at MDA T. As noted by HydroGeoLogic (1989), the soil water contents measured by Nyhan et al. (1984) may be the residual after the main pulse has passed, rather than a series of advancing pulses. Differing rates of movement of the water and radionuclides mean that the radionuclide pulse for the most part will be retarded. These results point to the need to understand the mechanisms controlling water and solute movement, rather than predicting the mechanisms from the residual evidence from past events.

The role of fractures in flow and transport is not well understood. Adequate models cannot be constructed to represent their function in variably saturated porous media. During the infiltration experiments conducted in 1960 and 1961 on absorption bed 1, there was evidence from Abrahams (1963) that the tuff was saturated and flow occurred through joints. The HydroGeoLogic (1989) report stated that the disappearance and reappearance at a lower depth of measurable plutonium is characteristic of flow in joints. One of the key issues to consider for unsaturated porous media is when, or under what conditions, flow occurs in fractures.

Lateral diversion of subsurface flow or perching of water can be caused by a discontinuity in the hydraulic properties of the tuff. The lateral movement of water has the potential of creating seeps on the canyon walls. This effect has not been documented at TA-21. Occurrence of perched water has been documented primarily in the alluvial material in canyons at Los Alamos (Abrahams 1963) and not within the main body of tuff. The alluvial water is perennial and fluctuates with snow melt and rainfall recharge. The alluvial aquifers are believed to be confined to the channels, and the presence of perched zones beneath the mesas has not been documented.

16.3.1.3 Source Term

The source of all waste disposed in MDA T was plutonium-processing waste from DP West, with the exception of waste from DP East added to the absorption beds from 1965 to 1967.

Table 16.3-VI summarizes the estimated radionuclide source terms from MDA T. The source input to the absorption beds was plutonium-processing waste, which contained organic extractants used in plutonium processing at the time it was input to the absorption beds. Some limited data are available on the composition of the waste input to the absorption beds (see Tables 16.3-VII thru 16.3-IX). No previous sampling has analyzed for metals or organics.

The material placed in the disposal shafts contains much greater activity than that added to the absorption beds; however, it was input as a cement paste into asphalt-lined disposal shafts. Again, whether organics or metals were part of this waste stream is unknown. No sampling has been done either adjacent to or beneath these shafts.

16.3.2 Objectives and Data Needs

The significant estimated radionuclide source term at MDA T and documented plutonium and americium contamination to 30 m lead to a need for extensive subsurface sampling data. Two modeling studies with different conceptual views of the subsurface pathway give similar results and indicate the mechanism controlling water and solute movement needs to be better defined. Additional surface sampling is also necessary because historical surface soil data from detailed surveys in 1984 and 1986 indicate MDA T and the down slope area to the north rim of DP Mesa contain elevated radionuclide concentrations.

The following data are needed:

1. Identification of contaminants present. Because this site received plutonium-processing waste, organic extractants and metals were likely present in the waste stream. At a minimum, a subset of surface and subsurface samples collected will require analysis for metals and organics. Because stabilization-in-place is the preferred remedial alternative, Level III/IV data will be used to define the contaminants present.

2. Determination of the vertical and lateral distribution of contaminants both within and beyond the MDA T fence.

   Surface. Previous surface sampling has shown contamination beyond the MDA T fence towards DP Canyon. Additional grid sampling and analyses for metals and organics, in addition to radioactive constituents, are needed, both within and outside the MDA T fence to define the nature and extent of surface contamination. Since these are surface samples, Level II VOA screening will be used to determine presence or absence. Level III data are required for other analyses.

   Subsurface. Subsurface sampling beneath the absorption beds beyond 30 m is required to define the vertical extent of the plume. The lateral extent of the subsurface plume, because of liquid wastes input to the

absorption beds, also needs to be defined. Emphasis will be placed on absorption bed 1 because it received the most effluent and because previous studies have shown contaminants to have migrated to the greatest depth in this bed. Additionally, data are needed on the presence of subsurface contamination and the lateral and vertical extent of contamination beneath the disposal shafts and the retrievable waste storage area. Level III/IV data will be used.

3. Characterization of all contaminant migration pathways. The vertical subsurface pathway and the surface lateral pathway (surface transport and erosion) toward DP Canyon are believed to be the most important.

4. Determination of geologic stability of the site, particularly with respect to erosion. Although this MDA is not immediately adjacent to the canyon side, the geologic stability of the site must be determined to evaluate whether capping and *in situ* stabilization of waste is a viable remedial alternative at this site.

5. Definition of the TA-21 OU conceptual model (see Chapters 7 and 12) is particularly important for this SWMU because previous modeling and field studies have not fully defined system behavior. This SWMU requires results of general TA-21 site characterization to define the importance of fractures, layering, presence of pumice inclusions, etc. This information is necessary to accurately assess the risks to human health and the environment from chemical and radionuclide contamination and to support the screening and selection of remedial alternatives.

16.3.3 Sampling investigation and rationale

No current information is available on surface contamination at MDA T because the site underwent surface stabilization in 1987. Surface sampling data will be collected on a 20- by 20-m grid within the MDA T fence and extending beyond the fence to the canyon edge north of MDA T, because previous surface sampling has indicated contamination to the north beyond the MDA T fence. This data will be analyzed in the context of the TA-21 OU surface sampling done on a 40- by 40-m grid (see Chapters 12 and 13) and the detailed drainage data (Sec. 16.1.4).

Because MDA T was a liquid disposal area, both vertical and angle boreholes will be drilled to define the source term and the lateral and vertical extent of contamination. Migration that has occurred since 1978 beneath absorption bed 1 will be evaluated by locating a drill hole close to a previous borehole.

Because only radionuclide data exist for MDA T, the initial investigation will require analyses for a full analytical suite of radionuclides, organics, inorganics, and metals.

Dependent upon results of initial sampling, the sampling program may need to be expanded. Results of mesa top characterization studies detailed in Chapters 12 and 13 will be important in

making this determination. In these additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.3.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation planned at MDA T. However, due to the large number of pages these tables have been placed in Section F.3 of Appendix F, Analytical Tables.

16.3.4.1 The MDA T Surface Sampling Plan

Samples collected inside MDA T as part of this sampling plan will be used to study erosion patterns and help assess the adequacy of the 1987 surface stabilization process. Because stabilization was only within the fence, the samples collected outside the fence will be used to characterize the extent of migration and to understand the migration patterns.

16.3.4.1.1 Initial Investigation

The kriging analysis of the 1986 data showed (Sec. 16.3.1.2.2) that additional sampling is needed to characterize the southern end of the site and the extent of migration from the northern perimeter to DP canyon. To accomplish these goals, the MDA T sampling plan will be sequential. The 40 initial investigation samples will be taken on a 20- by 20-m grid within the fence, extending to the canyon edge and coordinated with the TA-21 OU surface-sampling plan described in Chapters 12 and 13 (Fig. 16.3-20). Radiation survey instruments will be used within the 20- by 20-m gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken of any such areas to further characterize the extent of migration. In addition, samples from drainages will be collected as described in Sec. 16.1.4. These sample data will be combined and used to develop spatial prediction surfaces such as those developed for the 1986 data (Sec. 16.3.1.2.2).

Five additional samples within the MDA and five in the area to the north will be taken 5 m from grid locations. These will allow estimation of the importance of spatial variability.

All samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. Table F.3-I (see Appendix F) gives the sample screening and analysis requirements.

16.3.4.1.2 Subsequent Investigation

The need for additional sampling and the required number and locations of additional samples will be determined on the basis of the initial sample analysis results and the accuracy requirements for the prediction surfaces.

For planning purposes, it is assumed that 30 surface samples on a 10- by 10-m grid surrounding MDA T will be required in the subsequent investigation. If appropriate, a reduced analytical suite determined by analytical results from the initial investigation will be used. However, for planning purposes, it is assumed the analytical suite used in initial investigations will be used. Table F.3-II (see Appendix F) presents the assumed screening and analysis requirements for the subsequent investigations.

16.3.4.2 Subsurface Sampling Plan

The subsurface sampling plan for MDA T emphasizes the characterization of potential contamination associated with

- the four liquid waste absorption beds;
- the 63-ft deep (up to 18.3 m) asphalt-lined vertical shafts containing waste immobilized in cement; and
- the deactivated retrievable waste storage area located between absorption beds 1 and 3 (Fig. 16.3.1).

16.3.4.2.1 Initial Investigation

The initial investigation of the subsurface sampling plan will concentrate on characterizing the source terms and the vertical extent of contamination in the four liquid-waste absorption beds. The subsequent investigation of subsurface characterization at MDA T will include the continuing delineation of the contaminant plumes associated with the absorption beds; and the examination of areas beneath and adjacent to the cement-filled shafts and the retrievable waste storage area for evidence of contaminant migration.

Initial drilling in absorption bed 1 will consist of two vertical holes which are designed to characterize the source term and to define the vertical extent of the contaminant plume beneath this bed. These two drill holes will be cored to a nominal depth of 150 ft below the bed; these holes will be deepened if necessary to penetrate the contaminant plume. One of these holes will be extended 50 ft below the contaminant plume. One of the drill holes (Fig. 16.3-21) is sited in the eastern

part of absorption bed 1 next to the hole drilled in 1978 to examine contaminant migration. The second drill hole is sited at the western end of the absorption bed to assess the amount of lateral variability in contaminant distributions. Information from these two drill holes will be used to compare contaminant concentrations to 100 ft with those reported in the 1978 study by Nyhan et al. (1984).

Absorption bed 2 will be characterized by two vertical drill holes (Fig. 16.3-21). One of the holes is located at the western end of bed 2 near the inlet from the distribution box which diverted effluent into the bed. The other hole is sited at the eastern end of bed 2 next to two holes drilled in 1978 that were used to examine contaminant concentrations with depth. Both holes in bed 2 will be drilled to a nominal depth of 75 ft. Information from the eastern hole will be used to assess the amount of contaminant migration that has occurred since 1978 (Nyhan et al. 1984).

Initial drilling in absorption beds 3 and 4 will consist of a single vertical drill hole located near the center of each bed. Fried et al. (1977) drilled to 14 ft in bed 3 and found elevated levels of plutonium and americium to that depth. Absorption bed 4 has not been previously drilled, and it is not known if radionuclides or other contaminants have migrated beneath it. It should be noted that beds 3 and 4 served as an overflow catchment to beds 1 and 2, respectively, and probably received relatively small amounts of contaminated effluent. The vertical holes in these beds are located near the inlet of the overflow pipes from beds 1 and 2 and thus probably represent the areas of maximum contamination. The nominal depth of each of these holes is 75 ft.

Samples for contaminant characterization in vertical holes will be collected at varying intervals along the length of the drill holes. More closely spaced samples will be taken at the interface separating the absorption beds from the underlying tuffs. Samples will be collected at 2.5-ft intervals in the absorption beds and across the interface separating the absorption beds and the underlying tuffs. Below the absorption beds, samples will be collected at 5-ft intervals. These sample intervals may be modified because of variable amounts of core recovery and to meet requirements for greater sample volumes for laboratory analyses. Samples for soil moisture determination will be collected at 5-ft intervals.

The nominal depth of the drill holes is given in Fig. 16.3-21. The borehole stopping criteria in Sec. 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. In the initial investigation, the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table F.3-III (see Appendix F).

One vertical hole in absorption bed 1 will be extended 50 ft below the contamination plume to determine whether the liquid waste infiltrating beneath MDA T has altered rock properties. In this region of this hole, samples will be analyzed at 10-ft intervals for geochemical parameters and mineralogy as detailed in Sec. 12.5.1.5 and given in Table F.3-IV (see Appendix F).

An important objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways, if fractures are encountered they will be preferentially sampled. If a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to provide data allowing a comparison between fracture and nonfracture intervals. This sampling is included as a contingency for 5 additional samples in Table F.3-III (see Appendix F).

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized in all initial boreholes on 20-ft intervals of core and on additional contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.3-IV (see Appendix F).

One 300-ft borehole will be drilled at MDA T (see Fig. 16.3-21) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.3.4.2.2 Subsequent Investigation

The location of subsequent investigation holes may be modified after results of the initial investigation drilling are evaluated.

Eighteen holes have been tentatively identified for subsequent drilling at MDA T (Fig. 16.3-21). Ten of the drill holes will be inclined at 20 to 80° to sample areas adjacent to and beneath absorption beds and the cement-filled shafts (Fig. 16.3-22). The inclination and orientation of these drill holes may be modified, based on data gathered during initial drilling of the four absorption beds. Eight of the drill holes will be vertical and will penetrate to depths of 75 to 150 ft.

Seven drill holes have been tentatively located to characterize the vertical asphalt-lined shafts containing waste immobilized in cement. The area in which the shafts are placed has not been drilled previously, and it is not known if radionuclides or other contaminants have migrated from the shafts. Initially, drill holes will penetrate tuff adjacent to and below the shafts without actually penetrating the shafts themselves. Several of these drill holes also will be used to characterize

the contaminant plumes associated with the adjacent absorption beds. Five of the subsequent investigation holes have inclinations of 60° and will penetrate to depths up to 150 ft adjacent and beneath the shafts (Figs. 16.3-21 and 16.3-22). Vertical drill holes are sited near the southwest and northeast corners of the shaft site to define lateral migration of contaminants. Source term characterization of the shafts is not planned in the present drilling program but may be added later if significant contaminant migration is found.

The deactivated retrievable waste storage area located between absorption beds 1 and 3 will be characterized by four drill holes as part of the subsequent investigation. Three of the planned holes are inclined 20° and serve the dual purpose of also characterizing tuff beneath absorption bed 3. A vertical drill hole is sited in the western part of the storage area (Fig. 16.3-21).

Because subsurface lateral migration has been observed (Sec. 16.3.1.3), four subsequent investigation vertical drill holes are sited along the northeast fence line next to DP Canyon (see Fig. 16.3-20). These holes will penetrate to a depth of 150 ft and will be used to assess the possible lateral migration of contaminants towards DP Canyon.

A reduced analytical suite, based on results from the initial investigation will be used in the subsequent investigations. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.3-V (see Appendix F) details the assumed screening and analysis requirements for the subsequent investigations.

Shallow angle boreholes beneath MDA T will help determine the presence of vertical fractures and enable evaluation of their importance as potential preferential transport pathways. Therefore, if fractures are encountered they will be preferentially sampled. If a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to compare analytical results for fracture and nonfracture intervals. A five-sample per borehole contingency is planned for fracture sampling, as indicated in Table F.3-V.

Depending on results of hydrogeological parameter determinations in both the planned OU-wide 300-ft vertical boreholes and the MDA T initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional subsequent investigations for characterization will be determined after results from the initial and subsequent investigations are evaluated. No additional phases are detailed herein.

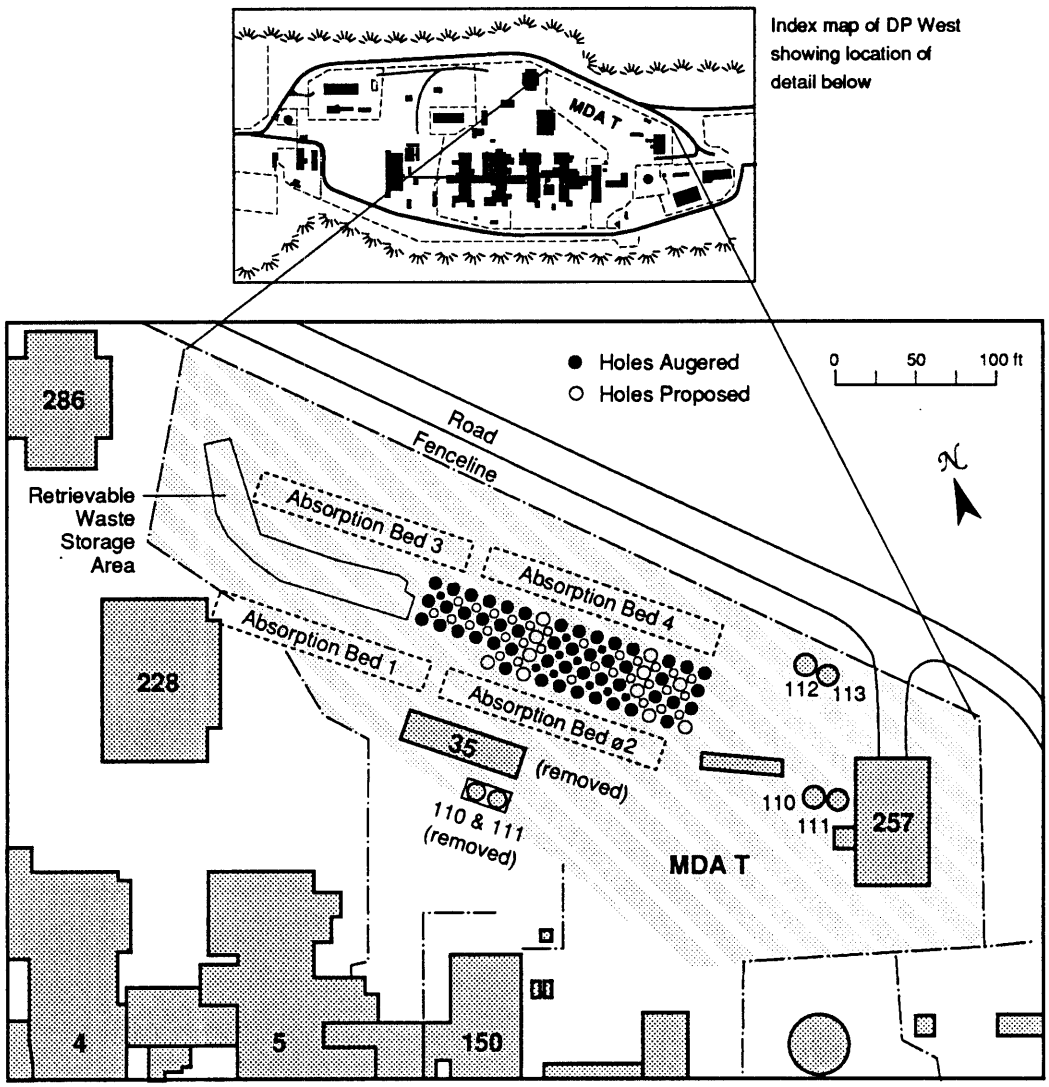


Fig. 16.3-1 General base map of MDA T showing locations of absorption beds, cement-filled shafts, the Retrievable Waste Storage Area, and Buildings 35 and 257. (LASL 1976c)

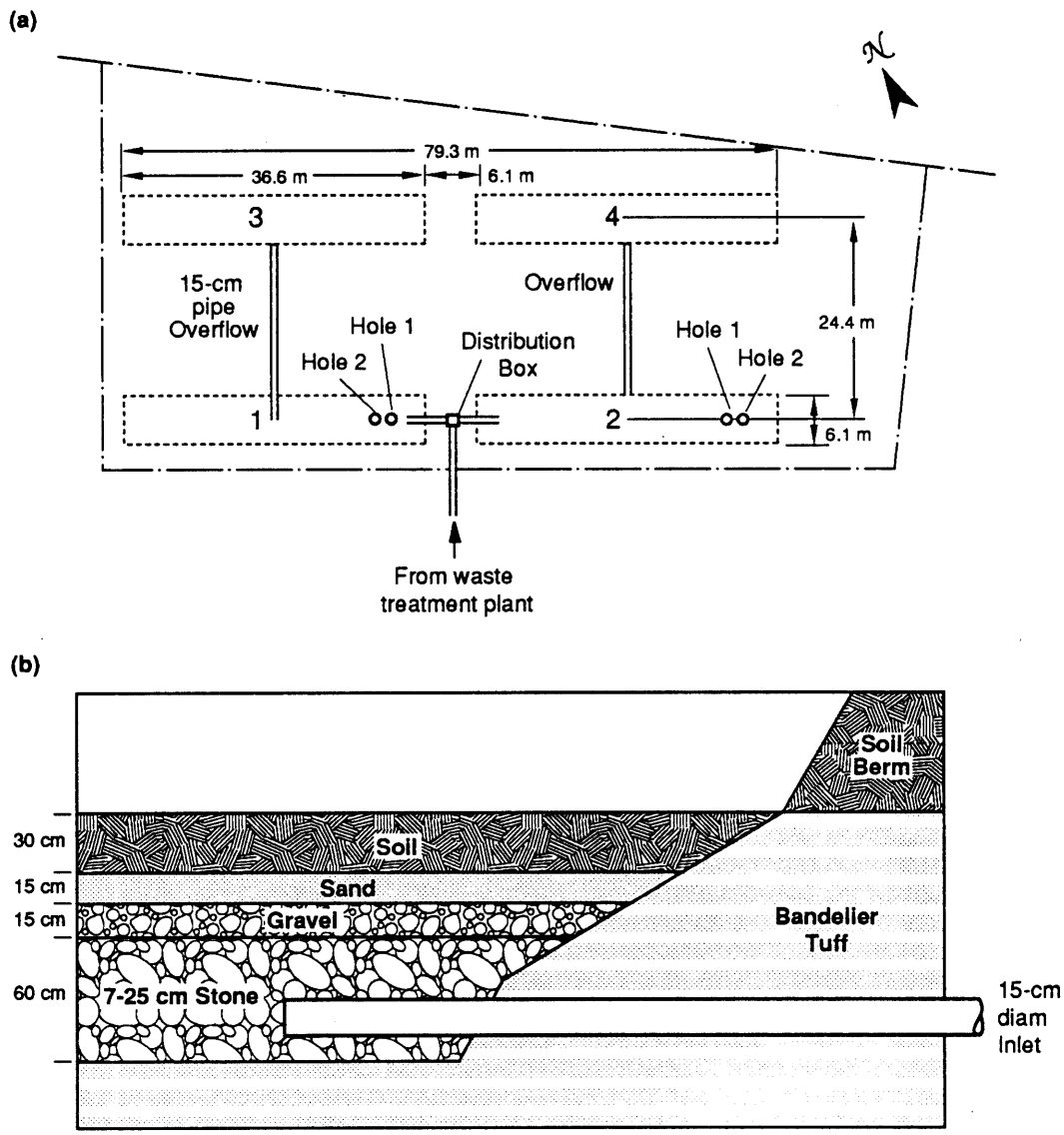


Fig. 16.3-2 Design of absorption beds at MDA T from Nyhan et al. (1984) showing a plan view (a) and cross section (b).

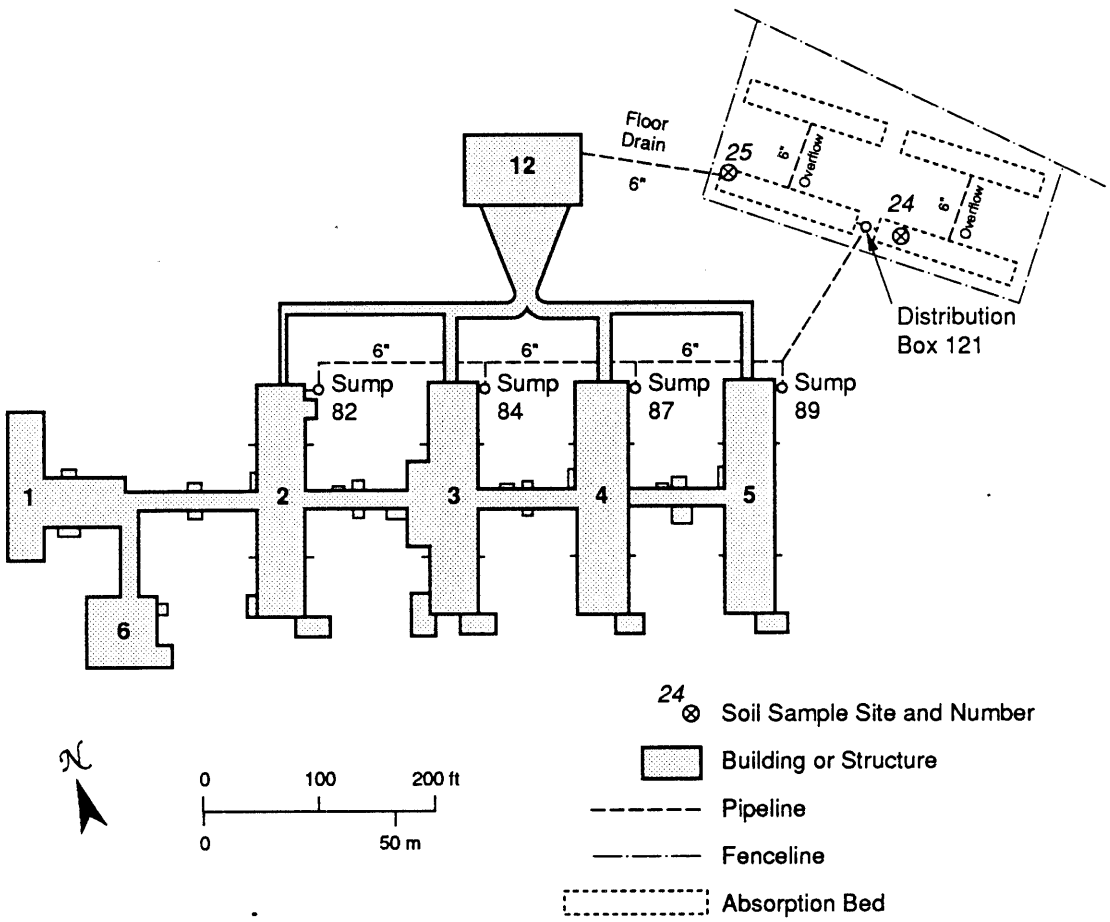


Fig. 16.3-3 Location of lines discharging to absorption beds at MDA T prior to 1952. (LASL 1945)

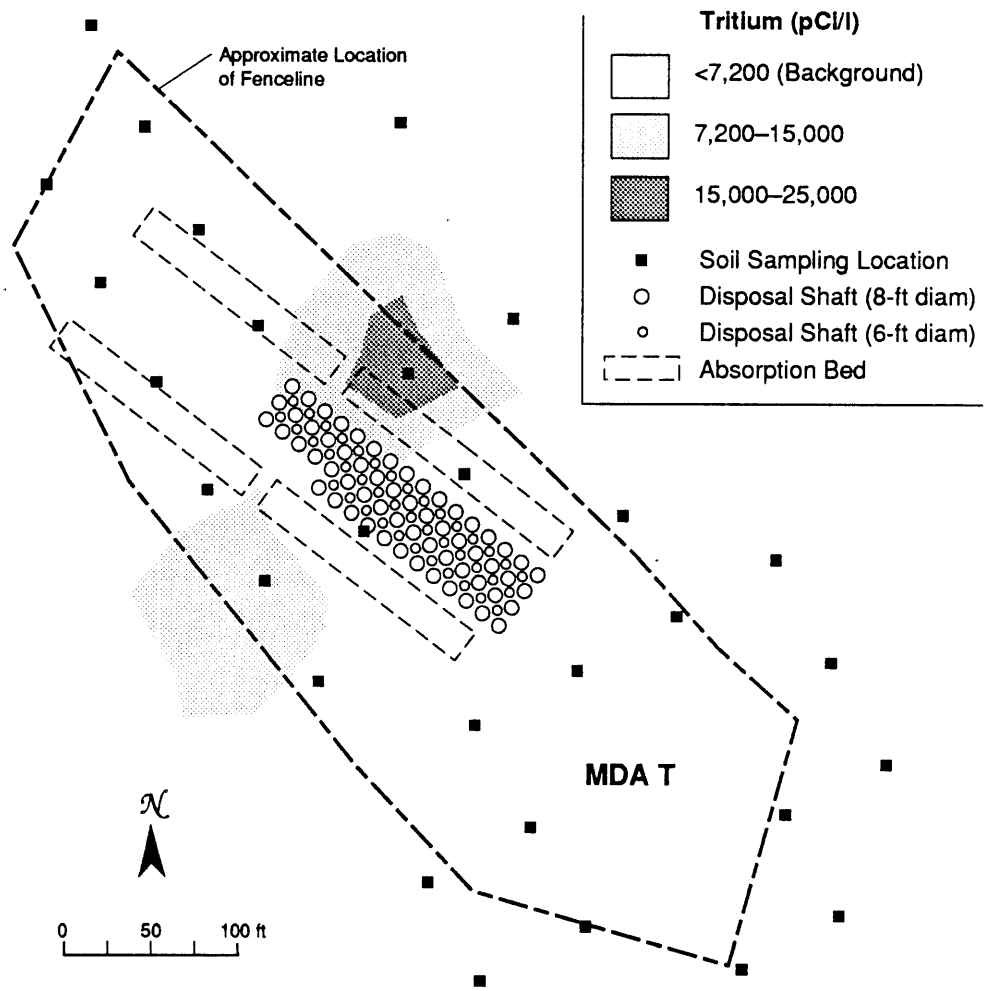
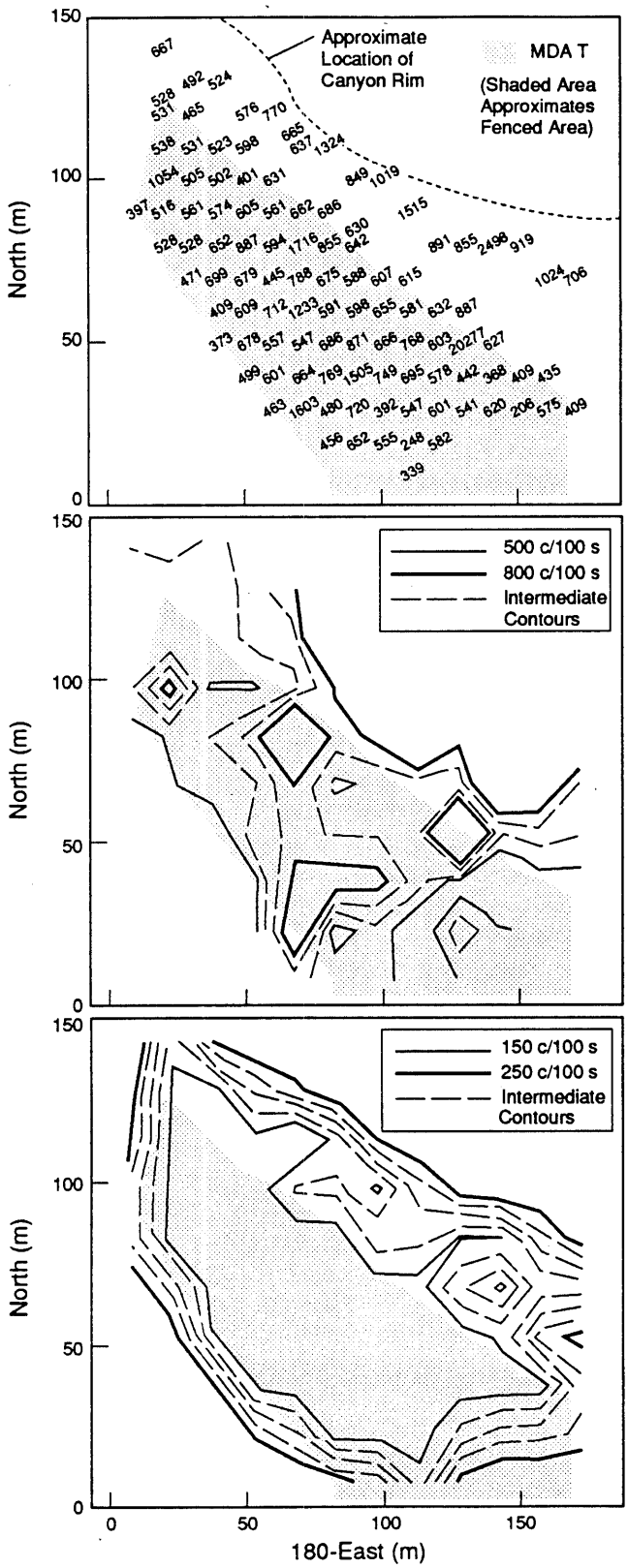


Fig. 16.3-4 Sample locations and soil tritium concentration contours for the 1984 sampling grid at MDA T (10- to 30-cm depth). (Nyhan and Drennon 1990)



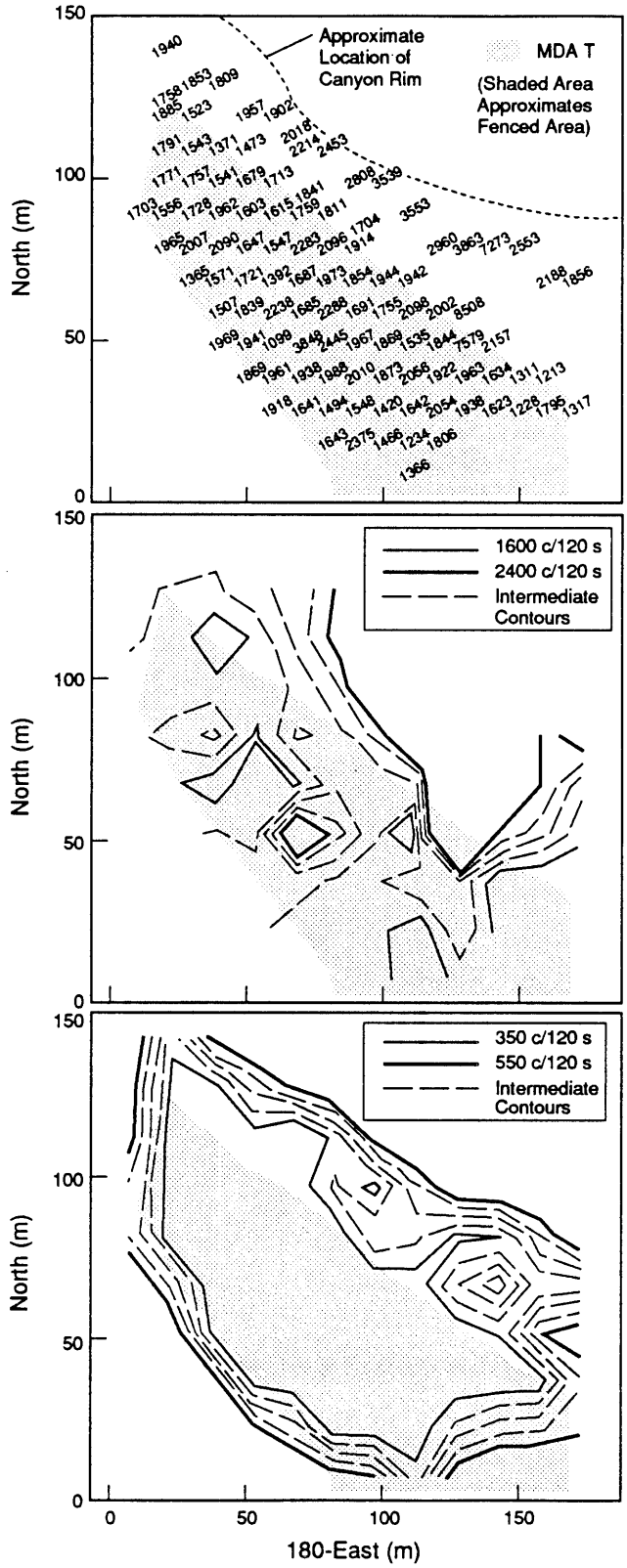
Phoswich Counts per 100 Seconds

Background <385 c/100 s
(Environmental Science Group 1987)

Kriged Phoswich

Phoswich Prediction Errors (+/-)

Fig. 16.3-5 Phoswich data from 1986 Survey for Environmental Surveillances for MDA T.



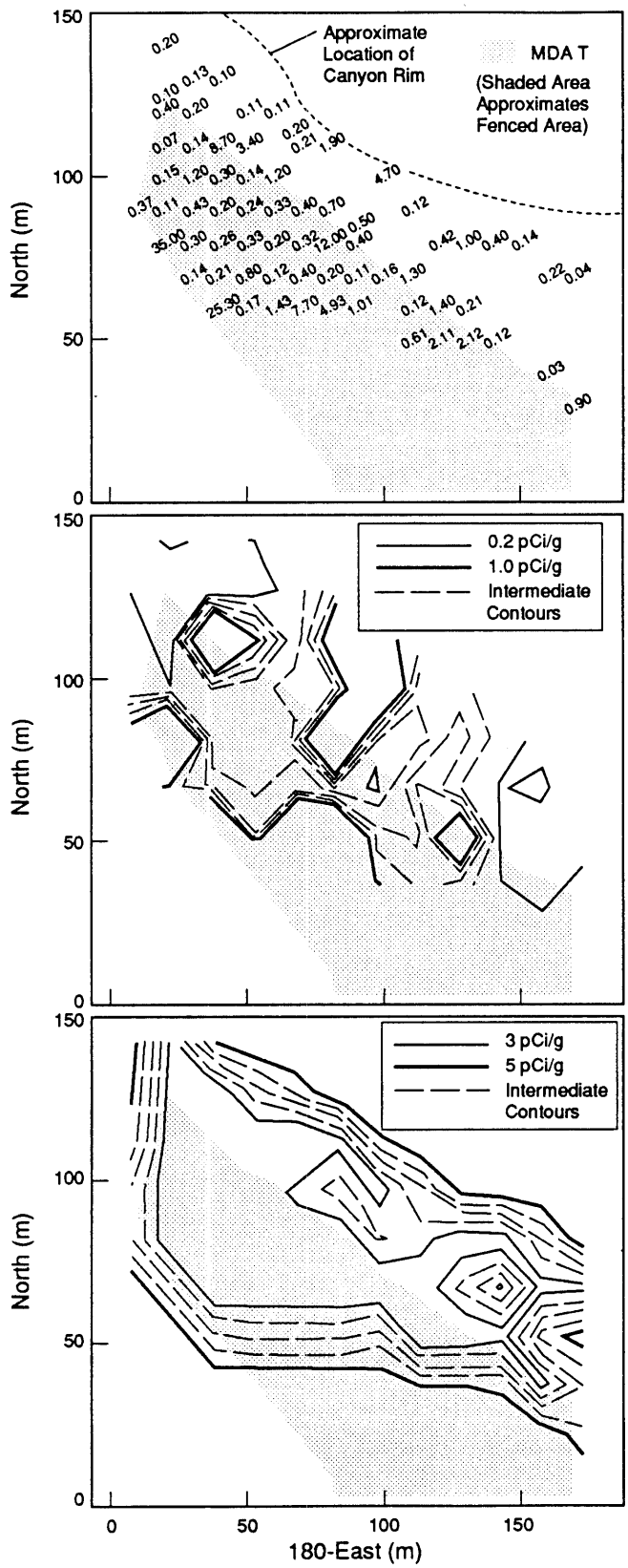
RASCAL Counts per 120 Seconds

Background <1,418 c/120 s
(Environmental Science Group 1987)

Kriged RASCAL

RASCAL Prediction Errors (+/-)

Fig. 16.3-6 RASCAL data from 1986 Survey for Environmental Surveillances for MDA T.



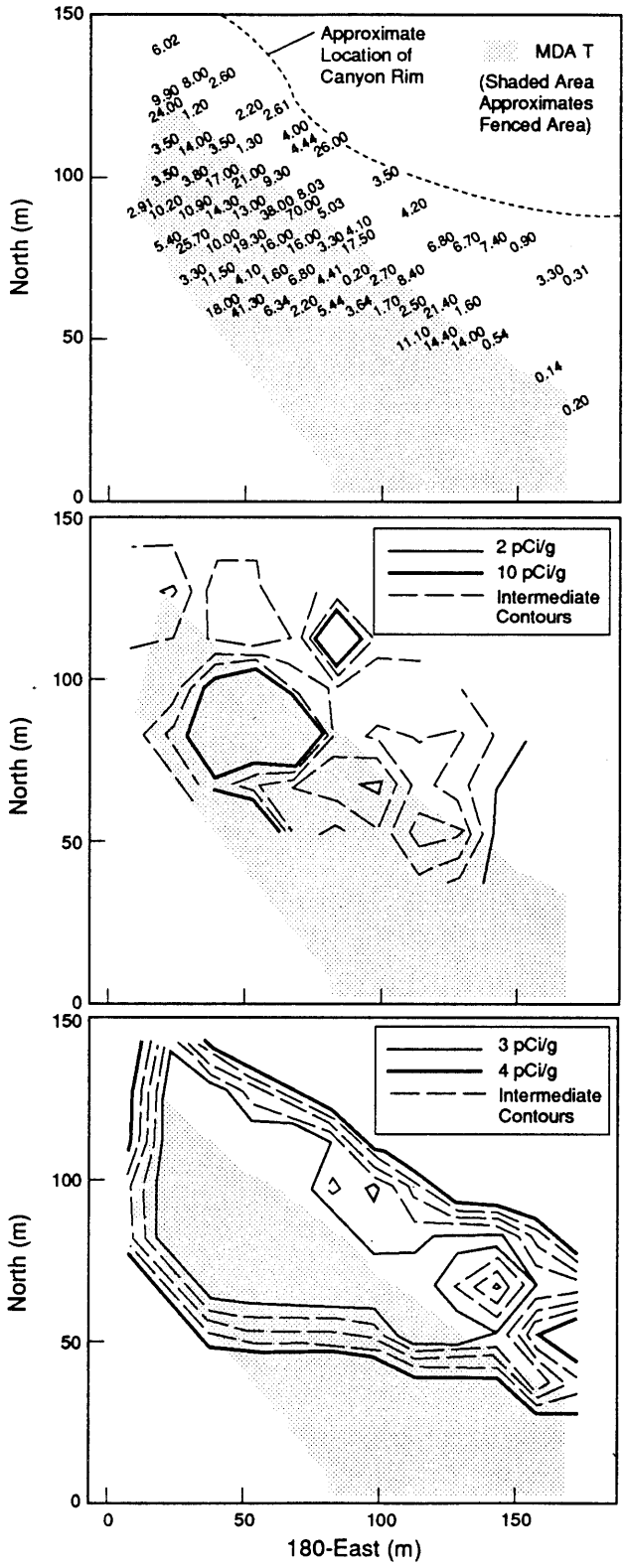
Plutonium-238 (pCi/g)

Worldwide Fallout Background <0.005 pCi/g (Purtymun et al. 1987)

Kriged Plutonium-238

Plutonium-238 Prediction Errors

Fig. 16.3-7 Plutonium-238 data from 1986 Survey for Environmental Surveillances for MDA T.



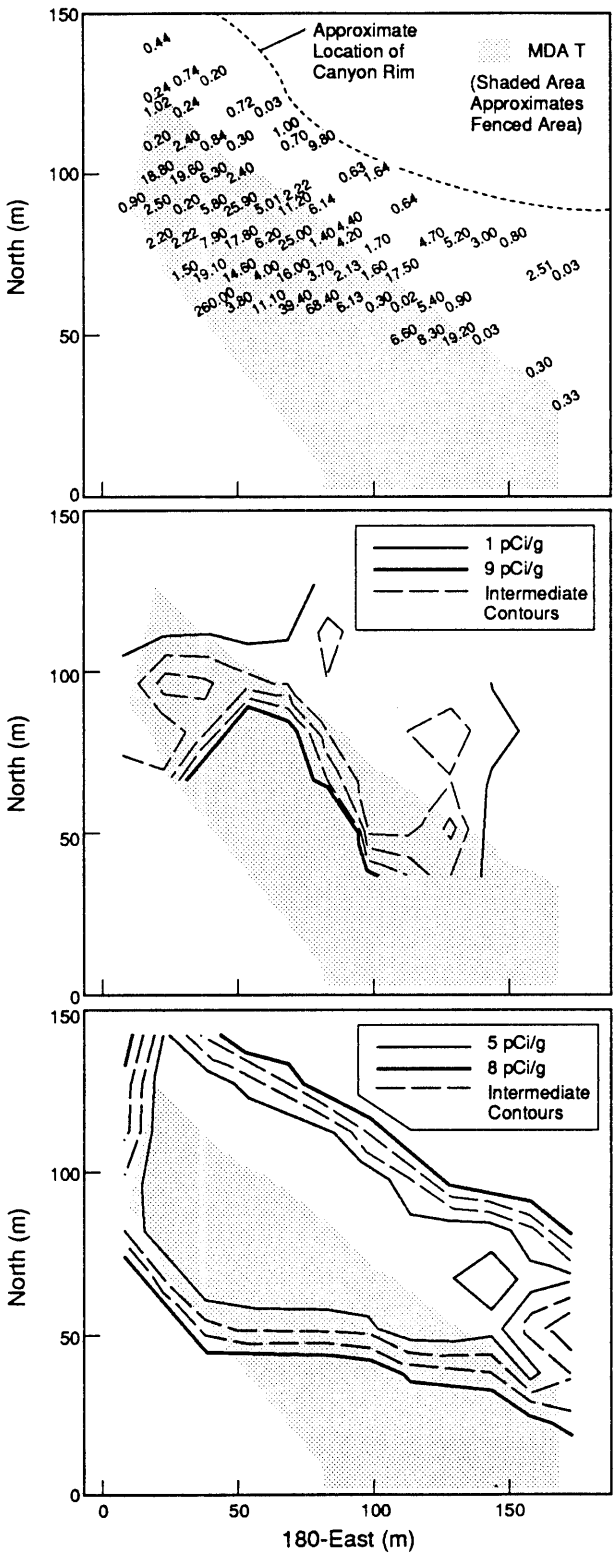
Plutonium-239/240 (pCi/g)

Laboratory Background <0.054 pCi/g (Environmental Science Group 1987)
Worldwide Fallout <0.025 pCi/g (Purtymun et al. 1987)

Kriged Plutonium-239/240

Plutonium-239/240 Prediction Errors

Fig. 16.3-8 Plutonium-239/240 data from 1986 Survey for Environmental Surveillances for MDA T.



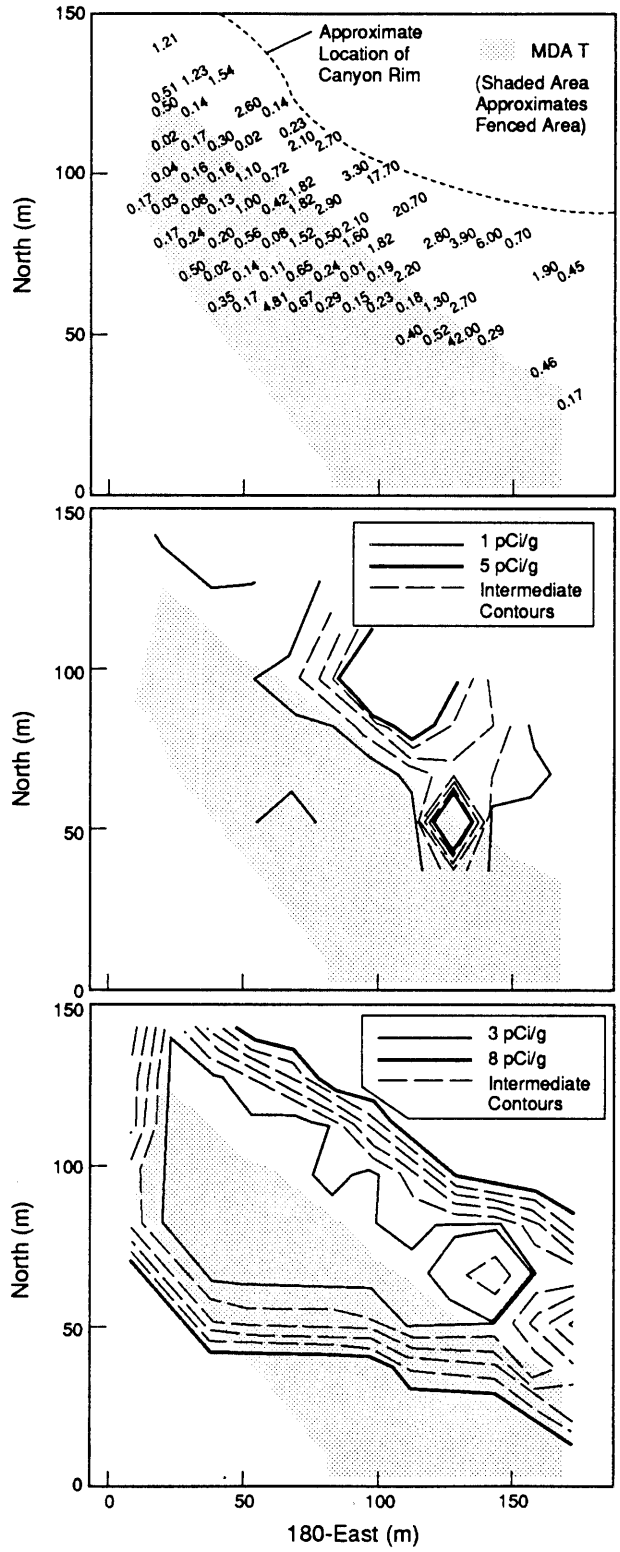
Americium-241 (pCi/g)

Background <0.23 pCi/g (Environmental Science Group 1980)

Kriged Americium-241

Americium-241 Prediction Errors

Fig. 16.3-9 Americium-241 data from 1986 Survey for Environmental Surveillances for MDA T.



Cesium-137 (pCi/g)

Worldwide Fallout Background 1.09 pCi/g (Purtymun et al. 1987)

Kriged Cesium-137

Cesium-137 Prediction Errors (+/-)

Fig. 16.3-10 Cesium-137 data from 1986 Survey for Environmental Surveillances for MDA T.

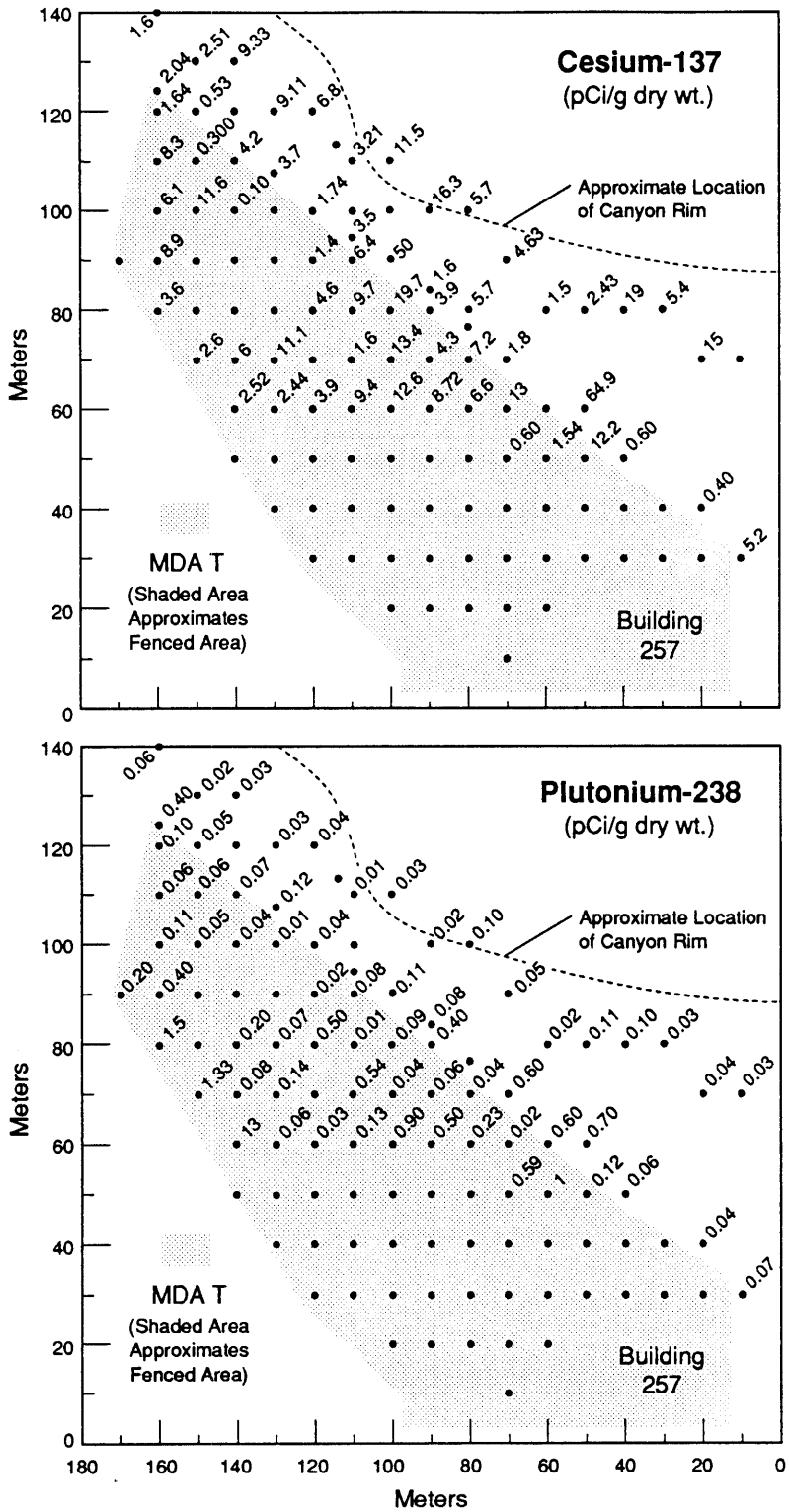


Fig. 16.3-11 Concentrations of cesium-137 and plutonium-238 in vegetation from MDA T in 1986.

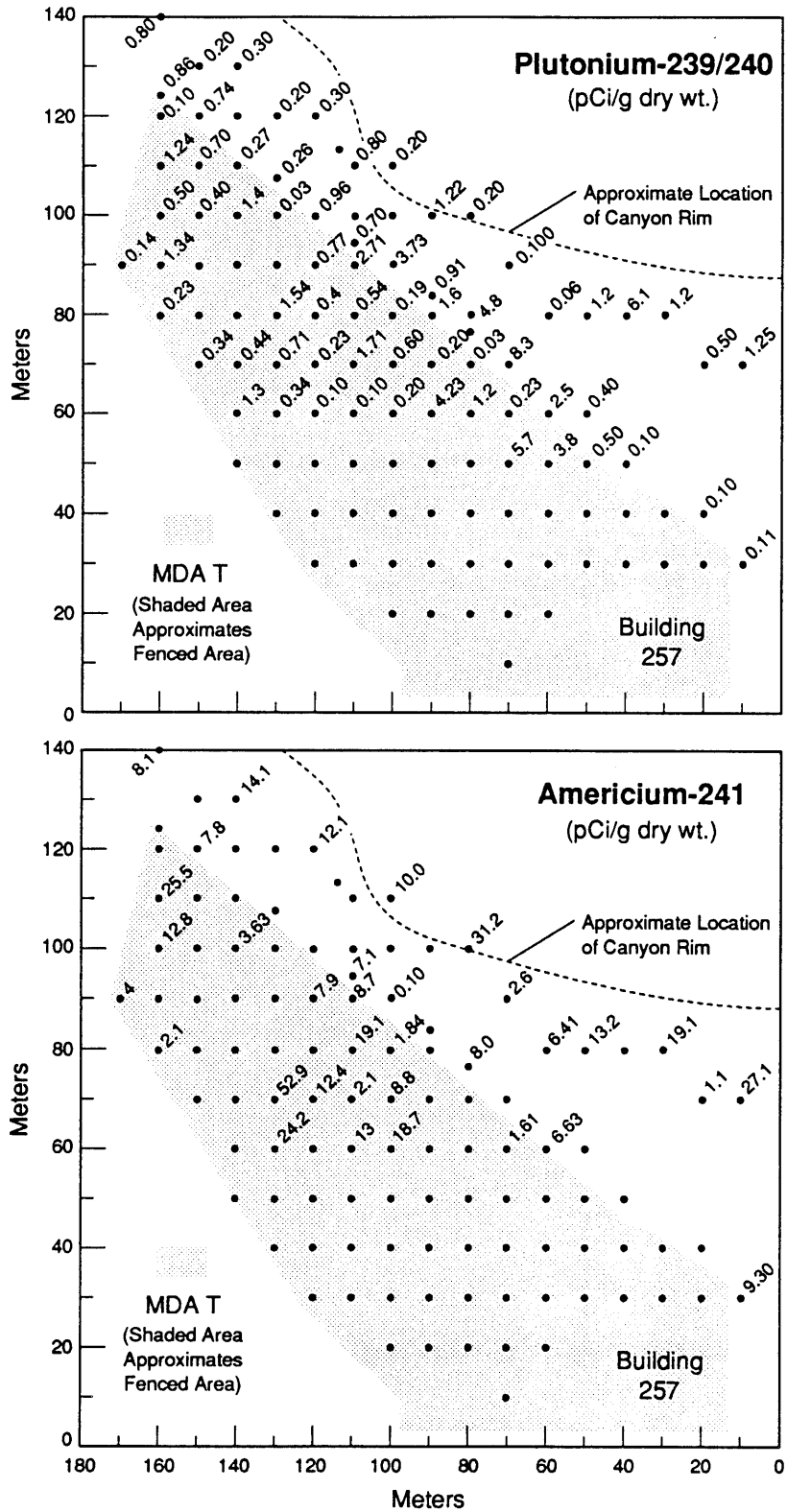


Fig. 16.3-12 Concentrations of plutonium-239/240 and americium-241 in vegetation from MDA T in 1986.

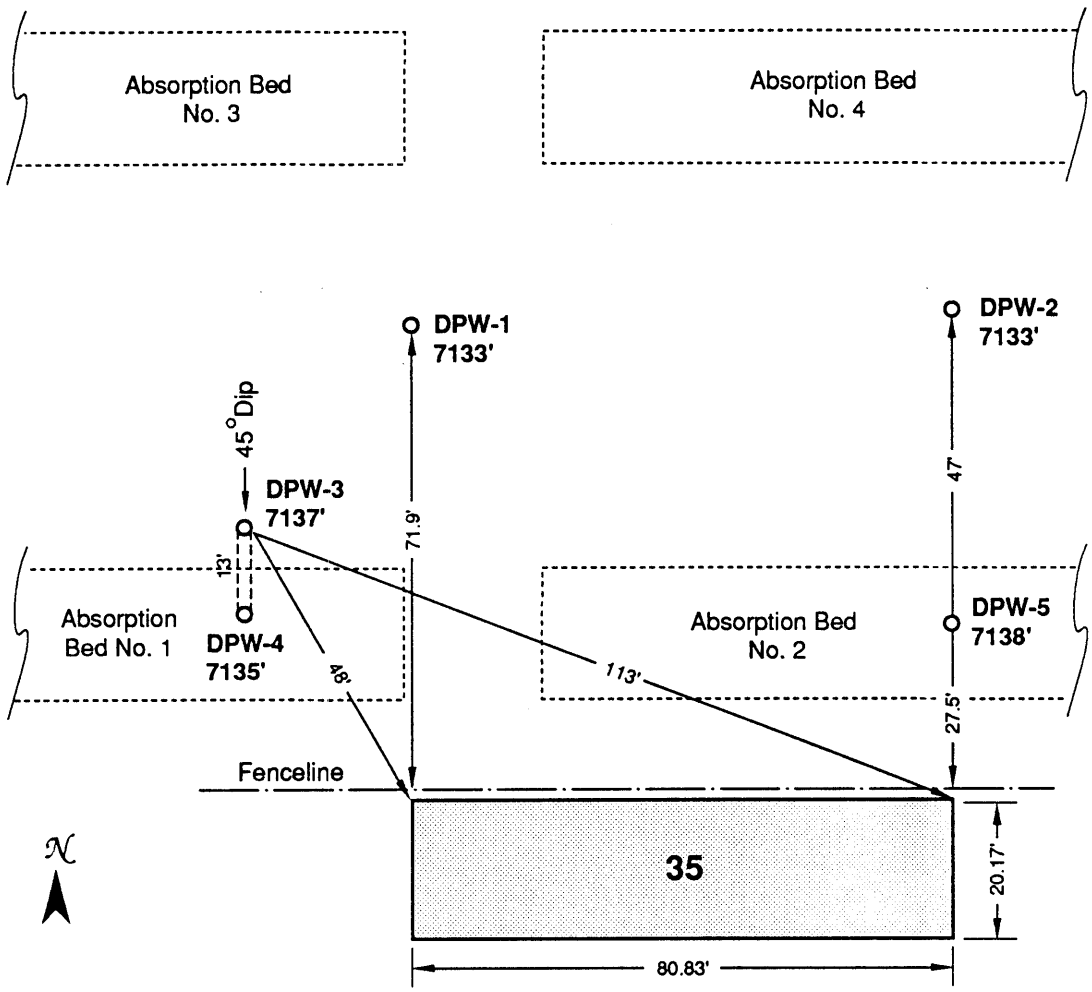


Fig. 16.3-13 Location of boreholes drilled in and around the absorption beds by Herman (1954) at MDA T.

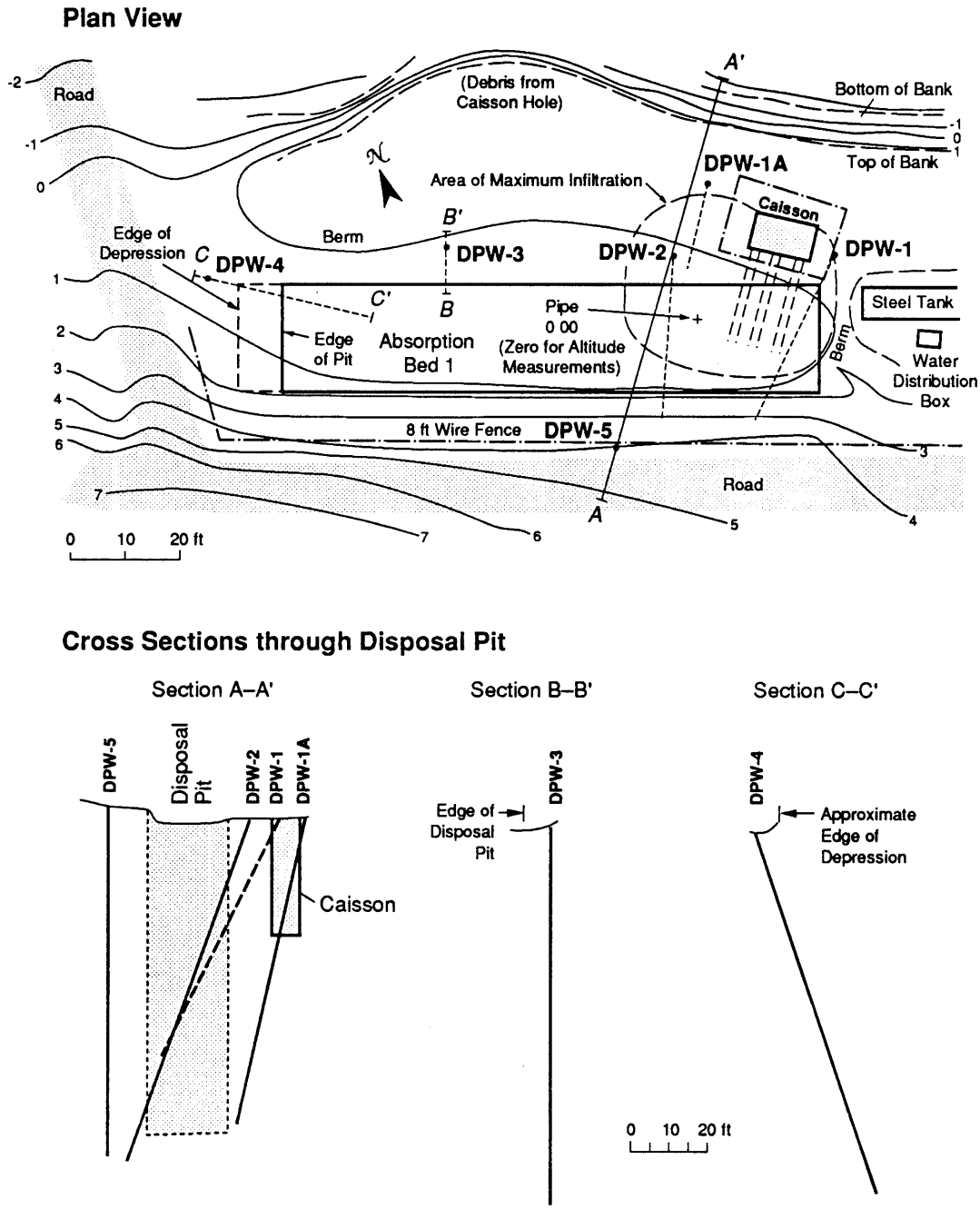


Fig. 16.3-14 Schematic of absorption bed 1 showing location of the caisson [SWMU 21-016(b)] and five boreholes drilled in 1960.

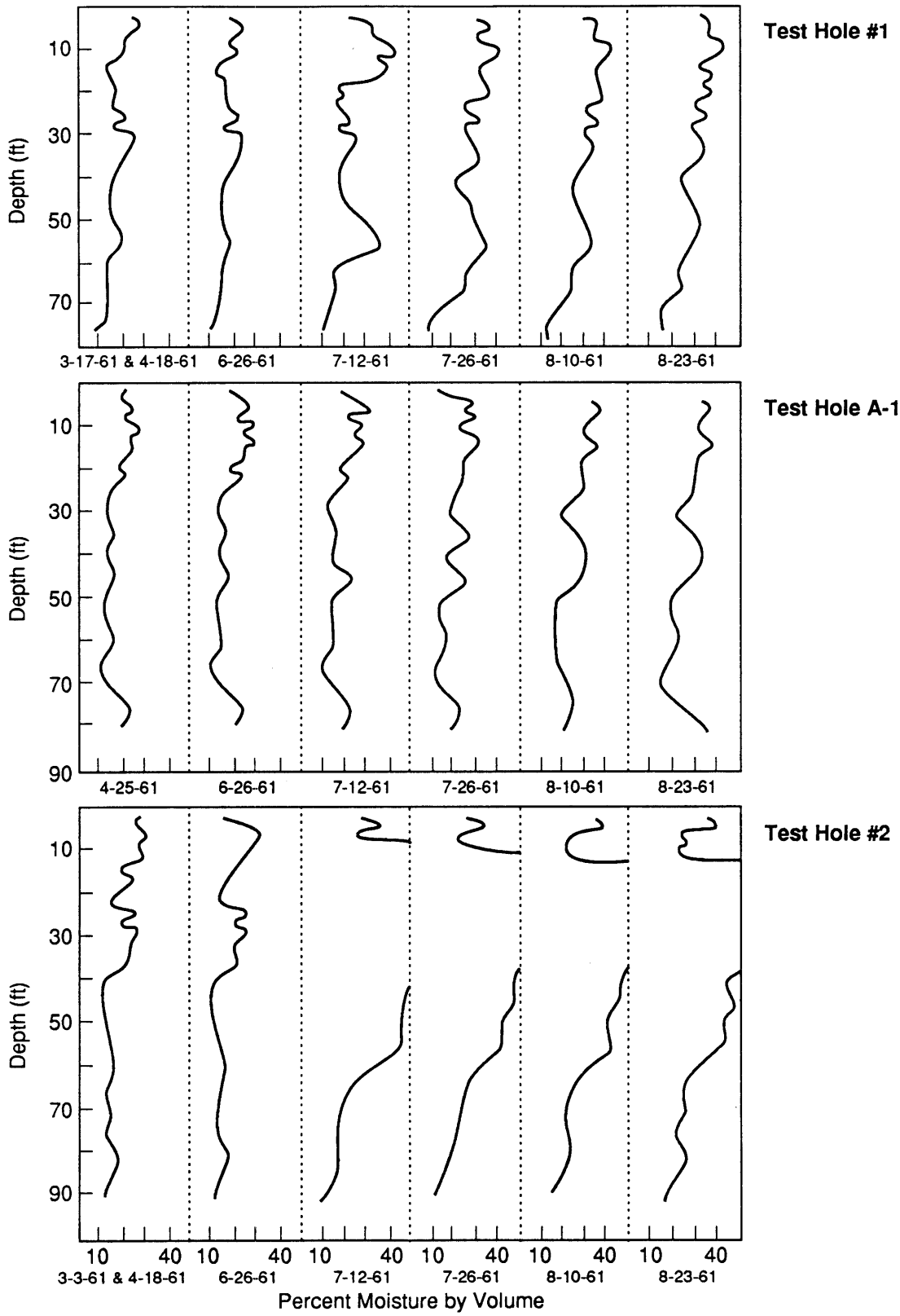


Fig. 16.3-15 Absorption bed 1 moisture distribution plots for Test Holes #1, A-1, and #2 (1961 infiltration experiment).

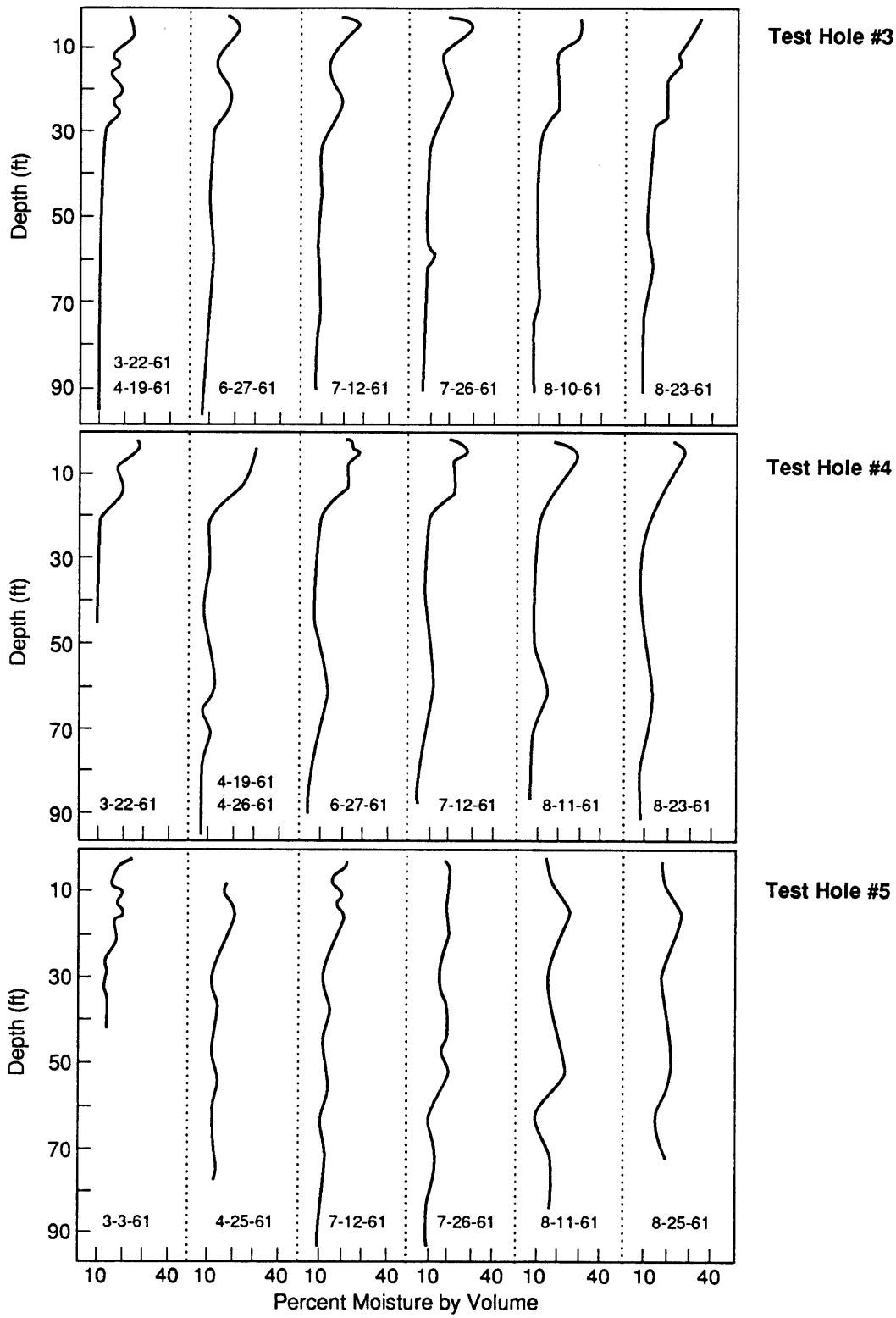


Fig. 16.3-16 Absorption bed 1 moisture distribution plots for Test Holes #3, #4, and #5 (1961 infiltration experiment).

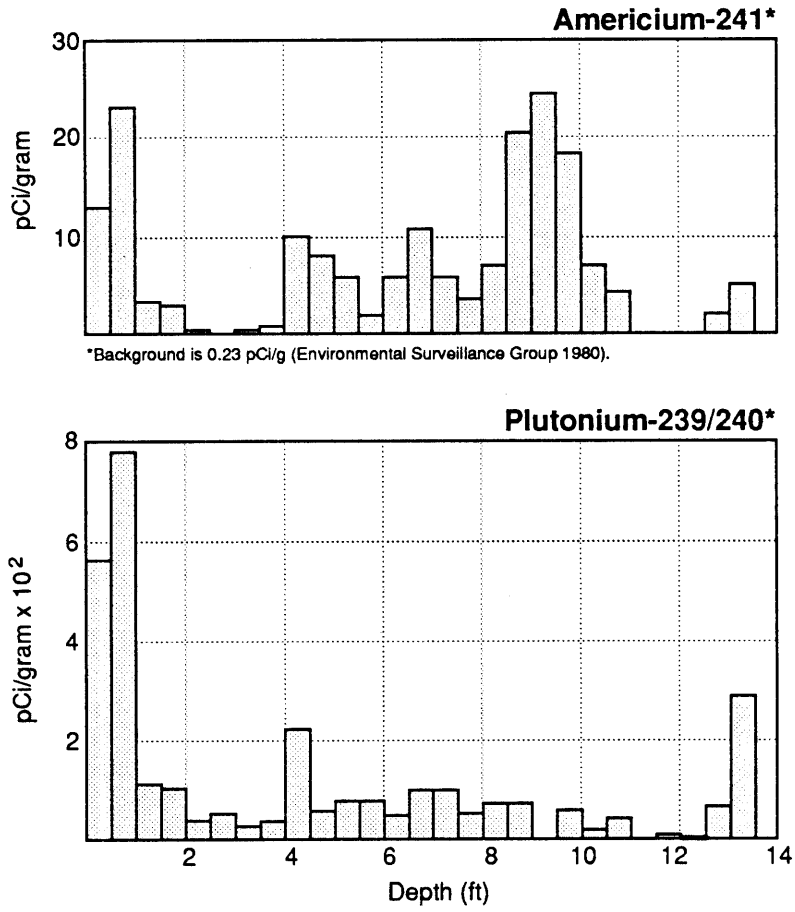


Fig. 16.3-17 Distribution of americium and plutonium in absorption bed 3 from 1974 sampling by Fried et al. (1977).

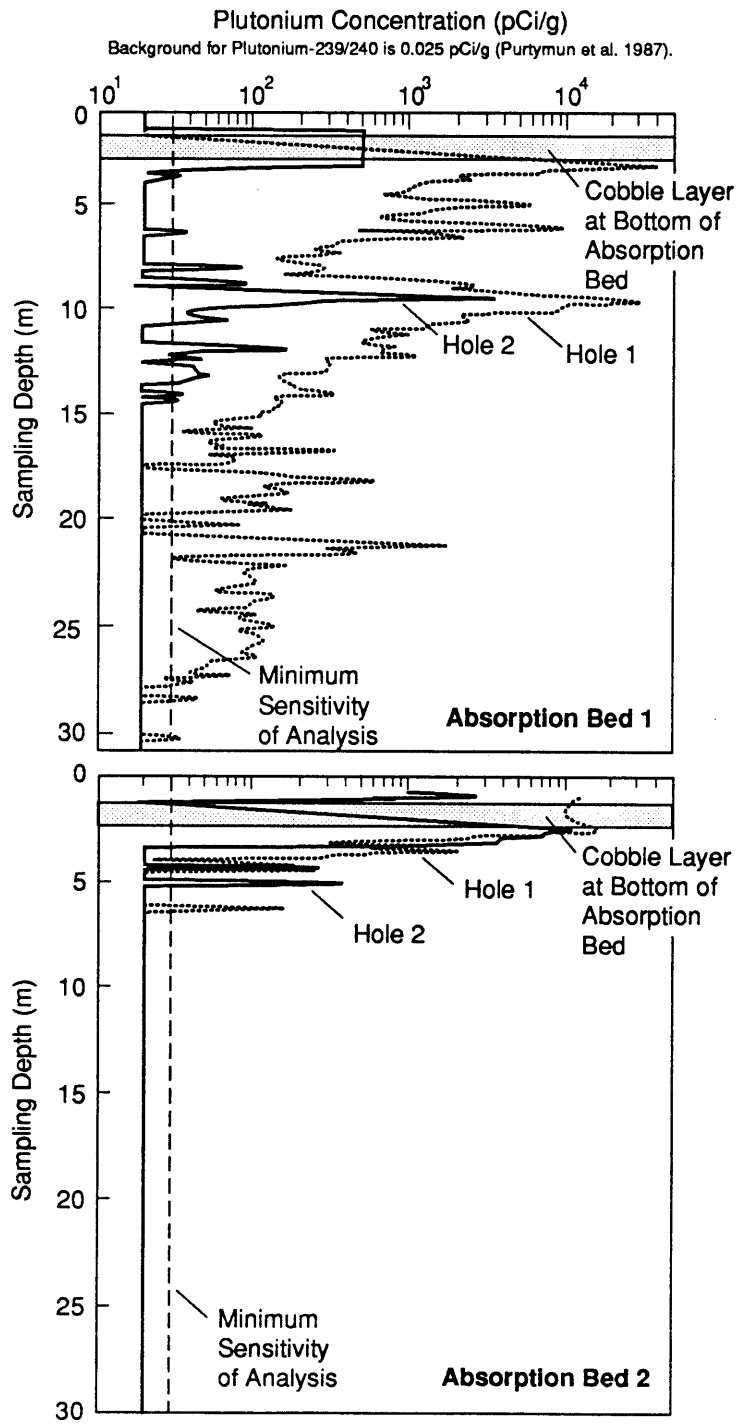


Fig. 16.3-18 Concentration of plutonium as a function of sampling depth for absorption beds 1 and 2 in 1978 from Nyhan et al. (1984).

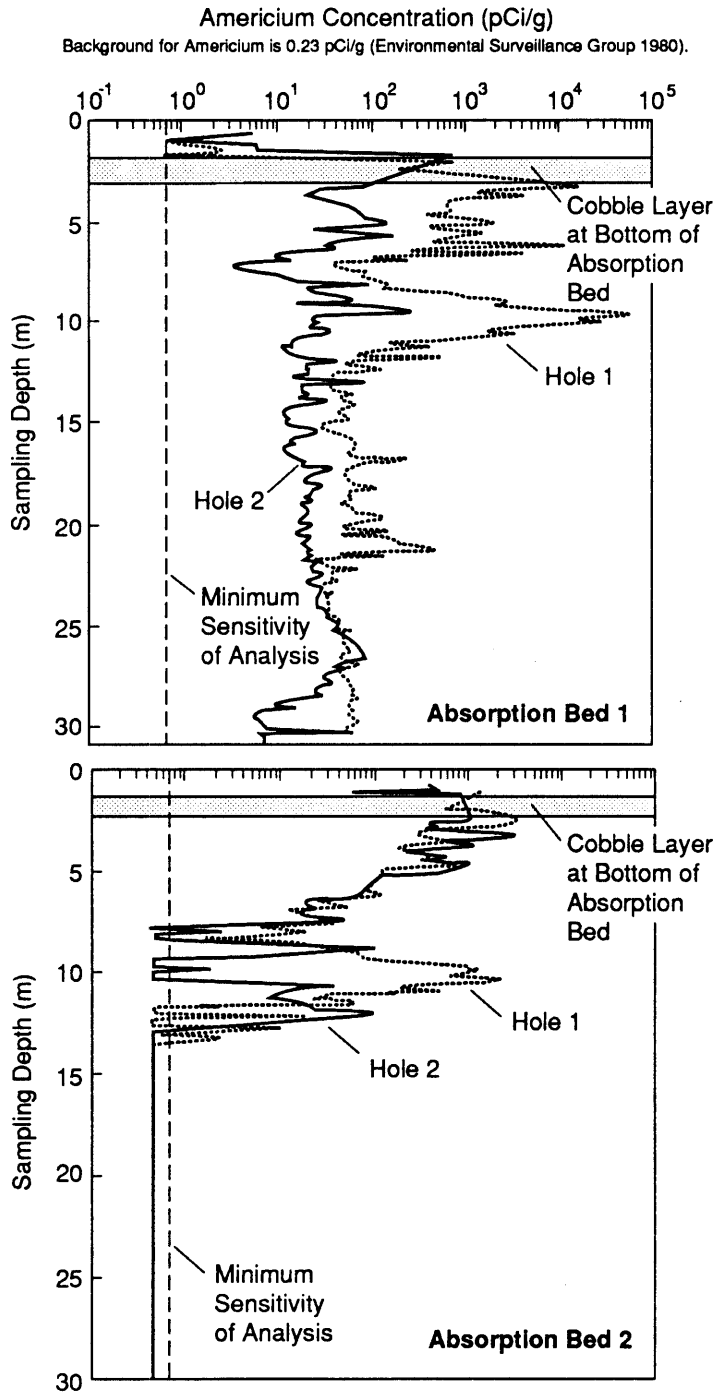


Fig. 16.3-19 Concentration of americium-241 as a function of sampling depth for absorption beds 1 and 2 in 1978 from Nyhan et al. (1984).

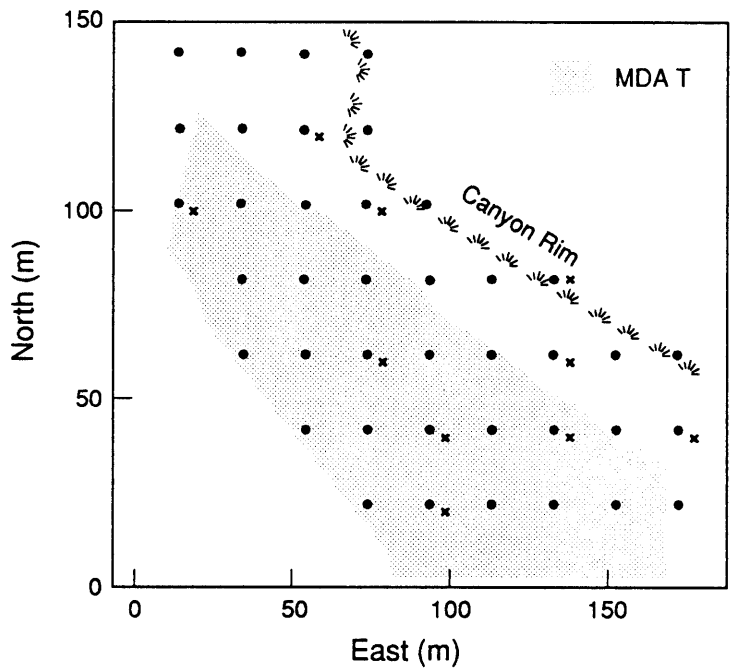


Fig. 16.3-20 Twenty-meter by twenty-meter grid for surface samples on MDA T. The x's indicate possible replicate sample locations.

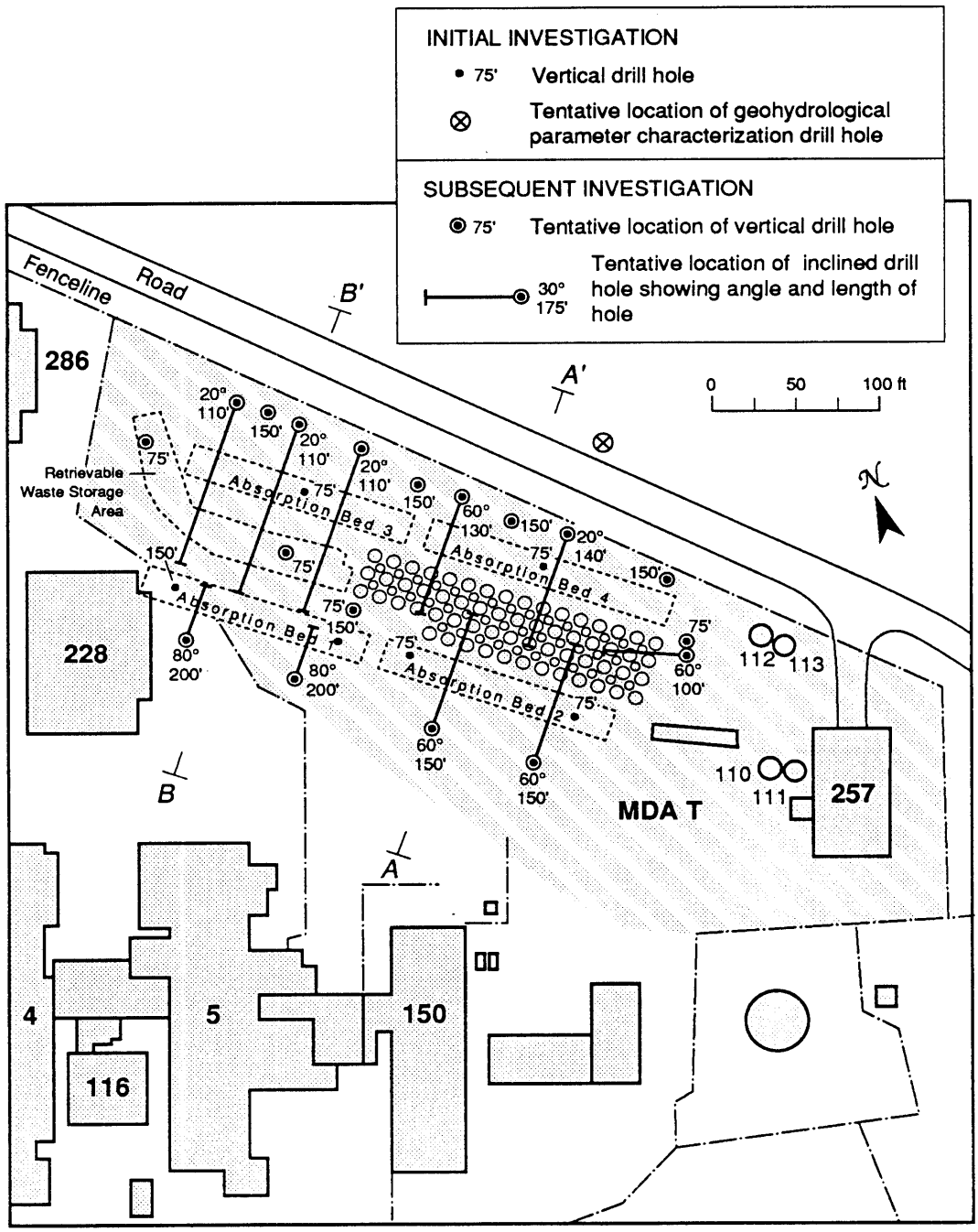


Fig. 16.3-21 Map of MDA T showing locations of absorption beds, cement-filled shafts, the retrievable waste storage area, and initial and subsequent investigation drill holes.

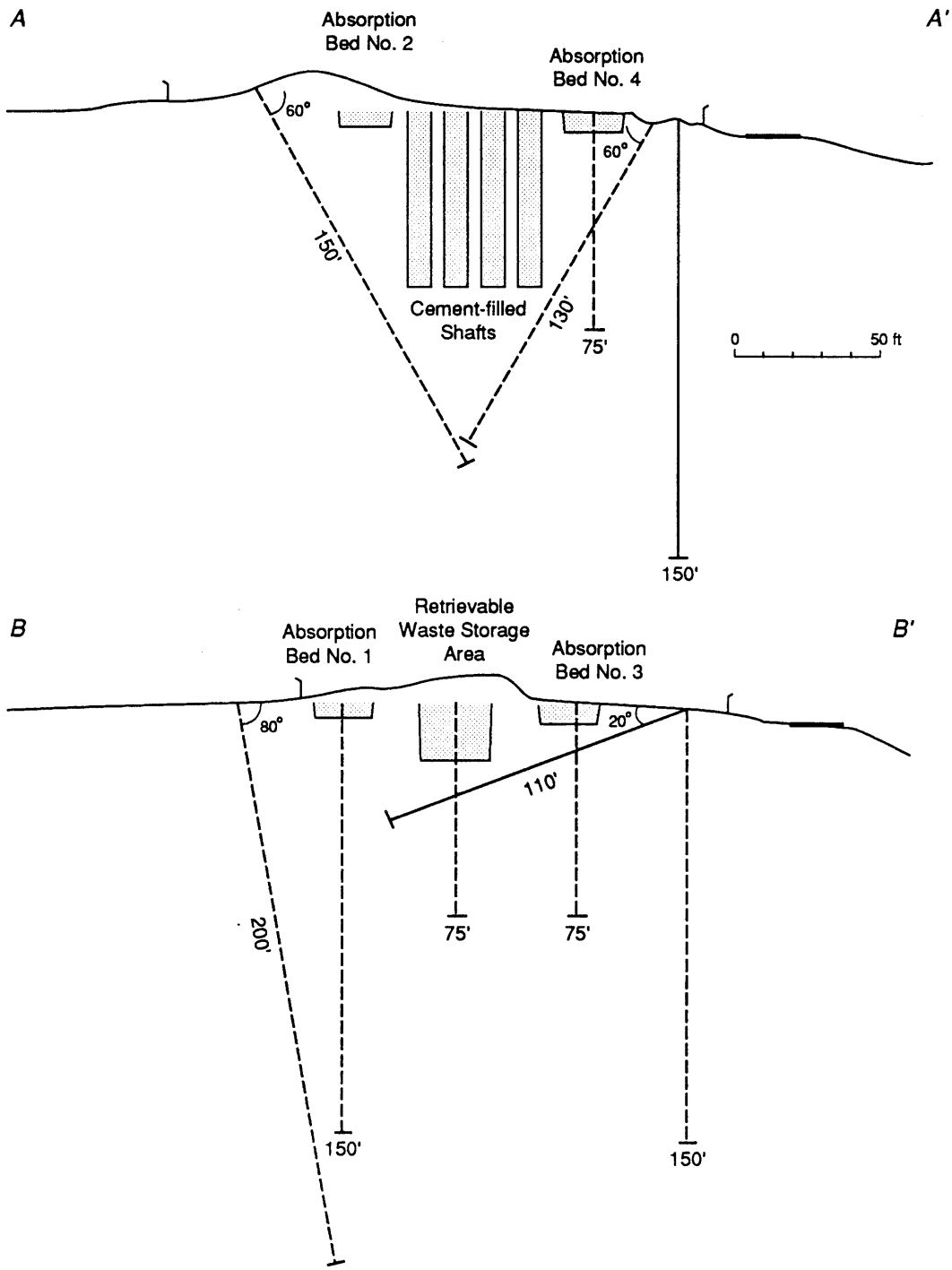


Fig. 16.3-22 Cross sections for MDA T showing layout of absorption beds, cement-filled shafts, the retrievable waste storage area, and initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE 16.3-I MDA T REGULATED UNITS

SWMU Subunit	Area of Concern	Description
21-011(c)	–	An acid holding tank (TA-21-120) and an acid sump (TA-21-121) located within MDA T. Both structures are located as shown in Figs. 16.3-3 and 16.5-1.
21-016(a)	–	Four absorption beds.
21-016(b)	–	TA-21-186, a caisson built at the northwest corner of absorption bed 1 in 1959 to study subsurface Pu distribution. It did not contain waste (LANL 1990).
21-016(c)	–	62 asphalt-lined shafts between absorption beds 2 and 4
21-028(a)	-	Satellite container storage area for alcohol, acetone, and freon inactive as of January 1990.
–	C-21-009	1978 spill of ^{241}Am in cement paste at MDA T shafts. Paste was removed and MDA was decontaminated.
–	C-21-012	1976 spill of ^{241}Am and plutonium in a cement paste.

TABLE 16.3-II
DEPTHS OF NONRETRIEVABLE WASTE DISPOSAL SHAFTS LOCATED AT MDA T.

Shaft Number	Diameter (m)	Depth (m)	Shaft Number	Diameter (m)	Depth (m)
1	2.4	18.7	46	2.4	20.1
2	2.4	6.4	47	2.4	7.6
3	2.4	8.2	48	2.4	19.2
5	2.4	8.8	49	2.4	20.4
6	2.4	8.2	50	2.4	19.9
8	2.4	20.4	51	2.4	9.1
9	2.4	19.2	52	2.4	7.1
10	2.4	7.1	53	2.4	15.8
11	2.4	8.5	54	2.4	19.1
13	2.4	19.8	55	2.4	21.0
17	2.4	15.2	56	2.4	18.9
18	2.4	18.0	57	2.4	7.6
19	2.4	19.8	58	2.4	6.8
20	2.4	19.2	59	2.4	16.5
21	2.4	19.0	60	2.4	19.1
22	2.4	19.5	70 6-10[a]	1.8	20.7
23	2.4	19.1	75 6-15[a]	1.8	20.3
24	2.4	18.6	76 6-16[a]	1.8	20.5
25	2.4	4.9	78 6-18[a]	1.8	19.7
26	2.4	4.6	80 6-20[a]	1.8	20.1
27	2.4	17.7	82 6-22[a]	1.8	19.5
28	2.4	20.4	83 6-23[a]	1.8	7.3
29	2.4	18.5	84	1.8	15.1
30	2.4	18.9	87 6-27[a]	1.8	20.0
31	2.4	5.6	91	1.8	7.9
32	2.4	4.6	92	1.8	8.2
33	2.4	19.5	94	1.8	6.6
34	2.4	18.4	95	1.8	4.9
35	2.4	19.0	100	1.8	20.2
36	2.4	18.7			
41	2.4	18.9			
42	2.4	6.4			
43	2.4	18.9			
44	2.4	19.2			

[a]Designation prior to 3-12-76.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
1945-1952	MDA T	N/A	Untreated wastes released to absorption beds from Buildings 2,3,4,5, and 12.
1945	MDA T	N/A	Construction of four absorption beds completed (115-ft long x 20-ft wide x 4-ft deep).
Jul-Nov. 1946	Absorption beds 1 & 2 of MDA T	1947 Los Alamos Report LAMS-516	Two soil and water samples from beds 1 & 2 for Pu and Po
1952-1967	MDA T	N/A	Treated liquid waste additions to absorption beds and to DP Canyon outfall from TA-21-35
1952	MDA T	N/A	Building TA-21-35 (first liquid waste treatment plant) installed to treat liquid wastes from DP West and DP East before they were released to DP Canyon Small amounts of liquid wastes were added to absorption beds from TA-21-35.
Aug-Sept 1953	5 holes drilled in and around the MDA T Absorption beds	Unpublished 1954 USGS Report cited in LA-6848-MS	Pu assays performed on samples collected to a depth of 20 ft geologic descriptions of core.
1959-60	Absorption bed 1 of MDA T	Unpublished 1963 USGS Report cited in LA-6848-MS, 1962 US Dept. of Commerce Report TID-7628	Hundreds of samples collected in a series of horizontal holes originating in a 9.1 m-deep caisson next to Absorption bed 1. Tuff samples and soil solution samples assayed for Pu and soil chemistry parameters. Neutron moisture gauge data collected in several locations near and under Absorption bed 1 to depths of 100 ft, before and after addition of about 11 m of water to the bed.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
1967-1986	MDA T	N/A	Treated liquid waste additions to DP Canyon from TA-21-257 (same outfall pipe as when effluents originated from TA-21-35)
1967	MDA T	N/A	Building TA-21-257 built and replaces building TA-21-35
Jan 1967	Area between Absorption bed 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	Soil solution samples and a tuff sample neutron moisture gauge data collected to 100 ft
1968-1976	MDA T	N/A	Treated wastes from TA-21-257 mixed with cement and pumped down 62 15–68 ft-deep, asphalt coated disposal shafts, located principally between absorption beds 2 and 4.
March 1974	10 sampling locations over Absorption beds 1 and 3 and between these two beds at MDA T	Los Alamos Report LA-6848-MS	Pu and Am surface contamination/external radiation survey (FIDLER and ionization chamber data).
April 17 & 18 1974	7 holes augered between Absorption beds 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	Samples collected at 2.5 foot intervals to 40 feet and assayed for water content, gross alpha, gross beta, ^{137}Cs, and tritium.
October 1974	Retrievable waste storage area pit between beds 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	23 samples collected from walls of pit and assayed for tritium, Pu, and Ludlum alpha counts.
1975-1983	MDA T	N/A	Retrievable Waste Storage Area, located between absorption beds 1 and 3, used to store treated waste-cement mixtures in CMPs (corrugated metal

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
			pipes with a diameter of 30 inches and a length of 20 feet).
March 1976 and	4 holes in Absorption beds 3 and 4 at MDA T	Los Alamos Report LA-6848-MS and Nevada Operations Office Report NVO-178	Samples collected to a maximum depth of 240 inches Assayed for plutonium and a ZnS detector.
3/17/78-10/5/78	Absorption beds 1 and 2 at MDA T	Los Alamos Report La-10159-LLWM, July 1984, Journal of Environ. Quality 14:501-509	Over 800 tuff samples collected in 4 100-ft holes and assayed for Pu, Am, and soil water content. Geologic characteristics published in a log of each hole. Hydrologic research done in the past used to evaluate migration of water and radionuclides.
4/13/78 and 4/17/78	Survey of MDA T: 10 locations inside fence and 5 locations outside MDA T	Los Alamos Notebook 20652	Phoswich and ZnS surveys with soil samples at 15 locations assayed for Pu and Am.
6/14/78 and 6/18/78	Survey of asphalt ditch area southwest of Building SM-257 at MDA T	Los Alamos Notebook 20652	10 soil samples assayed for Pu and Am.
2/28/80	23 locations around perimeter of MDA T and 11 locations inside MDA T	Los Alamos Notebook in A411 Project File	Phoswich and µR meter survey.
Sometimebefore 5/20/80 (assay date)	2 locations inside MDA T and 2 locations north and east of MDA T	Los Alamos Notebook A411 Project File	Soil samples from 3 depths assayed for tritium, total uranium, Pu, and gamma emittors (^{137}Cs).

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
Sometime before 6/10/80 (assay date)	1 location inside MDA T and 2 locations north and east of MDA T	Los Alamos Notebook A411 Project File	7 vegetation samples assayed for tritium, total total uranium, ^{235}U, ^{238}U, Pu.
Sometime in 1982	Several locations around MDA T	A411 Project File	Qualitative observations on fencing and erosion from MDA T. R meter measurements at 6-7 broad locations within MDA T. Phoswich monitoring along MDA T fence. 9 soil samples collected from 3 locations (3 depths/location) outside of MDA T and assayed for tritium, total U, Pu, and gamma spectrometer assays.
4th quarter 1982	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1983 Los Alamos report LA-9762-ENV	TLD data.
Sometime in 1983	North of paved road immediately north of MDA T (generally north of Absorption bed 4)	A411 Project File	18 samples collected from 0 to 88 ft and assayed for tritium, total uranium, Pu, and ^{137}Cs, as well as gamma spectrometry assays.
4 quarters 1983	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1984 Los Alamos report LA-10100-ENV	TLD data.
1984-1986	MDA T	N/A	CMPs relocated from MDA T to Area G.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
6/14/84-7/19/84	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	HPIC survey locations.
6/20/84-	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	Soil samples collected from 0-1 cm, 1-10 cm and 10–30-cm depths at all locations and assayed for tritium, total uranium, ^{238}Pu, $^{239/240}Pu$, and gamma spectrometry assays.
6/20/84-	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	15 vegetation samples identified and assayed for tritium, uranium, ^{238}Pu, and gamma spectrometry assay.
7/12/84-8/15/84	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	Phoswich survey of locations.
4 quarters 1984	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1985 Los Alamos report LA-10421-ENV	TLD data.
6/13/85	MDA T Annual Site Inspection	A411 Project File	Field observations on breach of confinement, condition of cap, intrusion.
4 quarters 1985	7 locations around MDA T perimeter	Los Alamos Notebook 23820 notes	TLD data.
1986	MDA T	N/A	Effluent from TA-21-257 transferred via pipeline to TA-50 for discharge into Mortandad Canyon (MDA T now an inactive waste disposal site).

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
April 1986	7 locations outside of and north of MDA T	LANL Memo HSE8-86-1094	Soil (tritium, Pu, ^{137}Cs; ^{90}Sr, total U and Am) and Phoswich radiation survey.
6/86-8/86	108 locations surveyed (75 inside MDA T and 33 outside MDA T)	A411 Project File	108 Phoswich and Rascal measurements, 73 soil samples, and 67 vegetation samples assayed for Pu, Am, ^{137}Cs.
10/30/86	12 locations in CMP Pit at MDA T	Los Alamos Notebook R-4251 notes	12 samples collected to an average depth of 15 inches and assayed for tritium and with ZnS detector for gross alpha.
4 quarters 1986	7 locations around MDA T perimeter	Los Alamos report La-10992-ENV	TLD data.
1987	MDA T	N/A	Surface stabilization of MDA T initiated, as well as measures to control runoff intrusion from paved portions around MDA T.

TABLE 16.3-IV
VOLUME OF WASTES DISCHARGED TO ABSORPTION BEDS AT MDA T IN CUBIC METERS[a]

Year	From DPE	From DPW	Year	From DPE	From DPW
1945	0	3,000 (est)	1966	4,355	0
1946	0	4,000 (est)	1967	666	0
1947	0	5,000 (est)	1968	0	0
1948	0	6,000 (est)	1969	0	0
1949	0	5,971	1970	0	0
1950	0	10,030	1971	0	0
1951	0	13,600	1972	0	0
1952	0	5,400	1973	0	0
1953	0	822			
1954	0	206			
1955	0	1,389			
1956	0	1,970			
1957	0	1,587			
1958	0	657			
1959	0	731			
1960	0	750			
1961	0	117			
1962	0	51			
1963	0	230			
1964	0	98			
1965	2,492	137			

[a]Emelity (1974).

TABLE 16.3-V
AMERICIUM AND PLUTONIUM CONTENT OF DISPOSAL SHAFTS AT MDA T[a]

Shaft Number	^{241}Am (gm)	$^{239/240}Pu$ (gm)	$^{239/240}Pu$[b] (gm)
1	21.836	20.767	
2	2.635	3.688	
3	5.524	10.208	290
5	25.007	12.001	
6	10.6	10.96	
8	30.61	44.97	
9	24.243	24.977	
10	4.378	3.97	
11	2.675	3.217	
13	35.924	39.608	
17	17.278	31.897	342
18	17.757	18.758	134
19	6.414	16.333	245
20	27.455	11.562	
21	23.532	13.255	
22	20.761	18.802	
23	32.609	20.412	
24	26.039	17.427	
25	10.382	7.235	
26	5.829	4.538	210
27	18.768	32.539	
28	34.837	40.429	
29	10.215	4.224	
30	19.52	14.048	
31	3.059	2.965	
32	9.74	5.355	
33	21.275	24.764	
34	22.157	11.425	
35	26.253	16.037	
36	26.915	12.408	
41	18.789	20.479	
42	2.573	4.203	
43	30.628	28.12	
44	22.004	14.542	
46	37.002	33.031	
47	16.157	16.552	
48	24.317	21.71	
49	51.391	62.244	
50	22.027	18.46	
51	12.193	11.398	
52	12.463	26.485	
53	35.248	28.68	
54	35.5	25.792	

TABLE 16.3-V
AMERICIUM AND PLUTONIUM CONTENT OF DISPOSAL SHAFTS AT MDA T[a]

Shaft Number	^{241}Am (gm)	$^{239/240}Pu$ (gm)	$^{239/240}Pu$[b] (gm)
55	27.735	45.886	
56	33.905	23.931	
57	12.398	19.147	
58	8.414	7.746	
59	32.37	44.17	
60	34.258	38.214	
70	30.99	79.85	
75	36.772	32.938	
76	55.18	56.74	
78	0.85	7.57	
80	4.18	19.97	
82	2.47	8.88	
83	5.0	19.61	
84	0.31	9.49	
87	0.43	7.71	
90	0.09	0.43	
91	0.49	1.88	
92	4.44	6.4	
94	0.54	1.6	
Totals	1155.28	1242.64	1221.0

[a]Warren (1979).
[b]Plutonium in bathyspheres

TABLE 16.3-VI. ESTIMATED RADIONUCLIDE SOURCE TERMS AT MDA T.

Disposal Area	Date	Radionuclide	Estimated Activity (Ci)
Absorption beds	1945-1951	Pu	9.8
		Tritium	14.0
Disposal shafts	1968-1983	^{241}Am	3743.1
		^{238}Pu	31.3[a]
		$^{239/240}Pu$	151.0
		^{233}U (731 g)	6.9[b]
		Mixed fission	7.7
Retrievable wastes		Removed to Area G	

[a]Buchholz undated personal communication to M.A. Devaurs.
[b]Warren 1980.

TABLE 16.3-VII. COMPOSITION OF WASTE APPLIED TO ABSORPTION BEDS[a]

	Avg.	Max.	Min.
pH	5.7[b]	10.2	3.0
Cond. G.P.G. NaCl	40	75	28
Na	140	175	75
P. Alk. as Ca CO3	77	375	0
M. O. Alk. as CaCO3	23	80	0
Chloride	26	40	18
Ca as Ca	7	17	0
Mg as Mg	3	8	0
Tot. Hard. as CaCO3	30	76	0
NH_4+ - N	10	20	7
NO_3 - N	75	125	55
Fluoride as F	160	225	100
Pu (c/m/ml)	60	600	20

[a]Christenson and Thomas (1962). Units are not provided in reference. Concentrations are most likely ppm.
[b]Median.

TABLE 16.3-VIII
COMPOSITION OF CITRATE WASTES APPLIED TO MDA T
ABSORPTION BEDS DURING 1951-1952[a]

Di-ammonium citrate	50,000 ppm
Magnesium	800 ppm
Calcium	160 ppm
Aluminum	160 ppm
Iron	10 ppm
Fluoride	200 ppm
Nitrate Nitrogen	1,680 ppm
pH	1 ppm
Pu (c/m/ml)	7,000

[a]Christenson and Thomas (1962).

TABLE 16.3-IX. WASTE STREAM COMPOSITION TO DP-257 JANUARY THROUGH MAY 1973.

Type of Wastes	Av Vol/Mo Gallons	Chemical Composition	Radioactivity Av/Mo
Main flow stream, DPW	129,300	pH 11.4; TS-1, 580 mg/l; Na-400 mg/l; NO_3-73 mg/l; Cl-57 mg/l	1.38×10^{-1} µCi/l gross a 1.32×10^{-3} mCi/l Sr
Main flow stream, DPE	13,700	Incl. above	Incl. above Low ^{235}U
Am-Pu acid wastes	2,500	HNO_3 + metals	22.15g ^{239}Pu, 20.4g ^{241}Am, ~0.01g ^{238}Pu
Bldg 2, NaOH wastes	400	(from recovery oper.) NaOH, Fe, Cl, NO_3, plus various others	188 mg total a include ^{239}Pu, ^{241}Am
Bldg 4, KOH	130	KOH, used to scrub HF lines	246mg ^{235}U + 2mg ^{239}Pu + trace ^{238}Pu
Bldg 5, KOH wastes	480	(scrubbing sol.), KOH, F^-	1.36g ^{239}Pu
Distillate	1,130	$-NO_3$	11.4g ^{235}U (incl. in main stream)
Scrub tank, Distillate	40	NO_3^-, Cl^-, Neut. KOH + misc. organics	800 mg ^{235}U
Alcohol	8	Ethyl Alcohol	1.78g ^{239}Pu
Strip wastes	255	Na, Mg, Al, Fe, Cr, Ni, NH_3 SO_4, NO_3	15.2g ^{235}U, trace amounts of ^{90}Sr and ^{137}Cs (MFP)
Organics, solvents	9	Acetone, Chlorethylene, etc.	^{235}U, ^{238}Pu, ^{239}Pu
Oils	8	Vacuum pump oil	^{238}Pu, ^{239}Pu

TABLE 16.3-X. PLUTONIUM CONCENTRATIONS WITH DEPTH FOR THE FIVE BOREHOLES LOCATED IN FIG. 16.3-13[a]

DPW-1		DPW-2		DPW-3		DPW-4		DPW-5	
Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)	(Slant) Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)
Surface	32	Surface	4	Surface	15	Surface	4	Surface	190
1	4	1	2	1	2	1	180	1	270
2	2	2	1	2	4	2	16410	2	5
3	4	3	<1	3	3	3	20730	3	36
4	2	4	1	4	4	12	640	4	1550
5	2	5	1	5	3	15	2270	5	240
6	2	6	1	6	2	16	2320	6	36
6-10	1	7	2	7	3	17	330	7	820
10-14	1	8	<1	8	1	18	11	8	18
15	2	9	1	9	1	19	5	9	170
		10	2	10	1	20	5	15	1090
		11	2	11	1				
		12	1	12	205[b]				
		13	1	12.5	686				
		14	1	13	605				
		15	1						
		16	2						
		17	1						
		18	1						
		19	1						
		20	1						

[a]Data taken from Rogers (1977) for five boreholes from Herman (1954). Data are given in this table in units originally reported in. Convert from dpm/dry gram to pCi/gm by multiplying by 0.4505.
[b]Point of intersection with absorption bed.

TABLE 16.3-XI
CHEMICAL AND MINERALOGICAL PROPERTIES FROM THREE HOLES DRILLED AT MDA T AND SHOWN IN FIG. 16.3-13[a]

		DPW-33	DPW-4	DPW-5
Ion Exchange Capacity (Me/kg)		17	7	32
Depth (ft)		12 (slant)	19	5
Clay fraction: < 2μ minerals (percent)	Feldspar	40	40	50
	Montmorillonite	30		20
	Hydrous mica	20		
	Kaolin	b		
	Cristobalite	b	40	b
	Tridymite	b	40	b
	Quartz	b	b	
Silt fraction: 2–62μ minerals (percent)	Feldspar	40	50	b
	Cristobalite	40	50	b
	Tridymite	10	10	b
	Quartz		b	

[a]Data taken from Rogers (1977) for three holes drilled in 1953 documented in Herman (1954). All values are in percent by weight.
[b]These minerals were detected but concentration too low to quantify.

TABLE 16.3-XII. ALPHA ACTIVITY FROM HORIZONTAL CORES TAKEN FROM THE CAISSON[a]

Depth (ft)	No. Cores	Average Gross a (c/m/dry gm)	Gross α - All Cores max (C/m/dry gm)	min
6	10	3003	6613	4
8	7	1306	2850	11
10	8	1143	1872	12
12	6	821	1729	414
14	9	749	2094	1
16	9	732	1305	8
18	4	517	923	141
20	7	183	506	45
22	4	15	20	11
24	8	402	1038	175
26	10	13	88	2
28	6	28	156	2

[a]Christenson and Thomas (1962).

TABLE 16.3-XIII. GROSS ALPHA ACTIVITIES FROM VERTICAL HOLES DRILLED NEAR BED IN 1960 (SEE FIG. 16.3-14 FOR LOCATION)[a]

Hole No.	No. Cores	Depth (ft)	Gross α (c/m/dry gram) (Avg.)	(Max)	(Min)
1[b]	10	76	2	3	1
1A[b]	10	83	24	34	9
2b	11	93	698	3722	142
3	11	99	3	7	2
4b	13	99	1.5	2	1
5	7	92	3	6	1

[a]Christenson and Thomas (1962).
[b]Slant holes.

16.4. Industrial Liquid Waste Treatment Facility

16.4.1. Site Description

This section describes the field activities for the location of the former industrial liquid waste treatment facility (SWMU 21-010) located at TA-21 (Fig. 16.4-1) (LASL 1968c). This SWMU addresses a site at which a contaminated building was located. The former industrial liquid waste treatment facility was decontaminated and decommissioned, but contamination may still remain at the site from the building and its past operations. Releases from the industrial liquid waste treatment facility to the environment are documented (LANL 1990).

The SWMU Report (LANL 1990) states that the former industrial liquid waste treatment facility, TA-21-35, is designated as SWMU 21-010(a), along with seven associated structures identified as SWMUs 21-010 (b)-(h) (Fig. 16.4-1).

In addition, a radioactive container loading operation was located on the northeast side of TA-21-35, just north of structure TA-21-191. The drums containing radioactive waste and cement were stored inside of the new addition to TA-21-35, just west of structure TA-21-191 and under a covered area on the north side of the building.

There are several areas of concern at the former location of TA-21-35. Area of concern C-21-010 (see Chapter 19) documents a leak from drums that was cleaned up. It is not shown on Fig. 16.4-1 because its location is unknown. The former locations of the following four structures were added as areas of concern C-21-034 through C-21-037, which includes the following: a 1,000 gal. raffinate tank (TA-21-91), two aboveground acid holding tanks (TA-21-110 and TA-21-111), and a 2,000 gal. aboveground acid tank (TA-21-256).

Presented below is a list and brief description of structures that comprise SWMU 21-010 at the former location of TA-21-35.

Building TA-21-35

SWMU 21-10(a) addresses the former industrial liquid waste treatment facility, TA-21-35. The treatment facility began operations in 1952 and was decontaminated and decommissioned in 1967. TA-21-35 was modified and added to several times throughout its years of operation. It began as a modification to a 40- by 20-ft building with a wood frame and corrugated metal covering, originally built in 1949 (Fowler 1964). Conversion to a waste treatment facility in 1952

required a 30-ft extension of that original building. In addition, exterior waste storage facilities and a batch waste treatment facility required a 10-ft extension. In 1956, a 15- by 20-ft vacuum filter room was added with pertinent equipment to the east side of the building. This eliminated the procedure of hauling contaminated sludge to the TA-45 treatment plant for filtration (Shipman 1958).

In 1959, an americium waste treatment facility was added to TA-21-35 to fix americium waste in cement. These wastes were placed in 55-gal. drums and stored on the northeast corner of the building until they were transported to MDA G for disposal. A chemical storage addition was added in 1960. Further space was added in 1961 because of an increased volume of americium waste being treated at the plant. In 1964, a 50% caustic storage facility was completed, along with a covered area for the temporary storage of the 55-gal. drums containing americium-cement mixtures mentioned above (Fowler 1964).

Associated Structures

SWMU 21-010(b), TA-21-93, was initially a water manhole, which was changed to an acid valve pit manhole. The manhole was located on the southwest corner of TA-21-35 and has been removed.

SWMU 21-010(c), TA-21-145, was a 500 gal. underground acid tank, which was located at the southwest corner of Building TA-21-35. The tank has been removed.

SWMU 21-010(d), TA-21-147, was a 500 gal. underground acid tank, which was located adjacent to TA-21-145 and near the southwest corner of Building TA-21-35. The tank has been removed.

SWMU 21-010(e), TA-21-185, was a 390 gal. septic tank, which was located on the northeast corner of Building TA-21-35. The tank received industrial waste. Overflow from the tank went to a drain field that was located east of the septic tank. The tank has been removed. It is not known if the drain field was removed when the tank was removed.

SWMU 21-010(f), TA-21-192, was a structure known as the "Grit Chamber," which was located at the northeast corner of building TA-21-35. This structure served as a setting tank for solids in the influent and is thought to have been highly contaminated with radionuclides. The grit chamber has been removed.

SWMU 21-010(g), TA-21-255, was a 2,000 gal. aboveground acid tank, which was located at the southwest corner of TA-21-35. The acid tank has been removed.

SWMU 21-010(h), TA-21-271, was an acid manhole located at the southwest corner of building TA-21-35. The manhole has been removed.

Areas of Concern

The location of area of concern C-21-010 is unknown. It will be assumed that it will be addressed by the sampling of the Building 35 area proposed herein.

Area of concern C-21-034, TA-21-91, was a 1,000 gal. raffinate holding tank, which has been removed. It was located at the southwest corner of TA-21-35 and was installed approximately October 1957 (LASL 1957). The former location of this structure will be investigated.

Area of concern C-21-035, TA-21-110, was an aboveground acid-holding tank on the south side of TA-21-35. It was relocated to the new treatment facility, Building TA-21-257, in 1967. Its location at TA-21-257 is listed as SWMU 21-011(d). The former location of the tank at TA-21-35 will be investigated.

Area of concern C-21-036, TA-21-111, was an aboveground acid-holding tank adjacent to TA-21-110 on the south side of TA-21-35. It was relocated in 1967 to the new treatment facility, Building TA-21-257. Its location at TA-21-257 is listed as SWMU 21-011(e). The former location of the tank at TA-21-35 will be investigated.

Area of concern C-21-037, TA-21-256, was a 2,000 gal. aboveground acid tank at the southwest corner of building TA-21-35. In 1967, it was relocated to the new industrial liquid waste treatment facility, TA-21-257. Its location at TA-21-257 is listed as SWMU 21-011(h). The former location of the tank at TA-21-35 will be investigated.

16.4.1.1. Site History

Four seepage pits, or absorption beds (Sec. 16.3 MDA T, SWMU 21-016), were constructed for liquid radioactive waste disposal at TA-21 in the 1940s. Because the volume of liquid discharged to the absorption beds began to exceed their holding capacity, a liquid waste treatment facility, TA-21-35, was constructed. TA-21-35 was constructed as a facility for treatment and disposal of contaminated liquid waste from the plutonium- and ^{235}U-processing laboratories at DP site (Romero 1967). The treatment operations at the plant began in 1952 (Fowler 1964).

The facility used chemical precipitation to treat wastes and was designed to treat wastes at a maximum rate of 50 gal./min. The most efficient operation was obtained at a treatment rate of 35

gal./min (Fowler 1964). Treatment of DP Site wastes continued at TA-21-35 until 1967 when it was replaced by a new waste treatment facility, TA-21-257 (Sec. 16.5, SWMU 21-011).

The waste treatment plant received waste concentrated in "both plutonium and mineral constituents" from DP West (Shipman 1958). The method of treatment involved the addition of ferric sulfate and lime to the incoming waste stream, causing a precipitate of ferric hydroxide to form. The ferric hydroxide precipitate then settled to the bottom of settling tanks, carrying the plutonium with it (Shipman 1958). These sludges (precipitates) were buried in MDA C (Abrahams 1962). The liquid that was derived from dewatering the plutonium-contaminated sludges was stored in tanks for several hours or days for control analysis and was then discharged to DP Canyon (Abrahams 1962) [see Sec. 15.4, SWMU 21-011(k)].

Other wastes, such as concentrated residues from plutonium separations (raffinates) containing large amounts of salts and plutonium and hydrofluoric washing solutions, were treated separately by batch methods (Shipman 1958). Hydrofluoric acid was neutralized and discharged to DP Canyon (Abrahams 1962). Procedure(s) for treatment and handling of other wastes are not known.

Decommissioning of Building TA-21-35 and its associated structures was initiated on June 30, 1967, and was completed on January 5, 1968 (LASL no date). All structures associated with the decommissioning of TA-21-35 were taken to MDA G for disposal. It is unknown whether any cleanup of the former site of TA-21-35 and its associated structures occurred.

Several of the structures were relocated or connected to the new treatment facility, TA-21-257. Relocated or reconnected structures included TA-21-110 and TA-21-111, aboveground acid-holding tanks (LASL 1976b); TA-21-191, a cement storage silo (LASL no date); and TA-21-256, an aboveground acid tank (LASL 1968c). The locations of the relocated structures are addressed and investigated in Sec. 16.5.

16.4.1.2. Existing Information

Records of the approximate volume of wastes processed at TA-21-35, as well as the gross alpha and plutonium concentrations for the years 1952 through 1961, are summarized in Table 16.4-I. Table 16.4-I shows that a maximum flow of 4,712,900 gal. was treated at TA-21-35 in 1957, and a low of 2,294,900 gal. was treated in 1960. The operational data from 1961 to 1967 could not be located. The general trend in gross alpha and plutonium concentrations increased from 1952 to 1961.

The text accompanying the table states that "the highest concentration of gross alpha in soil samples collected in August of 1954, a short distance downgradient from the point of discharge into DP Canyon, was 184 disintegrations per minute per dry gram" (Abrahams 1962).

16.4.1.3. Source Term

Plutonium-processing operations and other operations at DP East and DP West produced wastes that were sent to TA-21-35 for treatment. Wastes containing uranium, plutonium, americium, and other actinides, as well as various acids (such as nitric, hydrofluoric, sulfuric, and hydrochloric), solvents, and chemicals were treated. Releases of contamination from treatment operations have not been documented, but the above-mentioned contaminants may be present in the soils at the former location of TA-21-35.

The loading and subsequent storage of 55-gal. drums of americium-cement mixtures at TA-21-35 may have resulted in contaminant releases. The drums were stored in an area on the northeast side of TA-21-35 just north of structure TA-21-191, in TA-21-35, and a covered area believed to be along the north side of TA-21-35. It is not known whether any leaks or spills resulted from the storage or loading of the drums.

16.4.2. Objectives and Data Needs

Environmental releases may have occurred as a result of past operations at the former industrial waste treatment facility or from the decommissioning of the Building TA-21-35.

SWMU 21-010 data needs are listed below as follows:

1. Determine the location of the former industrial waste treatment facility, TA-21-35, and its associated structures by surveying based on old drawings.

2. Identify the presence of contamination in the areas that were beneath the former locations of the industrial waste treatment facility and its associated structures by analysis of subsurface soil samples using Level II/III data.

3. If contaminants are identified, determine the vertical and lateral extent of contamination by additional subsurface soil sampling and analyses using Level III/IV data.

16.4.3. Sampling/Investigation Rationale

Two phases of investigation are planned for SWMU 21-010. The initial investigation consists of a land survey to mark the former locations of the waste treatment facility, TA-21-35 [SWMU 21-

010(a)], and its associated structures, TA-21-91, -93, -110, -111, -145, -147, -185, -192, -255, -256, -271 [SWMUs 21-010(b)-(h) and areas of concern C-21-034 to C-21-037], for investigation. Prior to decommissioning, Building TA-21-35 was found to have removable alpha contamination, and its waste storage tanks and waste-processing tanks were found to be highly contaminated with radionuclides. Therefore, shallow boreholes will be drilled, and subsurface soil samples will be collected at the former location of Building TA-21-35 and at the locations of the associated structures. These samples will identify the potential for residual contamination remaining after D&D of Building TA-21-35 and its associated structures.

Surface soil samples will not be taken at TA-21-35 as part of this sampling plan. Surface soil samples to characterize TA-21-35 will be obtained during the field investigation of MDA T. The MDA T surface characterization will provide surface soil samples on a 20- by 20-m grid within the fenced area of MDA T (which includes the area of Building TA-21-35) and extending to the northern edge of DP Mesa (see Sec. 16.3.4.1, MDA T Surface Sampling Plan).

Shallow borehole samples obtained during the initial investigation will be submitted for field laboratory analysis. Thirty percent of those samples will then be submitted to an analytical laboratory and subjected to the full analytical suite to determine the types and concentrations of contaminants present. Samples that are "hot" in the field laboratory will be sent to the analytical laboratory. If no samples are "hot", the analytical laboratory will be used to confirm absence of contamination.

If required, additional subsurface soil sampling will constitute a subsequent investigation of sampling to define the lateral and vertical extent of contamination. These samples will be submitted for analytical laboratory analysis and will be subjected to a full suite of analyses unless sampling results from the initial investigation allow specification of a more focused analytical suite.

16.4.4. Sampling Plan

16.4.4.1. Initial Investigation

Building TA-21-35

The former location of Building TA-21-35 [SWMU 21-010(a)] and its associated structures [SWMUs 21-010(b)-(h) and areas of concern C-21-034 to C-21-037] will be surveyed from an engineering drawing (LASL 1968) (for method see Sec. 11.4.3) and marked.

A mobile office trailer, TA-21-382, presently occupies a portion of the former site of Building TA-21-35. It is not known how much of the area is covered by the trailer, but it may be necessary to relocate the trailer during the investigation if it hinders the placement of the boreholes.

Five shallow boreholes will be drilled in the footprint of former Building TA-21-35 [SWMU 21-010(a)] (for method see Sec. 11.5.3.1) to determine whether any past releases from the building occurred. Three of the boreholes will be drilled on the center line of the long axis of the original part of the building, at equal distances from one another. The other two boreholes will be drilled in the addition that housed a radioactive container storage area. The boreholes will be drilled to a nominal depth of 10 ft at locations shown in Fig. 16.4-2. Each borehole will result in four samples (2.5-ft core interval).

In addition, two shallow boreholes will be drilled in the area directly north of the container storage addition where the drum-loading operation was carried out. These boreholes will be drilled to a nominal depth of 5 ft at the locations shown in Fig. 16.4-2. Each borehole will result in two samples (2.5-ft core interval).

Table 16.4-II identifies the screening and analysis requirements for the 24 samples to be collected.

Associated Structures

Shallow boreholes (for method see Sec. 11.5.3.1) will be drilled at former locations of structures that were associated with TA-21-35 operations. One borehole will be drilled at the center of each of the former structures TA-21-110 (area of concern C-21-035), TA-21-111 (area of concern C-21-036), and TA-21-192 [SWMU 21-010(f)]. These boreholes will be drilled to a nominal depth of 5 ft at the locations shown in Fig. 16.4-2. Each borehole will result in two samples (2.5-ft core interval).

Three vertical boreholes will be drilled (for method see Sec. 11.5.3.2) at the southwest corner of the former building to address contamination that may have resulted from a group of underground structures: TA-21-91 (area of concern C-21-034), TA-21-93 [SWMU 21-010(b)], TA-21-145 [SWMU 21-010(c)], TA-21-147 [SWMU 21-010(d)], TA-21-255 [SWMU 21-010(g)], TA-21-256 (area of concern C-21-037), and TA-21-271 [SWMU 21-010(h)]. These boreholes will be drilled to a nominal depth of 20 ft at the locations shown in Fig. 16.5-2. Each borehole will result in four samples (5-ft core interval).

Two vertical boreholes will be drilled (for method see Sec. 11.5.3.2) at the northeast corner of the former TA-21-35 to address contamination that may have resulted from septic tank TA-21-185 [SWMU 21-010(e)] and its associated drain field. These boreholes will be drilled to a nominal depth of 20 ft at the locations shown in Fig. 16.5-2. Each borehole will result in four samples (5-ft core interval).

The screening and sample analysis requirements for the 26 samples collected in this investigation are shown in Table 16.4-II.

For the Building TA-21-35 and associated structures site characterization, a total of 50 samples will be collected and processed in the field laboratory. Approximately 30% of these samples (16) will be sent to the analytical laboratory for the full suite of analyses. Samples that are "hot" as a result of field laboratory analyses will be sent to the analytical laboratory. If no samples are "hot", the analytical laboratory will be used to confirm absence of contamination. The field laboratory will also be used to define whether nominal depths for both shallow and vertical boreholes are adequate or whether boreholes need to be deepened (see Sec. 11.5.3 for borehole stopping criteria).

16.4.4.2. Subsequent Investigation

From the initial samples collected, it will be possible to determine whether contamination exists. If a subsequent investigation is required, additional boreholes will be drilled and sampled. Borehole locations will be placed at 20-ft spacings in an outward direction from sampling points in which contamination is identified. This investigation will be integrated with characterization of MDA T (See Sec. 16.3). For planning purposes, it is anticipated that no more than eight additional shallow boreholes to a nominal depth of 10 ft and no more than five additional vertical boreholes to a nominal depth of 20 ft will be required. Example locations for the additional boreholes are shown in Fig. 16.4-2. This will result in a total of 52 samples to be analyzed in the field laboratory. Twenty-five percent of those samples will be submitted to an analytical laboratory for confirmatory and additional analyses. The screening and sample analysis assumptions for the subsequent investigations are shown in Table 16.4-III.

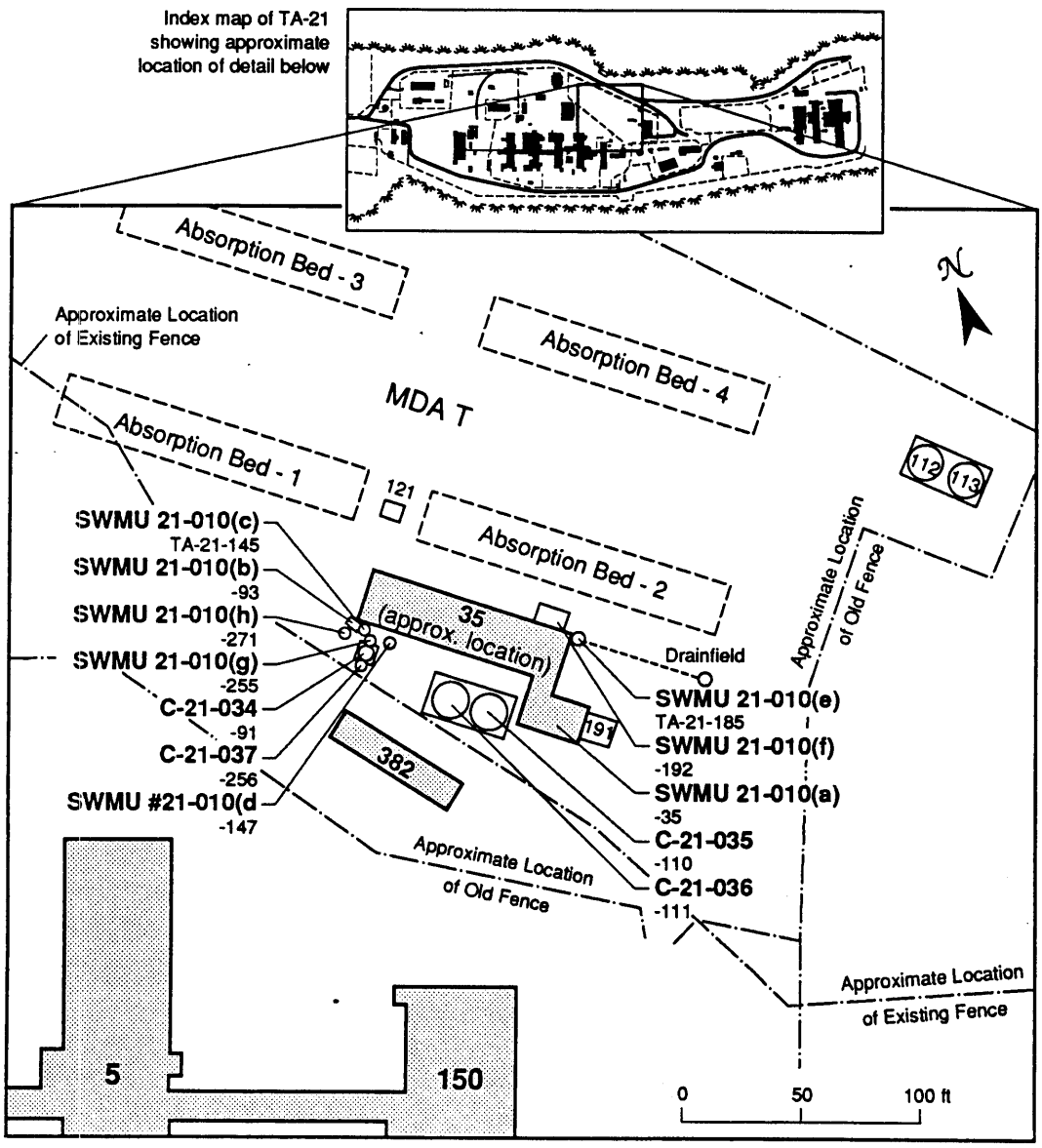


Fig. 16.4-1 Location of the former Industrial Liquid Waste Treatment Facility, TA-21-35 and its associated structures, and their approximate relationship to existing Building TA-21-382. (LASL 1976b; LANL 1983a)

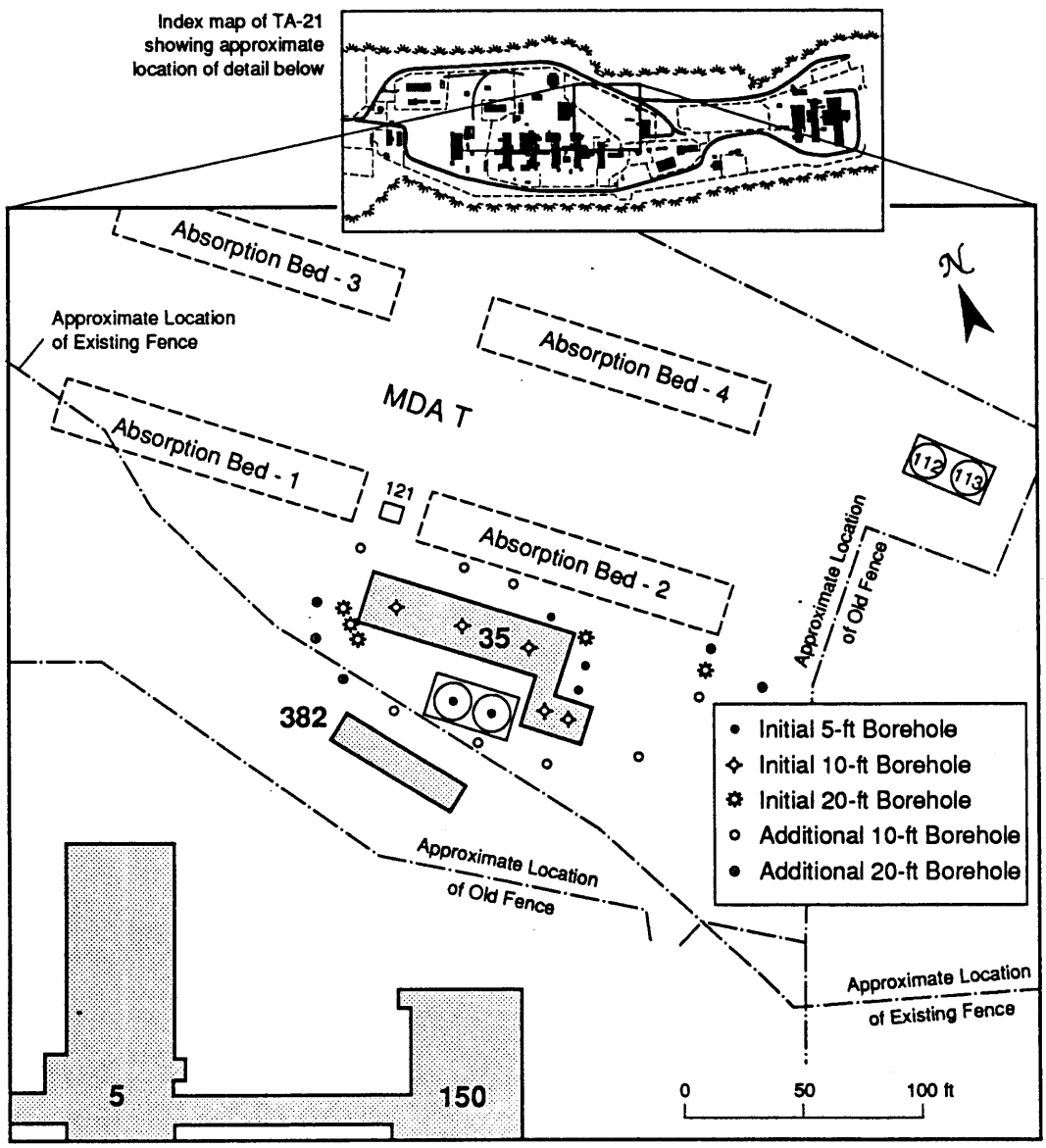


Fig. 16.4-2 Borehole locations for the initial investigation at TA-21-35. Also shown are the additional borehole locations for the subsequent investigation, if required.

TABLE 16.4-I
VOLUME OF FLOW INTO BUILDING 35 TREATMENT PLANT, AND INFLUENT AND EFFLUENT CONCENTRATIONS OF GROSS ALPHA AND PLUTONIUM[a]

Year	Volume (thousands of gallons)	Gross Alpha Influent (thousands of counts minute per liter[b])	Gross Alpha Effluent (counts per minute per liter[b])	Plutonium Influent (milligrams liter[b])	Plutonium Effluent (counts per minute per plant (mg))	Total (equivalent to)
1952	2683.0	58.2	35	8,781	35.0	8,781
1953	4043.6	421.0	52	92,378	79.0	92,378
1954	3226.8	187.0	73	33,560	93.0	37,836
1955	2,894.5	218.0	116	30,004	97.0	36,555
1956	3810.1	90.0	60	18,490	59.0	23,683
1957	4712.9	58.5	65	14,883	65.0	21,030
1958	2658.8	163.0	64	23,949	62.0	38,017
1959	2496.4	236.0	114	32,532	98.8	56,541
1960	2294.1	626.0	310	81,159	223.0	427,829[c]
1961	2488.2	661.0	695	99,154	639.0	173,938

[a]Abrahams (1962).
[b]Weighted average.
[c]Includes 1.141 grams of ^{238}Pu.

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
SWMU 21-010(a) TA-21-35							X																										
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
Field Duplicate																						X	X	X	X		X	X	X				
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X				
Field Blank																												X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																
Trip Blank																												X					
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X													
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X													
		7.5 - 10.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
TA-21-192 (SWMU 21-010(f))																													
Shallow Borehole	1	0.0 - 2.5 ft				X		X	X	X	X	X	X	X	X	X													
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X													
TA-21-110 (SWMU 21-035)																													
Shallow Borehole	1	0.0 - 2.5 ft				X		X	X	X	X	X	X	X	X	X													
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
TA-21-111 (SWMU 21-036)																													
Shallow Borehole	1	0.0 - 2.5 ft				X		X	X	X	X	X	X	X	X	X													
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X													
Southwest Corner TA-21-35							X																						
Vertical Borehole	1	0.0 - 5.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
Rinsate Blank																			X	X	X	X		X	X	X			
Field Blank																									X	X			
		5.0 - 10.0 ft						X	X	X	X	X	X	X	X	X													
		10.0 - 15.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
		15.0 - 20.0 ft						X	X	X	X	X	X	X	X	X													
Trip Blank																													
	2	0.0 - 5.0 ft						X	X	X	X	X	X	X	X	X									X				
		5.0 - 10.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
		10.0 - 15.0 ft						X	X	X	X	X	X	X	X	X													
		15.0 - 20.0 ft						X	X	X	X	X	X	X	X	X													
	3	0.0 - 5.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E			
		5.0 - 10.0 ft						X	X	X	X	X	X	X	X	X													

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
Trip Blank																												X					
Northeast Corner TA-21-35							X																										
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
Field Duplicate																						X	X	X	X		X	X	X				
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X				
Field Blank																												X	X				
Trip Blank																												X					

Table 16.4-III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
SWMU 21-010																																		
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
Field Duplicate																						X	X	X	X		X	X	X					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X					
Field Blank																												X	X					
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																												X						
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					

Table 16.4-III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																					X	X	X	X		X	X	X						
Field Blank																											X	X						
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																											X							
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E						
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																	
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E						
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																	
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																											X							
	3	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E						
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																	

Table 16.4–III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		15.0 – 20.0 ft						X	X		X	X	X	X	X	X	X																
	4	0.0 – 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		5.0 – 10.0 ft						X	X		X	X	X	X	X	X	X																
		10.0 – 15.0 ft						X	X		X	X	X	X	X	X	X																
		15.0 – 20.0 ft						X	X		X	X	X	X	X	X	X																
Trip Blank																												X					
	5	0.0 – 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E				
		5.0 – 10.0 ft						X	X		X	X	X	X	X	X	X																
		10.0 – 15.0 ft						X	X		X	X	X	X	X	X	X																
		15.0 – 20.0 ft						X	X		X	X	X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X				
Field Blank																												X	X				
Trip Blank																												X					

16.5. New Industrial Waste Treatment Plant

16.5.1. Site Description

This section describes the field activities for the collection of environmental data associated with the new industrial waste treatment plant, TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a), including both SWMUs and areas of concern.

The Solid Waste Management Unit (SWMU) report (LANL 1990a) states that the new industrial waste treatment plant, TA-21-257, is designated as SWMU 21-011(a) and contains nine associated structures identified as SWMUs 21-011(b)-(j). The plant includes a clarifier/flocculator, four vertical storage tanks, a pumping station, several pumps that were part of MDA T disposal operations, several above-ground storage tanks, raw waste storage tanks, and several chemical holding tanks (LANL 1990a). A cement silo also existed at the treatment plant. In addition, two radioactive container storage areas were located at TA-21-257 (SWMU 21-001). The first storage area, identified in the SWMU report (LANL 1990a), has been described as active and is located outside at the southwest corner of the building. The second storage area (probably a staging area) is located south of the building along the fence, as identified in LANL photograph #83038K-162 (LANL 1983b). Detailed descriptions of each SWMU subunit follow.

Building TA-21-257

SWMU 21-011(a), the new industrial waste treatment plant (TA-21-257), was put into operation in 1967 after TA-21-35 ceased operations (Fig. 16.5-1). TA-21-257 treated liquid waste produced from operations associated with DP West and DP East.

Associated Structures

SWMU 21-011(b), a sump pump (TA-21-223), was built in 1965 and is located approximately 400 ft east of TA-21-257 (Fig. 16.5-2) (LASL 1976a). It transports waste from DP East to TA-21-257 via a 3-in.-diameter cast iron line. Before TA-21-257 was built, the same line connected the sump pump with the former industrial liquid waste treatment facility, TA-21-35. The sump pump is connected to Buildings TA-21-152, TA-21-155, and TA-21-209 6-in.-diameter cast iron drain lines.

The sump may have discharged to DP Canyon on occasion through a drain pipe before two 3,000 gal. holding tanks, TA-21-346, were installed. That situation is discussed in detail in Sec. 14.3, SWMU 21-004(b) and (c) and Sec. 15.8, SWMU 21-004(d).

SWMU 21-011(c) includes an acid holding tank (TA-21-120) and an acid sump (TA-21-121) (Fig. 16.5-1). These two structures will not be included in the characterization of SWMU 21-011 because they are located inside MDA T (see Sec.16.3, SWMU 21-016).

SWMU 21-011(d) is an acid holding tank (TA-21-110) located on the west side of TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was relocated from TA-21-35 to TA-21-257 in 1967 (LANL 1990a). The tank is aboveground, inactive, and has a 13,500 gal. holding capacity (LASL 1968a). The tank received waste from DP East (Romero and Vigil 1990). The years that the tank received waste are not known.

SWMU 21-011(e) is an acid-holding tank (TA-21-111) located on the west side of TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was relocated from TA-21-35 to TA-21-257 in 1967 (LANL 1990b). The tank is aboveground, inactive, and has a 13,500 gal. holding capacity (LASL 1968b). The tank received waste from DP West and from the "General's Tanks" at MDA A (Roy F. Weston 1990b). The years that the tank received waste are not known.

SWMUs 21-011(f) and (g) are two final effluent-holding tanks (TA-21-112 and TA-21-113) located northwest of TA-21-257 (Fig. 16.5-1) (LASL 1967c; LASL 1976b; LANL 1983a). The tanks are aboveground (LASL 1968b) and have a capacity of 12,700 gal. each (LASL 1967a). Before 1967, underground piping connected these two tanks to TA-21-35 (the former industrial liquid waste treatment facility). After 1967, underground piping from the two tanks was routed to TA-21-257 (the new industrial waste treatment plant). Before 1982, treated effluent was retained in the tanks for 3-to-5-day periods before being discharged to DP Canyon (Romero and Vigil 1990). Since 1982, the treated effluent contained in the tanks has been pumped to TA-50 for disposal. The two tanks are plumbed together (LASL 1968b) allowing effluent to be transferred from one tank to the other, to prevent overflows.

SWMU 21-011(h) is a 2,000 gal. above-ground acid storage tank (Pug Mill Tank, TA-21-256). It was relocated from TA-21-35 to the southwest corner of TA-21-257 (LASL 1977; LANL 1983a) in 1967 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was removed in 1986 (LASL no date).

SWMU 21-011(i) is an inactive 50% sodium hydroxide storage tank (TA-21-288) located on the west side of TA-21-257, immediately north of the americium raffinate storage tank, TA-21-289 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). This aboveground tank was installed in 1968 and has a 1,000-gal. holding capacity (LASL 1968b). At present, the tank has an undetermined amount of liquid in it (Romero and Vigil 1990).

SWMU 21-011(j) is an inactive americium raffinate storage tank (TA-21-289) located on the west side of TA-21-257, immediately south of TA-21-288 (Fig. 16.5-1) (LASL 1967c; LASL 1976b; LANL 1983a). This run-off tank was installed in 1968 and has a 1,600-gal. holding capacity (LASL 1968b). According to LANL employees, when the americium storage tank was in operation, the area west of the tank was not asphalted (LASL 1967d). Tanker trucks would back up to the americium tank and transfer waste into the tank. The hose line that transferred the waste from the tanker truck to the americium tank would occasionally break apart, thereby spilling untreated waste on the ground. The area was finally asphalted, approximately 1 year before the tank was taken out of operation. The exact dates for when the tank was taken out of operation and when the area was asphalted are not known (Romero and Vigil 1990).

The parts of TA-21-257 listed below are not specifically identified as SWMU subunits but were part of the SWMU description.

Vertical storage tanks refer to two below-ground raw waste storage (RWS) tanks located immediately north of the plant (LASL 1967e; LASL 1968b). These tanks do not have structure numbers, but within the treatment system they are referred to as RWS 1 and 2. The tanks are active, and both have a 28,000 gal. holding capacity. From 1967 to 1984, the storage tanks received waste from DP West. After 1984, the two storage tanks received waste from both DP West and DP East (Roy F. Weston 1990). These tanks are clearly shown on engineering drawings ENG C-36383, -36384, and -36387.

Several sumps include an active grit chamber used to separate solid materials from the liquid influent waste stream before it enters RWS 1 and 2. The grit chamber does not have a structure number. It is clearly shown on engineering drawings ENG C-36383, -36384, and -36387.

The pumping station reference in the SWMU description refers to two valve pits/pumps (TA-21-204 and TA-21-205), located immediately north of holding tanks TA-21-112 and TA-21-113 (LANL 1983a), that transfer effluent from the holding tanks to TA-50 for final disposal.

SWMU 21-001 is defined as an active radioactive container storage area located outside, at the southwest corner of TA-21-257 (LANL 1990a) (Fig. 16.5-1). During the TA-21 site reconnaissance walk-through (Roy F. Weston 1990), 20 55-gal. drums of unused thermal oil from TA-50 were observed to be staged in the area. No drums of radioactive waste were observed. The thermal oil stored at the site is product and has reportedly never been opened (Salazar 1990). One employee currently working at LANL stated that drums containing filter media are occasionally stored at the southwest corner of TA-21-257 but only for periods of about one week (Salazar

1990). The LANL employee also stated that a number of drums of mixed waste were also stored along the fence south of TA-21-257 for about 1 year; however, he could not recall the specific year (Salazar 1990). Documentation from a 1983 LANL photograph (LANL 1983b), which shows nine drums lined up along the fence, seems to confirm this statement.

From 1968 until 1983, disposal operations at TA-21-257 included a direct flow system, which was used to pipe radioactive wastes mixed with cement from TA-21-257 to asphalt-lined disposal shafts at MDA T (see Sec. 16.3). During certain periods (i.e., during routine maintenance of the cement-waste piping system, drilling additional disposal shafts, etc.), the wastes that were generally disposed of at MDA T were drummed and stored at the southwest corner.

Areas of Concern

Area of concern C-21-005, was a spill between Buildings 5 and 257 resulting from a 1959 fire in a filter in Building 5. The resulting contamination was cleaned up (LANL 1989).

Area of concern C-21-007, refers to a 1982 spill from a tank vent at TA-21-257. This leak contaminated the building's roof, wall, and surrounding area with low levels of plutonium, americium, and uranium. This spill was reportedly cleaned up (LANL 1989).

Area of concern C-21-033, refers to a 1976 cement paste spill which occurred when radioactively contaminated cement was being pumped from TA-21-257 into shafts between absorption beds 1 and 3 at MDA T (see Sec. 16.3). The exact location where this spill occurred in unknown (LANL 1989).

16.5.1.1. Site History

In the 1940s, four absorption beds were constructed (which became known as MDA T) at TA-21 for disposal of liquid radioactive waste. From 1945 to 1952, the four absorption beds received untreated waste. In 1952, the untreated liquid waste was diverted to the newly constructed industrial liquid waste treatment facility, TA-21-35. Treated wastes were then sent from TA-21-35 to the absorption beds until 1967 when operations at TA-21-35 were discontinued and the new industrial waste treatment plant, TA-21-257, came on line (see Fig. 16.5-1) (LASL 1976b; LANL 1983a).

Coprecipitation of plutonium with ferric sulfate has been, and currently is, the basis of the treatment process at TA-21-257 (Romero and Vigil 1990). The following is a brief description of the treatment process:

> A "continuous stream" of influent is received at TA-21-257 and is temporarily retained in two, raw waste storage tanks. Feed pumps lift the waste in the storage tanks to a flash mixer where lime, ferric sulfate, and coagulant aids are added (Christenson and Emelity 1970). The waste flows to a flocculator and on to a settling (or sedimentation) tank. Settled effluent is pumped through a pressure filter and, at this point, sampled to verify treatment. If the effluent is determined to be adequately treated, it is pumped to two final effluent holding tanks and sent to TA-50 for final disposal. If the effluent is not sufficiently treated, it is recirculated through the treatment system.

In addition to the routine waste stream treatment process described above, a variety of other wastes classified as "batch wastes" were treated at TA-21-257 from 1967 to 1984 (Romero and Vigil 1990). Some of the batch wastes sent to TA-21-257 via 1.5-in., stainless steel lines were rich in americium. These wastes were collected and contained in stainless steel or concrete holding tanks (Christenson and Emelity 1970). Highly acidic solutions were also delivered to TA-21-257 in 270-gal. tanker trailers. Most of these wastes were treated by neutralization in special stainless steel, water-cooled tanks (Warren 1983). Batch wastes that required the greatest treatment were those that had high-dissolved solids or were highly acidic. Treatment of these types of batch wastes included neutralization with 50% sodium hydroxide, then mixing with cement in a pug mill, and finally, pumping the cement paste to asphalt-lined shafts at MDA T, located west of TA-21-257 (Christenson and Emelity 1970). This type of disposal was in operation from 1968 until 1983 when it was discontinued (LANL 1990a). According to LANL employees, during the pumping of the cement paste to the asphalt-lined disposal shafts at MDA T, the fire hose lines that were used to transport the cement paste would occasionally break apart or leak, thereby spilling the cement paste on the ground (Romero and Vigil 1990). Although documentation is not available, another LANL employee reported that an operational release of cement paste occurred approximately 100 ft west-northwest of TA-21-257, as a result of a break in the fire hose transfer line (Romero and Vigil 1990). These types of releases were reportedly cleaned up immediately after each spill occurred; however, a few such releases have been identified as areas of concern (see Table 16.5-I).

Sludges that accumulated from chemical treatment of the continuous (main) waste stream were also added to the pug mill feed for eventual disposal to the absorption beds at MDA T (Christenson and Emelity 1970). Other wastes treated at TA-21-257 included americium-plutonium solutions that were alkaline and rich in fluorides, chlorides, and radionuclides. These wastes were mixed with cement via the pug mill and pumped to the asphalt-lined disposal shafts at MDA T along with the other wastes discussed previously.

At present, the wastes produced at DP East and DP West are transported to TA-21-257 through cast iron lines (Romero and Vigil 1990). The 3-in., cast iron line that carries waste from DP East

to TA-21-257 originates at Buildings TA-21-155 and TA-21-209 (LASL 1967c; Romero and Vigil 1990). The DP East liquid waste is sent to TA-21-257 via a sump pump, TA-21-223 (LASL 1975). The sump pump (TA-21-223) has a 6-in. overflow line, which trends north and is connected to two 3,000-gal. holding tanks [SWMUs 21-004(b) and (c)]. The tanks serve as emergency storage if the sump is inoperative or if it overflows (see Sec. 14.3). Before the tanks were installed, wastes that overflowed from TA-21-223 went to an outfall near the edge of DP Canyon [see Sec. 15.8, SWMU 21-004(d)]. At DP West, a 4-in., mild steel (or possibly glass) line and three 1.5-in., stainless steel lines transport liquid waste from Buildings TA-21-2, TA-21-3, TA-21-4, TA-21-5, and TA-21-150 to Building TA-21-257 (LASL 1968a; LASL 1975; LASL 1976b) (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a).

Additional waste lines that may exist include a 6-in. cast iron waste line and a 3-in. cast iron waste line. These lines presently deliver, or have delivered, liquid wastes from DP East, DP West, and the former industrial liquid waste treatment facility, TA-21-35, to the new industrial waste treatment plant, TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a) (see Sec. 18.5).

16.5.1.2. Existing Information

The following summarizes and evaluates existing data from TA-21-257 and provides the basis for determining whether additional information is needed to complete characterization and assessment of the site.

On October 4, 1972, an alpha radiation survey was performed at TA-21-257 (Stafford 1972). A Ludlum Model 139 alpha meter was used for the survey. Counts of up to 250,000 counts/minute were recorded outside of the building on the surface at a location under the americium raffinate storage tank (TA-21-289) (Fig. 16.5-3) (Stafford 1972). The highest recorded readings inside of the building were 25,000 counts/minute obtained at the Pug Mill (TA-21-256). Because the average gross alpha concentration per gram for this area is 3.2 counts/minute (Purtymun et al. 1987), these readings are believed to be well above background levels.

Radiation surveys performed by LASL employees in 1978 identified plutonium, ^{137}Cs, ^{241}Am, and tritium surface contamination inside the exclusion fence at TA-21-257 and across the public access road north of the building (Romero 1978). Radionuclide contamination was identified in run-off ditches to DP Canyon and from the TA-21-257 outfall to DP Canyon (LASL 1967d).

A soil and phoswich radiation survey was performed outside of the TA-21-257 exclusion fence in

April 1986 by HSE-1. Seven soil samples were taken on the north and south side of the paved public access road near the building (Wenzel and Romero 1986). Table 16.5-II shows the radiochemical and radiation counting results for the seven samples. Conclusions made by Wenzel and Romero (1986) from their investigation indicate above-background radionuclide contamination and downgradient movement of ^{238}Pu, $^{239/240}Pu$, ^{137}Cs, and tritium from the building area above the paved road surface and also in culverts and ditches leading to DP Canyon. However, based on the comparison with background levels (Purtymun et al. 1987) shown in Table 16.5-II, it is clear that all radionuclides analyzed were present at above-background concentrations in almost all of the seven soil samples that were collected.

In June 1987, three soil samples were collected around a leaking pipe at the northwest corner of TA-21-257 (Soholt 1987). The exact sampling locations are not known. Americium contamination was confirmed in all three samples, with a maximum concentration of 56.1 nCi/g. The area investigated by the sampling has not been remediated or backfilled (Soholt 1987).

No additional information on either the radioactive container storage area (SWMU 21-001) or the areas of concern exists.

16.5.1.3. Source Term

TA-21-257 began operations in 1967 and continues to receive both radioactive and hazardous liquid wastes for treatment. In 1968, it received 244,900 gal. of waste with an average gross alpha activity of 562 counts/minute/liter (LASL 1969). Of the 244,900 gal. received, 40% was discharged to DP Canyon without treatment. Table 16.5-III shows the types of radioactive wastes that were treated at the plant from January through May 1973 and the chemical composition and average monthly radioactivity of each waste. These wastes are presumably similar in composition to wastes that have been processed at the plant from the time it first came on line in 1967.

The plant also has treated large volumes of tritium-contaminated waste (Table 16.5-IV). In 1970, a total of 2,866,300 gal. of tritium waste, which contained a total activity of approximately 51 mCi, was treated. The volume of tritium-contaminated waste currently being treated is not known. It is, therefore, not known if the volume of tritium-contaminated waste that was treated in 1970 is representative of the volumes of tritium-contaminated waste that have been treated annually since that time.

Over the years, the outfall from Building TA-21-257 (currently permitted as NPDES No. EPA050050) discharged an undetermined amount of untreated waste (LASL no date) into DP

Canyon. This resulted in the need for a chemical and radionuclide investigation of the outfall drainage (see Fig. 15.4-4). This outfall is further discussed in Sec. 15.4, SWMU 21-011(k).

Operational Data at Building TA-21-257. The Waste Management Group (HSE-7) records raw data for treatment operations conducted at Building TA-21-257. The available data include the volumes of influent processed and the chemical quality of influent and effluent for the years 1967 to 1972 and 1978 to 1989. Data for the years 1973-1977 are not available.

Tables 16.5-V through 16.5-VII are a summary of the raw data tables. The summary tables show comparisons of influent and effluent sample concentrations for gross alpha and beta, radionuclides, and selected inorganic constituents, respectively. The information provided in the three tables is based on the best collection of data available at this time and is assumed to be representative of the more complete data set. The data provided are not consistent between years and do not provide both influent and effluent data in all cases.

Data in Table 16.5-V show that influent flow was greatest in 1970 at 2,863,700 gal. and was at a low of 484,000 gal. in 1979, which was the year after the plutonium-processing operations moved to TA-55. The general trend in flow has decreased from 1967, when the plant first came on line, to the present. The removal efficiency for gross alpha and beta from 1978 to 1989 appears to be between 97 and 99%. There is a wide variation in influent concentrations from 1978 to 1989. The concentrations in gross alpha and beta vary over approximately three orders of magnitude with no apparent pattern or trend.

In general, the data in Table 16.5-VI show that the greatest concentration of radionuclides in influent wastes was between 1979 and 1983. Since 1983, substantial decreases of two to three orders of magnitude are recorded in the influent concentrations of radionuclides. Removal efficiencies of radionuclide concentrations in the effluent range from 89% to greater than 99% of the influent radionuclide concentrations.

In general, the data in Table 16.5-VII show that concentrations of selected inorganic constituents (selected on the basis of toxicity, etc.) were low, except for values recorded for cadmium in 1981 and 1987 (3.4 and 418 mg/L, respectively). Removal efficiencies of inorganic constituents in effluent ranged from less than 1% for hexavalent chromium (which exhibited low influent concentrations) compared to 94 to 99% for most of the other inorganic constituents.

16.5.2. Objectives and Data Needs

In the course of operations at TA-21-257, documented leaks and spills have occurred outside in the area surrounding the facility. Two areas were also used for drum storage of radioactive materials. Although cleanup of leaks and spills at areas of concern has been performed, surface and subsurface soil contamination may still exist. Stored drums may also have leaked and released contaminants.

SWMU 21-011 data needs are listed below as follows:

1. Determine the location and below-ground dimensions of underground structures TA-21-223, the two 28,000 gal. raw waste storage tanks, the grit chamber, TA-21-204, and TA-21-205 from engineering drawings.

2. Identify the presence of contamination beneath the foundation of Building TA-21-257 by analysis of subsurface soil samples using Level II/III data.

3. Identify the presence of contamination at selected waste treatment and storage tanks and at locations of historical spills and leaks by Level II/III analysis of surface and subsurface soil samples.

4. If contaminants are identified, determine the vertical and lateral extent of contamination by additional surface and subsurface soil sampling and Level III/IV analysis.

16.5.3. Sampling/Investigation Rationale

Two phases of investigations are planned for SWMU 21-011. Building TA-21-257 and the other associated tanks and structures are in active use; therefore, field sampling for both phases will be conducted only around the building exterior. Investigation of the two radioactive container storage areas (SWMU 21-001) and three areas of concern will be performed in conjunction with the investigation of SWMU 21-011.

The initial investigation will consist of surveying and marking existing underground structures, a field survey for radiological surface contamination, and angled and shallow boreholes for subsurface soil sampling. All underground structures and the foundation of Building TA-21-257 will be surveyed and the subsurface depth recorded in order to assure structural integrity during drilling at these locations. The field radiological survey will identify any surface contamination remaining from past leaks and spills. Angled drilling beneath Building TA-21-257 will investigate the potential presence of contamination resulting from operations. Shallow drilling will investigate potential environmental contamination at the two radioactive container storage areas, selected waste treatment and storage tanks, and at locations of historical spills and leaks.

Soil samples collected from the initial investigation will be field-screened and submitted for selected field laboratory measurements to determine the general types and concentrations of contaminants present. Approximately 30% of the total number of samples collected will then be submitted to an analytical laboratory for confirmation of contaminants and a full suite of additional analyses.

All samples will be analyzed in the field laboratory. These analyses will be used to define whether the nominal borehole depth has reached the edge of the contaminant plume or whether each borehole needs to be deeper. Because this investigation presupposes the Building 257 area is contaminated, the purpose of samples sent to the analytical laboratory is twofold: 1) to define the source term and 2) to define the edges of the contaminant plume. Therefore, samples sent to the analytical laboratory for confirmatory analysis will include "hot" samples for source term definition and samples from the edges of the plume to confirm absence of contamination.

Additional investigation will be needed if contaminants are identified in the angled boreholes beneath Building TA-21-257. A subsequent investigation may also include additional boreholes and subsurface sampling to define the lateral and vertical extent of contamination. The analytical suite in the subsequent investigation, based on initial investigation results, may be narrowed to specific analytes.

16.5.4. Sampling Plan

16.5.4.1. Initial Investigation

The area of investigation surrounding Building TA-21-257 is bounded on the north and east by security fences, by MDA T on the west, and by a road to the south (Fig. 16.5-2) (LASL 1976a, 1976b). Figure 16.5-2 (LASL 1967d) also shows the location of the sump pump TA-21-223 [SWMU 21-011(b)].

Underground structures TA-21-223, the two 28,000 gal. raw waste storage tanks, the grit chamber, TA-21-204 and TA-21-205, will be surveyed and marked from engineering drawings (LASL 1967e; LASL 1968b; LANL 1983a) (for method see Sec. 11.3.3). The depth below ground surface for these structures and the foundation of Building TA-21-257 will also be determined from engineering drawings in order to assure structural integrity during the drilling program.

A radiological field survey (for methods see Sec. 11.4.1.1 and Sec. 11.4.1.2) will be conducted in the area surrounding Building TA-21-257. Because some areas are now covered by asphalt, it is

anticipated that surface radioactivity from previous spills and leaks will be identified at no more than five locations. Up to five locations will be evaluated by the collection and analysis of near-surface soil samples to a 30-in. depth (for method see Sec. 11.5.2.2). If five locations are sampled, this will result in 25 samples sent to be processed in the field laboratory. Approximately 30% of the samples collected will be sent to the analytical laboratory. The field screening, field laboratory and sample analysis requirements are shown in Table 16.5-VIII.

Four angle boreholes (for method see Sec. 11.5.3.3), one on each side, will be drilled beneath the foundation of Building TA-21-257 at the locations shown in Fig. 16.5-1 (LASL 1976b). The angle of borehole penetration will be 45 degrees. Nominal length of these boreholes will be 20 ft. Sixteen samples (5-ft core intervals) will be processed in the field laboratory. Approximately 30% of these samples will be sent to the analytical laboratory. The field screening, field laboratory, and sample analysis requirements are shown in Table 16.5-VIII.

Seven shallow boreholes will be drilled (for method see Sec. 11.5.3.1). Six of the boreholes will be at locations surrounding Building TA-21-257 as shown in Fig. 16.5-1 (LASL 1976b). The seventh borehole will be drilled near the sump pump, TA-21-223, as shown in Fig. 16.5-1 (LASL 1976a). Nominal depth of these boreholes will be 10 ft (four 2.5-ft soil cores). Twenty-eight samples will be collected and processed in the field laboratory. Of these samples, approximately 30% will be sent to the offsite analytical laboratory. The field screening, field laboratory, and sample analysis requirements are shown in Table 16.5-VIII.

16.5.4.2. Subsequent Investigation

If contaminants are identified during the initial investigation, additional subsurface soil sampling and analyses will be necessary to determine the vertical and lateral extent of contamination. Samples obtained from the subsequent investigation will be submitted for a full suite of laboratory analyses, except if results from the initial investigation indicate a more focused analytical suite is appropriate.

Additional angled drilling may be required if sources of contamination are identified beneath Building TA-21-257. These boreholes will be positioned at 20-ft spacings on either side of initial angled borehole locations that were determined to be contaminated. Drilling will be performed at a 45° angle according to the method in Sec. 11.5.3.3. For planning purposes, it is anticipated that no more than four additional angled boreholes be drilled to a nominal length of 20 ft. If four additional angled boreholes are drilled and sampled, a total of 16 samples will be collected.

Additional shallow boreholes may also be required to determine the vertical and lateral extent of contamination near the two radioactive container storage areas, waste treatment and storage tanks, or at the locations of historical spills and leaks. These boreholes (for method see Sec. 11.5.3.1) will be positioned at 20-ft spacings outward from sampling points at which contamination is identified. For planning purposes, it is anticipated that no more than 10 additional boreholes to a nominal depth of 10 ft will be required. If 10 additional boreholes are drilled and sampled, a total of 40 samples will be collected.

For planning purposes, it is assumed that the analytical program will be the same as for the initial investigation. Table 16.5-IX gives the screening and analysis assumptions for the 56 samples that are assumed for the subsequent investigations.

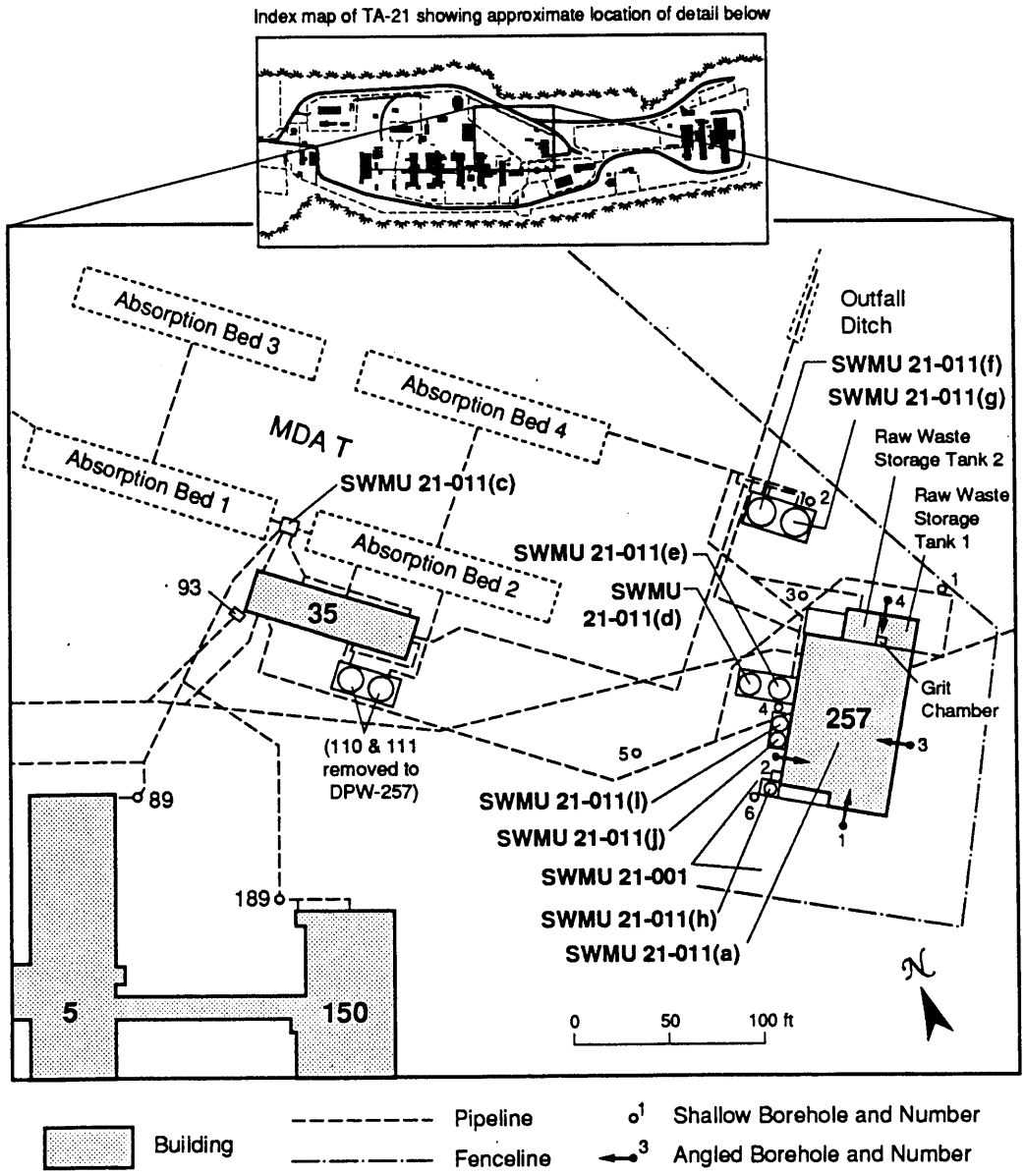


Fig. 16.5-1 SWMU and borehole locations for the New Industrial Waste Treatment Plant TA-21-257. (LASL 1976b; LANL 1983a)

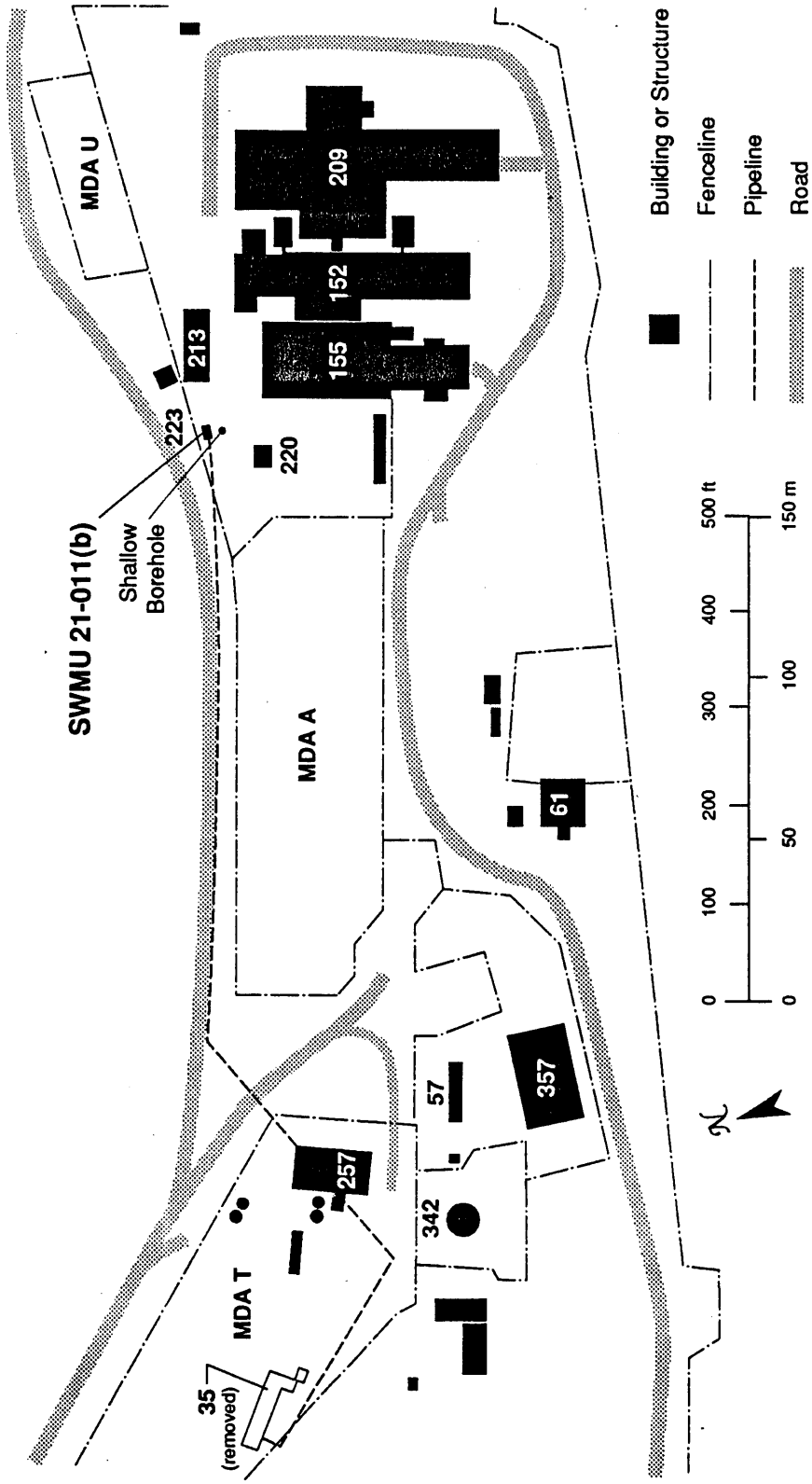


Fig. 16.5-2 Sump TA-21-223, SWMU 21-011(b), and borehole location, approximately 400 ft east of the New Industrial Waste Treatment Plant TA-21-257. (LASL 1976b, c)

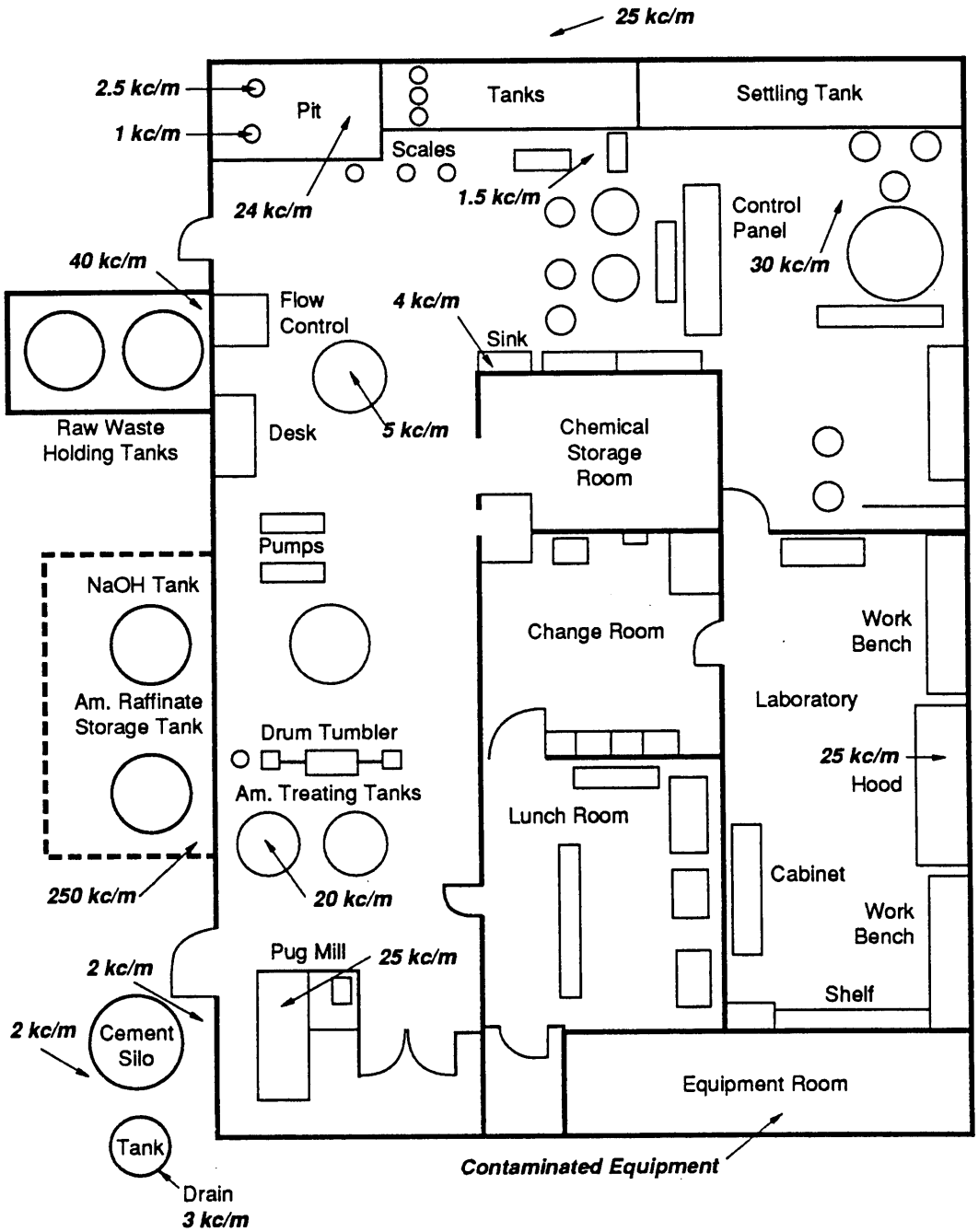


Fig. 16.5-3 Alpha survey at the New Industrial Waste Treatment Plant TA-21-257. (Stafford 1972)

TABLE 16.5-I
AREAS OF CONCERN ASSOCIATED WITH TA-21-257[a]

Site Number	Description
C-21-005	Release of ^{241}Am and plutonium on west side of building; soil was decontaminated. (RFA Unit 21.018, Task 10, Record 180) Addressed as part of 21-011.
C-21-007	Release of plutonium, americium, and uranium from a tank vent. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 183) Addressed as part of 21-011.
C-21-033	1976 TRU cement paste spill. (Task 10, Record 181) Addressed as part of 21-011.

[a]Data source in parentheses is TA-21 Release Site Data Base, LANL 1989.

TABLE 16.5-II
RADIONUCLIDE CONCENTRATION IN SOIL SAMPLES NEAR TA-21-257[a]

Constituent	Upper Limit of Background $\bar{X} + 2s$[b]	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Tritium (pCi/ml)	0.0072	4.8	1.9	140	240	3.1	2.6	2.8
239/240Pu (pCi/g)	0.025	13.3	5.1	5.7	6.1	10.5	6.9	0.366
238Pu (pCi/g)	0.005	0.30	0.24	0.21	0.92	1.80	0.23	0.109
137Cs (pCi/g)	0.44	4,320	13.7	1.45	1.48	45.1	1.99	0.0547
90Sr (pCi/g)	0.88	1,510	4.0	0.13	0.79	17.3	0.54	0.25
Total U (µg/g)	3.4	4.49	3.49	3.52	3.08	3.94	5.95	2.64
241Am (pCi/g)	Not reported	0.082	ND[c]	ND	ND	ND	ND	ND

[a]Wenzel and Romero (1986).
[b]Purtymun et al. (1987).
[c]Not detected.

TABLE 16.5-III. WASTE STREAM COMPOSITION TO DP-257 JANUARY THROUGH MAY 1973.

Type of Wastes	Av Vol/Mo Gallons	Chemical Composition	Radioactivity Av/Mo
Main flow stream, DPW	129,300	pH 11.4; TS-1, 580 mg/l; Na-400 mg/l; NO_3-73 mg/l; Cl-57 mg/l	1.38×10^{-1} µCi/l gross a 1.32×10^{-3} mCi/l Sr
Main flow stream, DPE	13,700	Incl. above	Incl. above Low ^{235}U
Am-Pu acid wastes	2,500	HNO_3 + metals	22.15g ^{239}Pu, 20.4g ^{241}Am, ~0.01g ^{238}Pu
Bldg 2, NaOH wastes	400	(from recovery oper.) NaOH, Fe, Cl, NO_3, plus various others	188 mg total a include ^{239}Pu, ^{241}Am
Bldg 4, KOH	130	KOH, used to scrub HF lines	246mg ^{235}U + 2mg ^{239}Pu + trace ^{238}Pu
Bldg 5, KOH wastes	480	(scrubbing sol.), KOH, F^-	1.36g ^{239}Pu
Distillate	1,130	$-NO_3$	11.4g ^{235}U (incl. in main stream)
Scrub tank, Distillate	40	NO_3^-, Cl^-, Neut. KOH + misc. organics	800 mg ^{235}U
Alcohol	8	Ethyl Alcohol	1.78g ^{239}Pu
Strip wastes	255	Na, Mg, Al, Fe, Cr, Ni, NH_3 SO_4, NO_3	15.2g ^{235}U, trace amounts of ^{90}Sr and ^{137}Cs (MFP)
Organics, solvents	9	Acetone, Chlorethylene, etc.	^{235}U, ^{238}Pu, ^{239}Pu
Oils	8	Vacuum pump oil	^{238}Pu, ^{239}Pu

TABLE 16.5-IV
TRITIUM DISCHARGED FROM TA-21-257 IN 1970[a]

Dated	Liters[b] x 10^3	mCi[c]
Jan	898	2
Feb	919	2
Mar	886	25
April	799	1
May	685	11
June	1,073	4
July	1,200	1
Aug	809	1
Sept	889	2
Oct	858	1
Nov	679	<1
Dec	1,153	1
TOTAL	10,849	51
Mo. Av.	904	4.2

[a]LASL (1971).
[b]Bldg. 257 average = 4.7×10^{-6} µCi/ml.
[c]mCi of tritium were calculated using DP-East volumes and analyses and assuming that the DP-West wastes contain no tritium.

TABLE 16.5-V
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS
FOR GROSS ALPHA AND BETA

Statistic	Influent Flow[a] (Liters)	Gross Alpha (mCi)[b] Influent	Gross Alpha (mCi)[b] Effluent	Gross Beta (mCi)[b] Influent	Gross Beta (mCi)[b] Effluent
Minimum	1,832,300	6.38	1.24	3.28	3.01
Maximum	10,839,300	5353.50	6.41	1030.64	20.44
Average	4,948,806	904.14	2.60	276.69	7.62
St. Deviation	3,088,736	1976.45	2.06	833.76	7.69
% Reduction			99		97

[a]Includes years 1967 - 1989.
[b]Includes years 1978 - 1989.

TABLE 16.5-VI
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS FOR RADIONUCLIDES

Statistic[a]	^{89}Sr (mCi)		^{90}Sr (mCi)		^{238}Pu (mCi)		$^{239/240}Pu$ (mCi)		^{241}Am (mCi)		^{234}U (mCi)		^{137}Cs (mCi)	
	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff
Minimum	0.03	0.03	0.0	0.07	0.87	0.04	1.35	0.06	1.06	0.59	0.50	0.89	0.19	0.16
Maximum	5.48	0.16	31.30	0.87	486.27	0.45	622.11	0.70	5022.74	1.72	813.30	31.60	48.27	0.97
Average	0.74	0.08	4.67	0.34	107.16	0.14	109.53	0.21	747.69	0.90	148.95	6.57	5.43	0.45
St. Deviation	2.04	0.06	11.63	0.33	202.40	0.17	230.54	0.27	1869.79	0.46	297.20	13.60	18.36	0.32
% Reduction		89		93		99		99		99		96		92

[a]Includes years 1979 - 1989 (not all years have complete data).

TABLE 16.5-VII
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS
FOR SELECTED INORGANIC CONSTITUENTS

Statistic	Cd (mg/L)		Cr-VI(mg/L)		Pb (mg/L)		Hg(mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.01	0.0	0.013	0.026	0.1	3.99E-3	0.01	4.0E-4
Maximum	418.20	0.32	0.3	0.15	0.89	3.30E-2	0.05	1.0E-3
Average	42.51	0.14	0.077	0.076	0.31	1.81E-2	0.02	5.94E-4
St. Deviation	161.00	0.15	0.103	0.051	0.29	1.21E-2	0.01	2.28E-4
% Reduction		99		4		94		97

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis										
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Subsurface Investigation																																			
Survey				X	X		X																												
Near Surface Soil	1	0.0 - 0.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		0.5 - 1.0 ft						X	X		X			X	X	X	X																		
		1.0 - 1.5 ft						X	X		X			X	X	X	X																		
		1.5 - 2.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		2.0 - 2.5 ft						X	X		X			X	X	X	X																		
	2	0.0 - 0.5 ft						X	X		X			X	X	X	X																		
		0.5 - 1.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		1.0 - 1.5 ft						X	X		X			X	X	X	X																		
		1.5 - 2.0 ft						X	X		X			X	X	X	X																		
		2.0 - 2.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
	3	0.0 - 0.5 ft						X	X		X			X	X	X	X																		
Field Duplicate																						X	X	X	X		X	X	X	X					
		0.5 - 1.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		1.0 - 1.5 ft						X	X		X			X	X	X	X																		
		1.5 - 2.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		2.0 - 2.5 ft						X	X		X			X	X	X	X																		
	4	0.0 - 0.5 ft						X	X		X			X	X	X	X																		
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
		0.5 - 1.0 ft						X	X		X			X	X	X	X																		
		1.0 - 1.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E					
		1.5 - 2.0 ft						X	X		X			X	X	X	X																		
		2.0 - 2.5 ft						X	X		X			X	X	X	X																		

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals
	5	0.0 – 0.5 ft						X	X	X			X	X	X	X			E	E	E	E		E	E	E	E		
		0.5 – 1.0 ft						X	X	X			X	X	X	X													
		1.0 – 1.5 ft						X	X	X			X	X	X	X													
		1.5 – 2.0 ft						X	X	X			X	X	X	X													
		2.0 – 2.5 ft						X	X	X			X	X	X	X			E	E	E	E		E	E	E	E		
Trip Blank																									X				
TA-21-257																													
Angled Borehole	1	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X													
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X													
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E		
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X													
	2	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X													
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X													
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E		
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X													
Trip Blank																									X				
	3	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X													
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X													
Rinsate Blank																			X	X	X	X		X	X	X	X		
Field Blank																									X	X	X		
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E		
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X													
	4	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X													
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E		
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X													
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X													

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis										
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
Trip Blank																												X						
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X																	
	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X					E	E	E	E		E	E	E	E				
Rinsate Blank																					X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
Trip Blank																											X						

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
TA-21-257																																	
Angled Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
Trip Blank																													X				
	3	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
	4	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																
Trip Blank																													X				
Other Areas																																	
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
Field Duplicate																						X	X	X	X		X	X	X	X			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Rinsate Blank																					X	X	X	X		X	X	X	X			
Field Blank																											X	X	X			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
Trip Blank																												X				
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis										
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
Trip Blank																												X				
	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Rinsate Blank																					X	X	X	X		X	X	X	X			
Field Blank																											X	X	X			
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
	10	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X															
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X															
Trip Blank																												X				

16.6 SWMU 21-017 Material Disposal Area (MDA) U

16.6.1 Site Description

Material Disposal Area U (MDA U) covers an area of 1,200 m^2 (0.2 acre) (Hansen 1980) and contains two absorption beds [SWMUs 21-017(a) and (b)] that were used for subsurface disposal of radioactively contaminated liquid wastes from 1948 to 1968 (Hakonson 1987; Hansen 1980). An associated sump, TA-21-164 [SWMU 21-017(c)], was located between the two beds. Figure 16.6-1 shows the location of MDA U at TA-21. A 1945 memo (Veltman 1945) described in some detail what are believed to be the design requirements for the MDA U absorption beds as follows:

> ... provision would be made to handle the so-called process sewage from Buildings 2, 3, 4, 5 and 52 in the following manner. A pit will be dug on the north side of the mesa approximately 6-ft deep and 10 x 50 ft in area for Building 52. A graded gravel bed will fill this pit with relatively large stones in the bottom and ordinary soil on top. This arrangement will allow satisfactory draining of process sewage.[1]

As constructed, the two absorption beds have a surface area of approximately 167 m^2 (1800 ft^2) with an estimated volume of about 510 m^3 (18000 ft^3). Figure 16.6-1 shows the absorption beds and Buildings 152 and 153. Process sewage was drained from these buildings to the absorption beds.

16.6.1.1 Site History

Historical records for MDA U are lacking. As a result, the amount of liquid wastes discharged to MDA U is unknown. However, the primary contaminant released was ^{210}Po (Christenson 1973). Records also indicated that about 2.5 Ci of ^{227}Ac were discharged into these beds in 1953 (Christenson 1973c).

There were early problems with the pits; they did not function properly, and it was reported that "the oil washing down from the precipitrons is lying on top of the ground. This [oil] is very definitely contaminated to a high degree (Drager 1946)."

MDA U became an inactive site in 1968 (Hakonson 1987). Site stabilization efforts began in 1985, with the pits remaining uncovered until that time and receiving some cooling water effluent

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[1]Buildings 52 and 53 were remembered to 152 and 153. This quote is referring to what is called building 52 in this Section.

until sometime after 1976 (Purtymun 1976). Site stabilization included the removal of an undocumented drain line. The drain line, apparently from the Tritium Systems Test Assembly (TSTA) cooling tower, drained into the west absorption bed (Mayfield 1985a). As part of the stabilization activities, a trench 20-ft wide, 100-ft long, and 4- to 13-ft deep was dug (presumably through the length of the beds), and soil contaminated with actinium was removed to MDA G (Hakonson 1987). Not all contaminated soil was removed because of lack of time and money. A plastic lining was placed in the trench to indicate the excavation boundary, and then the trench was filled with uncontaminated tuff. The excavated area was covered with 6 in. of top soil, and surface stabilization was conducted to remedy several drainage problems.

In 1987, additional site stabilization was completed (Salazar 1987). Stabilization included placement of ditches along the south fence of MDA U to prevent runon; topsoil, gravel mulch, and reseeding inside the fence; and placement of four brass markers at the corners of the site. In 1990, additional run-off collection drainage ditches were added to prevent run-off from the surrounding area from flowing across MDA U (Hakonson 1990).

16.6.1.2 Existing Information

16.6.1.2.1 Waste Discharge Information

Existing information on waste discharge is scant. It is known that the primary contaminant of waste discharged to the two beds was ^{210}Po (Christenson 1973c). Although the amount of ^{210}Po discharged is unknown, its half-life of 138.4 days indicates that it has decayed to undetectable levels. Christenson (1973) also stated that these beds received 2.5 Ci of ^{227}Ac in 1953. Actinium-227 came principally from the effluents of filter building 153, which scrubbed ^{227}Ac out of the air in several process buildings at TA-21 (Department of Energy 1979). Identification of other wastes at MDA U must come from sampling data.

A Purtymun (1976) memo stated that on December 18, 1975, water from a cooling process was being released into the west pit from a nearby building. At that time, there appeared to be permanent water in the west pit, although no overflow into the adjacent drainage was observed. A handwritten note on this memo stated "12/17/85 Purtymun states that liquid effluent used to run down into the canyon and pond in a swampy area there."

16.6.1.2.2 Historical Surface Sampling Data

A 1946 memo (Tribby 1946) reported results of analyses of various effluents for plutonium and polonium (Table 16.6-I). Data given therein for chemical sewer numbers 22 and 23, which drained into Los Alamos canyon after passing through MDA U, indicated contaminant levels that were released from MDA U, probably at higher concentrations than in the effluent. Assuming the units of disintegrations per minute per liter (dpm) imply that the measurements were calibrated properly, a conversion to pCi/L can be made, as given in Table 16.6-I. These range from 35 to 645 pCi/L of plutonium in the effluent.

In 1976, soil samples were taken outside of and within the pits, which were still uncovered at the time. These samples showed elevated gross alpha levels both inside and outside the fence (Purtymun 1976). The locations of the samples are given in Fig. 16.6-1 (LASL 1976a). Gross alpha values are given in Table 16.6-II. Purtymun recommended that "...consideration should be given to end release of water into the pits from near-by buildings."

Soil, tar, and vegetation samples were collected in 1980 (Mayfield 1985). The analytical results are given in Table 16.6-III. Three sampling locations were noted: U-1 at the west end of the west absorption bed, U-2 at the east end of the east absorption bed, and U-3 at the northeast corner just outside the fenced area (Fig. 16.6-1). The soil data show low-level plutonium contamination on the west absorption bed (e.g., 17.5 pCi/g) and ^{227}Ac daughters in the tar on the east absorption bed. The tar may have originated from oil from precipitrons (Drager 1946). Tritium was also observed in elevated concentrations (e.g., 37,000 pCi/L) in soil from the east absorption bed. Uranium concentration was highest on the west absorption bed (e.g., 26 µg/g). Tritium concentrations in vegetation from the absorption beds indicated low levels of contamination (e.g., 7,200 pCi/L). Gamma radiation levels ranged up to ten times background level on absorption bed surfaces (Mayfield 1985). The elevated levels appeared to be associated with the measured elevated levels of radioactive contaminants.

In 1984, soil samples were taken at 12 locations around MDA U; only one location was within the fence (Figs. 16.6-2 --16.6-4). Samples were collected at three depths (0-1 cm, 1-10 cm, and 10-30 cm). Samples were assayed for tritium, uranium, and $^{239/240}$Pu. Not all locations and depths were assayed for each radionuclide. The most complete data is for the 0-1-cm profile.

For the 0-1 cm profile, the maximum background levels for tritium, uranium, and $^{239/240}$Pu were exceeded in 42, 83, and 100% of the samples, respectively. Figures 16.6-5 through 16.6-7 show the spatial prediction surfaces generated from the data at depth 0-1 cm for each of the radionu-

clides. These contours are for concentration levels above the maximum background levels. Because only 12 data points were available, the kriged contours have large uncertainties. However, the contour plots graphically illustrate that the tritium concentration was highest at the southeast end outside MDA U (Fig. 16.6-5) and that $^{239/240}Pu$ was highest inside MDA U and appears to migrate north (Fig. 16.6-6). The $^{239/240}Pu$ contours also indicate that plutonium may have migrated outside the fence to the north (Fig. 16.6-7).

Generally, for all three radionuclides, the contaminant levels present in the 0-1-cm depth were also present in the 1-10-cm depth. However, in the 10-30-cm-depth interval, $^{239/240}Pu$ contamination only exceeded maximum background levels in one sample. Uranium remained present at the same concentration as in the previous two depth intervals. No data were available for tritium for the 10-30-cm interval.

Tritium concentrations in vegetation (Fig. 16.6-8) ranged from 3,100 to 10,000 pCi/L, well above a background level of 800 pCi/L.

16.6.1.2.3 Historical Subsurface Sampling Data

The 1983 subsurface sampling study took samples from two holes outside of MDA U as shown in Fig. 16.6-3. At each location, samples were collected at 12 depths ranging from 0 to 16.2 m. The samples were assayed for tritium, uranium, and ^{137}Cs. The data for this study are reported in Table 16.6-IV. Tritium values in both holes at all depths exceeded the maximum background level. In the east hole, tritium levels were increasing with depth ranging from 19,000 pCi/l to 78,000 pCi/l (Fig. 16.6-9). In both holes, uranium values exceeded the maximum background level in over 80% of the values. Concentrations did not decrease with depth. All ^{137}Cs values were below the maximum background level.

16.6.1.2.4 Summary of Historical Data

Historical data suggest tritium, $^{239/240}Pu$, and uranium surface contamination extend beyond the MDA U fence; and tritium and uranium contamination exists to a depth of 16m in two holes just north of the MDA U fence. These conclusions are based on very little data with few locations sampled within the fenced area. The spatial and temporal resolution of the data does not adequately define source distribution; nor evidence of transport that may have occurred in the past. The source of the tritium contamination is not known, but it may be caused by the TSTA. The uranium "contamination" is very low-level and may actually be indicative of background in the tuff.

16.6.1.3 Source Term

Radioactively contaminated liquid waste was disposed of at MDA U from 1948 to 1968. Records on the volume and composition of the waste do not exist. It is only known that about 2.5 Ci of ^{227}Ac was added to MDA U in 1953 (Christenson 1973c). Actinium-contaminated soil was partially removed in 1985. Subsequent surface and subsurface sampling has found tritium, uranium, and plutonium contamination. The source concentration of these contaminants is unknown. Whether organics or metals were present in the waste stream to MDA U is unknown.

16.6.2 Objectives and Data Needs

The objective is to define the extent of source term migration and determine whether capping and stabilization-in-place is a possible remedial alternative at this site. Specific data required to assess MDA U include the following:

1. Identify the contaminants present using Level III/IV analyses. Several radionuclides have been found in surface and subsurface samples from MDA U. Whether organics or metals are present is unknown. However, the potential for contaminants other than radionuclides cannot be ruled out because oil washing down from precipitrons was observed in the absorption beds and tar was sampled in 1980.

2. Determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and analysis, both within and beyond the MDA U fence, using Level II screening and Level III/IV laboratory analyses. Subsurface radionuclide data to a depth of 16 m indicate low-level radioactive contamination and some vertical migration. Subsurface lateral migration is undefined. Existing surface sampling data indicate lateral migration or erosion effects beyond the MDA U fence. Additional surface sampling is required to define surface lateral migration. Therefore, drainages from MDA U need to be identified and sampled.

3. Determine the primary migration pathways through the evaluation of sample analysis results. The primary migration pathways are expected to be surface erosion and subsurface transport. Therefore, drainages from MDA U need to be identified and sampled, and vadose zone sampling is needed.

16.6.3 Sampling/Investigation rationale

No information is available on surface contamination because MDA U underwent site stabilization in 1987. Surface sampling data on a 10- by 10-m grid within MDA U and extending outside MDA U to the canyon rim will be analyzed in conjunction with the TA-21 OU surface-sampling done on a 40- by 40-m grid (see Chapters 12 and 13). This data will be augmented by the detailed

drainage data as described in Sec. 16.1.4.

As discussed in Sec. 16.1.5, because MDA U was a liquid disposal area, both vertical boreholes to define the source term and its depth and angle boreholes to define the lateral and vertical extent of contamination will be drilled. Because all contaminant species in MDA U cannot be identified at this time, a full analytical suite will be specified for surface and subsurface samples.

Dependent upon results of initial sampling, the sampling program may need to be expanded to include a larger area. In these additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.6.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation planned at MDA U. However, due to the large number of pages these tables have been placed in Section F.6 of Appendix F, Analytical Tables.

16.6.4.1 Surface Sampling Plan

In 1987, MDA U underwent site stabilization activities, which have been discussed in Sec. 16.6.1.1. Because MDA U was covered with top soil and graded inside the fence, the previous surface data are no longer appropriate but represent a layer beneath the surface. The data collected here should help determine the effectiveness of this stabilization activity and give insight into erosion patterns.

16.6.4.1.1 Initial Investigation

The MDA U sampling plan will be sequential. The initial investigation will consist of 40 samples from a 10-m by 10-m grid over the entire MDA and extending to the DP canyon edge. The sampling will be coordinated with the OU-wide surface sampling plan. (Fig. 16.6-10). Radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. If such areas are detected, up to 10 samples to further characterize the extent of contamination will be collected. These sample data will be combined with the drainage data (Sec. 16.1.4) and the data from the TA-21 OU surface sampling (Chapters 12 and 13) in the vicinity of MDA U to develop spatial prediction surfaces such as those described for the 1984 data (Figs. 16.6-5 to 16.6-7).

Five sample locations within the MDA and five off the MDA will be sampled at 3 m from the grid locations to allow an assessment of spatial variability.

All samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. The screening and analysis requirements are identified in Table F.6-I (see Appendix F).

16.6.4.1.2 Subsequent Investigation

Any need for additional sampling and the identification of the numbers and locations of additional samples will be dictated by the results of the initial investigation and the accuracy requirements for the prediction surfaces.

For planning purposes, it is assumed that 20 surface samples on either a 10- by 10-m or 5- by 5-m grid, as appropriate, surrounding MDA U will be required in the subsequent investigation. A reduced analytical suite, determined by analyzing the results from the initial investigation will be used. Table F.6-II (see Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

16.6.4.2 Subsurface Sampling Plan

The characterization targets at MDA U are the two former liquid waste absorption beds. Both absorption beds were largely excavated in 1985, and the contaminated soil was removed to MDA G. Excavation was terminated before the absorption beds could be completely removed, and the area of excavation was lined with plastic before being covered with uncontaminated soil.

16.6.4.2.1 Initial Investigation

The subsurface investigation will focus on source term characterization, determining the vertical extent of contamination, and identifying transport pathways beneath the absorption beds. Four vertical drill holes with nominal depths of 50 ft are sited in the absorption beds. Each absorption bed will be initially characterized by two drill holes located at the extreme eastern and western ends of the beds. The number and placement of these source-term holes may be modified based on the results of the source term holes into absorption beds at MDA V that will be drilled prior to the holes at MDA U.

A full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table Table F.6-III (see Appendix F).

Samples for both contaminant characterization and soil moisture determination will be collected at 5-ft intervals along the length of the drill holes. The nominal depth for each drill hole is 50 ft. The borehole stopping criteria in Sec 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. One vertical hole will be extended 50 ft below the contamination plume to determine whether the liquid waste infiltration beneath MDA U altered rock properties. Samples will be analyzed at 10-ft intervals in this 50-ft extension for geochemical parameters and mineralogy (Table F.6-IV, see Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals. This sampling is included in Table F.6-III (see Appendix F).

Geochemical parameters and mineralogy will be characterized in all initial investigation boreholes on 20-ft intervals of core and on additional contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes, it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.6-IV (see Appendix F).

One 300-ft borehole will be drilled at MDA U (see Fig. 16.6-VI) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.6.4.2.2 Subsequent Investigation

Six additional drill holes are tentatively identified for subsequent investigation (Fig. 16.6-11). Four of these holes will be inclined 15 to 20° from horizontal and two holes will be vertical (Figs. 16.6-11 and 16.6-12). The four inclined drill holes will be used to define the extent of the contaminant plumes and to further characterize contaminant pathways adjacent to and beneath the absorption beds. The inclination and orientation of these drill holes will be modified, if necessary, to take into account the data gathered during initial drilling. The two vertical holes, located on the canyon slope north of the site, will be drilled to determine if contaminants are moving laterally northward towards DP Canyon.

Samples from subsequent investigation holes will be collected at 5-ft intervals. The analytical suite will be reduced in scope, as appropriate, based on initial investigation analytical results.

However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.6-V (see Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

Depending on results of hydrogeological parameter determinations in both the planned OU-wide 300-ft vertical boreholes and the MDA U initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional subsequent investigation for characterization will be determined after results from the initial and subsequent drilling are evaluated. Surface geophysics will be used to locate the buried solid waste disposal pits if the results indicate a need for more detailed source term characterization. Placement of additional drill holes will be based on results from the surface geophysics and all earlier drill holes.

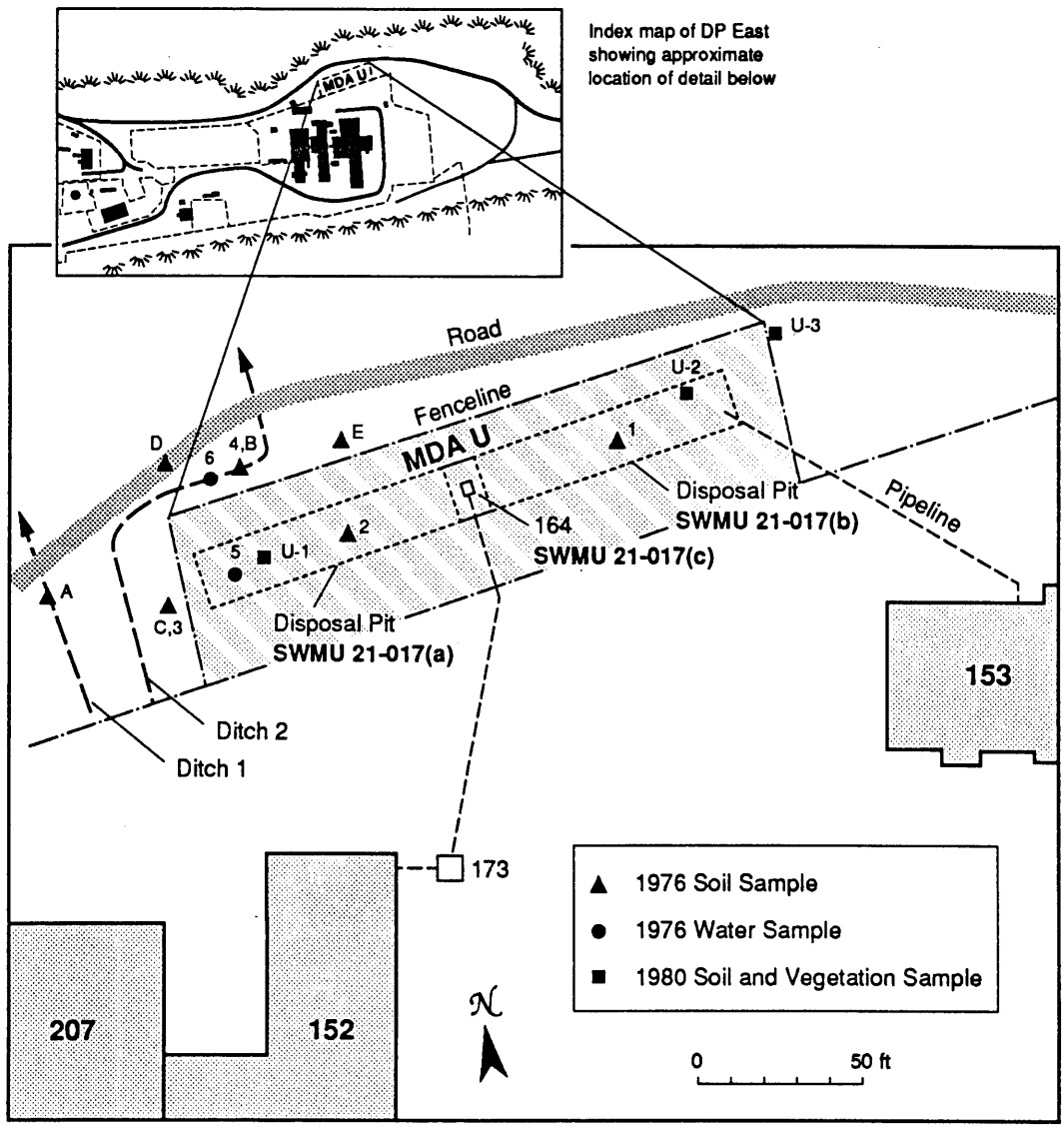

Fig. 16.6-1 Soil, water, and vegetation samples taken at MDA U in 1976 and 1980. (LASL 1976a)

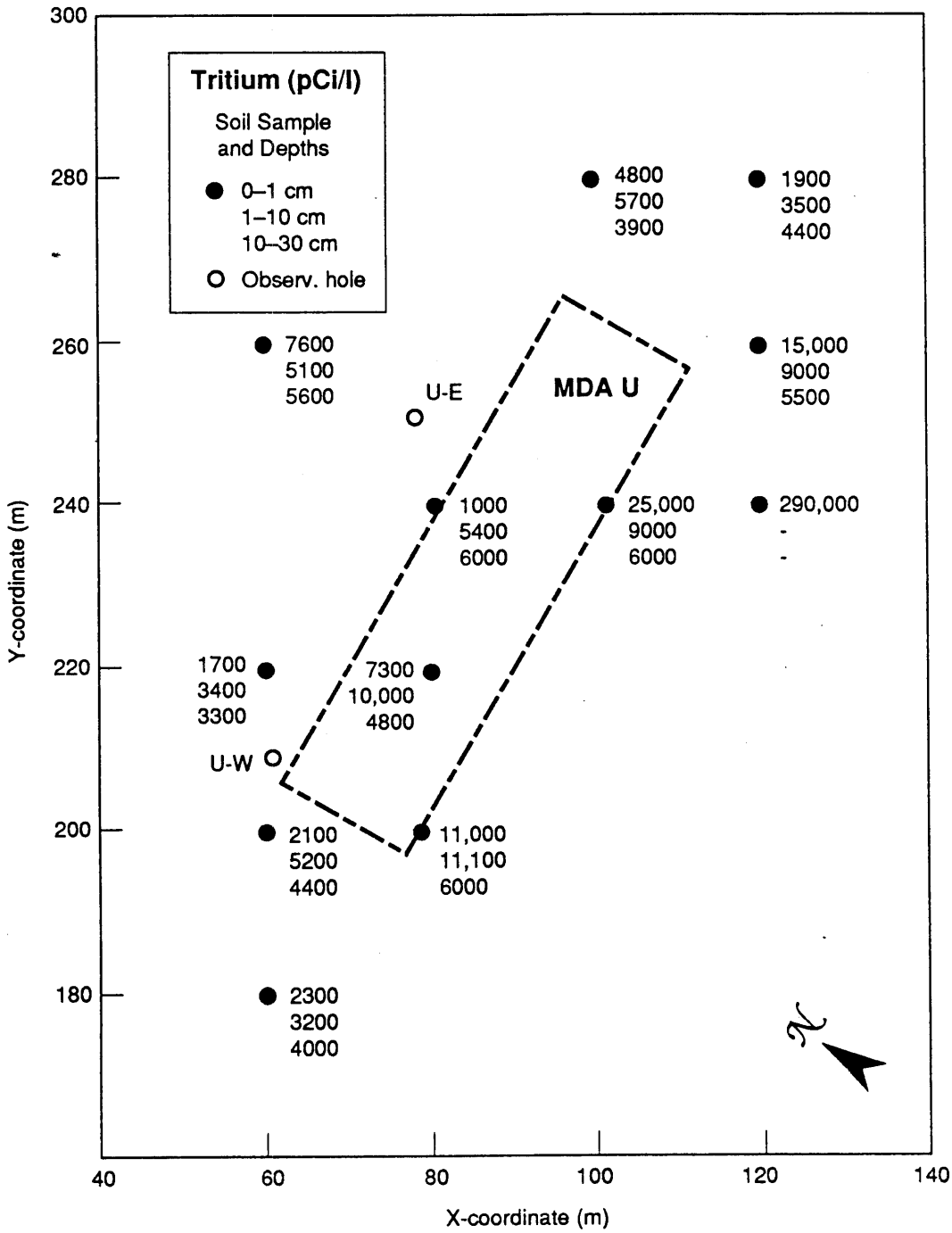

Fig. 16.6-2 1984 MDA U tritium data for soils (pCi/l).

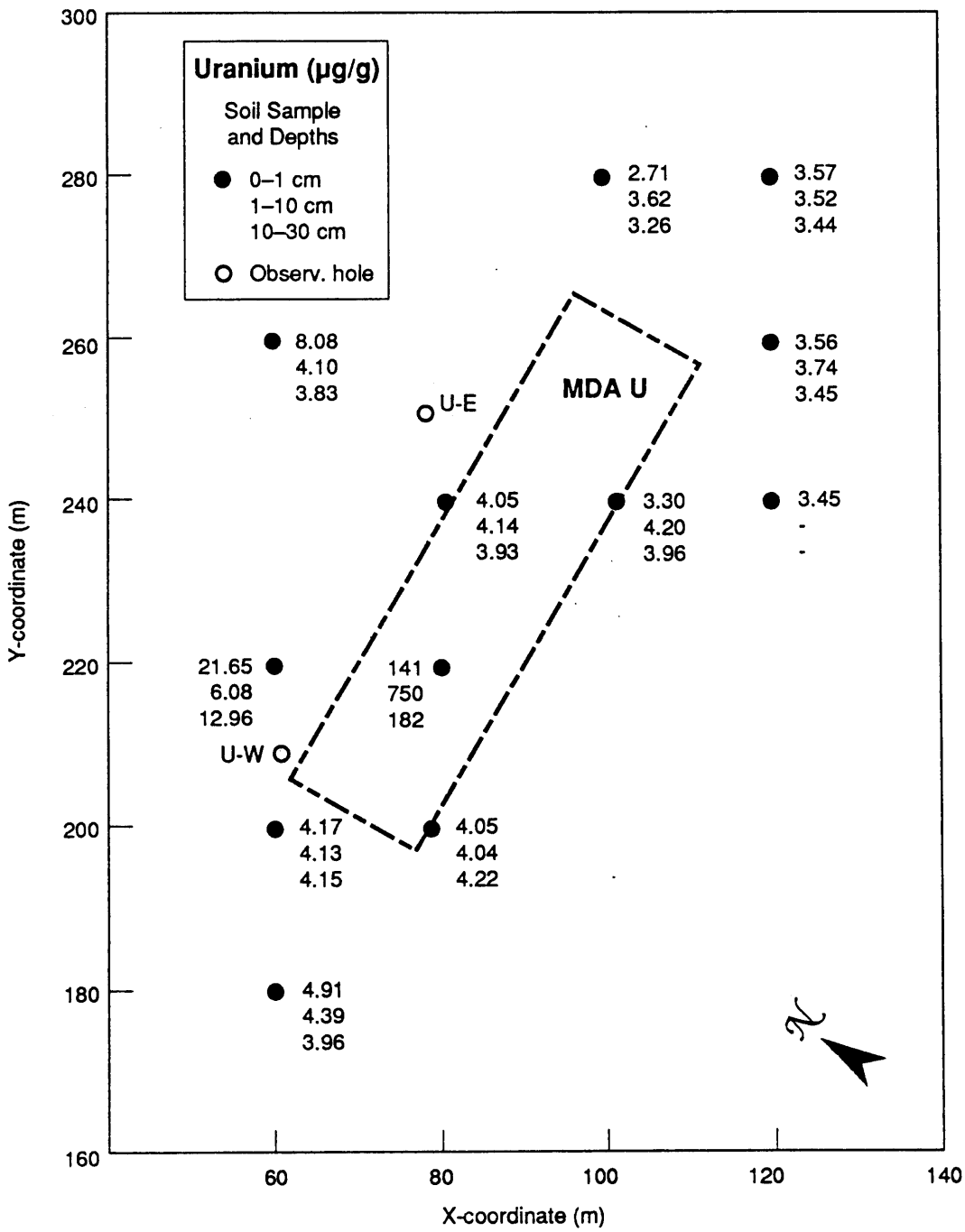

Fig. 16.6-3 1984 MDA U uranium data for soils (µg/g).

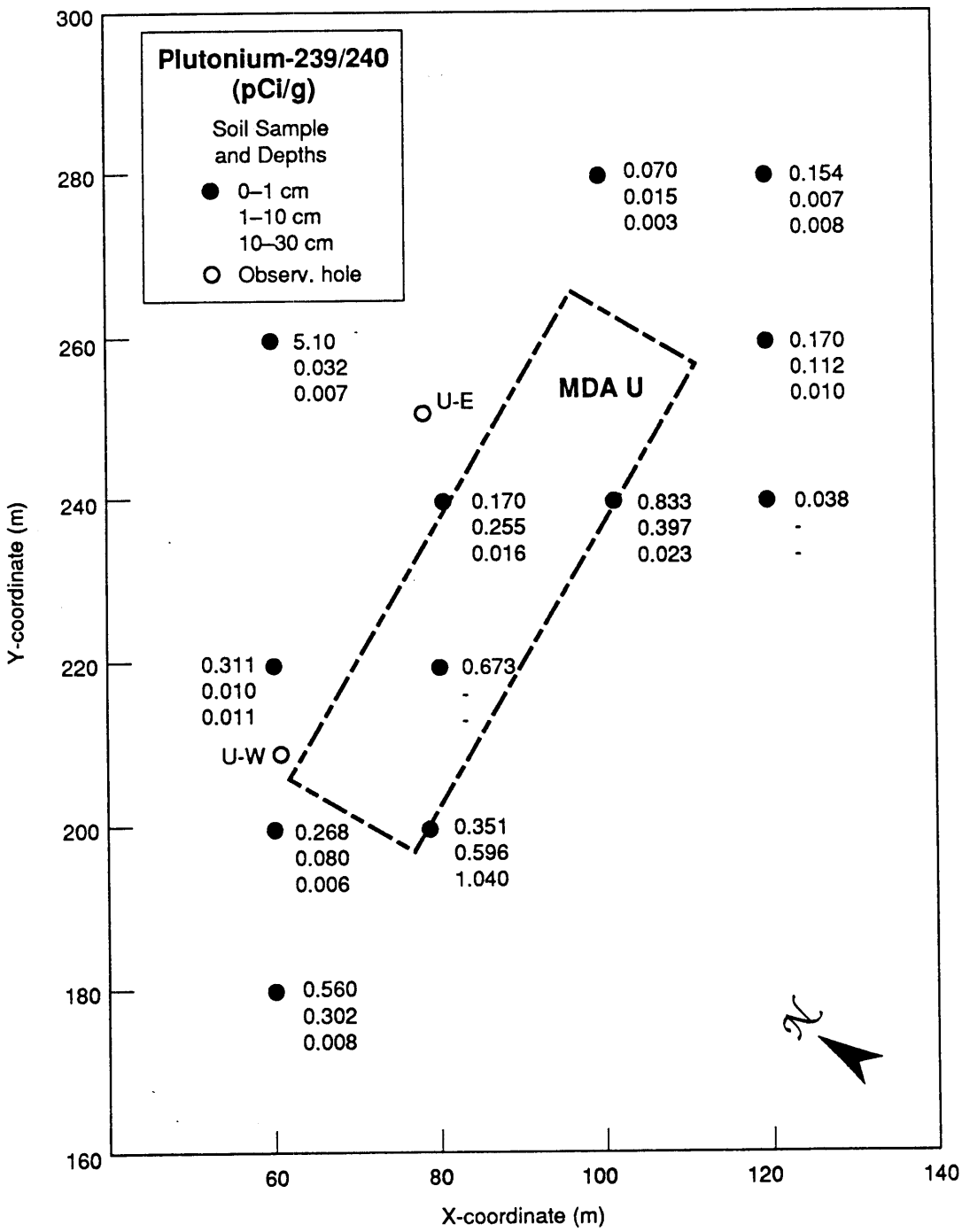

Fig. 16.6-4 1984 MDA U plutonium-239/240 data for soils (pCi/g).

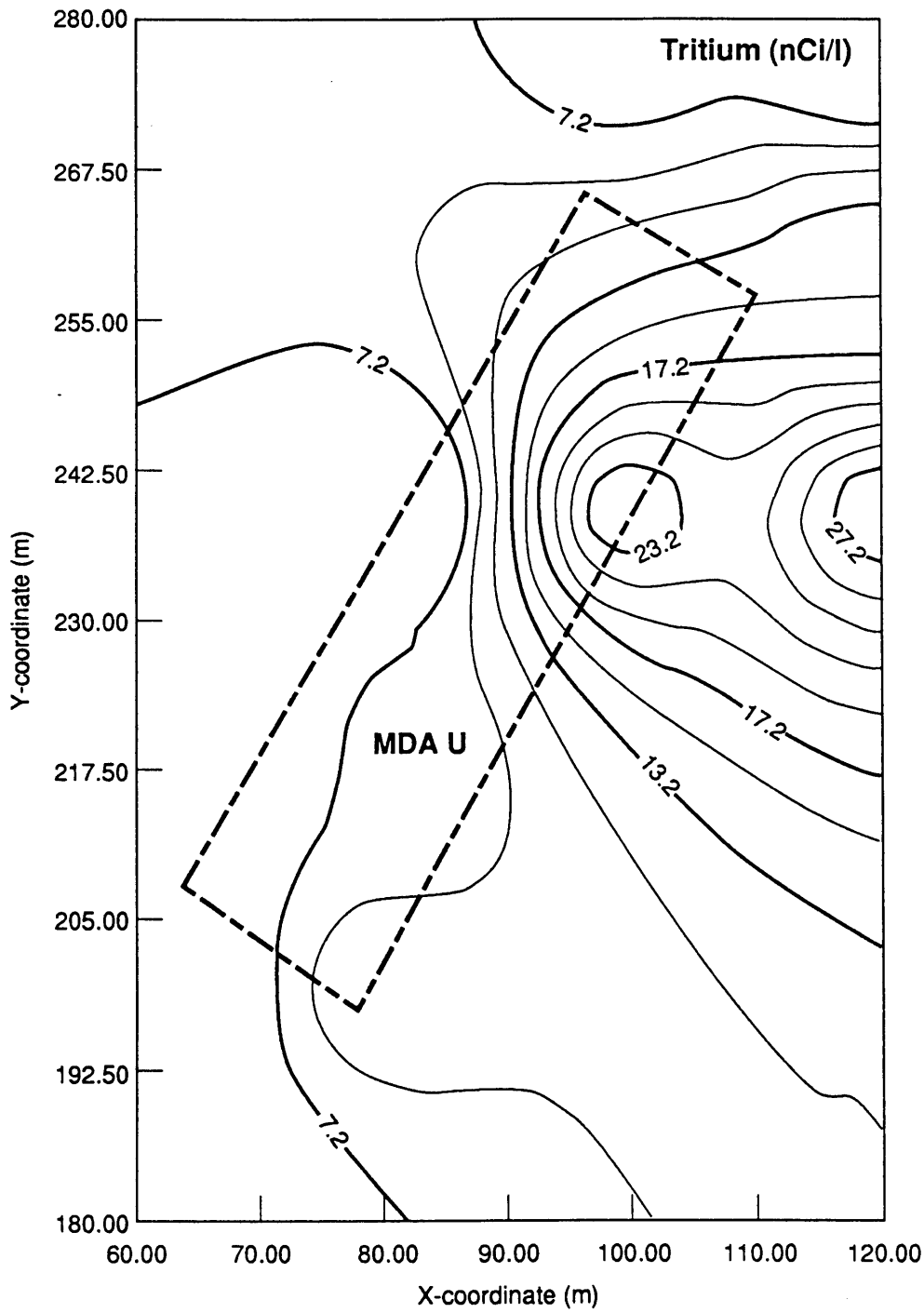

Fig. 16.6-5 Concentration contours for tritium from the 1984 surface soil samples on MDA U.

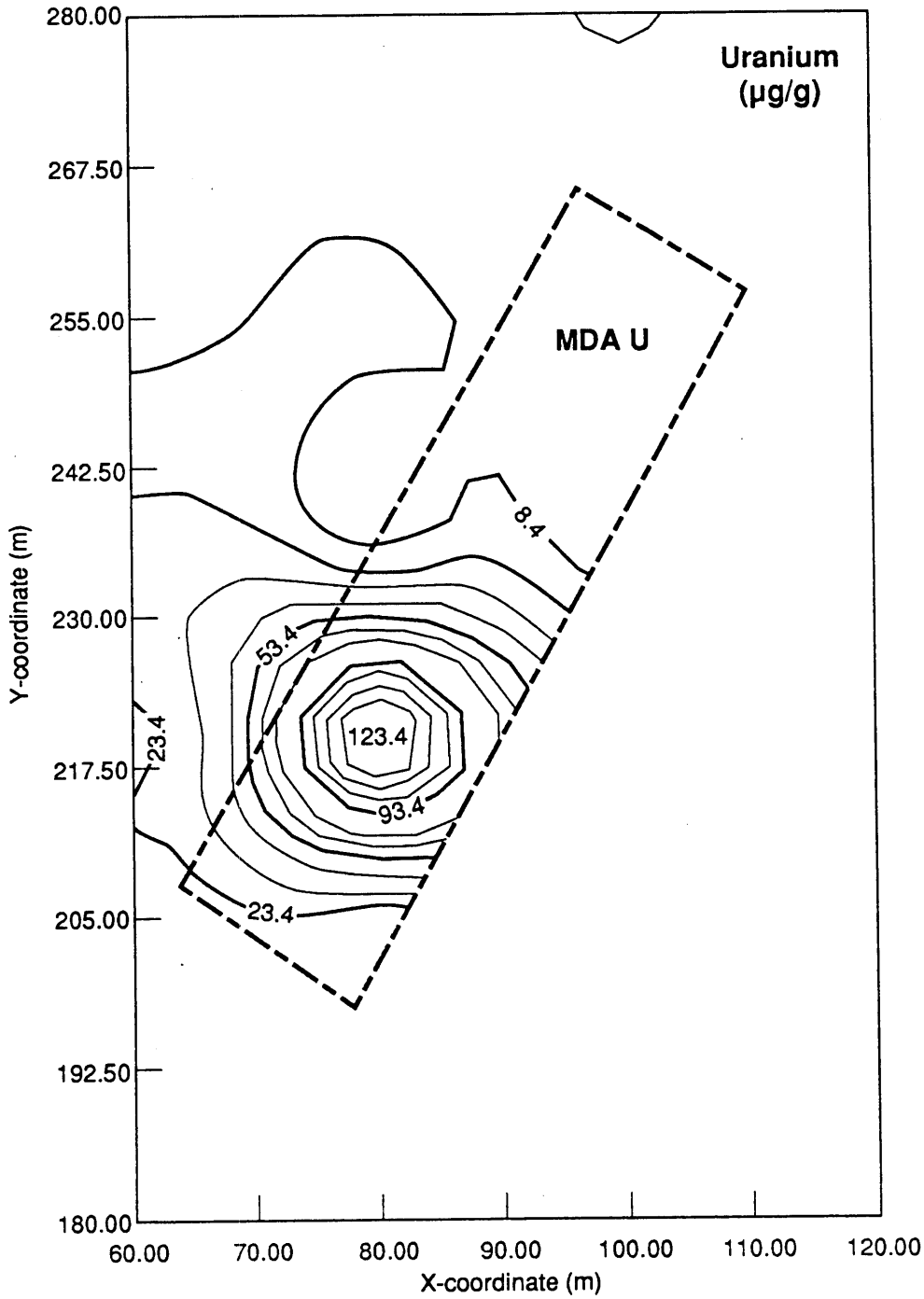

Fig. 16.6-6 Concentration contours for uranium from the 1984 surface soil samples on MDA U.

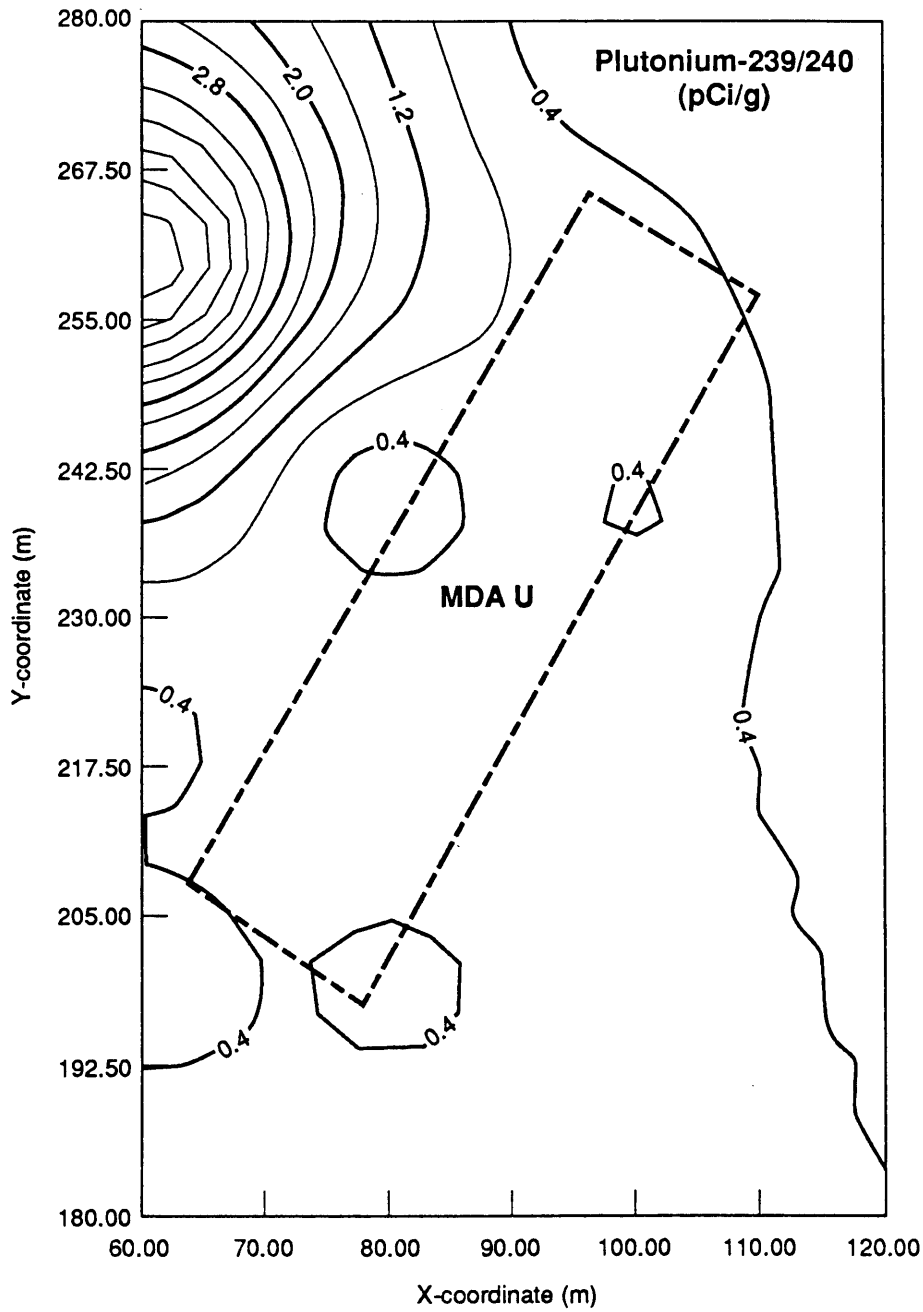

Fig. 16.6-7 Concentration contours for plutonium-239/240 from the 1984 surface soil samples on MDA U.

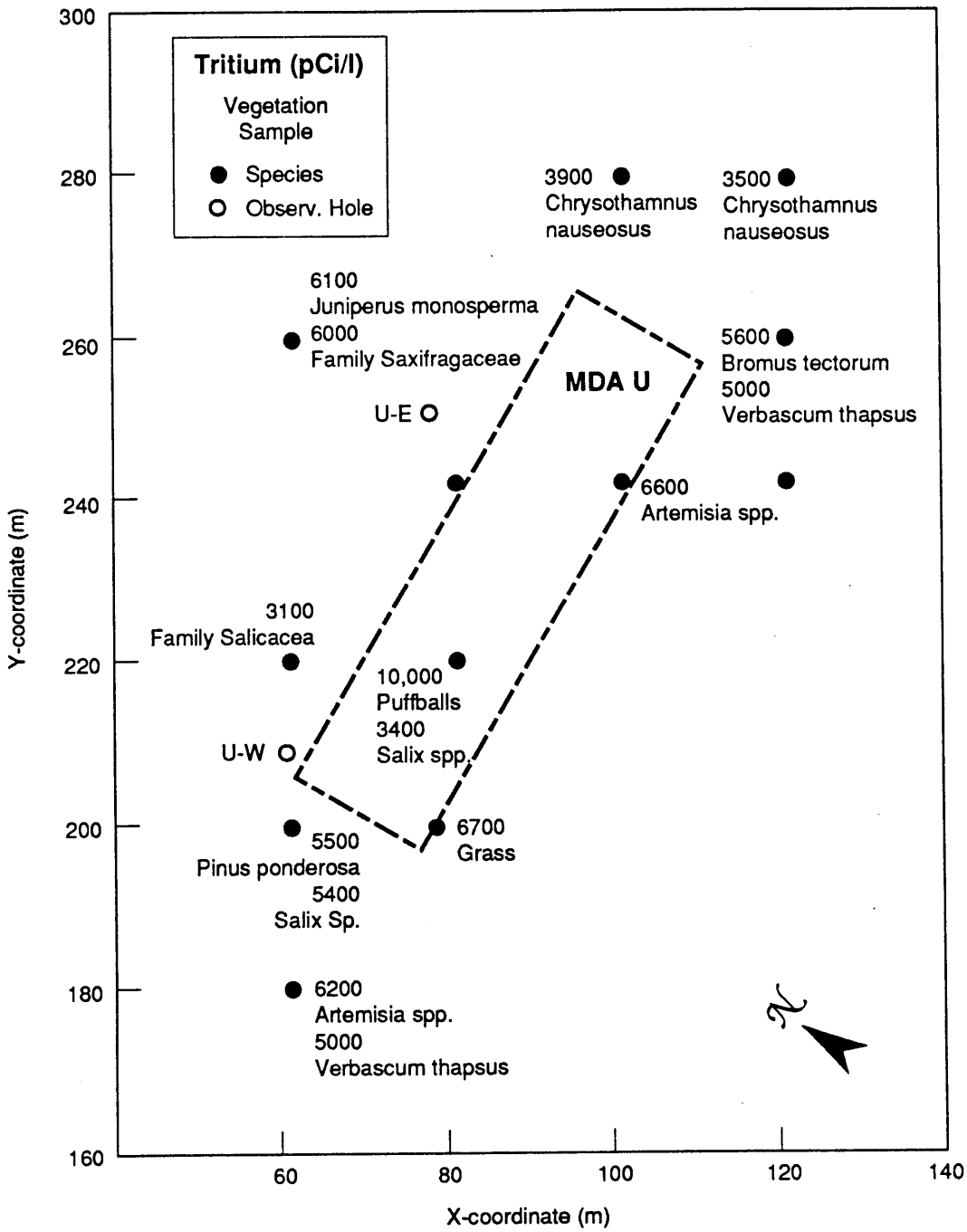

Fig. 16.6-8 1984 MDA U tritium data for vegetation (pCi/l).

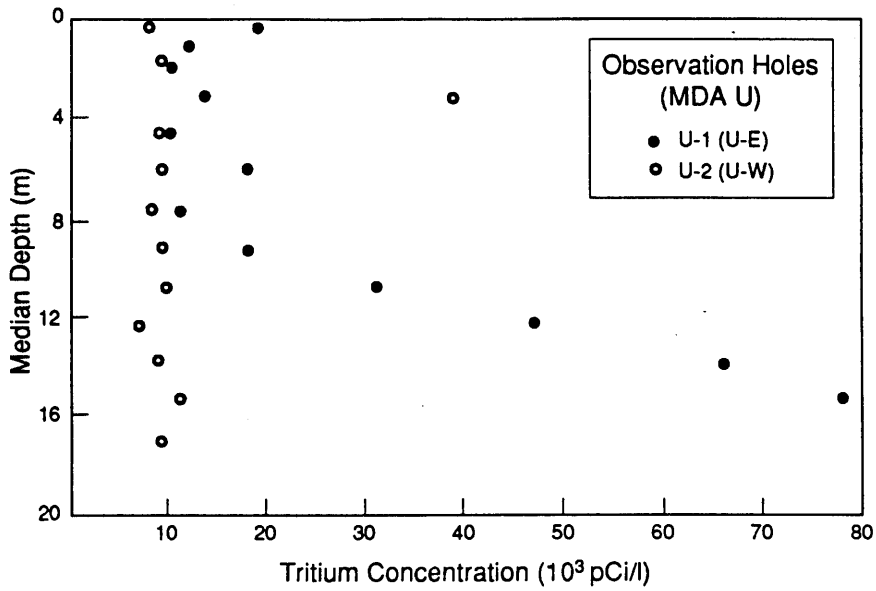

Fig. 16.6-9 1983 MDA U tritium data

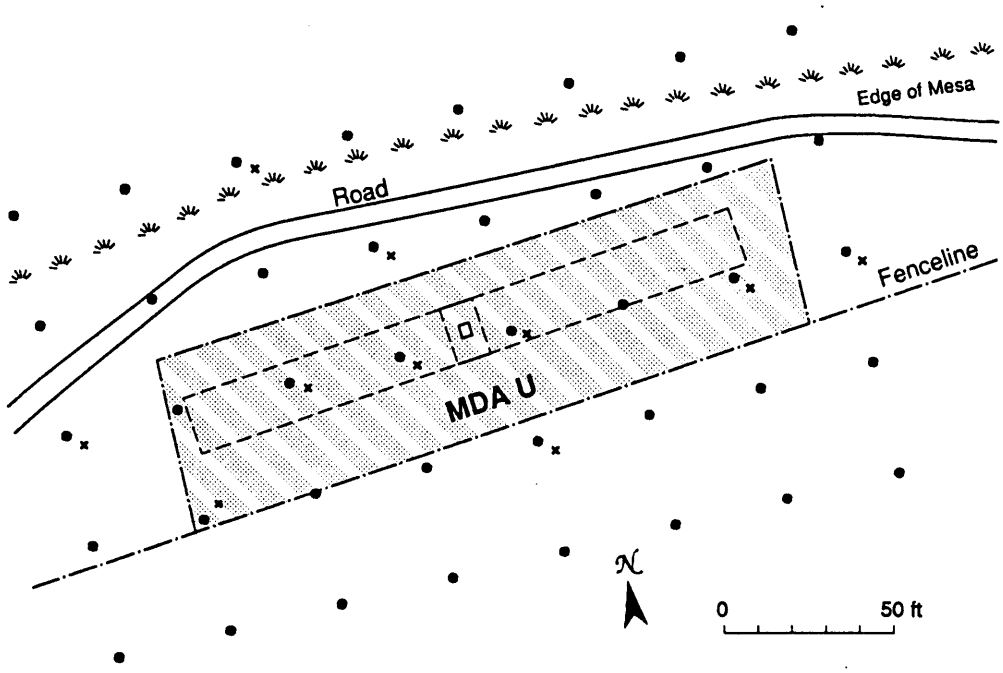

Fig. 16.6-10 Ten-meter by ten-meter surface sampling grid for MDA U. The x's indicate possible replicate samples.

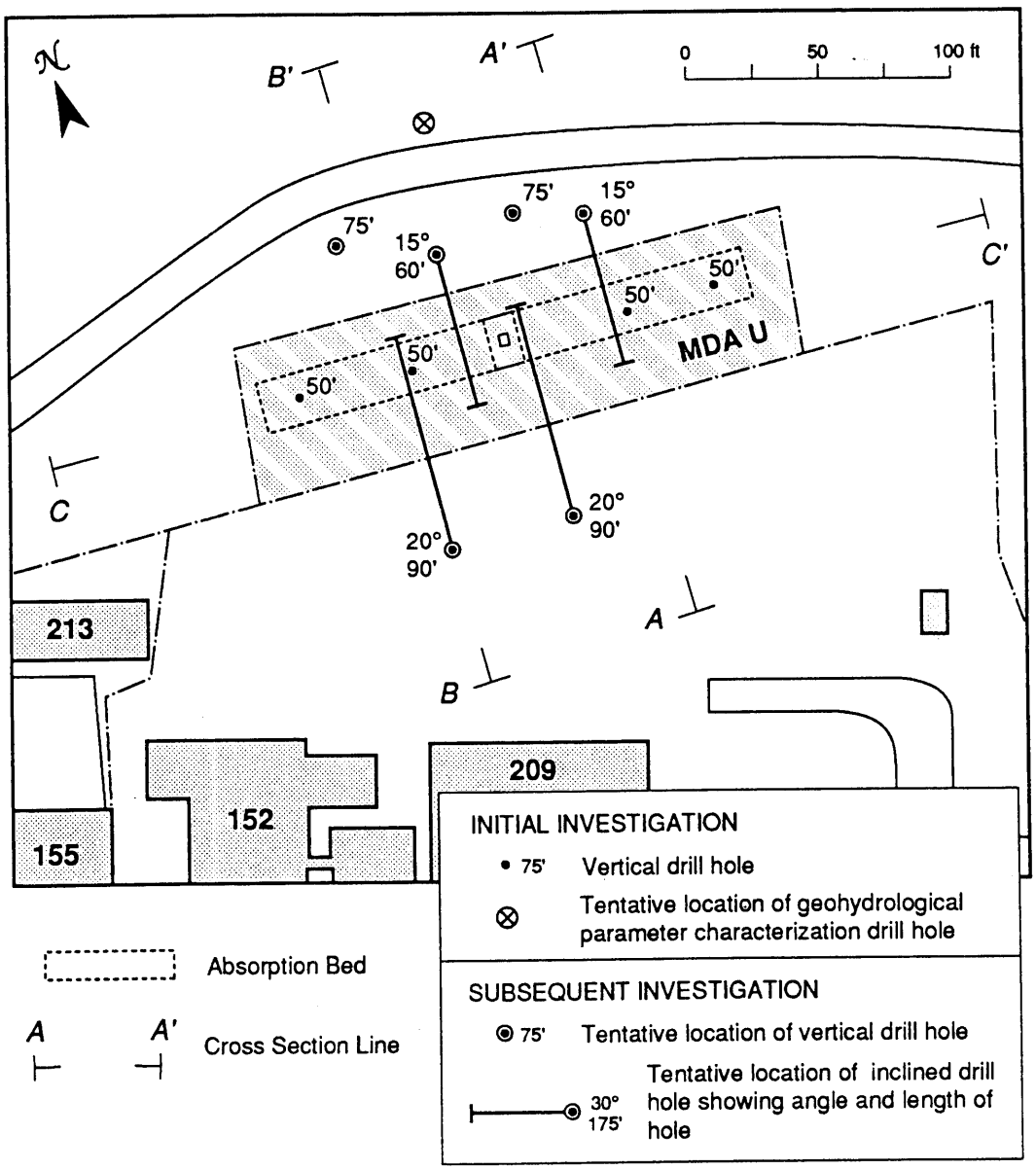

Fig. 16.6-11 Approximate location of excavated absorption beds and initial and subsequent investigation drill holes at MDA U.

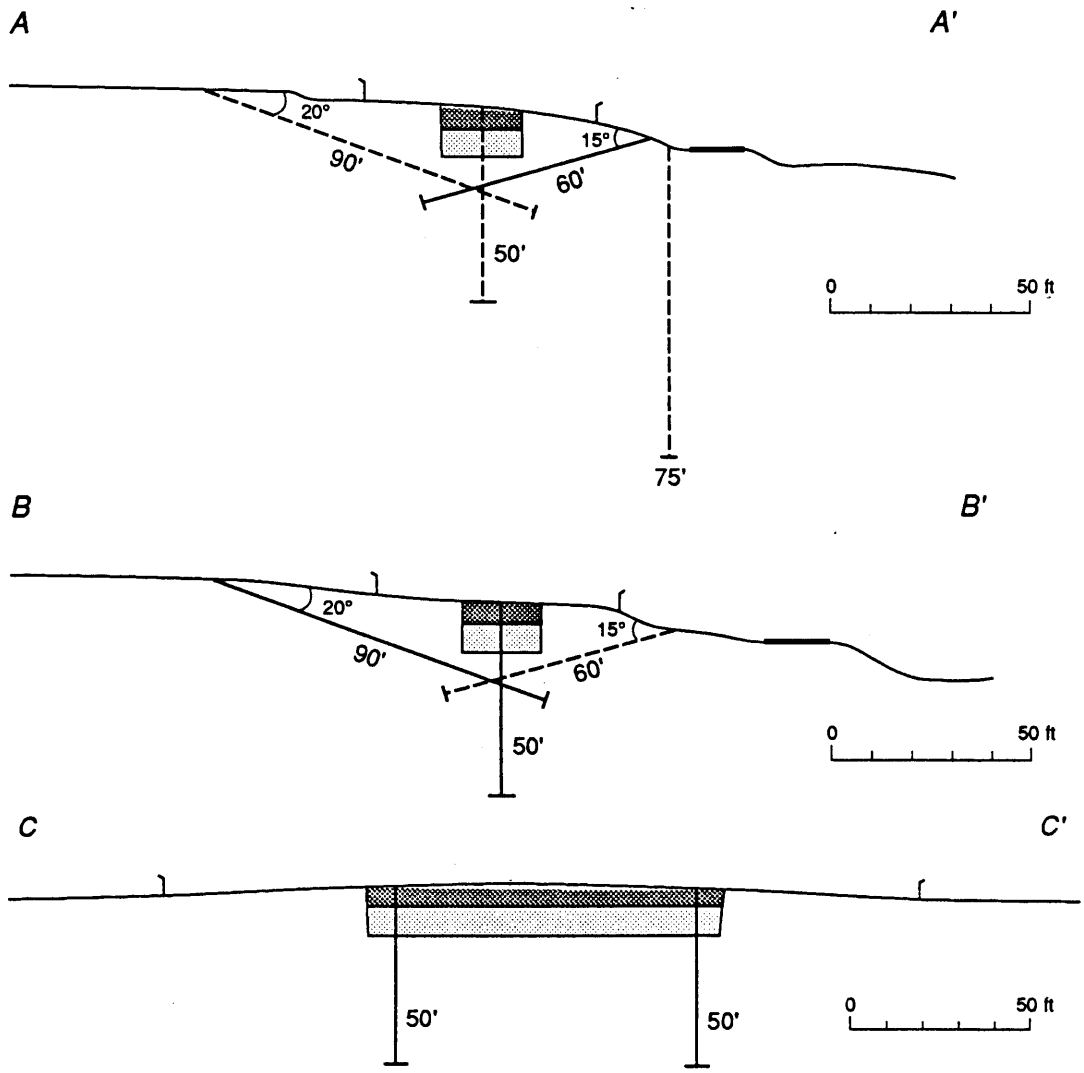

Fig. 16.6-12 Cross sections for MDA U showing appoximate location of excavated absorption beds and of initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE 16.6-I
PLUTONIUM AND POLONIUM CONCENTRATION FROM VARIOUS EFFLUENTS AT TA-21

Sewer Number	Exits of drain into canyon	Source of sewage	Vol of fluid (liters)	Po (pCi/L)	Pu (pCi/L)
#22 chemical	Into LA Canyon after passing through seepage pits north of Bldg. 153, DP East	Bldg. 153 Filter House	2	21,200	645
#23 chemical	West end of #22	Floor drain in Bldg. 152, DP East	2	109	36

TABLE 16.6-II
1976 ANALYTICAL RESULTS FOR GROSS ALPHA AT MDA U
(SEE FIG.16.6-1 FOR SAMPLE LOCATIONS)

Group H-7 Analysis (12-12-75)

Location	Description	Gross Alpha[a] (d/m/g)	Gross Alpha[c] (pCi/g)
1	Soil 0 - 2" (East Pit)	7360	3345
1	Soil 2 - 4" (East Pit)	730	331
2	Muck Surface (West Pit)	1990	904
3	Soil Surface (Outside Fence)	12.5	6
4	Soil Surface (Drain 2)	7.4	3
5	Water (West Pit)	40	18
6	Water (Drain 2)	148	67

Group H-8 Soil Analyses (12-22-75)

Location	Description	Gross Alpha[b] (d/m/g)	Gross Alpha[c] (pCi/g)
A	Surface (Drain 1)	<44	<20
B	Surface (Same H-7 Loc. 4)	120	55
C	Surface (Same H-7 Loc. 3)	<44	<20
D	Surface (Composite Road)	<44	<20
E	Surface (Slope)	<44	<20

[a]Acid Leach
[b]Direct soil counting with a ZnS gross alpha detection system.
[c]Assuming original measurements were properly calibrated to d/m/g.

TABLE 16.6-III
SELECTED RADIONUCLIDE ANALYSES FOR 1980 SOIL AND VEGETATION SAMPLES

Location BKGD[c]	Depth (cm)	Tritium (pCi/L[a]) 7200[c]	Soil Total U (µg/g[b]) 3.4c	$2^{39/240}Pu$ (pCi/g[b]) 0.023[c]	Gamma Spectra
U-1	0-1	2700 ± 400	26.1±2.6	tracer swamped	Total U is high enriched with ^{235}U
	1-10	3900 ± 400	25.6±2.6	17.5±0.3	
	10-30	3800 ± 400	10.9±1.1	2.2±0.0	
U-2	0-1	37200 ± 800	7.0±0.7	2.4±0.1	^{227}Ac daughters in great abundance
	1-10	11800 ± 500	6.3±0.6	2.2±0.1	
	10-30	27300 ± 700	4.3±0.5	0.1±0.0	
U-3	0-1	10600 ± 500	4.7±0.5	1.6±0.0	Normal
	1-10	6500 ± 500	4.4±0.5	2.5±0.1	Normal
	10-30	5400 ± 500	4.5±0.5	2.0±0.1	Normal

[a]liter of soil moisture
[b]gram of soil
cUpper limit background levels from Purtymun (1987).

Location BKGD+	Species	Vegetation Tritium (pCi/L[d]) 800+	$239/240Pu$ (pCi/g[e]) .00023[f]
U-1	Salix sp. (willow)	7200 ± 400	0.8±0.1
U-2	Pinus pon. (ponderosa)	5800 ± 300	0.6±0.0
	Bromus tec. (downychess)	-9800 ± 1300	1.1±0.1
U-3	Guttierezia s. (snakeweed)	3300 ± 300	0.2±0.0
	Bromus tec. (downy chess)	-800 ± 300	2.3±0.1
	Artemesia car. (wormwood)	300 ± 300	1.8±0.0

[d]liter of tissue moisture
[e]gram of ash
[f]Upper limit background levels from The Environmental Surveillance Group (1987).

TABLE 16.6-IV
1983 VERTICAL DISTRIBUTION OF SELECTED RADIONUCLIDES IN TEST HOLES NORTH OF MDA U

Test Hole U-E				Test Hole U-W			
Depth (m) BKGD[a]	Tritium (pCi/L) 7200[a]	Total U (µg/g) 3.40[a]	^{137}Cs (pCi/g) 1.09[a]	Depth (m)	Tritium (pCi/L) 7200[a]	Total U (µCi/g) 3.40[a]	^{137}Cs (pCi/g) 1.09[a]
0–0.9	19000±2000	3.79±0.18	0.18±0.07	0–0.9	7800±800	4.75±0.18	0.16±0.07
0.9–1.5	11700±1200	3.76±0.18	0.10±0.04	0.9–2.4	9200±1000	3.88±0.18	0.01±0.04
1.5–2.4	10100±1000	3.46±0.18	0.09±0.04	2.4–4.0	39000±4000	3.70±0.18	0.02±0.07
2.4–4.0	13500±1400	3.75±0.18	0.03±0.03	4.0–5.5	9000±900	3.80±0.18	0.07±0.03
4.0–5.5	10200±1000	3.49±0.18	0.08±0.04	5.5–7.0	9300±1000	3.63±0.18	0.06±0.05
5.5–7.0	17700±1800	3.65±0.18	0.06±0.05	7.0–8.5	8300±900	3.27±0.18	0.10±0.05
7.0–8.5	11100±1100	3.19±0.18	0.04±0.07	8.5–10.1	9600±1000	3.70±0.18	0.02±0.04
8.5–10.1	18100±1800	3.09±0.18	0.02±0.03	10.1–11.6	9300±1000	3.52±0.18	0.06±0.03
10.1–11.6	31000±3000	3.75±0.18	0.06±0.03	11.6–13.1	7100±700	3.51±0.18	0.08±0.04
11.6–13.1	47000±5000	3.41±0.18	0.06±0.03	13.1–14.6	8900±900	3.55±0.18	0.16±0.06
13.1–14.6	66000±7000	3.67±0.18	0.08±0.04	14.6–16.2	11400±1200	3.51±0.18	0.04±0.03
14.6–16.2	78000±8000	3.48±0.18	0.09±0.05	16.2–17.6	8900±900	3.11±0.18	0.04±0.03

[a]Upper limit background levels from Purtymun (1987).

16.7 SWMU 21-018 Material Disposal Area (MDA) V

16.7.1 Site Description

Material Disposal Area V [SWMU 21-018(a)] is a 3561-m^2 (0.88-acre) site containing three absorption beds that occupy 1390 m^2 (15,000 ft^2) and a volume of 4250 m^3 (150,000 ft^3) (Walker et al. 1981). Figure 16.7-1 shows MDA V's location on the north side of a tributary to Los Alamos Canyon and details the layout of the three absorption beds. The absorption beds were used for liquid waste disposal from a laundry operation at Building 20 [SWMU 21-018(b)] and were in continuous use from October 1945 to 1961.

16.7.1.1 Site History

An early memo (Veltman 1945) documented that the layout of MDA V (presumed to be the engineering drawings) was completed in early 1945. This memo stated that three 7.6- by 61-m (25 by 200 ft) pits were located on the south side of the laundry, immediately adjacent to Los Alamos Canyon. The first pit was to act as a "grease sump," whereas the second and third were to receive "ordinary seepage." The pits were designed on a "conservative 1/2 gal. per square foot per day" (20.37 $L/m^2/d$) percolation rate. The latter statement probably meant that the pits and underlying tuff were expected to absorb in excess of 1/2 gal. effluent/ft^2/day. More recent estimates of the saturated conductivity of the tuff underlying the pits indicate about one-fourth of the original design rate (Abeele et al. 1981). Therefore, the pits may have been underdesigned for the volumes of liquid wastes expected.

In Abrahams (1962), further details about the site suggested that the pits were 244-cm (8 ft) deep and were dug adjacent to a small tributary canyon feeding Los Alamos Canyon. The pits were filled with 152-183 cm (5 to 6 ft) of large gravel with layers of small gravel, soil, and tuff above. The capacity of each pit was estimated as 227,100 L (60,000 gal.).

Abrahams (1962) also estimated that the average discharge of laundry waste to MDA V between October 1945 to 1961 was 22,710 to 30,280 L (6,000-8,000 gal.) per day, 7.57 million L per year (2 million gal. per year), or about 151.4 million L (40 million gal.) over the use history. Other unaveraged estimates of flow, based on data from 1951 to 1952, ranged from 1,514 to 83,270 L/d (400 to 22,000 gal./d) (Tribby 1946). All of the discharge was into pit 1, which overflowed into pit 2 and then pit 3. The volume of water reaching pits 2 and 3 is unknown, but relatively little is thought to have reached pit 3 (Abrahams 1962). Only one reference to effluent overflow into pit 3 appears in the archives (Drager 1946).

A pond, which contained emergent aquatic vegetation (cattails, rushes), formed on pit 1 in the early 1950s. There are several possible explanations for this pond: the overflow pipe may have clogged; permeability to downward flow may have decreased; and/or the initial design specifications on percolation rates into the tuff may have been overly optimistic (Abrahams 1962). Other studies (Drager 1946) reported that the pits did not perform as expected. For example, "a large amount of contaminated water was lying above the ground in the pits." This observation would be consistent with the overestimation of seepage rates used in designing the pits.

Liquid waste disposal to MDA V ceased in 1961, and the facility was placed on standby until September 1963 (Property Group Office 1962). It is unknown when a soil cover was first placed over the absorption beds. However, in 1985, a soil cover was placed on the site to repair erosion damage (Hakonson 1987).

MDA V is currently maintained under the Environmental Surveillance Group's low-level radioactive waste management program for MDAs. The site is fenced and is inspected annually to identify and remedy maintenance problems.

16.7.1.2 Existing Information

16.7.1.2.1 Waste Discharge Information

The following data were taken from a variety of sources predating 1980. The data are highly qualitative and are presented here to identify radionuclides present in the waste.

Periodic grab sampling for contaminants in the pits dates back to 1946 when Tribby (1946) reported plutonium and polonium concentrations in pit water of 460 dpm/L (207 pCi/L) and 2,000 dpm/L (909 pCi/L) respectively. In 1954, Hermann reported that MDA V soils contained 26,000 dpm Pu/g (11,712 pCi/g Pu/g) dry soil at the surface to 120 dpm Pu/g (54 pCi/g Pu/g) dry soil at a depth of 135 cm (53 in.). The exact location of the Hermann samples is not known.

In a memo by Mead and Newell (no date), the laundry effluent was reported to average 1,500 cpm/L gross alpha (primarily plutonium), 750 ppm total solids, and have a biological oxygen demand (BOD) of 500 ppm. The memo also stated that no synthetic detergents were used in the laundering operation at that (unspecified) time.

Beginning in 1955, daily laundry effluent samples were composited each week and analyzed for selected radionuclides. Based on an analysis of that data, Abrahams (1962) estimated that plutonium accounted for 1/3 to 1/2 of the gross alpha activity, whereas strontium accounted for 1/

10 to 1/25 of the gross beta activity. Further analysis by Christenson (1973c) indicated that 0.0035 Ci/y Pu (mostly $^{239/240}Pu$) was added to the pits from 1952 to 1961 (0.0315 Ci during those 9 years). Christenson (1973c) estimated ^{90}Sr additions of 0.002 Ci/y from 1945 to 1961 (or 0.034 Ci total). He reported that about 3 Ci of ^{89}Sr, ^{140}Ba and ^{140}La were also added to MDA V from 1945 to 1961, but because of their short half-lives (less than 50 days), they will not be detectable in present samples from the site.

16.7.1.2.2 Historical Surface Sampling Data

In 1980, surveillance activities were initiated to characterize the distribution of radionuclides within the near-surface environment of MDA V and particularly within 0.5 m of the ground surface. A chronological history of surveillance activities at MDA V is summarized in Table 16.7-I. These data range from low-resolution, qualitative field instrument surveys to higher-resolution quantitative soil and vegetation sampling. Some of these data collection efforts were poorly documented, and only incomplete data sets are available from sampling activities in the early 1980s.

A summary of radiochemical analytical data on soils and vegetation samples collected from 1982 to 1984 are given in Tables 16.7-II and 16.7-III. In 1982 soil samples were collected at locations V-1, V-2, and V-3 (Fig. 16.7-1). In 1984, samples were taken at 16 locations on what appears to be a 20- by 20-m grid. Unfortunately, the information is not available to place the grid locations on the site. In all cases, samples were collected at three depths; 0-1 cm, 1-10 cm, and 10-30 cm. In 1982, soil samples were analyzed for tritium, uranium, ^{238}Pu, and $^{239/240}Pu$, and in 1984, for tritium, uranium, and $^{239/240}Pu$.

The 1982 soils data show that concentrations of all radionuclides for which samples were analyzed (i.e., tritium, U, ^{238}Pu, $^{239/240}Pu$) were elevated above the maximum background level in over 80% of the samples. The 1984 data show tritium levels within the background level range for all samples except four at the 10-cm to 30-cm depth. The levels for these four samples range from 10,000 pCi/L to 22,000 pCi/L. Uranium levels are reported for only one depth (depth not specified) and are generally above background, ranging from 4.5 to 17.3 mg/g. Plutonium-239 and -240 levels are also generally above background levels. The maximum value observed for plutonium is 7.8 pCi/g.

It is interesting to note that the 1982 tritium levels are considerably elevated over the 1984 levels. There are no records of tritium being put into MDA V. This may indicate some other source for tritium contamination.

In 1980, vegetation samples were analyzed for tritium, uranium, ^{238}Pu, and $^{239/240}Pu$ (Table 16.7-III). Concentrations of all of these radionuclides were elevated above the maximum background levels in all samples. In 1984, the vegetation samples were analyzed for only ^{137}Cs. All sample concentrations were below the maximum background level for ^{137}Cs.

The radionuclide concentration data for soils and vegetation in Tables 16.7-II and 16.7-III do not reflect current site conditions because a soil cover was placed on the site in 1985 to repair erosion damage (Hakonson 1987). Consequently, the data in Tables 16.7-II and 16.7-III now apply to an unspecified zone beneath the current surface of the site.

16.7.1.2.3 Historical Subsurface Sampling Data

The only subsurface information available for MDA V is from a 17.7-m deep hole drilled in pit 2 in 1983. The location of this borehole is shown in Fig. 16.7-1. Core samples were collected at 0.9-m (3-ft) and at 1.5-m (5-ft) intervals down to 17.7 m (58 ft). The samples were analyzed for tritium, uranium, ^{238}Pu and $^{239/240}Pu$, and cesium. These data are presented as a function of depth zone in Table 16.7-IV.

The 0.9- to 2.4-m sample, which corresponds to the interface between the bottom of the pit and the underlying tuff, had the highest concentrations of uranium, ^{137}Cs, and $^{239,240}Pu$. The elevated levels of contaminants at the pit/tuff interface may be explained by noting that the highly permeable rock layer above the interface and the relatively impermeable tuff below the interface provide a physical (and possibly chemical) barrier to downward movement of low-solubility contaminants.

Cesium-137 was within background levels in all samples. Uranium concentrations were within a factor of 2 of background levels, with the exception of the pit/tuff interface.

Tritium and $^{239/240}Pu$ concentrations exceeded background level at all sampling depths. A large body of literature suggests that plutonium mobility in the unsaturated subsurface environment is minimal (Watters et al. 1980). The presence of plutonium at the lower sampling depths in the tuff beneath MDA V probably reflects the influence of the large amount of effluent water added to the site that enhanced the downward migration of plutonium. The presence of plutonium at the 16.2- to 17.7-m depth suggests that more mobile contaminants may have migrated to greater depths. The extent of this migration, if it has occurred, is completely unknown at this time.

16.7.1.2.4 Summary of Historical Data

Available data suggest a low-level contamination of soils and vegetation with tritium, uranium, and plutonium exists in MDA V, including the underlying tuff. Qualitative data indicate that ^{90}Sr may be present. The spatial and temporal resolution of the data does not adequately define source distribution or evidence of transport that may have occurred in the past. The limited available data also suggest that certain contaminants, i.e., uranium, and $^{239/240}Pu$, have elevated levels at the pit/tuff interface. The borehole sampling conducted in 1983 suggests that transport of some radionuclides into the tuff has occurred to at least 16 m. A very limited amount of data suggests that transport of radionuclides into vegetation is low.

No data are available on whether contaminants other than radionuclides (i.e., organics, semivolatiles, metals, or any other hazardous constituents) are present in the absorption beds. As mentioned previously, Mead and Newell (no date) stated that no synthetic detergents were used in the laundering operation; however, pit 1 was to act as a "grease sump" (Veltman 1945). Therefore, the presence of hazardous constituents cannot be ruled out.

16.7.1.3 Source Term

About 3 Ci of ^{89}Sr, ^{140}Ba, ^{140}La (now decayed to undetectable levels), 0.1 Ci of plutonium, and 0.034 Ci of ^{90}Sr were released into the pits (Balo and Warren 1983; DOE 1979). Other radionuclides, such as uranium, were released, but the total amounts are unknown. Whether organics or metals were part of the waste stream is unknown. Recall that the first pit was to act as a "grease sump" (Veltman 1945), an indication that the waste may not have been purely radioactive.

16.7.2 Objectives and Data Needs

The objective is to define the extent of source term migration and to determine whether capping and stabilization-in-place is a possible remedial action at this site. No chemical data exist for MDA V, and radionuclide data with depth exist to 17.7 m for one drill hole in pit 2. The data required to assess MDA V include the following:

1. Identification of contaminants present using Level III/IV analyses. Although this MDA received laundry waste, the presence of hazardous constituents (e.g., solvents) cannot be ruled out with the existing data.

2. Determination of vertical and lateral distribution of contaminants both within and beyond the MDA V fence using Level II surveys and Level III/IV

laboratory analyses. Some surface radionuclide data exist, and radionuclide data with depth exist to 17.7 m. The radionuclide data indicate low-level contamination and some vertical migration. Because this was a liquid waste disposal area, both vertical and lateral migration are likely. To assess lateral migration and to help understand erosion effects, surface samples will be taken. To assess vertical migration, boreholes for subsurface samples are required.

3. Characterization of all contaminant migration pathways. The vertical and lateral pathways are believed to be most important, both because MDA V was a liquid waste disposal site and because of its proximity to the rim of an auxiliary canyon to Los Alamos Canyon.

4. Determination of the geologic stability of the site, particularly with respect to erosion. Because this MDA is adjacent to a canyon side, the geologic stability of the site must be determined to evaluate whether capping and *in situ* stabilization of waste is a viable remedial alternative at this site.

16.7.3 Sampling/Investigation rationale

MDA V surface sampling on a 10- by 10-m grid was conducted in October 1990. Additional sampling from MDA V will include detailed drainage samples as described in Sec. 16.1.4. Whether additional surface sampling at MDA V is required will be determined by evaluating these combined data.

In the initial investigation, combined data from samples collected in the investigations described above will be used to determine spatial prediction surfaces, such as kriging surfaces for MDA V and the surrounding area. These surfaces will be used to determine radionuclide contaminant levels and study migration patterns and erosion effects. Requirements for additional radionuclide sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Because MDA V was a liquid disposal area, boreholes will be drilled to define the lateral and vertical extent of contamination as discussed in the rationale given in Sec. 16.1.1. Because contaminant species in MDA V cannot be identified at this time, a full analytical suite will be specified for surface and subsurface samples.

The sampling program may need to be expanded to include a larger area, depending upon results of initial sampling. In these subsequent investigations, the analytical suite will be focused on specific contaminants identified in the initial investigation.

16.7.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analyses requirements for each planned investigation of MDA V. However, due to the large number of pages, these tables have been placed in Section F.6 of Appendix F, Analytical Tables.

16.7.4.1 Surface Sampling Plan

16.7.4.1.1 Current Surface Sampling

MDA V was sampled for surface radionuclide contamination in October 1990. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste program. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.7-2, several areas have additional sample locations based on a 3- by 3-m grid. These additional samples allow for characterization of the local variability, increasing precision for the prediction of contaminant concentration distributions. Phoswich and μR counts will be determined for each sample location and samples are being analyzed for radionuclide contamination.

16.7.4.1.2 Initial Investigation

Data from the TA-21 OU surface sampling plan described in Chapters 12 and 13 will be used, in conjunction with the 1990 MDA V data and the detailed drainage samples, to study migration patterns and erosion effects and to determine what, if any, subsequent investigations are needed.

16.7.4.1.3 Subsequent Investigation

For planning purposes, it is assumed that 20 surface samples on a 20- by 20-m grid surrounding MDA V will be required in the subsequent investigation. Additionally, radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken of any such areas detected.

For planning purposes, it is assumed that all samples will be sent to an analytical laboratory for radionuclide, metals and semivolatiles analysis. The actual analytical suite will be determined by the results from initial sampling. Table F.7-I (see Appendix F) presents the assumed screening and analysis requirements for subsequent investigations.

16.7.4.2 Subsurface Sampling Plan

The subsurface sampling at MDA V will examine potential contaminant migration from the three liquid waste absorption beds that received radioactive effluent from the DP laundry facility. Bed 1 received effluent directly from laundry operations and acted as a "grease sump." Overflow from bed 1 entered bed 2, which in turn overflowed into bed 3. Beds 1 and 2 are believed to contain most of the radioactive contaminants. Only small amounts of laundry effluent reached bed 3, and contamination levels are expected to be low. Previous studies indicated that tritium and plutonium concentrations are generally above background levels to depths of at least 17.7 m beneath bed 2 (Table 16.7-IV). Therefore, preliminary characterization activities will focus on determining the extent of contamination, identifying transport pathways, and deriving source term information.

16.7.4.2.1 Initial Investigation

Vertical drill holes are sited in the three absorption beds to characterize the source term for contaminant transport modeling to determine the vertical extent of the contaminant plume and to determine the suite of contaminants that should be analyzed during the subsequent investigation (Fig. 16.7-3). Three holes are located in bed 1, two holes are in bed 2, and one hole is in bed 3. The three holes in bed 1 will be used to evaluate the homogeneity of contaminants in that liquid waste absorption bed. All source term holes will be drilled to a nominal depth of 75 ft.

MDA V will be the first liquid waste MDA that is drilled for this OU. Results of the source term characterization in bed 1 at MDA V will be used to evaluate, and if necessary, modify the number and types of source-term drill holes at the other liquid waste MDAs (e.g., MDAs U and T) at TA-21.

Samples for contaminant characterization will be collected at varying intervals along the length of the drill holes. More closely spaced samples will be taken at the interface between the floor of the absorption bed and the underlying tuff because the highest levels of contaminants were observed here, and there is indication that there may be some natural barrier to downward movement at this interface (See Sec. 16.7.2.3). Samples will be collected at 2.5-ft intervals in the absorption beds and across the interface separating the absorption beds and the underlying tuffs. Below the absorption beds, samples will be collected at 5-ft intervals. These sample intervals may be modified because of variable amounts of core recovery and requirements for greater sample volumes for laboratory analyses. Samples for soil moisture determination will be collected at 5-ft intervals.

All core samples collected in the initial investigation will be submitted for the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements for the initial investigation are given in Table F.7-II (Appendix F).

The nominal depth of the drill holes is given in Fig 16.7-3. The borehole stopping criteria in Sec. 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. One vertical hole in absorption bed 1 at MDA V will be extended 50 ft below the contamination plume to determine whether the liquid waste additions altered rock properties. In this region of this hole, samples will be analyzed at 10-ft intervals for geochemical parameters and mineralogy as detailed in Sec. 12.5.1.5 and given in Table F.7-III (Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered within a 5-ft-sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals. This sampling is included as a contingency in Table F.7-II (Appendix F).

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized in all initial boreholes on 20-ft-core intervals and within contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.7-III.

One 300-ft borehole will be drilled at MDA V (see Fig. 16.7-3) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.7.4.2.2 Subsequent Investigation

The subsequent investigation includes nine drill holes at tentative locations around the perimeter of the site. Five of these holes are inclined 10 to 30° (Fig. 16.7-3 and Fig. 16.7-4) and are designed to determine the shape and extent of the contaminant plume. The angles and orientation of these inclined holes will be adjusted to provide the best characterization of the contaminant plume by incorporating information derived from initial drill holes. Four vertical holes are also tentatively sited west, south, and east of the MDA V fence to determine if contaminants are migrating laterally towards Los Alamos Canyon. These vertical drill holes are tentatively planned

for total depths of 75 ft. Samples for contaminant characterization will be collected at 5-ft intervals along the length of all subsequent investigation drill holes.

The analytical suite for subsequent investigations will be reduced in scope, as appropriate, based on analytical results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.7-IV (Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

Depending on results of hydrogeological parameter determinations in both the OU-wide 300-ft vertical boreholes and the MDA V initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional characterization will be determined by evaluating results from the initial and subsequent investigations. Placement of additional drill holes will be based on results from these holes.

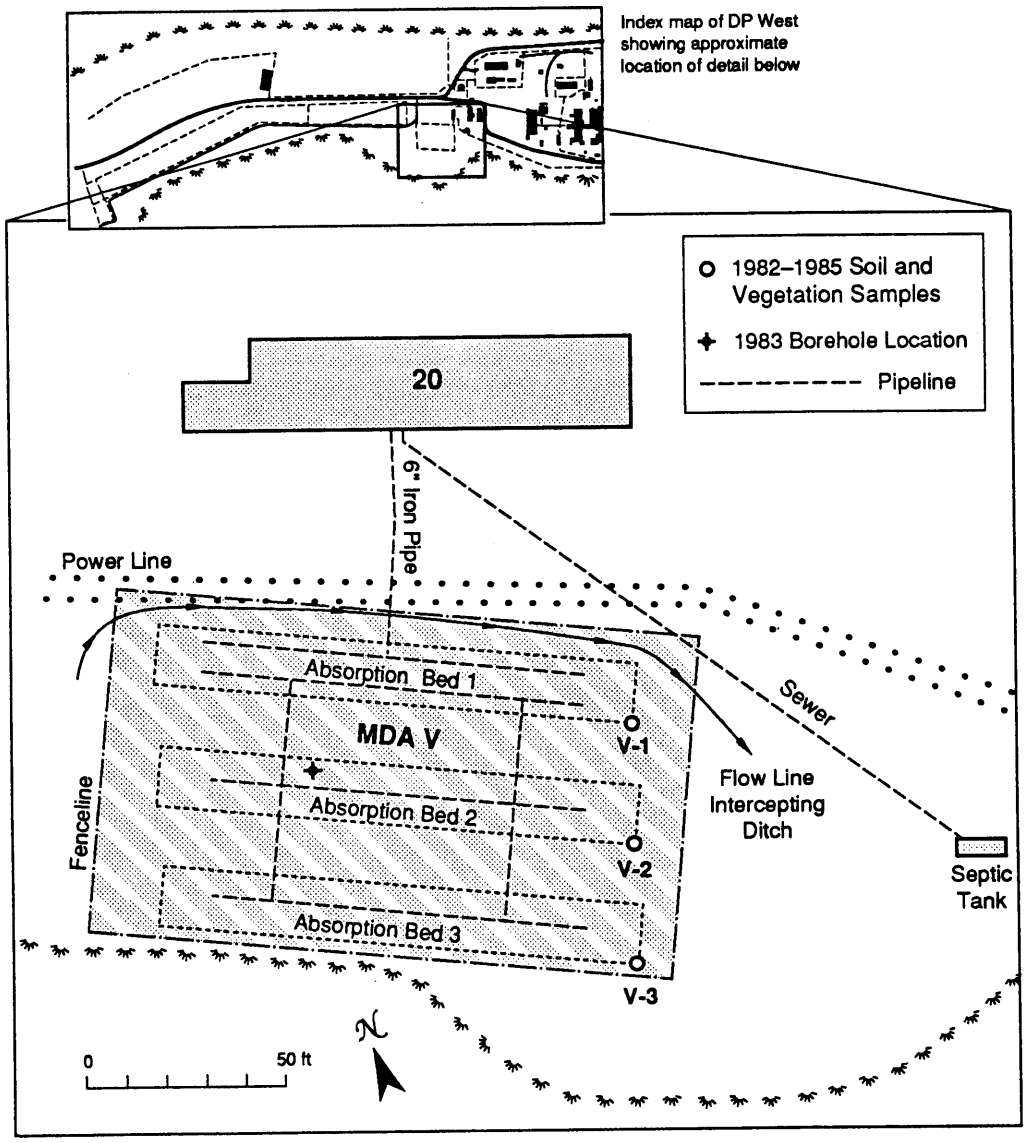

Fig. 16.7-1 General site map of MDA V showing former location of Building 20 and associated lines, and soil and vegetation sampling locations.

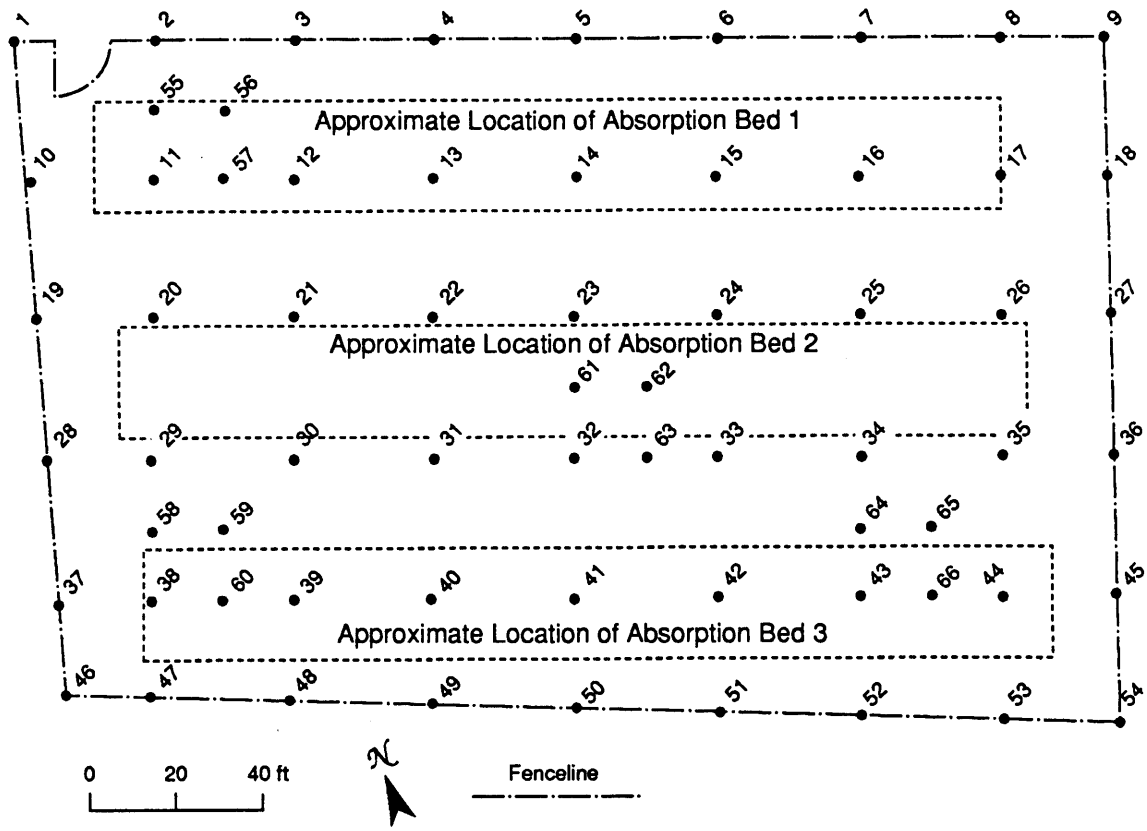

Fig. 16.7-2 Surface sampling grid for 1990 low-level radioactive waste surveillance program for MDA V.

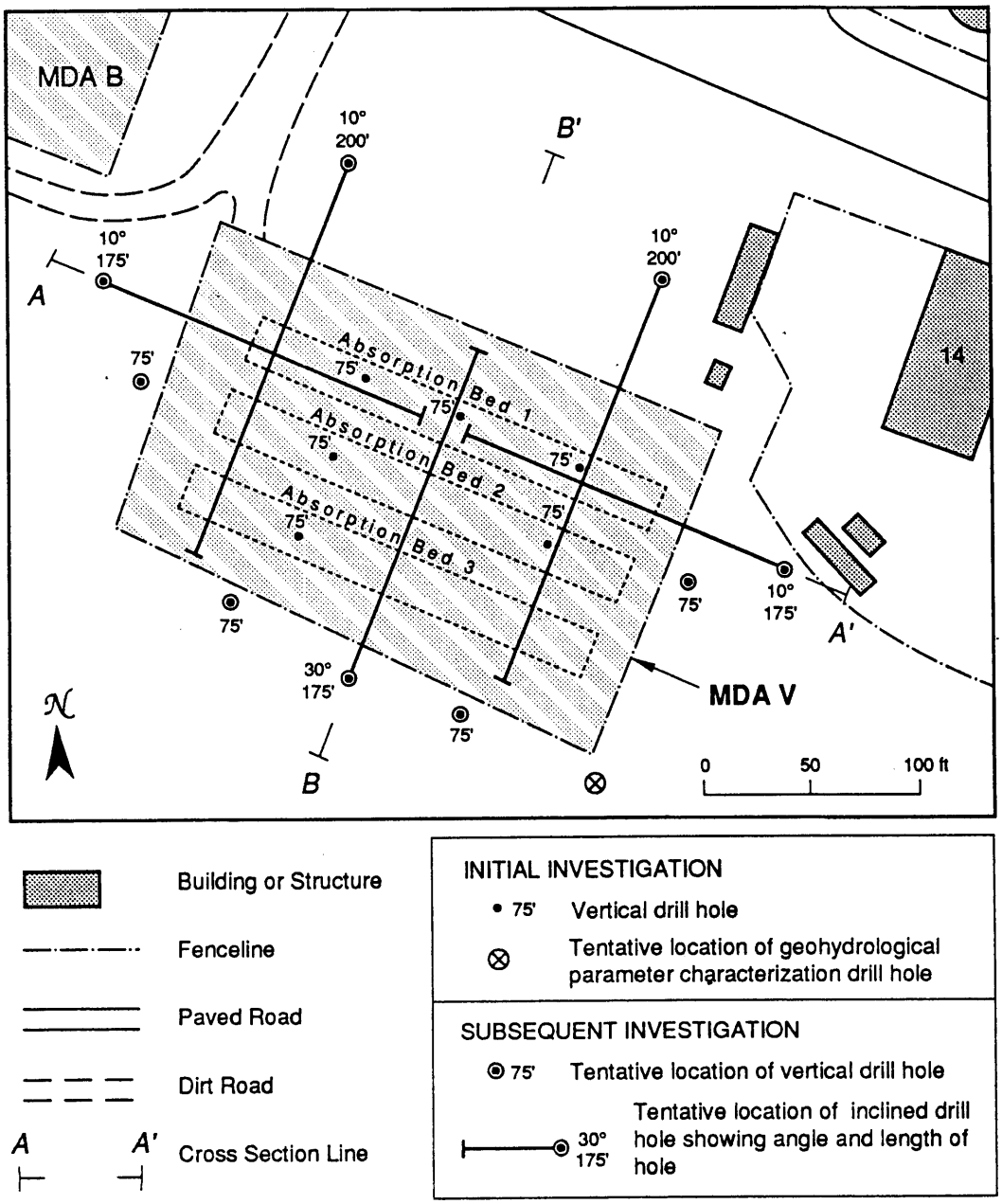

Fig. 16.7-3 Approximate location of absorption beds and initial and subsequent investigation drill holes for MDA V.

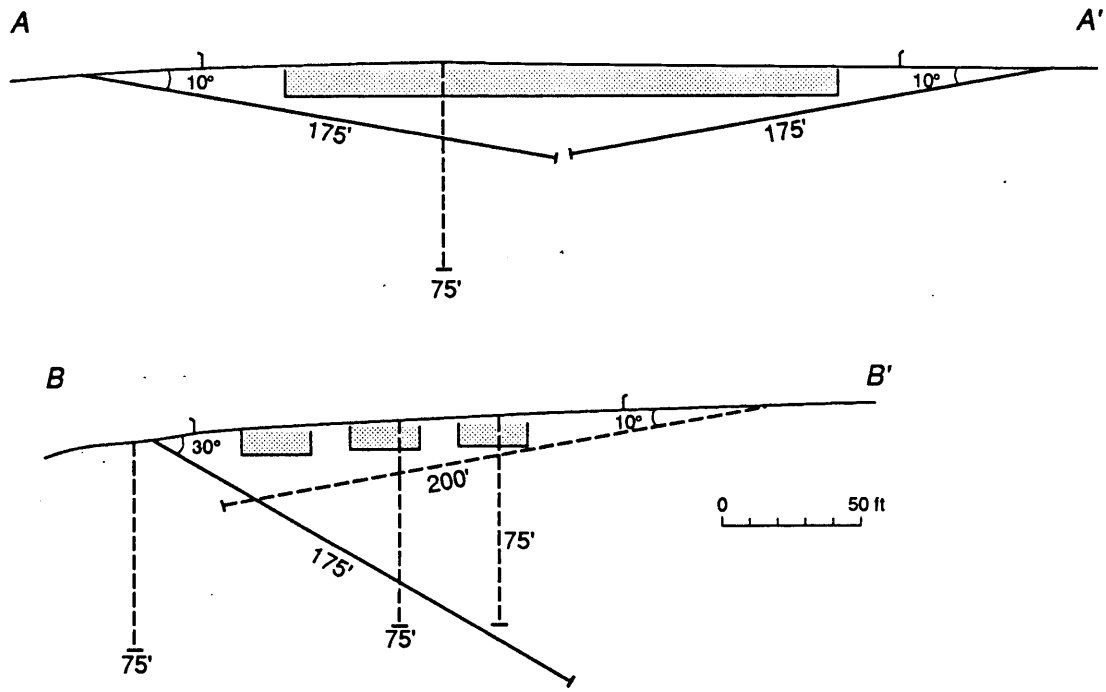

Fig. 16.7-4 Cross sections for MDA V showing the layout of absorption beds and initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE I6.7-I. CHRONOLOGICAL EVENTS AT MDA V

Date	Location	Reference	Data Collected
1980	MDA V 3 sampling locations ^{3}H, U, ^{238}U, $^{235}U/^{238}U$,	Los Alamos Notebook A411	Vegetation
files			^{238}Pu, $^{239/240}Pu$
			Soil (surface) $^{239/240}Pu$, ^{3}H, U
			Gamma scan
			Areal Survey Phoswich, Gamma µR-meter
1982	MDA V	Los Alamos Notebook A411 Files	Soil (surface) Tritium, U, ^{238}Pu, $^{239/240}Pu$
		Los Alamos Notebook No.23820	TLD
1983	MDA V On location	Los Alamos Notebook A411 Files	Soil (subsurface) Tritium, U, $^{235}U/^{238}U$, ^{238}Pu, $^{239/240}Pu$, ^{137}Cs
		Los Alamos Notebook No. 23820	TLD
1984	MDA V	Los Alamos Notebook A411 Files	Soil (subsurface) ^{238}Pu, $^{239/240}Pu$
			Vegetation ^{137}Cs

TABLE 16.7-I. CHRONOLOGICAL EVENTS AT MDA V (CONTINUED)

Date	Location	Reference	Data Collected
1984 (cont.)		Los Alamos Notebook No. 23820	TLD
			Soil (surface) Tritium, U, $^{239/240}Pu$
1985	MDA V	Los Alamos Notebook A411 Files	Soil (surface) Gamma spectrum
		Los Alamos Notebook No. 23820	TLD
1986	MDA V	Los Alamos Report LA-10992-ENV	TLD

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location BKGD.[b]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[b]	+/-	Uranium Value (µg/g) 3.4[b]	+/-	^{238}Pu Value (pCi/g) 0.0050[b]	+/-	$^{239/240}Pu$ Value (pCi/g) 0.025[b]	+/-	^{137}Cs Value (pCi/g) 1.09[b]	+/-
82.09433	V-1	0-1	17800	400	3.300	0.300	0.0230	0.0030	2.5300	0.0400		
82.09434	V-1	1-10	20100	500	4.200	0.400	0.0110	0.0010	1.1400	0.0200		
82.09435	V-1	10-30	14900	400	4.200	0.400	0.0220	0.0030	2.8400	0.0400		
82.09436	V-2	0-1	28300	600	4.500	0.500	0.0067	0.0010	0.5130	0.0150		
82.09437	V-2	1-10	64700	1100	4.000	0.400	0.0068	0.0010	0.5040	0.0150		
82.09438	V-3	0-1	10700	2000	3.800	0.400	0.0037	0.0010	0.5350	0.0140		
82.09439	V-3	1-10	19900	500	4.200	0.400	0.0180	0.0030	2.3300	0.0400		
82.09440	V-3	10-30	13400	400	3.800	0.400	0.0410	0.0040	6.6500	0.0800		
85.03529	-80,20	0-1	1400	400								
85.03530	-80,20	1-10	2400	400								
85.03531	-80,20	10-30	1000	300								
85.03532	-60,60	0-1	3200	500								
85.03533	-60,60	1-10	2200	400								
85.03534	-60,60	10-30	3600	500								
85.03535	-60,40	0-1	4700	600								
85.03536	-60,40	1-10	4200	600								
85.03537	-60,40	10-30	5800	700								
85.03538	-60,20	0-1	600	300								
85.03539	-60,20	1-10	1700	400								
85.03540	-60,20	10-30	2500	400								
85.03541	-60,0	0-1	-400	300								
85.03542	-60,0	1-10	2200	400								
85.03543	-60,0	10-30	4300	600								
85.03544	-40,60	0-1	2200	400								
85.03545	-40,60	10-30	2800	400								
85.03546	-40,40	0-1	2400	400								
85.03547	-40,40	1-10	2500	400								
85.03548	-40,40	10-30	3100	500								
85.03549	-40,20	0-1	2100	400								
85.03550	-40,20	1-10	3400	500								
85.03551	-40,20	10-30	10000	1000								
85.03552	-40,0	1-10	5800	700								
85.03553	-40,0	10-30	22000	2000								
85.03554	-40,40	0-1	5400	700								

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location BKGD.[b]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[b]	+/-	Uranium Value (µg/g) 3.4[b]	+/-	^{238}Pu Value (pCi/g) 0.0050[b]	+/-	$^{239/240}Pu$ Value (pCi/g) 0.025[b]	+/-	^{137}Cs Value (pCi/g) 1.09[b]	+/-
85.03555	-40,40	1-10	4100	500								
85.03556	-40,40	10-27	3400	500								
85.03557	-20,60	0-1	3100	500								
85.03558	-20,60	1-10	2000	400					0.0035	0.0014		
85.03559	-20,60	10-30	3600	500					0.1280	0.0105		
85.03560	-20,40	0-1	2900	500								
85.03561	-20,40	1-10	3100	500					0.4390	0.0232		
85.03562	-20,40	10-20	2900	500					2.2900	0.0800		
85.03563	-20,20	0-1	1200	400								
85.03564	-20,20	1-10	3400	500					0.1940	0.0142		
85.03565	-20,20	10-30	6400	700					0.2960	0.0190		
85.03566	-20,0	0-1	200	300								
85.03567	-20,0	1-10	2400	400					2.2600	0.0997		
85.03568	-20,0	10-30	11000	1000					5.9800	0.3600		
85.03569	-20,-20	0-1	33000	3000								
85.03570	-20,-20	1-10	5800	700					4.3600	0.1840		
85.03571	-20,20	10-30	18000	2000					7.2000	0.4800		
85.03572	0,0	0-1	2300	400								
85.03573	0,0	1-10	2000	400					1.9600	0.0923		
85.03574	0,0	10-30	900	300					0.2140	0.0156		
85.03575	0,20	0-1	3000	500								
85.03576	0,20	1-10	2200	400					0.0134	0.0030		
85.03577	0,20	10-30	2800	400					0.0221	0.0034		
85.03650					4.93	0.40						
85.03651					4.83	0.40						
85.03652					4.53	0.40						
85.03653					4.61	0.40						
85.03654					4.54	0.40						
85.03655					4.67	0.40						
85.03656					4.67	0.40						
85.03657					4.50	0.40						
85.03658					5.14	0.40						
85.03659					7.89	0.60						
85.03660					6.53	0.60						
85.03661					4.80	0.40						

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/L)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]		7200[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]	
85.03662					5.03	0.40						
85.03663					4.51	0.40						
85.03664					4.76	0.40						
85.03665					4.46	0.40						

[a]Sample numbers 85.03529 to 85.03665 are for data collected in 1984. The +/- values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper background levels from Purtymun (1987).

TABLE 16.7-III
SUMMARY OF MDAA V RADIOCHEMICAL DATA FOR VEGETATION[a]

Sample Number	Sample Location	Sample Depth (cm)	Species	Tritium Value (pCi/L)	+/-	^{235}U Value (ppb)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]			800[b]		156[b]		.00015[b]		.00023[b]		1.0[6b]	
80.05326	V-1		Bromus anomalous	3600	300	430	50	0.0030	0.0040	0.0760	0.0090		
80.05327	V-1		Andropogon desetorum	3300	300	180	50	-0.0020	0.0020	0.0800	0.0080		
80.05328	V-2		Yucca clauca	6400	400	810	80	0.0021	0.0013	0.0800	0.0050		
80.05329	V-2		Bromus tectorum	5600	300	2910	290	0.0045	0.0013	0.0980	0.0050		
80.05330	V-5		Juniperus monosperma	5700	300	2570	260	0.0250	0.0020	0.2930	0.0090		
80.05331	V-5		Bromus tectorum	2600	300	890	90	0.0440		0.1110	0.0120		
80.05332	V-5		Artemesia caruthii	1900	300	3700	370	0.0189	0.0018	0.4540	0.0130		
85.03507	0,0		Melilotus albus									0.7580	1.3000
85.03508	0,0		Grass									-0.2140	0.8550
85.03509	0,20		Grass									0.3970	0.2490
85.03510	0,20		Forb									0.0985	0.1060
85.03511	-20,-20		Grass										
85.03512	-20,-20		Artemesia									2.1100	0.4700
85.03513	-20,0		Poplar Tree									1.3200	1.0900
85.03514	-20,20		Poplar Tree									0.0545	0.9830
85.03515	-20,20		Gumweed									0.2390	0.2380
85.03516	-20,40		Ground Cherry									0.0904	0.1020
85.03517	-40,-40		Shrub Oak									0.3000	0.3210
85.03518	-40,-40		Grass									0.5410	0.2700
85.03519	-40,20		Gumweed									0.5350	0.3520
85.03520	-40,0		Artemesia drac.									0.5990	0.3960
85.03521	-40,0		Russian olive									1.2900	0.3210
85.03522	-40,20		Melilotus									0.1530	0.6420
85.03523	-40,40		Bromus Tectorum									0.3500	0.2010
85.03524	-40,40		Melilotus albus									0.6360	0.5640
85.03525	-60,20		Snakeweed									0.6370	0.5790
85.03526	-60,60		Melilotus albus									0.8540	0.6500
85.03527	-80,20		Cottonwood									0.1110	0.1090
85.03528	-80,20		Grass									0.6870	0.4790

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper background levels from the Environmental and Surveillance Group (1987).

TABLE 16.7-IV
SELECTED RADIONUCLIDES CONCENTRATIONS IN SUBSURFACE SOIL AT MDA V IN 1983[a]
(Sample location V-1)

Depth (Meters)	Tritium (pCi/L)	Total U (µg/g)	239/240Pu (pCi/g)	137Cs (pCi/g)
BKGD.[b]	7200[b]	3.4[b]	0.025[b]	1.09[b]
0-0.9	11300 ± 1200	4.1 ± 0.2	1.300 ± 0.050	0.20 ± 0.06
0.9-2.4	21000 ± 2000	62.7 ± 4.3	7.700 ± 0.200	0.60 ± 0.12
2.4-4.0	17000 ± 1700	7.3 ± 0.4	c	0.16 ± 0.07
4.0-5.5	24000 ± 2000	4.0 ± 0.2	1.420 ± 0.04	<0.1
5.5-7.0	22000 ± 2000	3.7 ± 0.2	0.271 ± 0.013	<0.1
7.0-8.5	19000 ± 2000	4.0 ± 0.2	c	0.17 ± 0.07
8.5-10.1	18000 ± 1800	4.0 ± 0.2	2.200 ± 0.70	<0.1
10.1-11.6	15100 ± 1500	3.8 ± 0.2	0.810 ± 0.030	0.10 ± 0.04
11.6-13.1	17700 ± 1800	3.8 ± 0.2	0.375 ± 0.015	<0.1
13.1-14.6	16500 ± 1700	3.9 ± 0.2	0.226 ± 0.009	<0.1
14.6-16.2	20000 ± 2000	3.7 ± 0.2	0.110 ± 0.006	<0.1
16.2-17.7	20000 ± 2000	3.7 ± 0.2	0.076 ± 0.006	<0.1

Detection Limits:	Tritium	Total U	239,240Pu
137Cs	(nCi/l)	(µg/g)	(pCi/g)
(pCi/g)	0.7	0.03	0.002 0.1

[a]Surface soil (0–30cm). Absorption bed materials (30–120cm). Tuff (below 120 cm)
[b]Upper background levels from Purtymun (1987).
[c]Concentration large enough to interfere with analytical results. Data are lacking regarding the concentration at which this occurred.

16.8 SWMU 21-014 Material Disposal Area (MDA) A

16.8.1 Site Description

All of MDA A is included in SWMU 21-014, with no subunits defined (LANL 1990). MDA A covers an area of 5000 m^2 (1.25 acre) (Walker et al. 1981) and contains two underground tanks (the General's Tanks), two pits on the east end of the site, and a large pit in the center (Fig. 16.8-1). There is some discrepancy in the records on the number of pits on the east end of the site. An early engineering drawing (ENG-1266) depicted four pits; however, later drawings (ENG-C2076), along with several reports and memos, referred to the existence of only two pits. A recent geophysical survey of MDA A (Gerety et. al. 1989) suggested that only two pits are present on the east end of the site; therefore, it will be assumed there are two pits, not four.

16.8.1.1 Site History

Table 16.8-I provides a chronological sequence of events and data that pertain to MDA A. The following summary and evaluation of this information provide the basis for identifying information needed to complete characterization and assessment of this site.

MDA A was actively used for waste disposal during two periods, 1945 to 1949 and 1969 to 1977. During the first period, the two pits on the east end of the site and the two underground tanks were used for waste disposal and storage. The second phase commenced in 1969 when the large pit in the center of MDA A was constructed to receive decontamination and decommissioning debris from TA-21 (Purtymun 1969; Meyer 1971; Desilets 1972; Christenson 1973c). This pit was used until late 1977. Remediation of the site cover was conducted in 1985 and 1987 (Mayfield 1985b; Salazar 1987). MDA A was decommissioned in May 1978.

Two Eastern Pits

The two eastern pits were constructed in 1945 and are shown (ENG-1266) as being about 5.5-m wide, 3.8-m long, and 3.8-m deep for a trench volume of about 750 m^3. They received "laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems and contaminated or toxic chemicals" (Meyer 1952). The possibility exists that "plutonium, polonium, uranium, americium, curium, Radium-Lanthanum [sic], actinium, and waste products from the Water Boiler" were present in the waste (Meyer 1952). Polonium and $^{239/240}Pu$ were also thought to be the major contaminants in the waste (Meyer 1952). If this were

the case, only the plutonium would remain at present because of the short half-life of the polonium.

There is also reference to the storage of several hundred 55-gal. drums containing "iodide waste" (Emelity 1978) on the east end of MDA A in the early 1950s. These drums contained a caustic sodium hydroxide (NaOH) solution and stable iodine, which were used to scrub ventilation exhaust air containing plutonium and perhaps uranium (Maraman 1990). Corrosion of the drums resulted in liquid releases to surface soil on MDA A. The volume of liquid and its chemical content are unknown. The drums were removed in 1960, and the storage area was paved to immobilize contaminants leaked to the soil.

General's Tanks

In 1945, two 50,000 gal. (about 190 m^3 3.7 m in diameter by 19.1 m in length) steel tanks (the "General's Tanks") were buried on the west end of MDA A to receive solutions containing $^{239/240}Pu$. The intent was to store these liquids until improved chemical recovery methods could be used to extract the $^{239/240}Pu$. The plutonium was never recovered as planned. However, from 1975 to 1983, the liquids in the tanks were removed and processed at the TA-21-257 waste treatment facility. A sludge remains in the bottom of both tanks; however, the volume of sludge is unknown. A memo (Voelz 1973) suggested that less than 1% of the radioactivity in the tanks was associated with the liquid that was processed. This implies that most of the radioactivity remains in the tanks and associated sludge. Estimates of the total $^{239/240}Pu$ (and ^{241}Pu which has decayed to ^{241}Am) stored in the tanks, based on several sources (Voelz 1973; Christenson 1973) is roughly 200-400 g (12-25 Ci). Evidence of rain water entry into the tanks led to the sealing of openings in the top of the tanks in 1985.

Central Pit

A large pit was constructed in the center of MDA A in 1969 to contain debris from demolition work at TA-21. It was to be excavated to a depth of 9.1 m (30 ft), allowing approximately 5,352 m^3 (7,000 yd^3) to be buried with a cover of 5 ft of earth (Purtymun 1969). As originally constructed, however, the available waste volume was only 3,735 m^3, with a depth of 22 ft (Purtymun 1969). The pit was enlarged (total volume of 14,325 m^3) in 1972, but not deepened, and used until late 1974 to accommodate additional building debris. After the demolition work was completed in 1974, waste of an unspecified nature was placed into the remaining unfilled portion of the large trench (Rogers 1977). The pit was decommissioned in May 1978 when a soil cover was placed over the pit (Environmental Surveillance Group 1985). The contaminants placed into the large pit

included $^{239/240}Pu$, ^{238}Pu, ^{235}U, depleted uranium, and other unspecified radionuclides associated with the waste. Asphalt was also a component of the waste.

16.8.1.2 Existing Information

16.8.1.2.1 Waste Discharge Information

The following information was taken from a variety of sources predating 1980. This information is highly qualitative and is presented here to identify radionuclides and other contaminants present in the waste.

Documentation detailing the quantities of contaminants and types of waste (i.e., specific radionuclides and hazardous chemicals) placed into the two eastern pits is nonexistent. It seems certain, based upon the early technical work conducted at TA-21, that radionuclides were present in the waste.

Most of the existing predecommissioning data on MDA A concern liquids in the General's Tanks. The residue still present in the tanks could contain most of the original radionuclide inventory, estimated to be about 12-25 Ci (200-400 g) of $^{239/240}Pu$. Whether these estimates are strictly for $^{239/240}Pu$ or also include ^{241}Am is unknown. Plutonium-241 is formed along with $^{239/240}Pu$ in the production reactor and is inseparable from the more well known plutonium isotope. Some estimates of the activity in the tanks (Rogers 1977) suggest that about one-third of it is ^{241}Am (ingrowth from ^{241}Pu decay).

The quantities and concentrations of contaminants placed into the large central pit, beginning in 1969, are unknown. However, because this pit contains building debris, Rogers (1977) stated it was contaminated with $^{239/240}Pu$, ^{238}Pu, ^{235}U, and depleted uranium along with other unidentified radioactive isotopes. Whether nonradiological hazardous wastes are present in this or any other pit in MDA A is also unknown.

16.8.1.2.2 Historical Surface Sampling Data

Beginning in 1980, sampling of the cover at MDA A began to better characterize the distribution of radionuclides. Three locations, one outside of MDA A, (Fig. 16.8-1) were selected in 1980 for sampling based on the results of field radiation instrument surveys with the phoswich and high pressure ion chamber (HPIC). Results of the follow-on soil and vegetation sampling are given in Table 16.8-II. The soil samples were taken in three intervals to a 30-cm depth and suggest that

tritium levels in the cover are at background level; uranium in sampling location A-2 soils is elevated to depths of 30 cm; and $^{239/240}Pu$ concentrations are elevated in samples from all three locations and in all three depth intervals with a maximum of 60 nCi/g in the 1- to 10-cm interval. Uranium concentrations in soil at location A-2 decreased with depth while plutonium concentrations were relatively uniform with depth. Location A-3 is outside of MDA A, and the plutonium levels there may be unrelated to MDA A. Vegetation sampling results show that tritium and total uranium concentrations are only elevated in vegetation within MDA A. The one vegetation sample outside MDA A had above-background plutonium.

In 1984, soil and vegetation sampling was conducted on MDA A, including analyses for plutonium, tritium, uranium, and radiation fields as measured with field instruments. The full sampling grid was used for the instrument survey (Fig. 16.8-2), while soil and vegetation samples were taken from the western one-third of the site, with particular emphasis on the General's Tanks area.

The results (Table 16.8-III) of the instrument survey with the phoswich detector analyzer set to respond to low-energy x-rays (16-60 KeV) from plutonium and americium suggest a fairly widespread distribution of these elements across the site. Some counts were two to three times background levels of about 800 counts per 200 seconds. Relative µR/hr as measured with the HPIC were also elevated above the background level rate. The HPIC responds primarily to moderate and high-energy x-ray and gamma ray photons.

Concentrations of selected radionuclides in cover soil profile samples and vegetation are shown by grid location in Tables 16.8-IV and 16.8-V. The 39 grid locations used for the soil and vegetation sampling (Fig. 16.8-2) included several locations outside of the fenced area to the west and two points to the northwest. Soil samples were collected at three depths: 0 --1 cm, 1 - 10 cm, and 10 - 30 cm. Not all locations and depths were assayed for each radionuclide. The most complete data are for the 1 - 10-cm depth.

Generally, tritium concentrations in soil and vegetation were less than background levels in the majority of samples. However, all soil samples contained uranium and plutonium concentrations that were well above maximum background levels, as detailed below. Uranium concentrations were also elevated above background levels in vegetation samples.

All uranium concentrations in soil (except one sample) were above the background level of 3.4 µg/g. Uranium concentrations in 88% of the vegetation samples exceeded the background level of about 1 µg/g by factors of 2 to 6. Because uranium concentrations were elevated in soil,

elevated uranium concentrations in plants may be because of the presence of contaminated dust on vegetation, instead of root uptake.

Plutonium-238 in soil was elevated above the maximum background level of 0.005 pCi/g in all samples, except one. Ninety percent of the values reported were greater than two times the maximum background level. Of 36 samples, the majority have ^{238}Pu concentrations that were more than ten times the maximum background level. Figure 16.8-3 shows the spatial prediction surface generated from kriging data at depth 1 to 10 cm. The contours are for concentration levels above background level. Plutonium-238 is most elevated over the pit that is at the edge of the data.

Concentrations of $^{239/240}Pu$ in soil were more than ten times the maximum background levels in the majority of samples. Plutonium-239 and -240 in soil generally exceeded background levels, ranging between 1 and 20 pCi/g. Figure 16.8-4 shows the spatial prediction surface generated from kriging data at depth 1 to 10 cm. The contours are for concentration levels above background level. Plutonium-239 and -240 are most elevated over the General's Tanks and outside of the fence to the east and to the northwest.

16.8.1.2.3 Historical Subsurface Sampling Data

Four test holes were drilled in MDA A adjacent to the General's Tanks in May 1974 to evaluate whether the tanks had leaked contaminants into the surrounding soil (Wheeler 1976). The holes were augered to a depth of about 10 m (35 ft), and composite samples were collected in 1.5-m (5-ft) intervals. The bottom of the tanks are at a depth of 15 ft. Results, as summarized in an internal memo, indicated that gross alpha and gross beta concentrations were well within regional soil background levels, suggesting that lateral migration of any leakage from the tanks could not be identified as of May 1974.

In 1983, soil profile samples were taken using a power auger at 90-cm (3 ft) intervals to a total depth of 900 cm (30 ft) at six locations around the perimeter of the General's Tanks (Fig. 16.8-5). Analyses for ^{238}Pu and $^{239/240}Pu$ are summarized in Table 16.8-VI. All samples in the 0-90-cm (0-3-ft) depth profile had levels of $^{239/240}Pu$ above background, and three of the six had levels of ^{238}Pu above background. In deeper sampling intervals, only one sample (27-30-ft depth) had a ^{238}Pu concentration elevated above background level. Nine samples at depths deeper than 3 ft exceeded the maximum background level for $^{239/240}Pu$. Generally, holes 1 and 3 have the most elevated levels.

16.8.1.2.4 Summary of Historical Data

Existing data on the spatial distribution of radionuclides in MDA A indicate that elevated levels of the radionuclides exist over most of the General's Tanks area as well as off the fenced area to the west and northwest. No data were taken on the east side of MDA A or off MDA A to the east or north down DP Canyon.

Surface soil concentrations of ^{238}Pu, $^{239/240}Pu$, and uranium were elevated above maximum background levels in both the 1980 and 1984 samples. Note however that these levels may no longer be present today because the cover was remediated in 1985 and 1987.

Limited vegetation data suggest elevated uranium levels. However, it is not known whether they reflect the presence of contaminated dust on the vegetation or root uptake.

Auger samples collected in 1974 and 1983 near the General's Tanks to 30-ft depths found levels of ^{238}Pu, $^{239/240}Pu$, and uranium elevated above maximum background levels in most sampling intervals. No other subsurface data are available from other parts of MDA A.

To date, no analyses for ^{241}Am in soil and vegetation have been performed, although it is likely to be present as a result of ingrowth from ^{241}Pu decay. No information exists on the nonradiactive hazardous waste content of MDA A.

16.8.1.4 Source Term

Two pits at the eastern end of MDA A contain solid waste that is known to be radioactively contaminated, with $^{239/240}Pu$ as the major contaminant. The central pit also contains solid waste that is radioactively contaminated. Source concentrations for these three pits are unknown. Drums stored on the surface prior to 1960, at the east end of MDA A east of the two pits, may have leaked stable iodine in an NaOH solution, with a good probability of plutonium and perhaps uranium contamination. Again, the volume of this possible contamination is unknown. Whether nonradiologic hazardous waste is present in these pits is unknown.

The General's Tanks contain a sludge estimated to have a total of 200 to 400 g (12-25 Ci) of $^{239/240}Pu$ (and ^{241}Am). The chemical composition of this sludge is unknown; however, it may contain metals and solvents used in plutonium processing.

16.8.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminant migration from MDA A. Specific data required to assess contaminant migration at MDA A include the following:

1. Confirm the absence of contaminant migration by identifying contaminants present in both the surface and subsurface. Plutonium-239/240 and ^{241}Am were disposed of in MDA A, and uranium has been found in previous sampling. However, whether other radionuclides and hazardous wastes may be present is unknown. Because the objective is to confirm absence of contamination, Level III/IV analyses are necessary.

2. Determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and analysis using Level II/III data.

3. Determine the primary migration pathways through the evaluation of sample analysis results. The primary migration pathway is expected to be surface erosion.

16.8.3 Sampling/Investigation Rationale

Surface sampling. Surface sampling within the MDA A fence was conducted in October 1990 on a 10- by 10-m grid, with several additional samples on a 3- by 3-m grid for assessing spatial variability. At this time, analytical results from this sampling are not available. Additional samples will be collected from the MDA A fence to the canyon rim. This sampling will be coordinated with the OU-wide surface characterization (Chapters 12 and 13). These data, along with the detailed drainage sampling (Sec. 16.1.4) will be evaluated to define whether further MDA A surface sampling is necessary either within or beyond the MDA A fence.

These data will be used to determine spatial prediction surfaces, such as kriging surfaces for MDA A and the surrounding area. These surfaces will be used to determine contaminant distributions, to study migration patterns and erosion effects, and to guide both subsequent sampling and analytical needs. Requirements for additional sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Subsurface sampling. As discussed in Sec. 16.1.5, because MDA A was a solid waste disposal area (with the exception of the General's Tanks), emphasis will be on how far contaminants have migrated and not on source term definition. Therefore, the focus is on angle drill holes reaching beneath MDA A to identify any migration of contamination. Although the General's Tanks re-

ceived liquid wastes, they are empty, and the initial investigation of this plan emphasizes angle holes beneath them to evaluate migration. Depending on the results of initial sampling, this approach to subsurface contaminant migration characterization may need to be modified or expanded to include a larger area.

Given limited contaminant information, initial sampling will analyze for a broad analytical spectrum of radionuclides, organics, inorganics, and metals. However, in any necessary additional investigations, the analytical suite will be focused as appropriate to specific contaminants identified.

16.8.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation at MDA A. However, due to the large number of pages, these tables have been placed in Sec. F.8 of Appendix F, Analytical Tables.

16.8.4.1 Surface Sampling Plan

16.8.4.1.1 1990 Surface Sampling

MDA A was sampled intensively in October 1990 for surface radionuclide contamination. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste sites. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.8-6, several areas have additional sample locations based on a 3- by 3-m grid. These replicate sample units allow for characterization of the local variability, increasing precision for the prediction of contaminant concentration distributions. Phoswich and μR counts will be determined for each sample location, and samples taken at these locations will be analyzed in the laboratory for radionuclide contamination.

In 1985, MDA A underwent site stabilization activities of removing surface contamination, adding cover material, recontouring, and reseeding. The data collected in 1990 should help determine the effectiveness of this stabilization activity.

16.8.4.1.2 Initial Investigation

To supplement the October 1990 sampling within the fence (see Sec. 16.8.1.2.2), 40 samples will be taken on a 20- by 20-m grid from the fence to the canyon rim. Five additional samples will also be collected approximately 5 m from selected grid nodes as shown in Fig. 16.8-7 to assess

spatial variability. The 20- by 20-m grid to the canyon rim will be coordinated with the 40- by 40-m grid of the TA-21 OU surface sampling plan described in Chapters 12 and 13. Drainage samples will be collected as described in Section 16.1.4. Radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken to further characterize any such areas detected.

The samples will be submitted to an analytical laboratory for radionuclides, metals, and semivolatiles analyses. The screening and analysis requirements are given in Table F.8-I (see Appendix F).

16.8.1.4.3 Subsequent Investigation

For planning purposes, it is assumed that 20 surface samples on a 10- by 10-m grid surrounding MDA A will be required in a subsequent investigation. A reduced analytical suite will be used, if possible, based on results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.8-II (Appendix F) gives the assumed screening and analysis requirements for the subsequent investigation.

16.8.4.2 Subsurface Sampling Plan

16.8.4.2.1 Initial Investigation

The subsurface sampling plan at MDA A is designed to provide information for the data needs described in Sec. 16.8.2. Sampling objectives are discussed in the Introduction (Secs. 16.1.2 and 16.1.5). Subsurface studies at MDA A will emphasize the characterization of potential contaminant infiltration beneath the two underground storage tanks (General's Tanks); two eastern solid waste disposal pits; the central solid waste disposal pit; and the NaOH-iodine drum site. These features have been accurately located with a previous geophysics study (Gerety et al. 1989), which has assisted in hole placement beneath features of interest.

Six holes will be drilled around the perimeter of the site (Fig. 16.8-8). Three of the holes will be inclined 15 to 30° from horizontal, and three of the holes will be vertical (Figs. 16.8-8 and 16.8-9). One inclined drill hole will penetrate beneath the General's Tanks to detect possible leakage of contaminants. One inclined drill hole will penetrate tuff adjacent and below the two eastern solid waste disposal pits, and another inclined hole will be drilled beneath the central solid waste storage pit. Two vertical drill holes are located north of these solid waste pits to detect possible

lateral movement of contaminants towards DP Canyon. An additional vertical hole will be drilled to determine the presence of contamination at the NaOH-iodine drum storage site.

Samples for contaminant characterization, along with samples for moisture determination, will be collected at 5-ft intervals along the length of the drill holes. The nominal length of the drill holes is given in Fig. 16.8-8. The borehole stopping criteria in Sec. 11.5.3 will be applied only to vertical boreholes (angled holes will stop at the defined length), and the field laboratory will be used to make these determinations.

A full suite of analytical laboratory analyses will be conducted on all core samples. The screening and analysis requirements are identified in Table F.8-III (Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered over a 5-ft sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals.

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized systematically at 20-ft intervals in the core and within contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.8-IV (Appendix F).

16.8.4.2.2 Subsequent Investigation

If the hypothesis is correct that no migration is occurring, then either no subsequent investigation or a minimal subsequent investigation may be required. However, if initial boreholes or modeling results suggest migration is occurring, then additional boreholes may be required. The necessity for additional characterization will be determined after results from the initial drilling are evaluated. Placement of additional drill holes will be based on results from the initial drill holes and modeling results.

It is anticipated that no more than five additional boreholes will be required. In any subsequent sampling, to the extent possible, a reduced analytical suite, determined by analyzing for the full suite of contaminants in the initial investigation, will be used.

For planning purposes, it is assumed that five 75-ft boreholes will be required (see Fig. 16.8-10). The analytical suite specified for the samples may be focused based on initial sample analysis results, but for planning purposes, it is assumed that a full analytical suite will be used. Table F.8-V (see Appendix F) identifies the assumed screening and analysis requirements for the subsequent investigations.

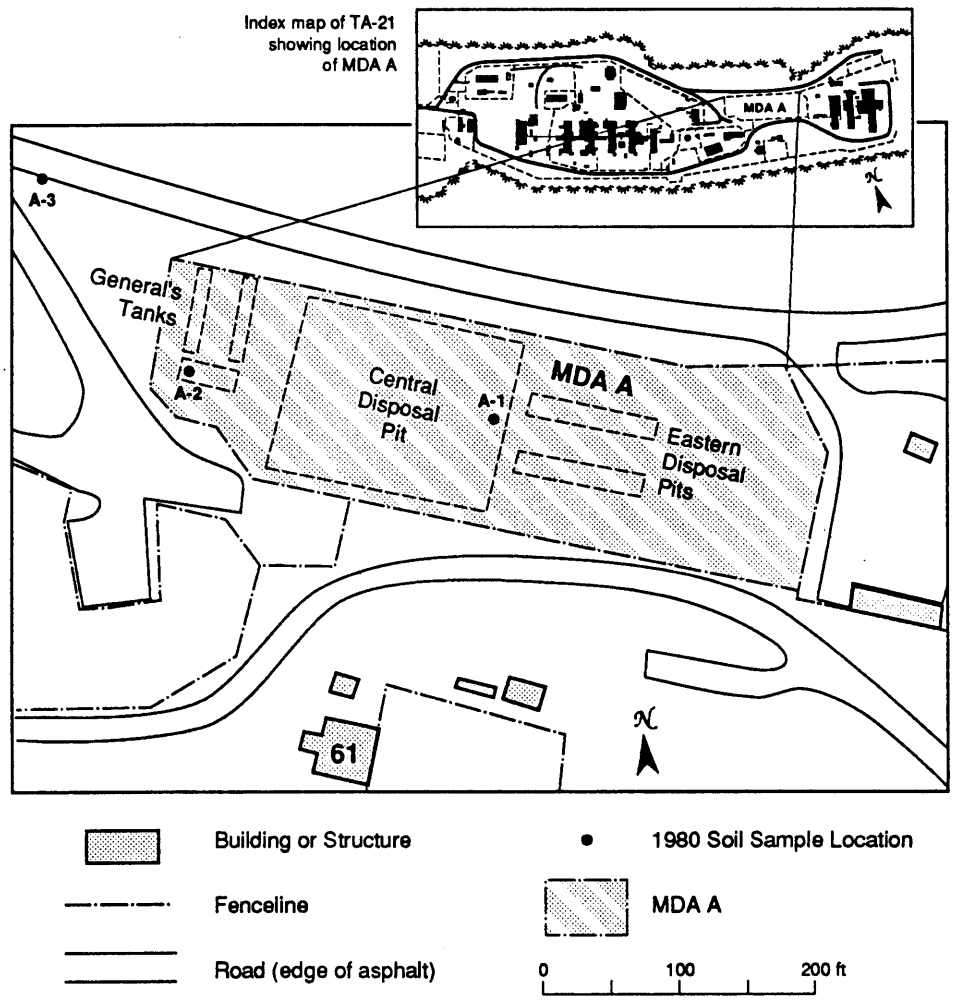

Fig. 16.8-1 General base map of MDA A showing location of 1980 soil samples.

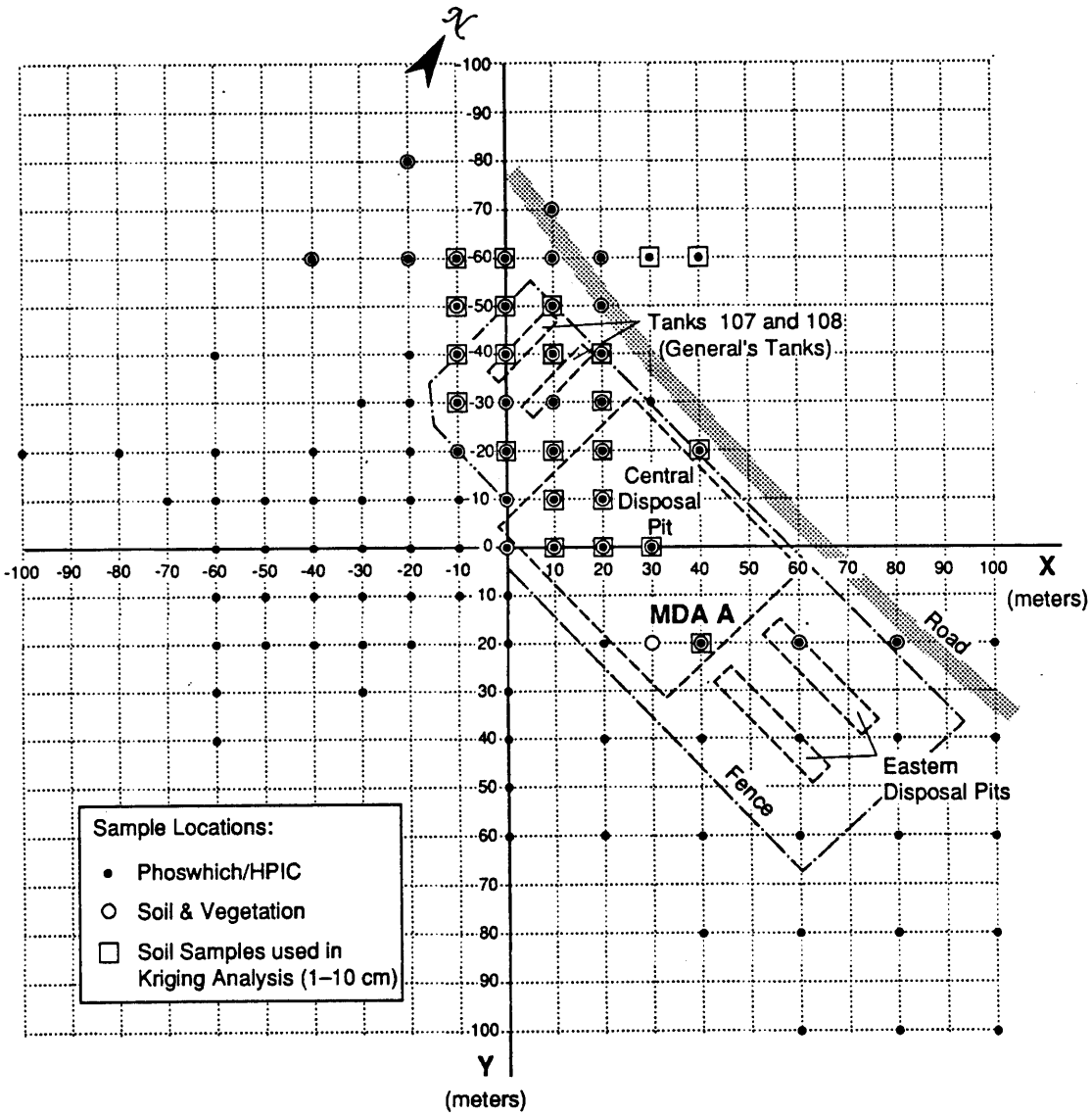

Fig. 16.8-2 Sampling grid used on MDA A in 1984.

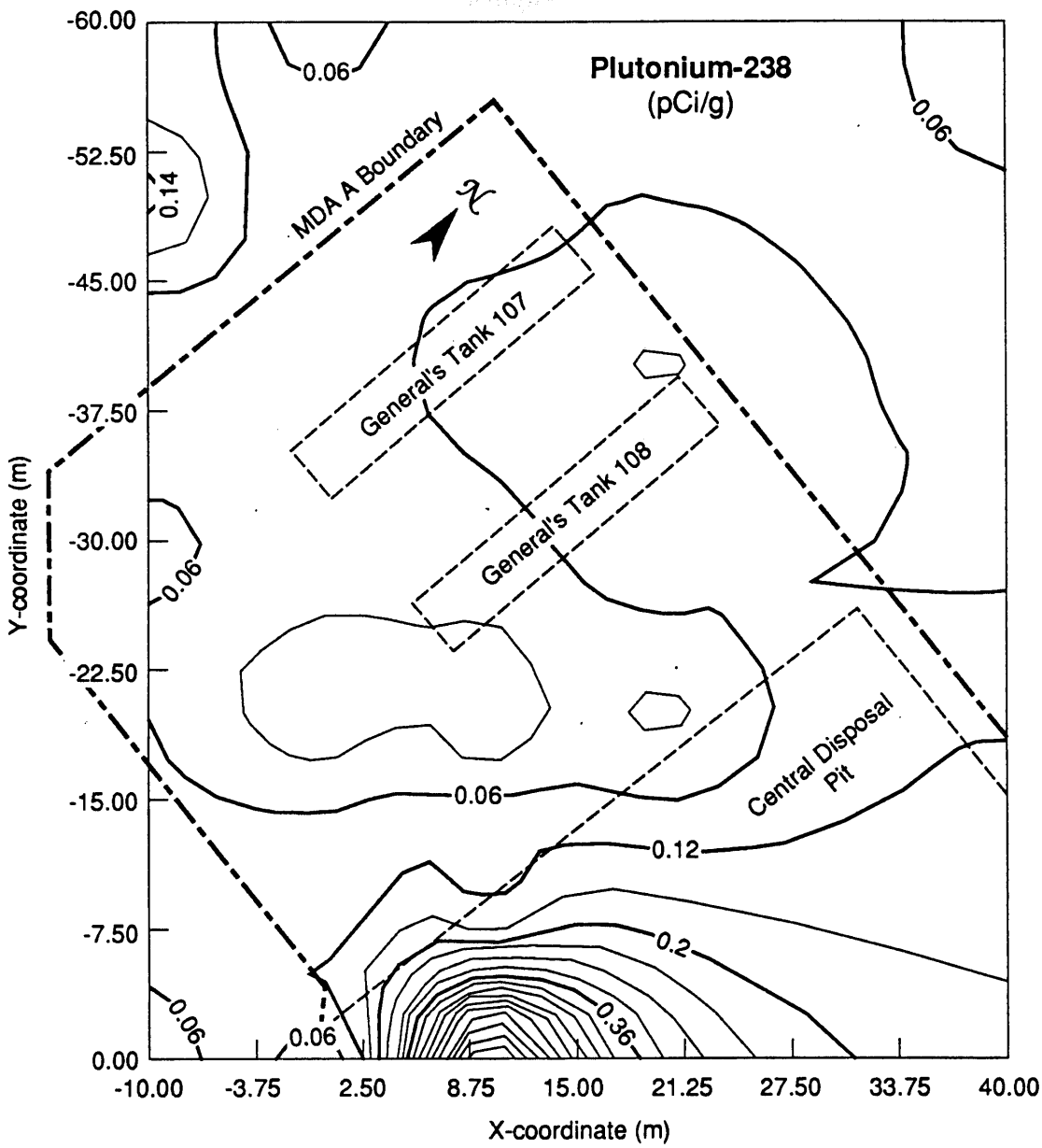

Fig. 16.8-3 Plutonium-238 contours from 1984 surface sampling program.

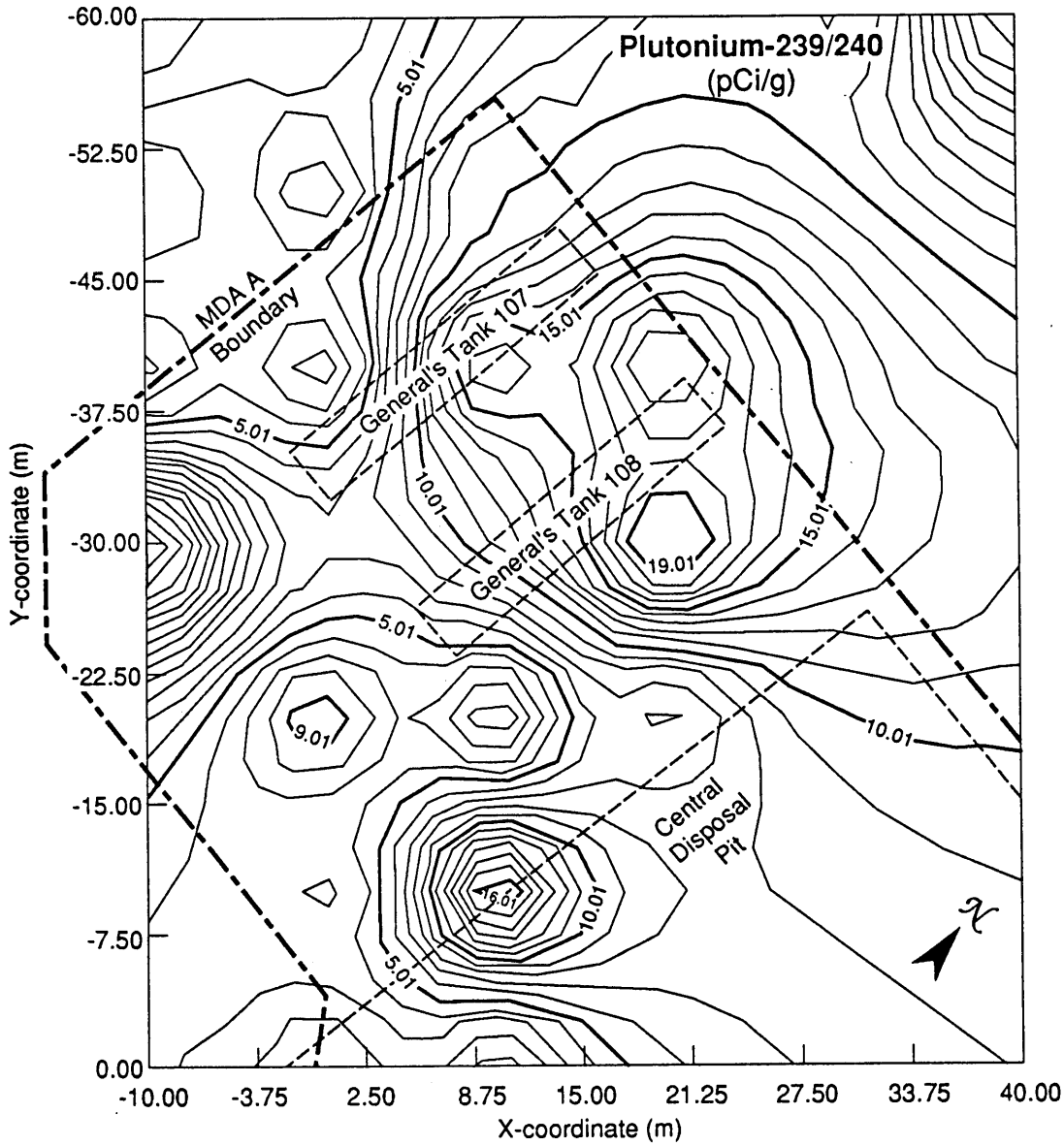

Fig. 16.8-4 Plutonium-239/240 contours from 1984 surface sampling program.

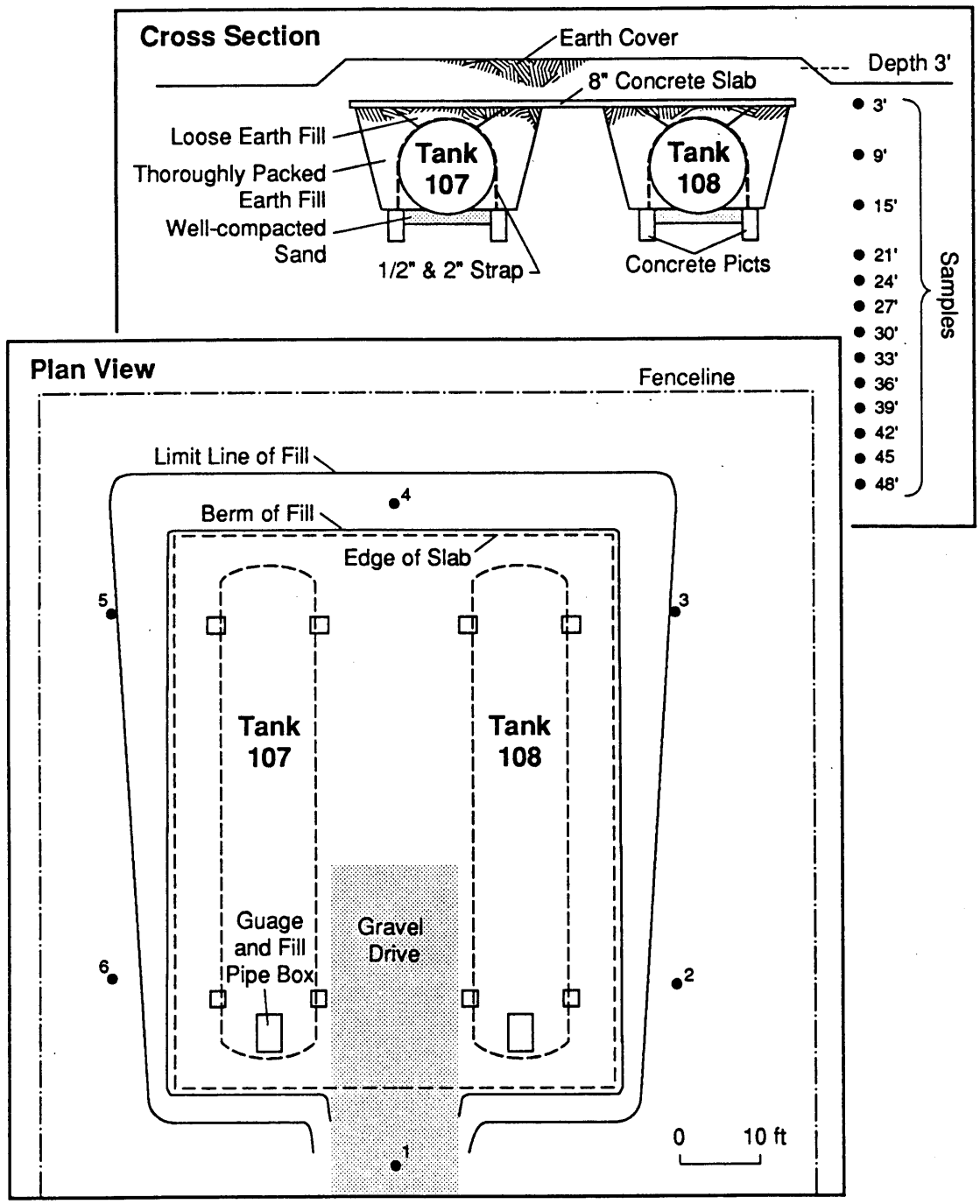

Fig. 16.8-5 1983 subsurface soil samples collected with "minuteman" drill (cross section). Locations perimeter to the "General's Tanks" as marked on map (plan view).

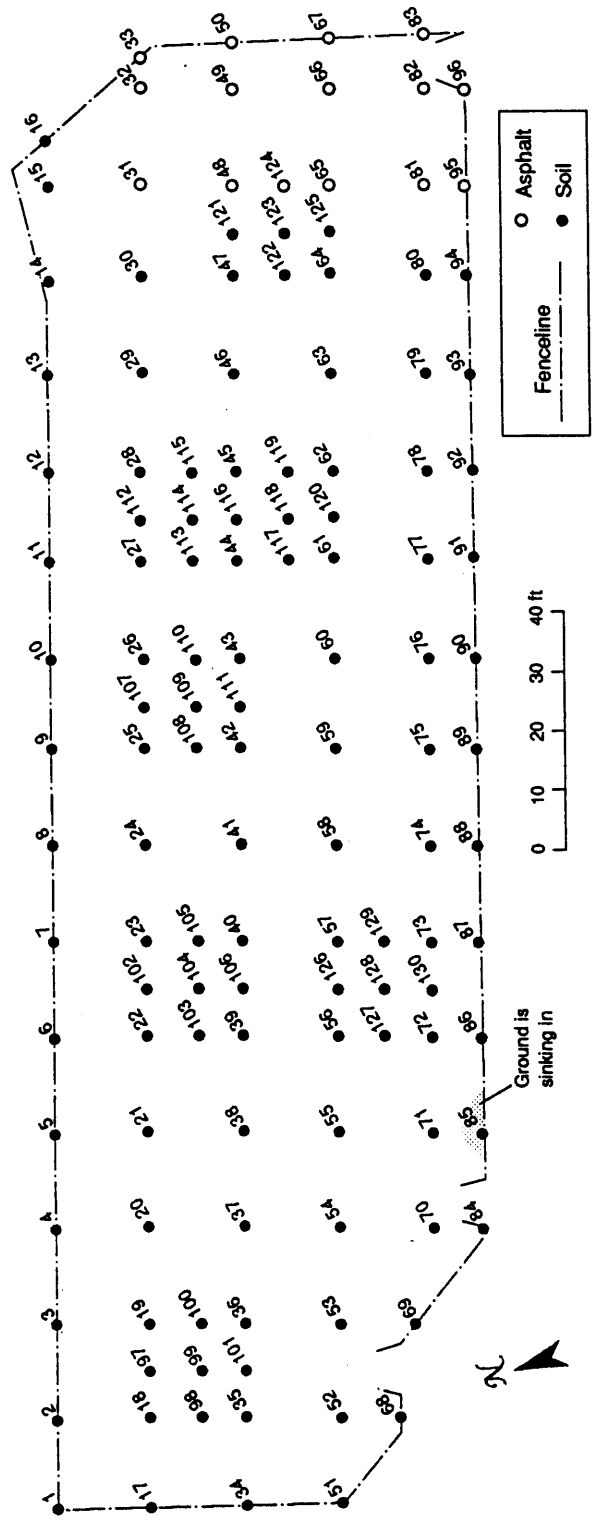

Fig. 16.8-6 Fall 1990 sampling locations for Environmental Surveillance Group's surveillance of low-level radioactive waste.

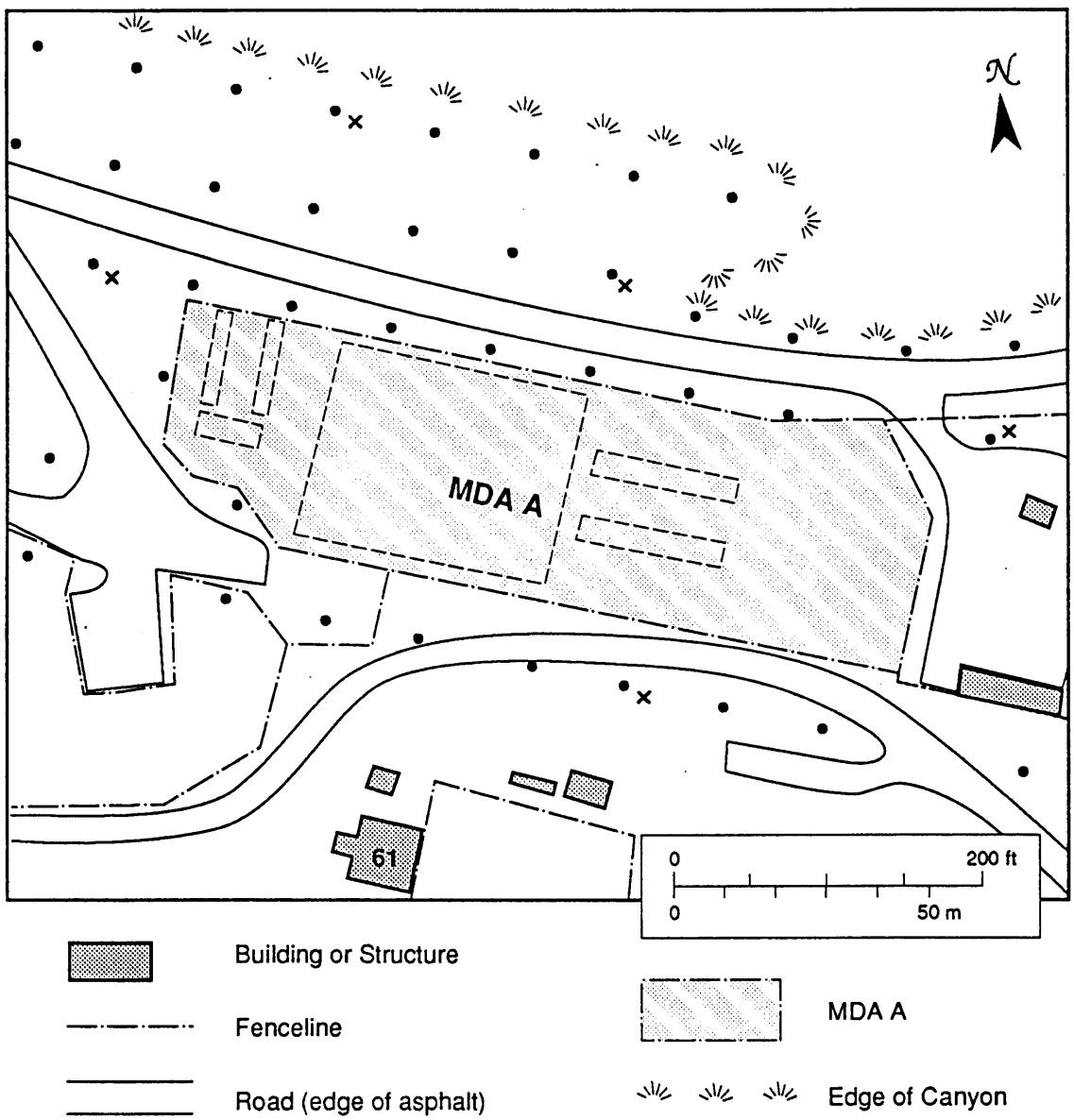

Fig. 16.8-7 Twenty-meter by twenty-meter surface sampling grid for MDA A. The x's indicate possible replicate sample locations.

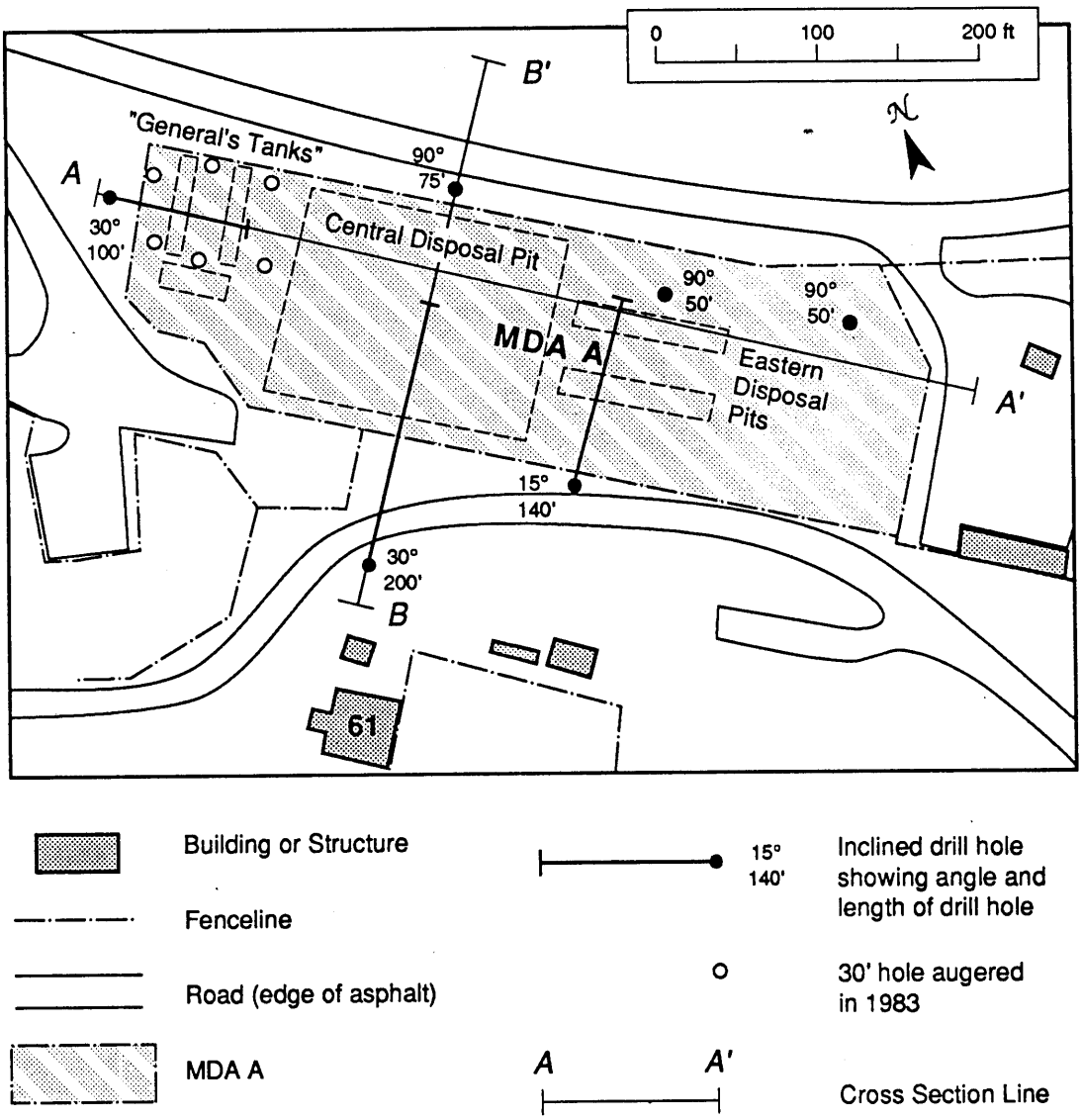

Fig. 16.8-8 Location of initial characterization drill holes at MDA A.

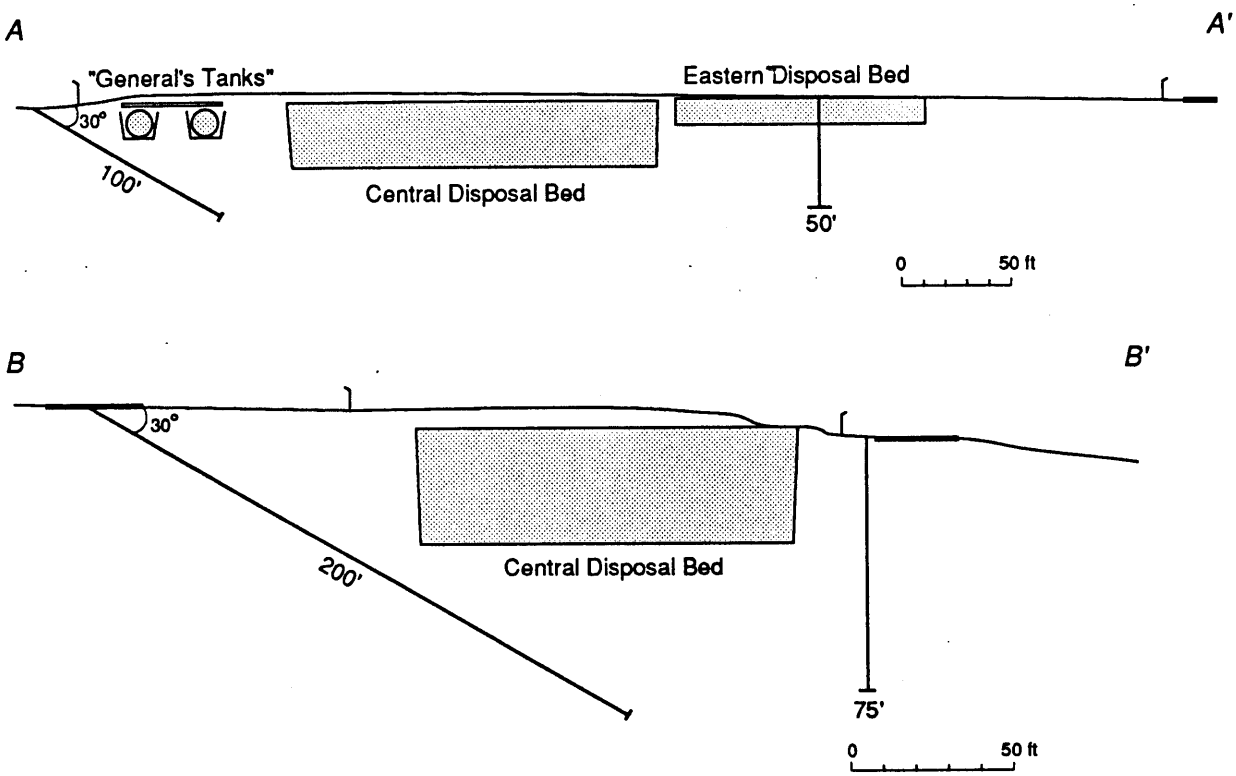

Fig. 16.8-9 Cross sections for MDA A showing layout of the "General's Tanks," disposal beds, and initial characterization drill holes. Drill holes outside the plane of the section are dashed.

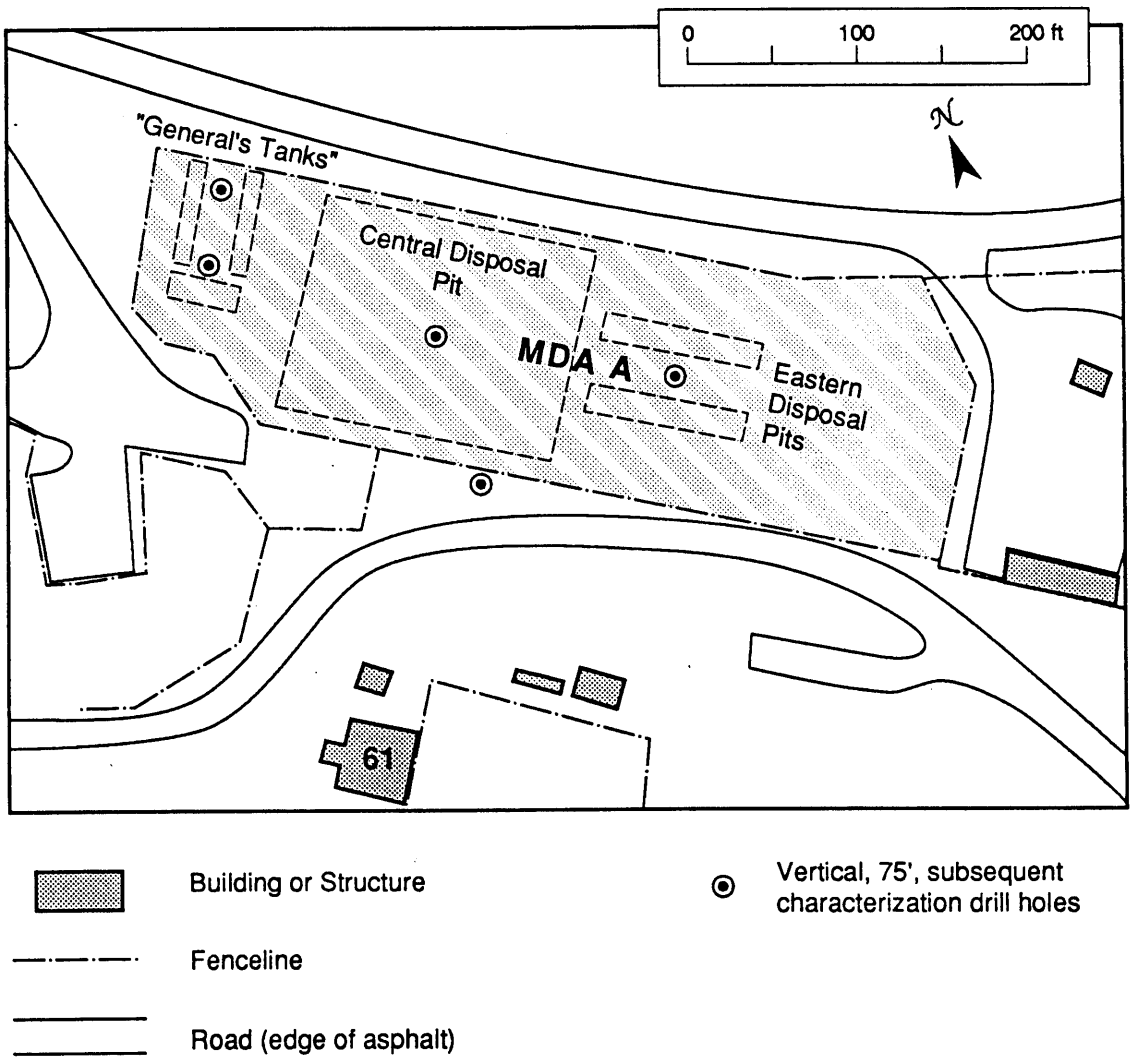

Fig. 16.8-10 Location of subsequent characterization drill holes at MDA A.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MDA A

Date	Location	Reference	Event
1945	MDA A	N/A	Construction of four pits on eastern end of MDA A (125 ft x 18 ft x 12 ft deep).
1945	MDA A	N/A	Construction of two storage tanks (General's Tanks: 12 ft in diameter and 62-ft 10-in. long.
1946	MDA A	N/A	4 pits on eastern end of MDA A closed.
1946	MDA A	N/A	Last addition of liquids to General's Tanks.
Early 1950s up to June 1952	General's Tanks liquids at MDA A (designated as site 6-2 SL in report)	Unpublished 1963 USGS Report cited in LA-6848-MS	Gross alpha assays on liquid contents.
1960	MDA A	N/A	Hundreds of drums of radiolodide waste, which were previously stored within MDA A, were removed.
1969-1972	MDA A	N/A	Building debris from demolition work at TA-21 added to large pit in center of MDA A.
1969	MDA A	N/A	Large pit constructed in the center of MDA A (150 ft x 40 ft x 22-ft deep).
1972	MDA A	N/A	Large pit in center of MDA A enlarged to bury building materials from the demolition of building TA-21-12 (172 ft x 134 ft x 22-ft deep).
1972-1978	MDA A	N/A	Waste materials added to large pit in center of MDA A.
1973,1975	General's Tanks liquids at MDA A	Memo No. H7-76-PEM-162	Gross alpha, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, and nitrate assays on grab samples.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
May 1974 segment.	Four locations immediately east and west of General's Tanks at MDA A	Los Alamos report LA-6848-MS, 1976 H-8 memo H8-WS-610	4 holes were augered to a depth of 35 feet and one composite sample collected from each 5 foot Gross alpha and beta assays performed.
1975	MDA A	N/A	Liquids in one of General's Tanks removed for processing at TA 21-257.
1978	MDA A	N/A	Large pit in center of MDA A covered over.
1980	31 locations outside of MDA A, 24 locations along MDA A fence, and 10 locations inside of MDA A	A411 Project File	Phoswich and uR meter field surveys
1980	MDA A site visit	A411 Project File	Overall qualitative evaluation of site surface condition.
5/20/80-6/2/80	2 locations within MDA A and 1 outside MDA A	A411 Project File	Soil samples collected for the 0–1-cm, 1–10-cm and 10–30- cm depths at each locations, as well as a total of 6 vegetation samples, and analyzed for tritium, total U, and $^{239/240}Pu$
10/6/82	Site visit of MDA A	A411 Project File	Overall qualitative evaluation of site conditions, µR meter survey. No soil and vegetation samples.
4th quarter 1982	5 locations on perimeter of MDA A	Los Alamos Notebook 23820 notes, 1983 Los Alamos report LA-9762-ENV	TLD data.
1983	MDA A	N/A	Liquids in General's Tanks removed for processing.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
1983	2 locations between north fence of MDA A and road	A411 Project File, memo HSE-8-85-271, 3/27/85	Subsurface samples collected in various depth increments to a depth of about 17.6 m and assayed for ^{137}Cs, $^{239/240}Pu$ and total U.
1983	Surface soils from 15 locations within MDA A and 5 locations outside of MDA A.	1984 Los Alamos report LA-10100-ENV	Soil samples from 0-1 cm, 1-10 cm and 10-30 cm depths assayed for tritium, total U, and $^{239/240}Pu$.
1983	6 locations adjacent to and surrounding the General's Tanks at MDA A	A411 Project File	Soil samples collected at 3 foot intervals to a depth of 30 feet in each hole using Purtymun's drill rig (auger samples). Samples assayed for tritium, uranium, ^{238}Pu, $^{239/240}Pu$, and ^{137}Cs
4 quarters 1983	5 locations on perimeter of MDA A	Los Alamos Notebook 23820, 1984 Los Alamos report LA-10100-ENV	TLD date.
1984	15 locations within MDA A and 5 locations outside of MDA A	1985 July A411 monthly report, memo HSE8-85-909	Soil samples collected at 0-1, 1-10 and 10-30 cm sampling depths at each of 20 locations and analyzed for tritium, total U and $^{239/240}Pu$.
May 1984	16 locations outside MDA A fence and 21 locations inside fence	A411 Project File	Phoswich and uR meter surveys.
May-July 1984	33 locations around MDA A	A411 Project File	Vegetation samples assayed for tritium, total U and $^{239/240}Pu$.
July-August 1984	16 locations outside MDA A fence and 21 locations inside fence	A411 Project File	Phoswich and µR meter surveys.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
4 quarters 1984	5 locations on perimeter of MDA A	Los Alamos Notebook 23820 notes, 1986 Los Alamos report LA-UR-86990, 1985 Los Alamos report LA-10421-ENV	TLD data.
1985	MDA A	N/A	Site stabilization activities in sealing and covering openings in the General's Tanks, removing surface contamination, adding cover material and recontouring and reseeding MDA A.
1st quarter 1985	7 locations within and outside of MDA A	A411 Project File	Gamma spectrum analysis of soils at 1–10-cm and 1030-cm depths.
6/85	Site visit of MDA A	A411 Project File	Overall qualitative evaluation of site conditions before and after stabilization.
6/12/85	MDA A trench cap	A411 Project File	Annual site inspection of opened trench cap.
4 quarters 1985	5 locations around MDA A perimeter	Los Alamos Notebook 23820 notes	TLD data.
7/86	Surface reconnaissance of MDA A	A411 Project File	Qualitative evaluations of site conditions.
7/18/86	Surface of MDA A	A411 Project file	Surface reconnaissance survey remarking on general conditions of cover.
4 quarters 1986	5 locations around MDA A perimeter	Los Alamos report LA-10992-ENV	TLD data.

TABLE 16.8-II. RADIONUCLIDES IN SOIL AND VEGETATION SAMPLES FROM MDA A IN 1980

Location	Soil Sample Depth (cm)	^{3}H (pCi/L) Soil	Veg	Concentrations Total U (µg/g) Soil	Veg	$^{239,240}Pu$ (pCi/g) Soil	Veg
Bkgd.[a,b]		7200[a]	800[b]	3.4[a]	9.6[b]	.025[a]	.00023[b]
A-3	0-1	2700		3.5		1.10	
	1-10	2200	100	3.3	0.1	0.93	0.29
	10-30	1600		3.5		2.00	
A-2	0-1	9100	5200[c]	38.0	1.3[c]	14,000	1700[c]
	1-10	3100	1300	13.0	0.4	60,000	1700
	10-30	3200	3500	6.5	0.1	17,000	80
A-1	0-1	5800	3400[c]	3.6	0.4[c]	11.6	2.16
	1-10	3000	5500	3.9	0.1	15.5	3.10
	10-30	4500		4.4		17.5	

[a]Upper background levels from Purtymun (1987).
[b]Upper background levels from The Environmental Surveillance Group (1987).
[c]Vegetation data are for different species.

TABLE16.8-III. FIELD SURVEY DATA FROM MDA A IN1984.

Grid Location x	y	Phoswich counts[a] per 200 sec	HPIC[b] µR/hr
0	0	1028	7.5
0	-10	712	9.0
-10	0	1419	8.5
-10	-10	812	3.0
-20	-20	963	12.5
-30	-20	496	4.0
-40	-20	710	6.5
-50	-10	796	7.5
-60	-10	1273	8.3
-60	0	1179	7.7
-60	-10	906	8.3
-70	-10	726	6.5
-50	-20	931	7.7
-60	20	771	6.5
-60	30	1234	9.0
-60	40	1253	8.3
-30	-10	1161	8.3
-40	10	1040	7.5
-50	0	1475	9.5
-50	10	1455	10.2
-40	20	1422	8.5
-30	20	1552	9.5
-20	10	1413	9.0
-20	0	1428	9.5
-29	0	807	7.5
-40	0	2107	10.5
-40	10	1503	10.2
-30	10	1407	8.5
0	0	1500	7.5
0	10	1819	7.7
0	20	1871	7.5
0	30	1837	8.3
10	-10	1768	8.5
-20	20	1761	7.7
-30	30	1634	6.3
20	20	922	2.1
40	20	728	5.0
60	20	860	4.1
40	40	1070	7.5
60	40	918	6.5
80	40	907	6.0
60	60	799	7.5
80	60	1333	5.7
100	60	1295	4.5

TABLE16.8-III. FIELD SURVEY DATA FROM AREA A IN1984 (continued)

Grid Location x	y	Phoswich counts[a] per 200 sec	HPIC[b] µR/hr
80	80	682	4.7
100	80	910	4.7
120	80	1152	6.5
100	100	1034	4.5
20	100	796	4.9
0	80	833	4.9
20	0	1146	9.3
-60	-20	1095	7.7
-80	-20	1057	—
-100	-20	963	5.7
0	40	1618	7.7
-20	40	1373	8.1
0	60	1345	8.5
20	80	1482	8.1
40	100	737	7.3
60	100	969	7.3
40	80	2293	8.0
20	60	1991	18.1
40	60	1501	13.7
20	40	1619	12.5

[a]Counts per 200 seconds, Phoswich window set to16 - 60 KeV, detector height =8 cm. Average background reading x = 872, s =143, n = 7.

[b]HPIC (high pressure ion chamber) readings were taken with the detector one meter above ground, and averaged over a five minute interval. For background, x = 2, s = 0.6, n = 7. The instrument was incorrectly calibrated (readings at Los Alamos should be in the range of 10-15 µR/hr); therefore, only relative and not absolute µR/hr can be compared.

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-20, 10	0-1	3500			
-30, -10		5900			
-20, 0		28000			
-29, 0		9100			
-40, 0		3600			
-50, 0		4200			
-30, 10		4600			
-40, 10		6200			
-50, 10		20000			
-30, 20		5300			
-40, 20		3900			
-40, 10		4300			
-30,-10	1-10	1500	4.03		
-20, 0		3200	4.24	0.0140	0.1380
-29, 0		4700	3.50	6.0000	1000.00
-40, 0		2600	4.22	0.0440	1.2400
-50, 0		3500	4.13	0.0450	1.0700
-40, -10		2900	3.84	0.0370	1.7400
-20, 10		2000	3.91	0.0032	0.0310
-30, -10		2400	5.11	0.0910	19.2000
-40, 10		1700	4.34	0.1040	17.2000
-50, 10		2600	4.24	0.0630	10.0000
-30, 20		2000	4.23	0.1180	21.1000
-40, 20		2100	4.87	0.1250	20.4000
-30, -1-	10-30	2100	4.07	0.1230	16.7000
-40, -10		2300	4.12	0.0480	3.6300
-20, 0		3100	4.15	0.0140	0.1220
-29, 0		5400	3.75	0.0190	3.1000
-40, 0		3700	3.94	1.3300	2.9000
-50, 0		3300	3.83	0.0130	1.4600
-20, 10		3200	4.27	0.0780	12.6000

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-30, 10	10-30	3500	3.93	0.2420	48.8000
-40, 10		2100	3.86	0.0080	0.9700
-50, 10		2600	3.60	0.0110	0.4300
-30, 20		3200	4.03	0.0310	6.1000
-40, 20		1400	3.80	0.0100	1.6400
-60, 40	0-1	6400			
0, 30		4300			
-60, 30		11800			
0, 10		9100			
-10, 10		3700			
-120, 120		3800			
0, 20		8000			
-60, 0		4500			
-10, 0		7000			
0, 0		4800			
-120, -20		5200			
-60, -10		5200			
-50, -10		6600			
-80, -20		2700			
-60, -20		2700			
-160, -40		4200			
-120, -40		4800			
-100, -40		3200			
-60, -40		3300			
-160, -60		5200			
-140, -60		4000			
-120, -60		5300			
-100, -60		3300			
-200, -80		3000			
-200, -80		2500			
-180, -80		6300			

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-160, -80		6400			
-140, -80		8600			
-100, -80		6200			
-80, -80		16600			
-100, -100		4000			
-60, -100		3400	4.12	0.0091	0.1200
-60, 40	1-10	4300	3.82	0.0115	0.2250
-60, 30		3200	4.05	0.0543	10.1000
0, 30		2500	3.87	0.0725	12.0000
-20, 20		4100	3.92	0.0319	5.7700
0, 20		3200	4.08	0.0500	8.6600
-10, 10		5700	3.96	0.1090	17.3000
0, 10		2000	3.96	0.7770	0.4470
-60, 0		5700	3.55	0.0197	2.0700
-10, 0		2800	3.78	0.0924	2.8100
0, 0		2500	3.90	0.0522	0.7820
-60, -10		2800	3.79	0.1020	0.9430
-50, -10		7000	3.53	0.1750	4.4600
-60, 40		2800	3.73		
-60, 30		3200	3.76		
0, 30		3400	3.90		
-20, 20		2700	3.84		
0, 20		3200	3.86		
-10, 10		3400	3.71		
0, 10		4100	3.67		
-60, 0		2400	3.22		
-10, 0		2600	3.66		
0, 0		3000	4.42		
-60, -10		2800	4.03		
-50, -10		2200	3.69		
20, 30	0-1	14100			

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location	Sample Depth (cm)	Tritium Value (pCi/L)	Uranium Value (µg/g)	^{238}Pu Value (pCi/g)	$^{239/240}Pu$ Value (pCi/g)
BKGD[a]		7200[a]	3.4[a]	0.005[a]	0.025[a]
20, 60		15000			
20, 40		5300			
-20, 40		6400			
-10, 20		3800			
20, 80	1-10	2800	3.70		
20, 60		3300	3.90		
20, 40		2400	3.89		
-20, 40		2400	4.05		
-10, 20		2000	4.05		
20, 80	10-30	3000	4.71		
20, 60		5800	3.95		
20, 40		3300	3.80		
-20, 40		3400	3.76		
-20, 20		3100	3.96		

[a]Upper background levels from Purtymun (1987).

TABLE 16.8-V. RADIONUCLIDE CONCENTRATIONS IN VEGETATION SAMPLES TAKEN FROM MDAA FROM THE SAMPLING GRID IN FIG. 16.8-2.

Sample Location BKGD[a]	Species	Tritium Value (pCi/L) 800[a]	Uranium Value (µg/g) 9.6[a]
-180, -40	Pinus Ponderosa	3800	9.890
-200, -40	Quercus Gambelii	2700	6.770
-60, -10	Medicago Sativa	2500	0.755
-50, -10	Chrysopsis Foliosa	2200	1.610
-50, -10	Pinus Ponderosa	3100	5.720
-40, -10	Gutierrezia Sarothrae	4000	3.740
-30, -10	Bromus Fectorum	5300	1.000
-30, -10	Artemisia Frigida	3000	4.950
-10, -10	Lactuca Spp.	3000	2.120
-60, 0	Medilolus Offician.	2700	0.930
-50, 0	Artemisia Frigida	3000	4.670
-50, 0	Artemisia Frigida	3400	4.910
-40, 0	Bromus Fectorum	1900	1.310
-29, 0	Artemisia Frigida	4200	6.840
-20, 0	Verbascum Thapsus	19000	4.560
-20, 0	Gutierrezia Sarathrae	17500	1.150
-10, 0	Verbascum Thapsus	2900	3.010
0, 0	Artemisia Frigida	2800	2.690
-40, 10	Artemisia Frigida	3100	2.740
-40, 0	Artemisia Frigida	3300	4.380
-20, 10	Verbascum thapsus	4000	4.090
-10, 10	Compositae	3400	2.320
0, 10	Gutierrezia Sarathrae	6100	1.050
10, 10	Poa Fendleriana	1400	1.260
-40, 20	Bromus Fectorum	3200	0.450
-30, 20	Verbascum Thapsus	3700	4.730
-20, 20	Lactuca Spp.	4300	1.590
-10, 20	Lactuca Spp.	6300	0.980
0, 20	Sitanion Hystrix	3300	2.340
0, 20	Lactuca Spp.	3700	0.880
20, 20	Verbascum Thapsus	6900	2.340

TABLE 16.8-V. RADIONUCLIDE CONCENTRATIONS IN VEGETATION SAMPLES TAKEN FROM MDAA FROM THE SAMPLING GRID IN FIG. 16.8-2.

Sample Location	Species	Tritium Value (pCi/L)	Uranium Value (µg/g)
BKGD[a]		800[a]	9.6[a]
20, 60	Lactuca Spp.	43000	1.090
20, 80		28000	0.550

[a]Upper background levels from the Environmental Surveillance Group (1987).

Table 16.8-VI
Plutonium concentrations in auger samples collected on the perimeter of the General's Tanks in 1983 at MDA A.

Sample Location Bkgd.[a]	Sample Depth (ft)	^{238}Pu (pCi/g) .005[a]	$^{239/240}Pu$ (pCi/g) .025[a]
Hole-1	0-3	0.0100	0.4200
"	6-9	-0.0004	0.0013
"	12-15	0.0003	0.0380
"	15-18	0.0009	0.0050
"	18-21	0.0008	0.1340
Hole-2	0-3	0.0400	6.8000
"	6-9	0.0007	0.0380
"	12-15	0.0003	0.0140
"	18-21	-0.0012	0.0016
"	21-24	0.0003	0.0140
"	24-27	-0.0004	0.0200
"	27-30	0.0011	0.0120
Hole-3	0-3	0.0240	2.5100
"	6-9	0.0008	0.0510
"	12-15	0.0004	0.0270
"	15-18	0.0015	0.0900
"	21-24	0.0008	0.0210
"	24-27	0.0004	0.0450
"	27-30	0.0310	0.0100
Hole-4	0-3	0.0036	5.7000
"	6-9	-0.0006	0.0850
"	12-15	0.0019	0.0007
"	15-18	0.0003	0.0039
"	21-24	-0.0007	0.0021
"	24-27	0.0005	0.0032
"	27-30	0.0025	0.0070
Hole-5	0-3	0.0060	0.4000
"	6-9	0.0009	0.0060
"	12-15	-0.0008	0.0010
"	15-18	-0.0007	0.0007
"	18-21	0.0012	-0.0008
"	21-24	-0.0004	-0.0016
"	24-27	0.0003	0.0062
"	27-30	0.0004	0.0011
Hole-6	0.5-3	-0.0005	0.1720
"	6-9	0.0003	0.0015
"	12-15	0.0002	0.0015
"	15-18	0.0002	0.0044
"	18-21	0.0004	0.0018
"	21-24	0.0007	0.0280
"	24-27	-0.0004	0.0027
"	27-30	0.0015	0.0007

[a]Upper background levels from Purtymun (1987).

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