RFI Work Plan for Operable Unit 1147

Environmental Restoration Program

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A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

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EXECUTIVE SUMMARY

Purpose of the Work Plan

The Technical Area 50 (TA-50) work plan, as part of the Los Alamos National Laboratory's Environmental Restoration (ER) Program, is designed to

1. Satisfy the regulatory requirements of the Hazardous and Solid Waste Amendment (HSWA) Module, Module VIII of the Laboratory's Resource Conservation and Recovery Act (RCRA) Part B operating permit, and

2. Serve as the field characterization plan for personnel who will implement the RCRA Field Investigation (RFI). The results of the RFI will be the basis for deciding whether a Corrective Measures Study (CMS) is needed.

The HSWA Module, issued by the Environmental Protection Agency (EPA), prescribes the corrective action program to be followed by the Department of Energy (DOE). The Laboratory's ER program is consistent not only with those requirements but also with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The TA-50 RFI work plan is designed to fulfill the requirements of Module VIII by addressing a certain percentage of the Laboratory's solid waste management units (SWMUs; i.e., potential release sites). The work plan is to be submitted to the EPA and the New Mexico Environment Department (NMED) by May 23, 1992. The TA-50 work plan thus contributes to the Laboratory's commitment to address cumulative totals of 35% of Table A SWMUs and 55% of Table B SWMUs by May 1992, as required by the HSWA Module. It addresses 11 of the 603 SWMUs listed in the HSWA Module as well as 15 that were added by the Laboratory's ER Program.

Conformance with Installation Work Plan

The HSWA Module requires that an installation-wide work plan be prepared to describe the system for accomplishing all RFI/CMS work at the Laboratory. This requirement is satisfied by the Installation Work Plan (IWP), originally submitted to the EPA on November 19, 1990 and updated annually. The IWP presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module, describes the Laboratory's SWMUs, and outlines their aggregation into 24 Operable Units (OUs).

All Laboratory work plans conform to the IWP, and IWP information relevant to a work plan is incorporated by reference. The TA-50 work plan is part of the second set of OU work plans required by the HSWA Module, as defined in the IWP.

Like the IWP, the TA-50 work plan addresses radioactive materials and other hazardous substances not subject to RCRA regulation. It is understood that those parts of the work plan are not enforceable under the RCRA Part B operating permit. However, the policy of the Laboratory and the DOE is to

include all hazardous materials in the RFI, whether or not they are regulated by statute.

Description and History of the TA-50 Operable Unit

Operable Unit 1147 makes up the north half of TA-50 (Fig. ES-1), located immediately northeast of the intersection of Pajarito Road and Pecos Drive, and occupies an area of about 21 acres, half (11.8 acres) associated with the Area C landfill and the rest (8.7 acres) with the waste treatment facilities. The site lies on the narrow mesa between Mortandad Canyon on the north and Two Mile Canyon on the south, at an elevation of about 7200 feet, in the transition zone between pinon-juniper woodland and ponderosa pine forest. The canyons are sharply incised and vary from a few feet deep to over 100 feet deep. The semiarid, temperate mountain climate brings an average of about 18 inches of precipitation per year, about one-third of that falling as snow. Drainage from TA-50 is to the east, into Ten Site Canyon, and runoff and erosion at the site can be large. The soils, consisting of loams and sandy loams, have been disturbed over most of the site by work-related activities. They are underlain by welded Bandelier Tuff and other volcanic strata, some 900 feet of unsaturated rock that separate the surface from the drinking water aquifer.

The fauna within the site are restricted to species able to survive among buildings, parking lots, and other such features. (The entire site is fenced, preventing access by larger species such as deer and elk.) The flora within the site are equally typical of disturbed environments, and most are the result of replanting. Current NEPA research has identified no critical species, habitats, or archaeological resources that will be adversely affected by this RFI.

The Laboratory's November 1990 SWMU report lists a total of 11 TA-50 SWMUs. These were subdivided into 26 units (Fig. ES-2), and all are addressed in the TA-50 work plan. (The SWMU report lists no areas of concern [AOCs] for TA-50, and the work plan proposes no additional SWMUs and no AOCs.) Twenty-three of the subunits are associated with the liquid waste treatment facility, two with the solid waste volume-reduction facilities, and one with the Area C landfill. Table B of the HSWA Module lists the spill area into Ten Site Canyon (50-006[a]), which resulted in soil surface contamination, and the Area C landfill (50-009) as priority sites.

The TA-50 work plan proposes three SWMUs for no further action (NFA): SWMU 50-009, listed as an underground fuel tank, is believed never to have existed; SWMUs 50-007(a) and (b), septic systems, are recent NPDES-permitted systems with no credible source of contamination.

Contaminants and Pathways of Concern

TA-50 includes facilities for the treatment and disposal of liquid and solid radioactive and mixed waste. Treatment facilities include the liquid waste treatment plant and associated waste transfer and storage systems, equipment decontamination areas, and an experimental solid waste volume-reduction facility that includes a mechanical volume-reduction complex and a controlled-air incinerator. Disposal facilities include a mixed waste landfill (Area C) and a

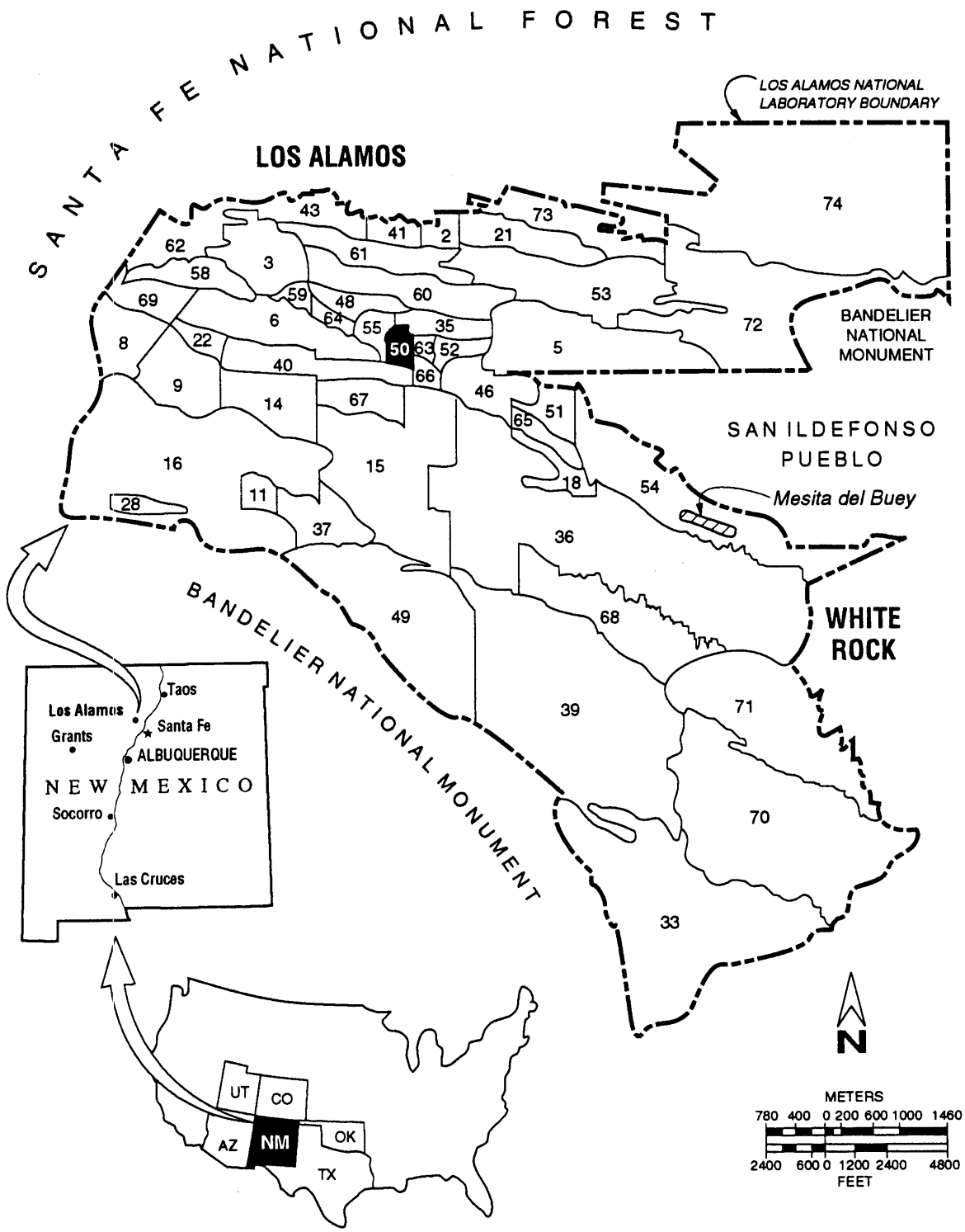


Figure ES-1 Location of TA-50 in relation to other Laboratory Technical Areas (TAs) and surrounding landholdings.

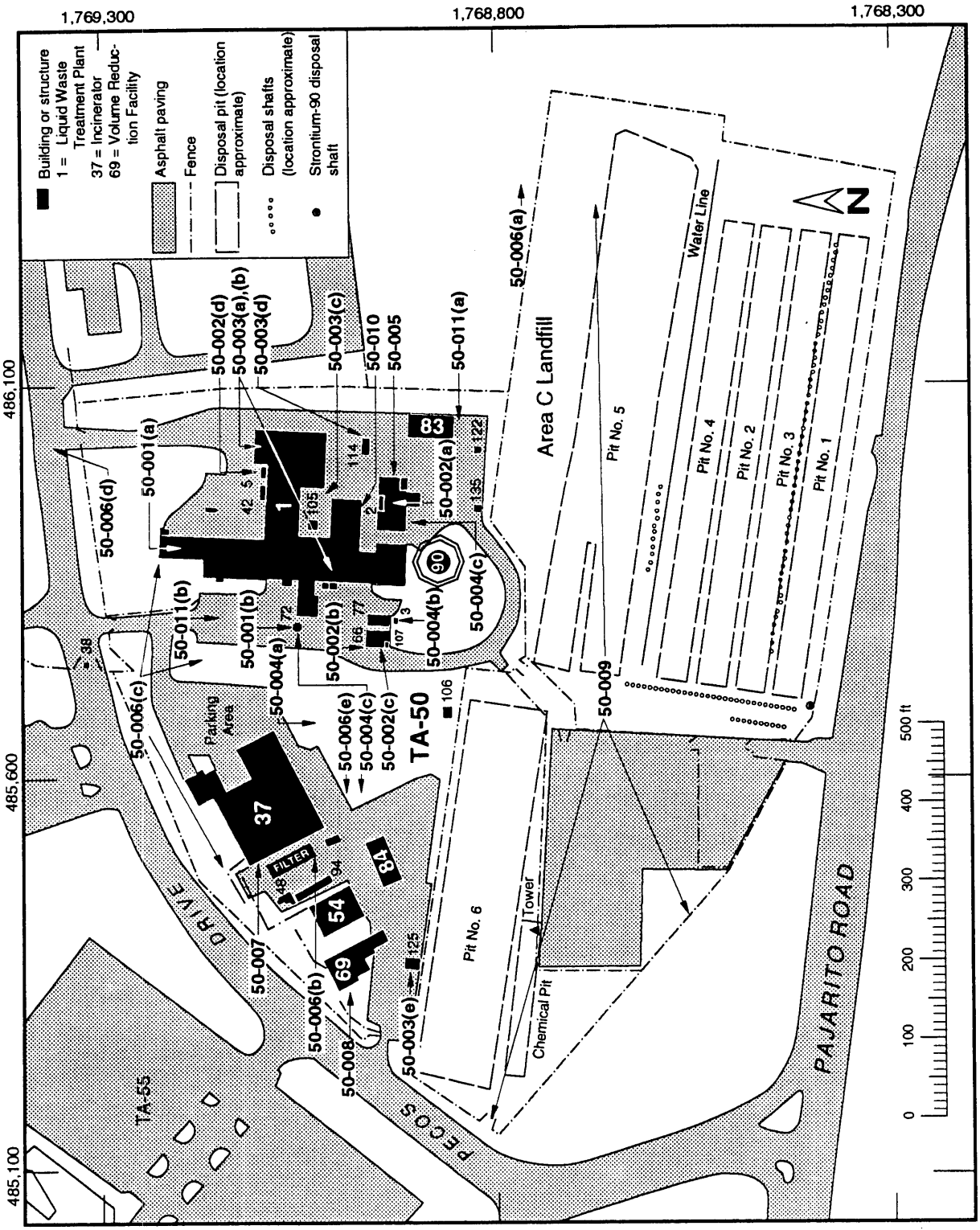


Figure ES-2 General location of SWMUs at OU 1147.

treated-liquid effluent outfall in Mortandad Canyon. Use of the treatment facilities at TA-50 began in 1963, and most of the facilities are still in use. The Area C landfill was used from 1948 until 1969, and was decommissioned in 1974. It consists of pits and shafts that received solid (and small amounts of liquid) radioactive and hazardous waste.

Because radioactive liquid waste comes into TA-50 from diverse operations (such as shops, chemistry laboratories, target preparation facilities, and plutonium fabrication, recovery, and research facilities), any spills or leaks could release solvents and other organics, heavy metals, low-pH liquids, and/or radionuclides. The pits and shafts of the Area C landfill, in which a wide variety of chemicals, metals, and radionuclides were disposed of, were unlined with the exception of a few shafts that were lined with concrete. To date, there is no evidence of major leaks in the waste transfer and storage system at the treatment facilities or of large-scale migration of contaminants from the Area C landfill.

Nearly all the existing data on contaminant concentrations from TA-50 environmental samples concern radionuclides; concentrations in surface soils average just slightly above background. These come primarily from stack releases from the liquid waste treatment plant. For a localized area around the head of Ten Site Canyon, however, the primary sources are spills from the liquid waste treatment plant and possible migration via erosion of surface contamination from Area C. In this area, concentrations in the 10s to 100s of pCi/g were recorded. Data on subsurface contamination comes largely from sampling done as a part of interim actions (replacement of drainlines or tanks, etc.). Some very localized subsurface contamination was found during excavations. Most of these sites were cleaned up to ALARA standards.

Although data on the concentrations of chemical contaminants are very limited, the nature of the R&D activities that generated the solid and liquid wastes sent to TA-50 lead to the conclusion that a variety of inorganic and organic materials are potential contaminants at the site.

Given the low probability of contaminant movement to groundwater at TA-50, erosion—driven by wind and water—is likely to be the dominant pathway for transport of contaminants to which workers and the public could become exposed. The primary human receptors are expected to be workers, both on the site and at adjacent technical areas. Visitors are much less likely to be exposed, given the current health and safety regulations governing visitors to technical areas such as TA-50. The public at large has an even lower probability of exposure, because TA-50 is located 3-4 km from White Rock and from Los Alamos, and the public is generally excluded from the site. Nonhuman receptors that will be subjected to continuous exposure to contaminants are native fauna and flora at the site.

Technical Approach

The DOE/UC approach and requirements for conducting the ER Program at Los Alamos are detailed in the IWP. That document also discusses the key concepts

that apply to RFI activities at all Los Alamos OUs, including the observational approach to reduce costs, sequential sampling within a decision analysis framework to focus effort (and thereby reduce cost), end-point criteria such as action levels and risk assessments, and compliance with DOE Orders, CERCLA, NEPA, and the RCRA permit.

The underlying assumption used in developing the TA-50 work plan is that the site will remain under institutional control for the foreseeable future, which would rule out any significant potential for exposure of persons other than site workers. Risk-based criteria, including action levels for hazardous contaminants and dose levels for radionuclides, will be used to evaluate remediation alternatives for the site.

Investigative Strategy

The large number of SWMU subunits (25 of the 26) associated with the ongoing liquid and solid waste treatment activities (and particularly with the active and decommissioned underground waste transfer and storage systems) makes it logical to structure the field investigations to deal with these SWMUs/subunits as one entity and with the remaining SWMU (the Area C landfill) as a second entity. Each will have its own surface and subsurface sampling plan. (The treatment facility SWMUs will also be grouped into several aggregates, based primarily on physical location, to simplify the investigations.)

The initial phase of the field investigations will be largely confined to TA-50 proper. The main reason for this focus is that sampling already done or proposed as a part of current work plans at adjacent OUs (Canyon Studies, TA-35), analysis of multiple sources of airborne radionuclides in the TA-50 area (e.g. TA-35), and ongoing environmental surveillance activities by the Laboratory's Environmental Protection Group show that radionuclide concentrations in the area surrounding TA-50 are well within DOE guidelines. If these initial field investigations find little or no evidence of contaminant migration from SWMUs associated with ongoing operations, further characterization will be delayed until facility decommissioning. However, if significant migration plumes (other than the permitted releases) are detected, sampling may be extended beyond the site boundaries.

The Laboratory's Waste Management Group (EM-7) has an ongoing program to upgrade the liquid waste treatment facilities at TA-50, including removal of several of the SWMUs. In addition, line-item funding is being sought for 1995, to replace TA-50. This plan plays an important role in the RFI sampling strategy, which calls for a single sampling phase for SWMUs associated with the liquid waste treatment plant at TA-50. As monitoring data from interim actions at the site become available, they can be incorporated into the RFI data base and/or used to confirm RFI results.

During the Phase 1 investigation, 4431 linear feet of drilling will be done, and 1971 samples will be taken as a basis for characterizing contaminant distribution around and beneath TA-50. An additional 255 samples will be taken for quality assurance and control. A total of 2196 soil and rock samples will be analyzed for both radionuclides and nonradionuclides. Phase 2 investigations are estimated

to potentially require about 1420 feet of drilling and 761 samples, plus 158 quality assurance/control samples.

Analytical Strategy

Localized radiological contaminants are considered to be the most significant potential source of contamination at TA-50, and thus are the primary focus of SWMU-specific investigations. Other contaminants are known or suspected to exist at TA-50 only in very limited quantities and generally in association with the primary contaminants. Sampling plans take these factors into account.

Field radiological screening will be used to identify samples and areas of gross contamination. A mobile field laboratory will be used for the rapid, on-site quantitative analyses needed to guide field operations and to minimize the number of samples that must be sent off site for more expensive analyses. Off-site laboratories will be used, as appropriate, to provide high-quality analytical data and to verify field screening and field survey results.

The primary TA-50 indicator analytes are:

- gross alpha, beta, and gamma emitters,
- total uranium,
- isotopic plutonium,
- americium-241,
- cesium-137, and
- RCRA-regulated metals (notably, lead and beryllium).

We recommend that subsurface samples be analyzed for potential minor contaminants, such as volatile and semivolatile organic compounds (VOCS and SVOCs).

Scope, Schedule, and Funding

The field investigations described are expected to require about 5 years (FY93-FY98) to complete, depending on the availability of funding. For most SWMUs, the RFI should be complete after Phase 1 investigations (about 3 years), but for some, the Phase 1 results may signal the need for a second phase. A summary of the scope of the investigations and the projected budget is given in Table ES-1. Table ES-2 summarizes the schedule for carrying out the field investigations and issuing reports.

Reports

Because the TA-50 RFI is scheduled to take about 5 years, the Laboratory is proposing to submit Phase Reports to EPA as work progresses. As needed, these reports can be used to revise the sampling plans. Phase 1 reports would also serve as input to Phase 2 work plans.

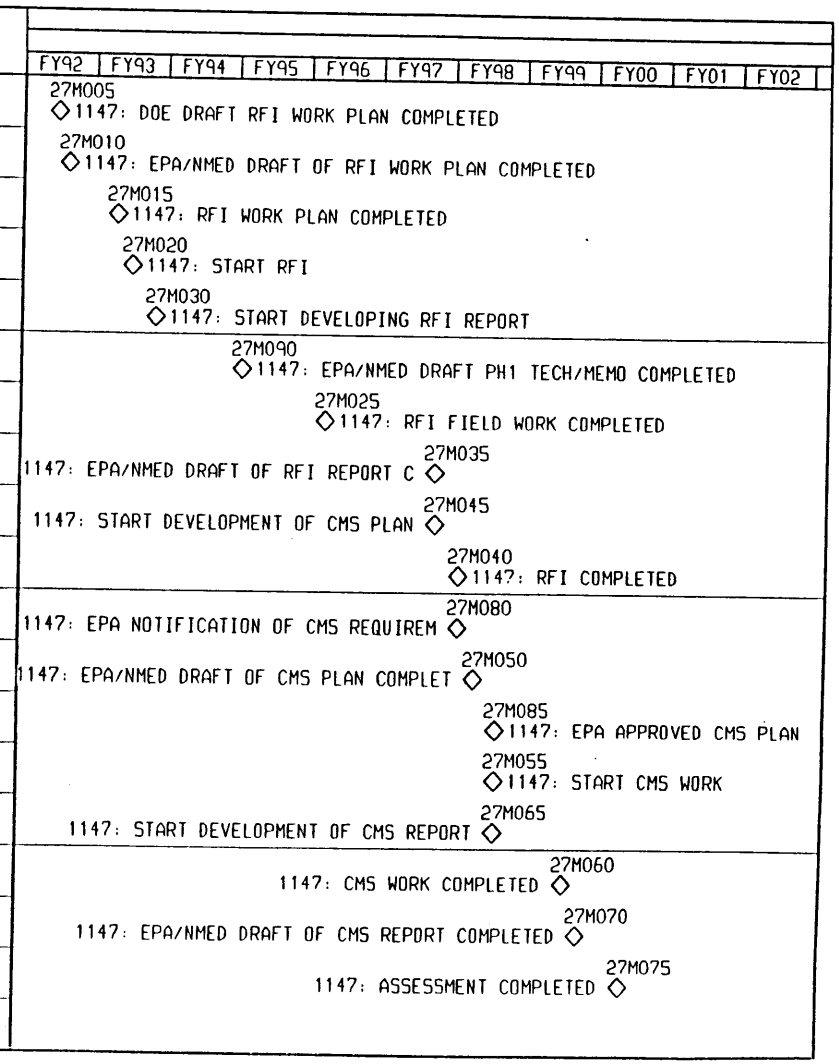
TABLE ES-1
SUMMARY OF RFI SCOPE AND BUDGET

	DUR	%	SUMMARY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
1	379	0	ASSESSMENT - RFI WORK PLAN	515118.58	.00	1OCT91	12APR93
2	675	0	ASSESSMENT - RFI	12518288.12	.00	13APR93	28DEC95
3	1522	0	ASSESSMENT - RFI REPORT	866935.92	.00	1OCT91	11NOV97
4	663	0	ASSESSMENT - CMS PLAN	46369.11	.00	14JUL97	14MAR00
5	245	0	ASSESSMENT - CMS	584779.00	.00	27MAY98	19MAY99
6	569	0	ASSESSMENT - CMS REPORT	143219.92	.00	12NOV97	29FEB00
7	2240	0	ASSESSMENT - ADS MANAGEMENT	1725332.56	.00	1OCT91	28SEP00
8	796	0	ASSESSMENT - VCA	99227.00	.00	2JAN97	14MAR00
REPORT TOTAL				16499270.21	.00		

	$ X 1000
EST TO COMPLETION	$16,499
ESCALATION	$156
PRIOR YEARS	$570
TOTAL AT COMPLETION	$17,225

TABLE ES-2
RFI SCHEDULE

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
27M005	1147: DOE DRAFT RFI WORK PLAN COMPLETED		24MAR92
27M010	1147: EPA/NMED DRAFT OF RFI WORK PLAN COMPLETED		18MAY92
27M015	1147: RFI WORK PLAN COMPLETED		22JAN93
27M020	1147: START RFI	13APR93	
27M030	1147: START DEVELOPING RFI REPORT	12AUG93	
27M090	1147: EPA/NMED DRAFT PH1 TECH/MEMO COMPLETED		31OCT94
27M025	1147: RFI FIELD WORK COMPLETED		28DEC95
27M035	1147: EPA/NMED DRAFT OF RFI REPORT COMPLETED		11JUL97
27M045	1147: START DEVELOPMENT OF CMS PLAN	14JUL97	
27M040	1147: RFI COMPLETED		11NOV97
27M080	1147: EPA NOTIFICATION OF CMS REQUIREMENTS		11NOV97
27M050	1147: EPA/NMED DRAFT OF CMS PLAN COMPLETED		2FEB98
27M085	1147: EPA APPROVED CMS PLAN		26MAY98
27M055	1147: START CMS WORK	27MAY98	
27M065	1147: START DEVELOPMENT OF CMS REPORT	27MAY98	
27M060	1147: CMS WORK COMPLETED		19MAY99
27M070	1147: EPA/NMED DRAFT OF CMS REPORT COMPLETED		3AUG99
27M075	1147: ASSESSMENT COMPLETED		14MAR00



The HSWA Module specifies the submission of periodic reports, including monthly programmatic status reports and quarterly technical progress reports. At the conclusion of the RFI, a comprehensive report will be prepared.

Reports generated during the TA-50 RFI and the final report will be made available to the public at the ER Community Reading Room in Los Alamos, New Mexico. The Reading Room is open from 9 a.m. to 4 p.m. on Laboratory business days.

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ACRONYMS AND ABBREVIATIONS USED IN THE TA-50 OU RFI WORK PLAN

ADS	Activity data sheet
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
AOC	Area of concern
ARAR	Applicable or relevant and appropriate requirements
ASTM	American Society of Testing Materials
AT	Accelerator Technology Division
BNM	Bandelier National Monument
CA	Corrective activities
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	Curie
CLP	Contract Laboratory Program
CMP	Corrugated metal pipe
CMS	Corrective measures study
COLIWASA	Composite Liquid Waste Sampler
CY	Calendar Year
D&D	Decontamination and decommissioning
DCG	DOE-derived concentration guide
DOE/AL	US Department of Energy Albuquerque Operations Office
DOE/HQ	US Department of Energy Headquarters
DOE/LAAO	US Department of Energy Los Alamos Area Office
DOT	Department of Transportation
DQO	Data quality objectives
EA	Environmental assessment
EES-1	Geology and Geochemistry Group
EIS	Environmental impact statement
EM	Environmental Management (Division)
EP toxicity	Extraction Procedure Toxicity
EPA	US Environmental Protection Agency
ER	Environmental restoration
ES&H	Environment, safety, and health
ESG	Environmental Surveillance Group
FID	Flame ionization detector
FIDLER	Field Instrument for Detection of Low Energy Radiation
FIMAD	Facility for Information Management, Analysis, and Display
FSP	Field Sampling Plan
FY	Fiscal year
FYP	Five Year Plan
gal	Gallon

GIS	Geographical information system
GM	Geiger-Mueller
H&S	Health and Safety
HDT	Hazardous Devices Team
HE	High explosive
HPIC	High pressure ion chamber
HS	Health and Safety (Division)
EM-7	Waste Management Group
EM-8	Environmental Surveillance Group
EM-9	Health & Environmental Chemistry Group
EM-13	Environmental Restoration Group
Ft	Foot
HSWA	Hazardous and Solid Waste Amendments
ICP-MS	Inductively Coupled Plasma-Mass Spectroscopy
In	Inch
INC	Isotope and Nuclear Chemistry (Division)
INC-4	Isotope and Structural Chemistry Group
IRM	Interim remedial measure
IWP	Installation work Plan
J	Field Testing (Division)
Kd	Distribution coefficient
Kg	Kilogram
LANL	Los Alamos National Laboratory; the Laboratory
LAMPF	Los Alamos Meson Physics Facility
LASL	Los Alamos Scientific Laboratory (LANL before 1979)
M	Dynamic Testing (Division)
MCL	Maximum concentration level
MDA	Material Disposal Area
MDL	Minimum detection limit
Mi	Mile
MST-3	Tritium Science and Technology Group
NaI detector	Sodium Iodide detector
NEPA	National Environmental Policy Act
NFA	No further action
NIST	National Institute of Standards and Technology
NMEID	New Mexico Environmental Improvement Division
NPDES	National Pollutant Discharge Elimination system
OM	Operational Management
OS	Operational Security and Safeguards
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PL	Project leader
PM	Program Manger (ER)
PMP	Program Management Plan
QAPjP	Quality assurance project plan
QA	Quality assurance
QP	Quality administrative procedure

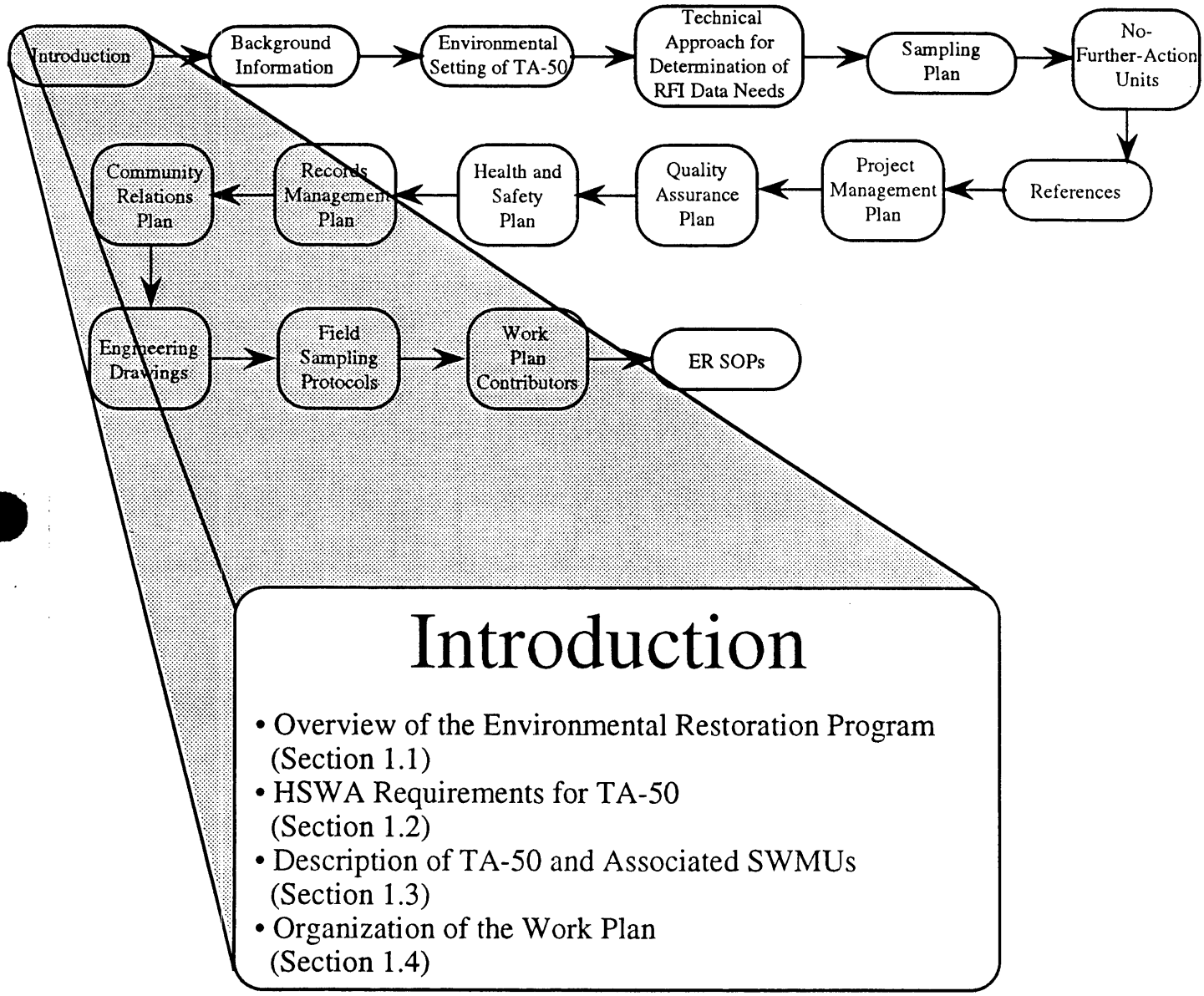
QPP	Quality Program Plan
QPPL	Quality Program Project Leader
RA	Remedial action
Rd	Retardation factor
RD	Remedial design
RFA	RCRA facility assessment
RCRA	Resource Conservation and Recovery
RFI	RCRA facility investigation
RI	Remedial investigation
RMP	Records management plan
RPF	Records Processing Facility
RWS	Raw waste storage
SARA	Superfund Amendment Reauthorization Act
SOP	Standard operating procedure
SSP	Site-specific plan
STP	Sewage Treatment Plant
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TA	Technical area
TAL	Target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TLD	Thermoluminescent dosimeter
TLV	Threshold limit value
TRU	Transuranic (waste)
UC	University of California
USC	United States Code
USGS	US Geological Survey
UST	Underground storage tanks
VCA	Voluntary Correction Action
VCP	Vitrified clay pipe
VOA	Volatile organic analyses
VOC	Volatile organic compound
WBS	Work Breakdown Structure
WIN	Waste Information Network
µCi	Microcurie

RADIONUCLIDES* AND METALS

^{241}Am	Americium-241
^{137}Cs	Cesium-137
^{239}Pu, ^{240}Pu, ^{241}Pu	Plutonium-239, 240, 241
^{90}Sr	Strontium-90
^{3}H	Tritium
^{235}U,^{238}U	Uranium-235, 238
Pb	Lead
Be	Beryllium

*Numbers refer to specific isotopes of radionuclides.

CHAPTER 1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• Description of TA-50 and Associated SWMUs (Section 1.3)
• Organization of the Work Plan (Section 1.4)

1.0 INTRODUCTION

1.1 Overview of the Environmental Restoration Program

In March 1987, the Department of Energy (DOE) established an Environmental Restoration (ER) Program to address environmental cleanup requirements at all of its facilities. Los Alamos National Laboratory (the Laboratory) is operated for the DOE by the University of California (UC) and is subject to the requirements of DOE's ER Program. These requirements are set forth in the Resource Conservation and Recovery Act (RCRA), particularly in Module VIII, the Hazardous and Solid Waste Amendments (HSWA) Module. This module, issued by the Environmental Protection Agency (EPA) (EPA 1990, 0306), gives specific requirements for the conduct of the ER Program and became effective at Los Alamos on May 23, 1990.

The HSWA Module requires the Laboratory to prepare an installation-wide plan on how DOE/UC will conduct the ER Program at the Laboratory, including the format for the RCRA Facilities Investigation (RFI) work plan. The Laboratory's Installation Work Plan (IWP) was first submitted to the EPA on November 19, 1990 (LANL 1990, 0144) and is updated annually. It contains installation-wide descriptions of current conditions, identifies the Laboratory's solid waste management units (SWMUs) and their aggregation into a number of operable units (OUs), and presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module.

Tables A and B of the HSWA Module were developed by EPA on the basis of the SWMU Report prepared in 1988 (International Technology Corporation 1988, 0329). Subsequent investigations by Los Alamos culminated in a revised SWMU Report, submitted to EPA in November 1990 (LANL 1990, 0145). As discussed in Section 3.4.2 of the IWP, no sites were eliminated in the revised report, but some were added and some were combined. The Laboratory's current SWMU list for all OUs is presented in Appendix G of the IWP (LANL 1990, 0144; 1991, 0553).

The HSWA Module also requires the Laboratory to prepare work plans for specific investigations at each OU. The Technical Area 50 (TA-50) work plan is one of 24 such plans that will be prepared. Within the ER Program, the TA-50 assessment task has the identifying numbers OU AL-LA-5, Activity Data Sheet (ADS) 1147. Additional information regarding the ER program and its implementation, as well as guidelines for preparation of specific work plans, are given in Section 3 of the IWP (LANL 1990, 0144; 1991, 0553).

1.2 HWSA Requirements for TA-50

The purpose of this work plan is twofold: (1) to satisfy the regulatory requirements of the HSWA Module with regard to TA-50 and (2) to serve as the implementation plan for personnel who will carry out the RFI field sampling. Its specific objective is to gather sufficient information for answering the following questions:

1. What contaminants are present at TA-50 and how are they distributed (vertically and laterally)?

2. How, at what rates, and to what locations are the contaminants being transported?

3. What are the consequences of, or risks associated with, contaminant transport out of TA-50?

4. What remediation alternative(s) are appropriate for TA-50?

The work plan will describe the process for collecting the necessary information. It seeks to strike a rational balance between technical data needs, regulatory requirements, and costs.

Table 1-1 presents both the original HSWA list of SWMUs for TA-50 and the current list, which includes those added in the November 1990 revised report. Several SWMU subunits are recommended for deletion from Table 1-1 on the basis of guidelines presented in Section 3.5 of the IWP. (A HSWA Module Class III permit modification can be proposed to remove SWMUs if existing information suggests that no further investigation is warranted.) Currently, seven SWMU subunits fall into that category. These are listed in Table 1-2, along with the reasons for excluding them from further consideration. Additional details on these subunits are presented in Chapter 6.

TABLE 1-1
EVOLUTION OF THE TA-50 SWMU LIST

Original SWMUs in RCRA Permit	Combined SWMUs	New Number (Renumbered SWMUs)	Added SWMUs	Current SWMU List
50-001		50-001(a)	50-001(b)	50-001(a,b)
50-002(a-d)				50-002(a-d)
			50-003(a-e)	50-003(a-e)
50-004		50-004(a)	50-004(b,c)	50-004(a-c)
			50-005	50-005
50-006		50-006(a)	50-006(b-e)	50-006(a-e)
			50-007	50-007
			50-008	50-008
50-009				50-009
			50-010	50-010
50-011(a-c)	50-011(a-c)	50-011(a)	50-011(b)	50-011(a,b)

1.3 Description of TA-50 and Associated SWMUs

TA-50 (Fig. 1-1) is located immediately northeast of the intersection of Pajarito Road and Pecos Drive and occupies an area of about 21 acres, half (11.8 acres) associated with the Area C landfill and the rest (8.7 acres) with the waste treatment facilities (Fig. 1-2). This area includes facilities for both treatment and disposal of liquid and solid radioactive and mixed waste. Treatment facilities include the liquid waste treatment plant and associated waste transfer and storage systems, equipment decontamination areas, and experimental solid waste volume-reduction facilities, including a mechanical size-reduction complex and a controlled-air incinerator.

Disposal facilities include a mixed-waste landfill (Area C) and a treated-liquid effluent outfall in Mortandad Canyon. Use of the treatment facilities at TA-50 began in 1963, and most of the facilities are still in use. The Area C landfill was used from 1948 until decommissioning in 1974 and consists of several pits and shafts that received solid (and small amounts of liquid) radioactive and hazardous waste.

Twenty-six potentially contaminated areas (Table A of the HSWA Module lists 11) were identified at TA-50 for further characterization as part of the ER Program (see Fig. 1-2 for locations). Twenty-three of these were associated with the liquid waste treatment facility, two with the solid waste volume reduction facilities, and one with the Area C landfill. Two of the SWMUs are listed as priority sites in Table B of the HSWA Module: the spill area into Ten Site Canyon (50-006 [a]) that resulted in soil surface contamination and the Area C landfill (50-009).

A detailed list of the various structures included in each SWMU at TA-50 is presented in Table 1-3.

1.4 Organization of the Work Plan

The DOE/UC framework for the conduct of the ER Program at Los Alamos is detailed in the IWP (LANL 1991, 0553). The relationships between the requirements of the RCRA Permit , the IWP, and the RFI work plan for TA-50 are presented in Table 1-4.

A detailed discussion of the approach and requirements for conducting ER activities at the various OUs is presented in the IWP (LANL 1991, 0553). That discussion covers the key concepts that apply to RFI activities at all Los Alamos OUs, including the observational approach to reduce costs, sequential sampling within a decision analysis framework to focus effort (and thereby reduce cost), end-point criteria such as action levels and risk assessments, and compliance with DOE Orders, CERCLA, NEPA, and the RCRA permit.

Initial field sampling for the TA-50 RFI will be largely confined to the site proper. The main reason for this focus is that sampling already done in adjacent areas (Canyon Studies, TA-35), analysis of multiple sources of airborne radionuclides

TABLE 1-2

TA-50 SWMUS PROPOSED AS NO-FURTHER-ACTION UNITS

SWMU Number	Basis For Proposal
50-005	The double-containment system of Kynar within stainless steel in the tanks and piping, plus the concrete berm underneath the plant, provide triple-containment redundancy, rendering the probability very low that a leak could develop and transport contaminants out of the SWMU. Releases from this site, which would be readily visible, have never been observed.
50-006(b)	The SWMU no longer exists. On September 18, 1990, a small-job ticket was issued to wash down the area around the radiator with a degreaser. The area was washed with a detergent, then the soapy liquid was picked up with a vacuum cleaner and disposed of in the acid waste drain in Building 37. The radiator, mineral oil fluid coupling, concrete foundation, and asphalt pad are scheduled for removal in the near future. The area will then be patched with new asphaltic concrete paving material. A new, direct-drive motor will be installed to power the blower.
50-006(e)	This SWMU no longer exists. On May 15, 1990, work order 6-5737-17 was issued to Pam Am to remove both the diesel fuel tank and the supply and return lines (up to the concrete approach ramp to the door at the southwest corner of the incinerator building). The fuel tank was removed, steam-cleaned, and sent to salvage. The tank's foundations were removed, and the supply and return lines were dug up and capped near their entrance to the building.
50-003(e)	No evidence of this SWMU could be found. Visual inspection of the site could find no evidence of the drums nor any indication of a spill in the area. The building engineer for TA-50-69 had no knowledge of these drums ever being present. It is possible that the drums identified in the SWMU Report were empties awaiting use in the volume reduction facility.

TABLE 1-2 (cont'd)

SWMU Number	Basis For Proposal
50-003(b)	This SWMU is a storage cabinet in Room 130 of TA-50-1 (first floor, southeast corner of the building). Mixed waste generated in Building TA-50-1 is brought to Room 130 in small (quart- to gallon-sized) bottles. These bottles are periodically picked up and stored at TA-54. Bottled waste is stored in double (encased) containers, and the cabinet is checked daily during working hours. Releases from this SWMU, which would be readily visible, have never been observed.
50-003(c)	SWMU 50-003(c) is a temporary, less-than-90-day storage area located on the asphalt paving immediately south of the tank farm. Chemical wastes are stored here, until they are emptied into the tank farm, in the 200- to 300-gal. "Tuff Tanks" in which they are hauled by truck from other technical areas. (These polyethylene tanks are enclosed in heavy-gauge steel and expanded metal cages.) This temporary storage site is inspected weekly for leaks. Another storage area listed as part of SWMU 50-003(c) is located between the north wall of the Vehicle Decontamination Facility and the south wall of the east wing of Building 1. This is a temporary storage area, completely paved with asphaltic concrete, used to store mixed waste generated from the treatment of industrial wastes from many technical areas. No TRU waste is stored at this site. The waste is processed in Building 1—first mixed with calcium hydroxide and ferric sulfate, then dewatered by a vacuum and filtering process until it is in the form of filter cake. About 30% solids and 70% water, the cake has the consistency of a damp clay. The filter cake is packed into 55-gal. drums, stored temporarily on site and then hauled to TA-54 for landfill disposal. There have been no documented releases from this SWMU. The area is monitored periodically for contamination on the storage pad, and the drums checked for any signs of leakage before they are moved onto the pad.

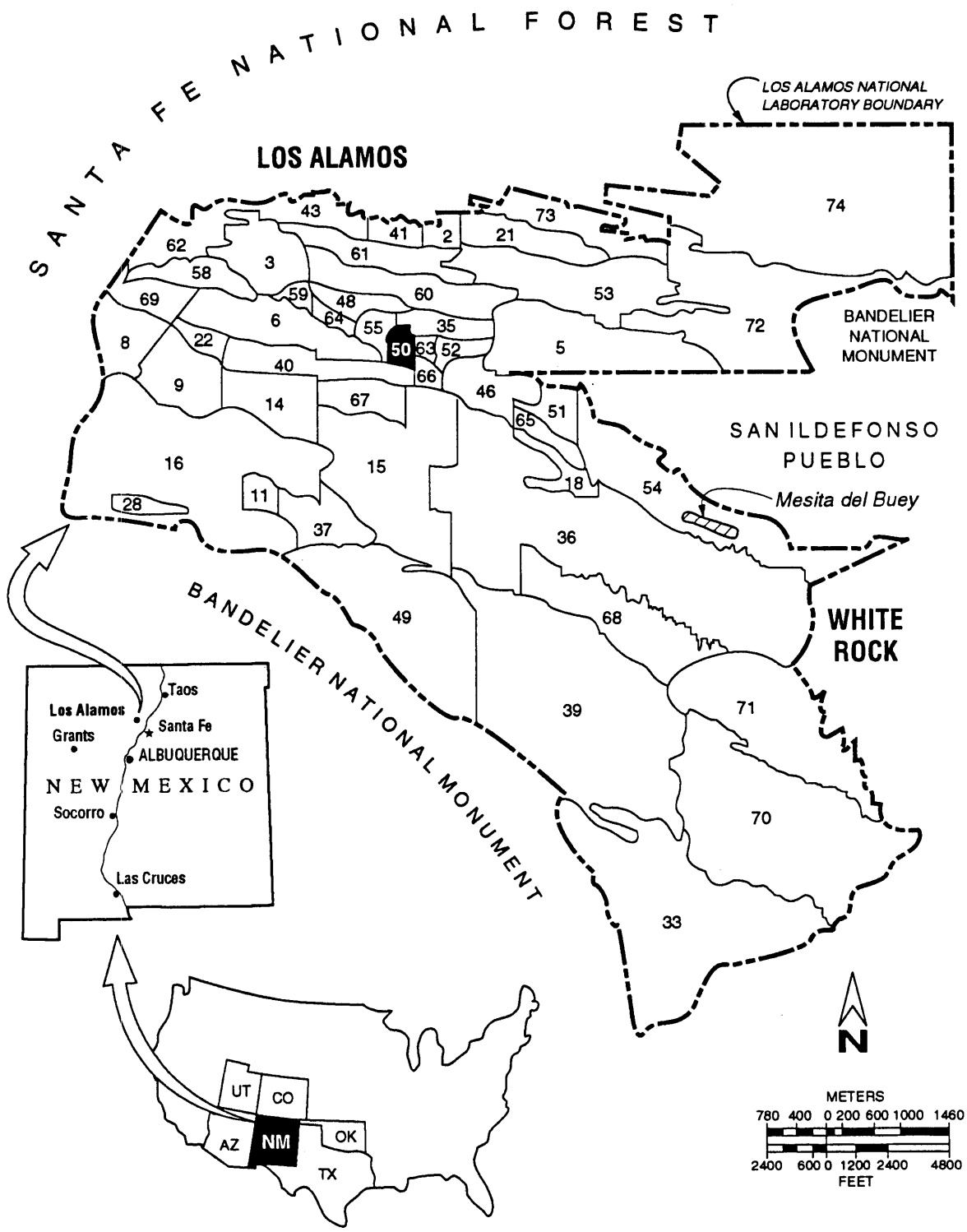


Figure 1-1 Location of TA-50 in relation to other Laboratory Technical Areas (TAs) and surrounding landholdings.

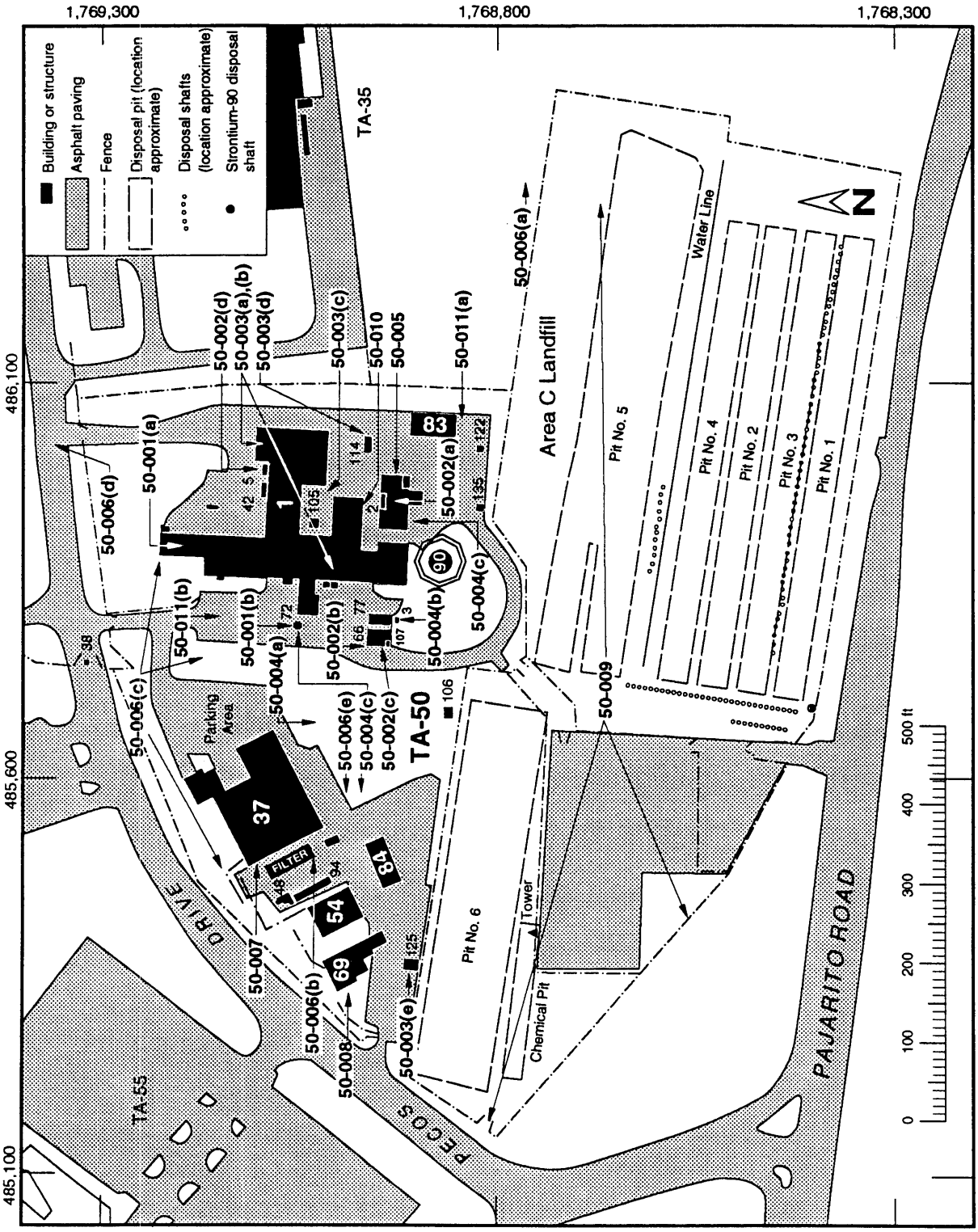


Figure 1-2 General location of SWMUs at OU 1147.

TABLE 1-3

STRUCTURES WITHIN SWMUS AT TA-50

RADIOACTIVE WASTE TREATMENT PLANT

50-001(a)—Liquid radioactive waste treatment facilities include

- wiped film evaporator (Room 71)
- clariflocculators (Room 116)
- pH adjustment tank (Room 16)
- evaporator storage tank (Room 70A)
- decant storage tank (Room 61)
- rotary drum vacuum filter (Room 116B)
- gravity filtration devices (Room 116)
- 100,000-gal. emergency holding tank (TA-50-90)
- waste mixers (Room 116)
- drum tumbler operation (Room 60A)

50-001(b)— Drain lines that transport liquid waste to the liquid waste treatment facility include

- collector manhole TA-50-72 to grit chamber in TA-50-1
- TA-50-69 and TA-50-37 to Bldg 1, via manhole TA-50-72
- TA-3, -35, and -48, via manhole TA-50-72
- manhole TA-50-7
- TA-55 to tank vault TA-50-66, via monitor pit TA-50-106
- manhole TA-50-72
- TA-50-66 to Bldg 1, Room 60A
- TA-50-66 to manhole TA-50-72

TANKS AND DRAINLINES

50-002(a)—Tank farm (TA-50-2) includes

- Six tanks
  - Two for incoming waste
  - One for sludge
  - Two for treated waste storage
  - One for storage of D&D liquid waste
- Thirteen lines
  - Six cast-iron transfer lines
  - Four steel lines from Room 61, Bldg 1
  - Three cast-iron lines from drains in Bldg 1

50-002(b)— Tank TA-50-67 in underground vault (TA-50-66) for caustic waste from TA-55.

50-002(c)— Tank TA-50-68 in underground vault (TA-50-66) for acidic waste from TA-55.

TABLE 1-3 (cont'd)

50-002(d)—Aboveground storage tank (TA-50-5) adjacent to north wall of Bldg 1

WASTE STORAGE AREA

50-003(a)—Primary drum storage area in Room 60D, Bldg 1

50-003(b)—Satellite storage area in Room 130, Bldg 1, for laboratory samples

50-003(c)—Temporary (<90 days) storage area at TA-50-1. Uses polyethylene carboys and 55-gal. drums

50-003(d)—Modular storage shed (TA-50-114) for containers in 50-003(c)

50003(e) — Four barrels under tarp near TA-50-125

DECOMMISSIONED TANKS AND DRAINLINES

50-004(a)— 520 ft of radioactive waste line from Building 1 west under incinerator building. Removed in 1975. Known to have leaked.

50-004(b)— Concrete vault and underground tanks from the TA-50-3 tank farm. Removed in 1989. Soil beneath vault contained background levels of radionuclides.

50-004(c)— Drainlines and associated manholes. Sixteen such structures were removed between 1981 and 1989.

NONRADIOACTIVE LIQUID WASTE TREATMENT PLANT

50-005 — Treatment system located in Room 24 of Building 1, for treating cyanide, chrome-plating solutions (copper and lead), acids, bases, and heavy metals. Mercury reclamation is also done on intermittent basis in Room 34.

OPERATIONAL RELEASES

50-006(a)— Upper Ten Site Canyon contaminated from radioactive industrial waste sump overflow at TA-50-2.

50-006(b)— Stained soil beneath active radiator on the west wall of TA-50-37 (incinerator).

50-006(c)— Airborne releases from liquid waste treatment plant.

50-006(d)— Treated liquid effluent from TA-50-1 into Mortandad Canyon (NPDES permitted). Monitored on a routine basis.

TABLE 1-3 (cont'd)

50-006(e)— Soil around diesel fuel tank (aboveground) at the incinerator complex (TA-50-37). Tank and lines removed in May 1990.

50-007 — Incinerator complex for combusting both solids and liquids containing radionuclides and organics. Many release controls on the facility. Liquid effluent from offgas treatment system goes to TA-50-1. Exhaust air passes through HEPA system. Only treated air is released; the rest goes either to the Treatment Plant or to Area L/Area G.

VOLUME REDUCTION FACILITY

50-008 — Facility in TA-50-69 to reduce volume and package metallic waste containing TRU. Liquids go to TA-50-1; air emissions are monitored.

AREA C LANDFILL

50-009 — The Area C landfill received radioactive and mixed waste from 1948 to 1974. It contains about 3.65 x 10^6 ft^3 of waste in 11.8 acres, in both pits and shafts (including a chemical waste disposal pit). Waste includes radionuclides, metals, hazardous materials, liquids, solids, and gases.

RADIOACTIVE DECONTAMINATION FACILITY

50-010 — The decontamination facility is on the south end of Building 1 and is used to clean radioactive contamination from vehicles and other objects. Liquids go to the tank farm (TA-50-2) via drain and line; solid wastes go to Area G at TA-54 (see Fig. 1-1) for storage (TRU) or burial (LLW). Wastes are primarily radionuclides.

SANITARY SEWER SYSTEM

50-011(a)— Decommissioned septic system including tank (TA-50-10), manhole (TA-50-9), a sanitary distribution box (TA-50-11), a leach field, and an infiltration shaft on the east side of the distribution box. All but the infiltration shaft was removed in 1984.

50-011(b)— Active sanitary waste system of 6-in. vitrified clay drainlines. The drainlines are not monitored.

TABLE 1-4
RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT

Scope of the RFI	ER Program Equivalent	
The RCRA Facility Investigation consists of five tasks:	LANL Installation RI/FS Work Plan	LANL Task/Site RI/FS
Task I: Description of Current Conditions A. Facility Background B. Nature and Extent of Contamination	I. LANL Installation RI/FS Work Plan A. Installation Background B. Tabular Summary of Contamination by Site	I. Quality Assurance Project Plan A. Task/Site Background B. Nature and Extent of Contamination
Task II: RFI Work Plan A. Data Collection Quality Assurance Plan B. Data Management Plan C. Health and Safety Plan D. Community Relations Plan	II. LANL Installation RI/FS Work Plan A. General Standard Operating Procedures for Sampling, Analysis, and Quality Assurance B. Technical Data Management Program C. Health and Safety Program D. Community Relations Program	II. LANL Task/Site RI/FS Documents A. Quality Assurance Project Plan and Field Sampling Plan B. Technical Data Management Plan C. Health and Safety Plan D. Community Relations Plan
Task III: Facility Investigation A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification	III.	III. Task/Site Investigation A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification
Task IV: Investigative Analysis A. Data Analysis B. Protection Standards	IV.	IV. LANL Task/Site Investigative Analysis A. Data Analysis B. Protection Standards
Task V: Reports A. Preliminary and Work Plan B. Progress C. Draft and Final	V. Reports A. LANL Installation RI/FS Work Plan B. Annual Update of LANL Installation RI/FS Work Plan C. Draft and Final	V. LANL Task/Site Reports A. Quality Assurance Project Plan, Field Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Community Relations Plan B. LANL Task/Site RI/FS Documents and LANL Monthly Management Status Report C. Draft and Final

in the TA-50 area (e.g. TA-35), and ongoing environmental surveillance activities by the Laboratory's Environmental Protection Group show that radionuclide levels in the area surrounding TA-50 are well within DOE guidelines. If significant migration plumes (other than the permitted releases) are detected, sampling may later be extended beyond the site boundaries.

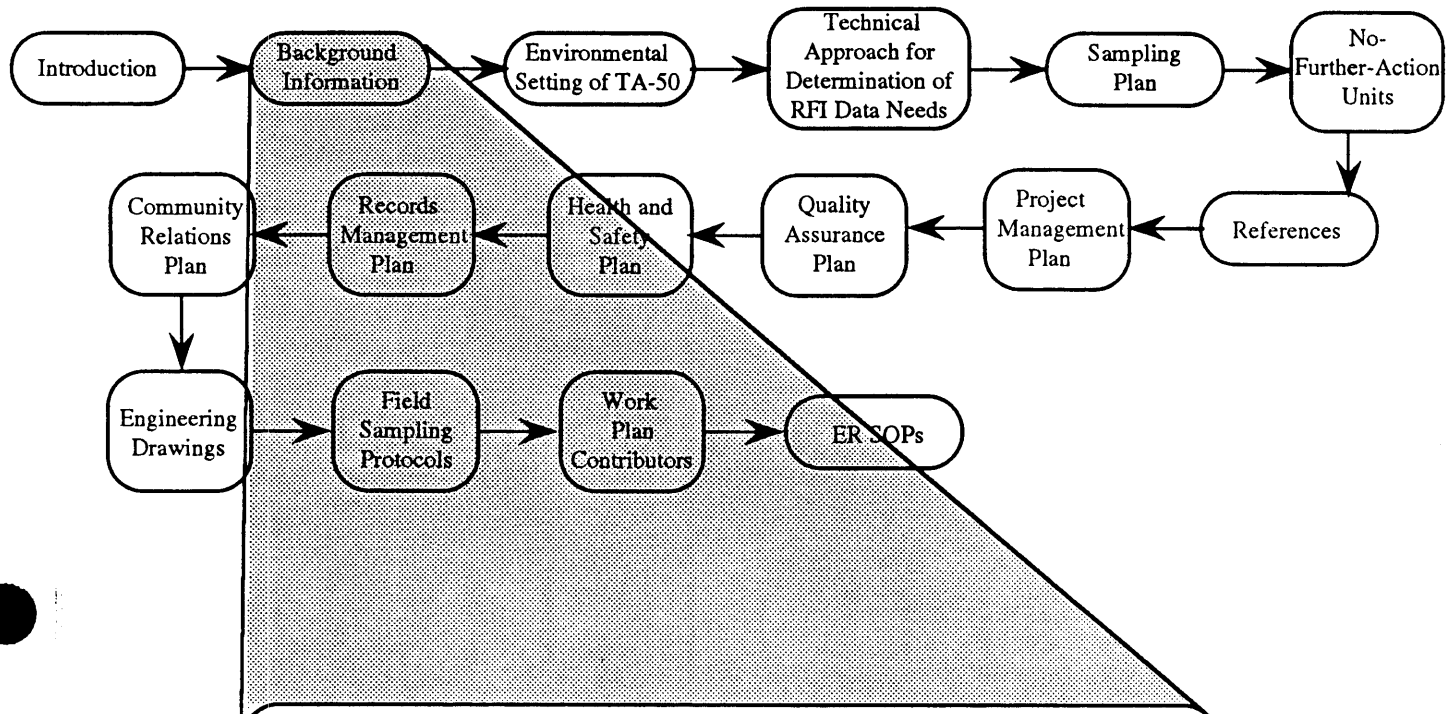
Many of the SWMUs at TA-50 are located beneath buildings with ongoing operations and, as such, will be difficult to characterize. Ideally, RFI activities should be delayed until decommissioning of the facilities; but given the possibility (however remote) of a significant tank and/or drainline leak, some level of sampling is needed to check the integrity of the liquid transfer and storage system. Only if the results of the initial sampling show little or no migration from SWMUs associated with ongoing operations will further characterization be delayed until facility decommissioning.

The Waste Management Group (EM-7) has an ongoing program (often constrained by budget) to upgrade the liquid waste treatment facilities at TA-50, including removal of several of the SWMUs at this site (see Chapter 2 for interim action plans for TA-50). In addition, line-item funding is being sought to replace TA-50, beginning in 1995. This plan plays an important role in the RFI sampling strategy for SWMUs associated with the treatment plant, as described in Chapter 5. As monitoring data from interim actions at the site become available, they can be incorporated into the RFI data base and/or used to confirm RFI results.

The large number of SWMUs associated with the ongoing liquid and solid waste treatment activities (25 of the 26 total), and particularly with the underground waste transfer and storage structures, makes it logical to treat those SWMUs as a group during the field investigations and to treat the Area C landfill (the 26th SWMU) separately. The treatment facility SWMUs are further aggregated, primarily on the basis of physical location (see Chapter 5). The treatment facility SWMUs are addressed in Section 5.1 of Chapter 5, and the Area C SWMU in Section 5.2.

Because the TA-50 RFI is scheduled to take about 5 years, the Laboratory is proposing to submit technical memoranda to EPA as work progresses. As needed, these memoranda can be used to revise the sampling plans to allow for new data and other relevant information. In other words, they would serve not only as RFI Phase 1 reports, but also as input to Phase 2 work plans. The schedule for submitting technical memoranda is presented in Annex I (Project Management Plan).

CHAPTER 2



TA-50 Background Information

- History of TA-50 (Section 2.1)
- SWMUs Associated With the Liquid and Solid Waste Treatment Facilities (Section 2.2)
- Area C Landfill: SWMU 50-009 (Section 2.3)
- Current Conditions at TA-50 (Section 2.4)
- Potential Public Health and Environmental Impacts (Section 2.5)

2.0 TA-50 BACKGROUND INFORMATION

Los Alamos National Laboratory was established during World War II to design and test the first nuclear weapon. Following the success of that venture, nuclear programs involving most disciplines of science became the Laboratory's central mission. That mission continues today.

In the 1950s, 60s, and early 70s, the Laboratory experienced tremendous growth in programs and facilities, mostly focused on nuclear energy research and development. Along with the indisputable gains, however, came wastes of a variety of forms—an unavoidable by-product of many of these programs. Liquid and solid wastes were an especially vexing problem because of their large volumes and radioactive and hazardous content. Facilities such as TA-50 were constructed in response to the need for treatment and disposal of these problem wastes.

2.1 History of TA-50

Throughout the 50-year history of the Laboratory, most of the potentially hazardous solid wastes were buried in landfills. Technical areas 1 and 21, in and near the present town of Los Alamos (see Fig. 1-1, Chapter 1), were the center of many of the R&D activities during the 1940s and 1950s, and several landfills were created at TA-21. But the area available for landfills at TA-21 was limited, the volumes of waste were increasing, and a conscious move was under way to develop the Laboratory to the south, away from the townsite. A very large fire in an open pit at Area B (TA-21) became a further spur to action, and in 1948 the 11.8-acre Area C landfill (Fig. 2-1) was established. Like many old DOE landfills, Area C consists of several pits and shafts that contain a diverse mixture of contaminants, including low-level, TRU, hazardous, and mixed wastes. Until the early 1950s, liquid wastes were either stored (for later recovery of scarce plutonium) or released, untreated, into Pueblo Canyon (from TA-1) or to absorption beds (TA-21). Later, liquid waste treatment plants were established at TA-45 and TA-21 to improve the quality of the effluent to comply with existing and emerging regulations.

The TA-50 liquid waste treatment plant (see Fig. 2-1) was built in 1963, both to meet the need for expanded treatment capability for the growing volume of waste and to locate a treatment facility nearer the technical areas generating the waste. The plant, which is still operational, receives liquid wastes from many technical areas, treats them to remove target contaminants, and monitors and then releases treated liquid effluent (a permitted outfall) to Mortandad Canyon. Treatment sludges go to TA-54, Area G (see Fig. 1-1, Chapter 1), for storage or disposal. Associated with the plant is an intricate system of drainlines and tanks to transfer, treat, and temporarily store the liquid waste and treatment sludge.

The incinerator complex (TA-50-37), built in 1975, and the volume reduction facility (TA-50-69), built in 1983 (Fig. 2-1), were R&D and/or prototype facilities for developing and testing improved methods of handling and treating certain types of waste. The stimuli for these new treatment approaches were the need to reduce the cost of waste disposal (e.g., by reducing the volume of large metal objects contaminated with TRU) and to comply with more restrictive disposal

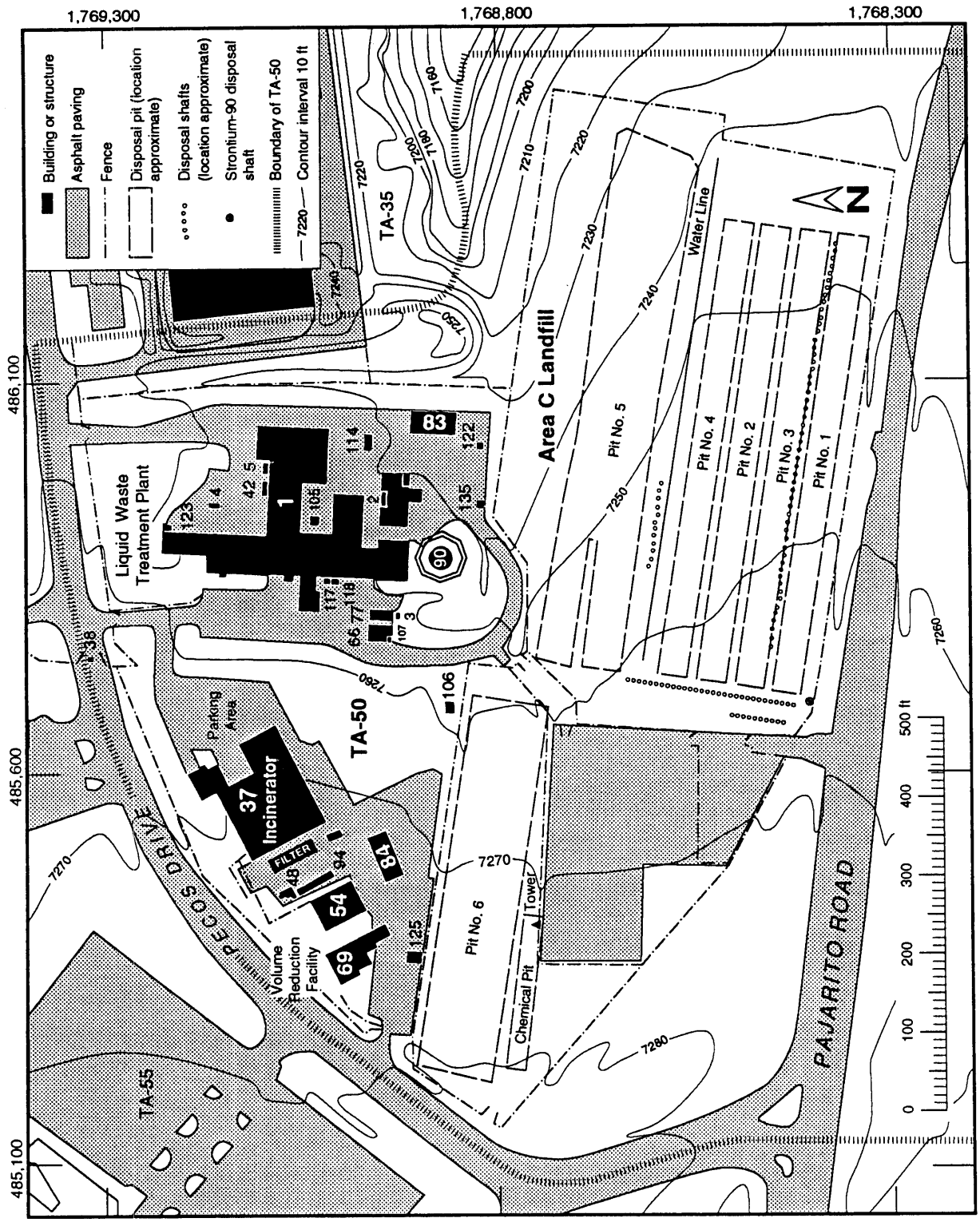


Figure 2-1 Technical Area 50 site map.

regulations for PCBs, other organic wastes, and mixtures of organics and radionuclides. Both facilities have the potential to generate liquid, solid, and gaseous wastes. However, many controls have been designed into these operations that meet current regulations. In addition, all effluent waste streams are monitored before release from the facilities.

By the time the liquid waste treatment facility began operating in 1963, the Area C landfill was being phased out in favor of the Area G landfill at TA-54, farther to the east. Most waste disposal at Area C ceased in 1969, and the landfill was officially decommissioned in 1974. The existing liquid waste treatment plant is antiquated and in some cases cannot meet new regulatory requirements. A new liquid waste treatment facility is planned, with design and construction activities to begin (given anticipated line-item funding) in 1995.

2.2 SWMUs Associated with the Liquid and Solid Waste Treatment Facilities

2.2.1 Description and History

TA-50 contains liquid and solid waste treatment facilities for radioactive and nonradioactive wastes generated by the Laboratory. Liquid wastes are brought to TA-50 via an underground drainline system and, to a lesser extent, by tank truck. Some solid wastes are trucked to TA-50 for treatment in the volume reduction facility, while other wastes (solid and liquid) go to the incinerator complex.

Because TA-50 receives liquid and solid wastes from a large number of technical areas, the wastes are often complex mixtures that contain chemicals and radionuclides, including TRUs. In addition, the composition of the wastes has changed markedly through the years, mirroring the changing research programs at the Laboratory. The liquid waste treatment plant was built specifically to remove plutonium, other transuranics, and beta-gamma contaminants from the waste stream; but later, special treatment processes were developed to meet specific needs (such as the nonradioactive batch liquid treatment facility and the distillation operation to recover mercury). A chronology of the major events related to the treatment plant is presented in Table 2-1.

2.2.1.1 Process Wastes

Process wastes are generated at TA-50 by the radioactive and nonradioactive liquid and solid waste treatment facilities. None of these wastes have ever gone into the Area C landfill. Liquid wastes are monitored, then released to Mortandad Canyon. The filter cake sludge that is left when contaminants are precipitated out of the low-level radioactive industrial influent or chemical influent from the Laboratory at large is packed into drums at TA-50 and, depending on the classification of the waste, is transported to either the hazardous waste or the low-level radioactive waste area at TA-54 for disposal. Some 200 to 300 drums of industrial waste are generated each year. The sludge from treating acidic and caustic liquid wastes from the Plutonium Processing Facility (TA-55), which are TRU wastes, is mixed with cement, temporarily stored in drums at TA-50, and then moved to storage at Area G for eventual disposal at the Waste Isolation Pilot Plant (WIPP). About 25 drums of TRU waste are generated each year.

TABLE 2-1

CHRONOLOGY OF EVENTS
RELATED TO LIQUID WASTE TREATMENT PLANT AT TA-50

Event	Date
Radioactive liquid waste treatment facility becomes operational	06/63
Sampling box and seepage pits installed to improve septic system performance	1973
Two spills of radioactive waste and unknown chemicals	1973
Waste line 45 installed	1974
Overflow of sump in WM-2 results in discharge of contaminated fluids into Ten Site Canyon through drainline 67	07/74 - 09/74
Drainline 67 sealed with flexible plug at the outfall to Ten Site Canyon	02/75
Waste line at TA-50-37 removed	1975
Aboveground storage tank for diesel fuel and buried fuel line to TA-50-37 placed in operation	1975
Incinerator complex becomes operational as an R&D facility	1975
Acid tank 66 and caustic tank 67 placed in operation	1977
Analysis of surface soil samples demonstrate the presence of radioactive contamination in Ten Site Canyon below the outfalls from TA-50-1 and TA-50-2	1977
Samples collected from surface soils at TA-50 show plutonium contamination from stack emissions	1975 - 1977
Sediments collected 2.2 km below the outfall in Mortandad Canyon show radioactive contamination	1975 - 1977

TABLE 2-1 (cont'd)

CHRONOLOGY OF EVENTS
RELATED TO LIQUID WASTE TREATMENT PLANT AT TA-50

Event	Date
Acid waste lines 49 and 54 removed	1981
Waste line 55 decommissioned; soil removed from trench below waste line contains radioactivity (below soil-cleanup guidelines)	1981
Drainline 67 decommissioned and removed. Soil in trench below line shows combined radioactivity (below soil-cleanup guidelines)	1981
Waste line 48A decommissioned and area decontaminated	1981
Ten Site Canyon outfall area partially decontaminated	1981
Continuously monitored waste lines constructed: • TA-55 to TA-50-57 • TA-50-72 to TA-50-1 • TA-50-69 (volume reduction bldg) • TA-50-37 (incinerator bldg) to TA-50-72 (manhole) via manholes TA-50-73 and TA-50-74 • Main waste line to TA-50-1 • TA-55 to TA-50-72	1982
Modifications to caustic tank 67 recommended, to correct buildups of sludge containing plutonium-239	01/82
Transformer substation TA-50-4, transformer pad TA-50-46, and transformer station TA-50-52 listed on TA-50 structures location plan	07/83
Mercury reclamation system in Room 34, TA-50-1, begins operation	1983
Septic system leach field and contaminated soil removed in the area southeast of TA-50-2	1983

TABLE 2-1 (cont'd)

CHRONOLOGY OF EVENTS
RELATED TO LIQUID WASTE TREATMENT PLANT AT TA-50

Event	Date
Volume reduction facility placed in operation	1983
Vehicle decontamination pad enclosed in a building	1983
Liquid waste batch treatment system (nonradioactive) in Room 24, TA-50-1, placed in operation	1983
Sanitary system lines installed to replace TA-50 septic system	03/83
Septic system decommissioned; septic tank, manholes, drainlines, leach-field pipes, and soil removed	05/83 1984
• Line 45A and manholes 73 and 56 removed • TA-50 waste line with manhole 6 removed; soil below manhole 6 determined to be radioactively contaminated • Waste lines 44, 45, 46, 47, and 48 removed	
Temporary waste storage area at TA-50-2 placed in operation	1985
Incinerator scheduled for conversion to a production facility	1985
Stainless-steel radioactive waste storage tanks and vault at tank farm (TA-50-3) removed. Inactive waste line 50 sealed during removal of vault	1989
Decommissioned sanitary leach-field pits covered by compacted soil and asphalt	1989
Acid waste line 65, from TA-52 to TA-50, removed. Monitoring during excavation and removal did not identify any leaks	1989

Most of the liquid wastes from the volume reduction and incinerator facilities are transferred by drainline to the liquid waste treatment plant, where they are treated as radioactive industrial waste. Liquid TRU wastes generated in a hood at the volume reduction facility are transferred to the special TRU treatment facilities in the liquid waste treatment plant. Solid wastes from both facilities are packaged as TRU waste and stored at Area G (for final disposal at WIPP).

2.2.1.2 Airborne Emissions

Stack air from hoods, off-gas, and/or ventilation systems in the liquid treatment, volume reduction, and incinerator facilities is monitored, and in many cases filtered, to remove particulates and contaminants. See Section 2.2.1.4.6.3 for more detailed information.

2.2.1.3 Sanitary Wastes

The original sanitary system at TA-50 consisted of a drain, septic tank, and leach field that were separate from the drainline and tank system serving the liquid waste treatment plant. The leach field was located at the head of Ten Site Canyon. The system did connect to some sinks, floor drains, and a lavatory in the liquid waste treatment plant, creating a certain potential for the presence of contaminants. The system was removed in 1984 when the new sanitary waste system went on line.

The new system connects to the main sewer line going to the TA-35 sewage treatment facility. Although sewage going out of TA-50 is not monitored, all incoming sewage to the TA-35 treatment facility is monitored for a variety of chemical and radioactive constituents.

2.2.1.4 SWMUs Designated for Field Investigations

Ten SWMUs, containing 25 potential SWMU subunits, have been identified as a part of the treatment facilities at TA-50. Seven of these 25, most associated with the liquid waste treatment system, are recommended for deletion from further consideration by the ER Program on the basis of record searches used in preparing this work plan. The rationale for deleting SWMUs 50-003(b,c,d,e), 50-005, 50-006(b), and 50-006(e) is given in Chapter 6. The remaining 18 sites (see Figures 2-2 and 2-3 for locations), which will undergo RFI, are

Radioactive Liquid Waste Treatment Facility: 50-001(a) and (b);

Radioactive Waste Treatment Facility Tanks and Drainlines: 50-002(a), (b), (c), and (d);

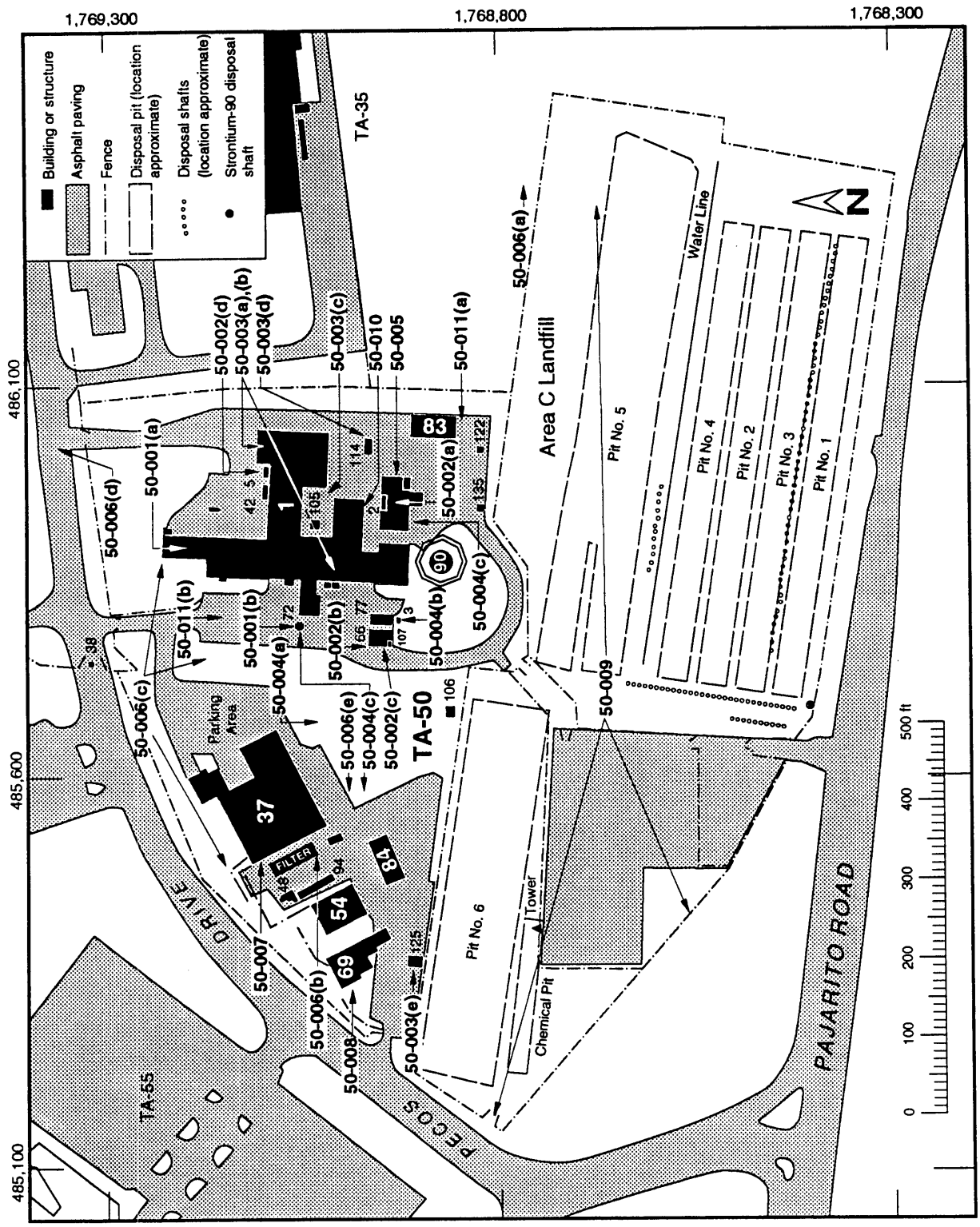


Figure 2-2 General location of SWMUs at OU 1147.

Transuranic Waste Storage Area: 50-003(a);

Decommissioned Tanks and Waste Lines: 50-004(a), (b), and (c);

Operational Releases/Outfalls: 50-006(a), (c), and (d);

Incinerator Complex: 50-007;

Volume Reduction Facility: 50-008;

Radioactive Decontamination Facility: 50-010; and

Septic Systems: 50-011(a) and (b).

The waste associated with these potential release sites includes acids, metals, inorganics, organics, semi-volatiles, volatiles, total dissolved solids, fission products, activation products, transuranics, and PCBs. The following sections give detailed information by SWMU.

2.2.1.4.1 Radioactive Liquid Waste Treatment Plant: 50-001(a) and (b)

2.2.1.4.1.1 50-001(a)

Subunit 50-001(a) is a radioactive liquid waste treatment plant (Building 1 in Fig. 2-2) that covers 37,000 ft^2 of a total 60,000 ft^2 in structure TA-50-1; it is designed to treat 250 gpm of liquid, primarily for removal of transuranic elements. In continuous operation since 1963, the plant provides for neutralization, flocculation/clarification, pH control, ion exchange and filtration of contaminated liquids. It includes a wiped film evaporator, located in Room 71 (recommended for deletion as a component of SWMU 50-001(a) because it has never been used); two clariflocculators, located in Room 116; a pH-adjustment tank, located in Room 16; an evaporator storage tank, located in Room 70A; a decant storage tank (used as an auxiliary sludge storage tank), located in Room 61; a rotary drum vacuum filter, located in Room 116B; two gravity filtration devices, located in Room 116; a 100,000-gal. steel emergency holding tank, designated as structure TA-50-90 (also recommended for deletion since it has never been used); and two waste mixers in which chemicals are combined with waste during treatment, located in Room 116. A drum-tumbler operation in Room 60A is used for cementation of TRU sludge that is temporarily stored at Area G awaiting final disposal at the Waste Isolation Pilot Plant (WIPP). The treatment plant has an outfall in Mortandad Canyon, regulated under an NPDES permit.

All of the industrial (low-level) waste that flows into TA-50-1 passes through a flow meter in Room 16. Samples are taken and the pH is adjusted with sodium hydroxide to minimize corrosion of the cast-iron lines leading to the tank farm (TA-50-2, WM-2). The pH is given a final adjustment in the 75,000-gal. tank at WM-2 and then pumped back to TA-50-1.

In the flash mixer (Room 116), calcium hydroxide and ferric sulfate are mixed into the waste; then the solution is transferred to a flocculator in Room 116 and slowly mixed for about 45 min to allow the sludge to settle. The remaining liquid

waste is sent to a clarifier, where further settlement takes place, again fed through a flash mixer, flocculator, and clarifier tank treatment cycle, and finally drained through a gravity filter to the treated waste tanks at TA-50-2 for eventual release to Mortandad Canyon.

The sludge is drained to the 25,000-gal. sludge holding tank at WM-2, pumped from this tank to a vacuum filter in TA-50-1, dewatered to the consistency of filter cake, and packaged in 55-gal. drums for temporary storage at TA-50. These drums (200-300/yr) are eventually taken to TA-54, Area G, for burial.

Caustic and acidic TRU liquid wastes from TA-55 are transported to 2600-gal. holding tanks in underground vault TA-50-66. Each type is piped to TA-50-1, Room 60, in a separate, double (encased) stainless-steel line. There the wastes are commingled in a neutralizer storage tank equipped with cooling coils, to partially adjust pH. Chemical is added to further adjust pH, then the transuranic waste is pumped through a flash mixer, a flocculator, a clarifier, and a gravity filter, drained to the low-level raw waste storage tank at TA-50-2, and retreated as industrial liquid waste. The residual sludge is mixed with cement, water glass, and vermiculite in a drum tumbler and stored in 55-gal. drums for shipment to TA-54. (Room 60D has been certified by EPA as a mixed waste storage area, including the drum tumbler. This permit has been in effect since February 1991.)

The TA-50-2 tank farm includes two 25,000-gal. treated waste holding tanks that are connected by a 6-in. cast-iron line to an outfall in Mortandad Canyon. A section of this line had to be rerouted a few years ago because it was in the way of a new building (TA-35-213) to be constructed on the north side of Pecos Drive. The tanks are emptied only when full, so there is no continuous discharge of treated liquids, and their contents are sampled for gross alpha count before emptying. If the count is 1000 counts/min/L or less, the treated waste is released into the canyon. If it exceeds 1000 counts/min/L, the contents of the tank are recycled through the Waste Treatment Plant. Treated wastes are sampled weekly and analyzed for a variety of constituents to satisfy EPA and New Mexico State regulations, as required to retain the NPDES permit. For record-keeping, a sample of each batch is taken before dumping, to be analyzed for radionuclides and many other hazardous materials.

2.2.1.4.1.2 50-001(b)

This subunit is the underground drainline system through which liquid waste is transferred to the radioactive waste treatment facility from many of the active technical areas. Drainlines and manholes that make up the system are shown in Fig. 2-4. All of the manholes on the industrial waste lines that transport liquid to the TA-50 Treatment Facility are continuously monitored by a drip-tray and conductivity-probe leak monitoring system.

Manhole TA-50-72 (see Fig. 2-4) is the central collection area for most of the industrial liquid waste coming into TA-50. A major line connecting several technical areas to this manhole was constructed in 1982 to replace the old line (50-004[a]) that transported low-level radioactive liquids to TA-50. The new pipe is a double (8-in. within 12-in.) polyethylene pipe that enters manhole 72 from the

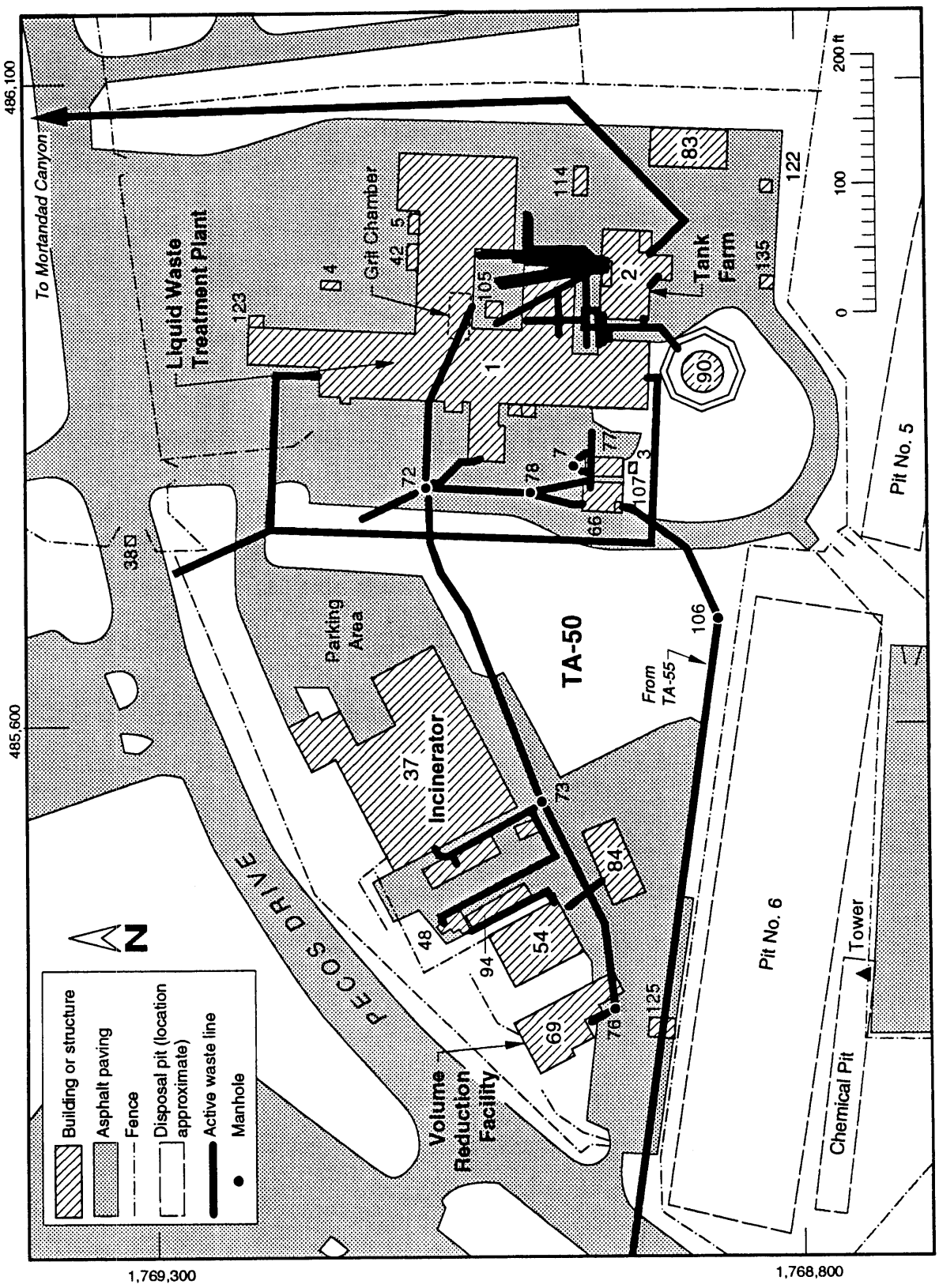


Figure 2-4 Location of active industrial waste lines and manholes at TA-50.

north side of Pecos Drive. Building TA-35-213, located directly north and across Pecos Drive from TA-50, is hooked into this line, but to date no industrial waste has been generated from Building TA-35-213. The original waste line connecting TA-35 to TA-50-3 has been removed, as has the waste line from TA-52 to manhole TA-50-7. (Note that low-level industrial waste from TA-2 (see Fig. 1-1, Chapter 1) enters the raw waste holding tanks in TA-50-2 via the 3-in. coated steel "cross-country" line from TA-21, and does not enter manhole 72 as described in the SWMU report [LANL 1990, 0145])

Another waste line into manhole 72, completed in 1982, transports low-level radioactive liquids from manhole 73, which receives wastes from both the volume reduction facility (TA-50-69) and the incinerator complex (TA-50-37) (Fig. 2-4). This is a 6-in. polyethylene line encased within a 10-in. polyethylene line that is equipped with a leak monitor and vacuum test capabilities. Radionuclides transported by this waste line may include isotopes of plutonium, americium, uranium, and cesium. (The small quantities of TRU waste—about 1000 gal./yr—generated in Building 69 are transported in tanks for treatment in Room 60 of TA-50-1.) The waste line has been used little in the last 2 years because of a lack of staffing at TA-50-37 and TA-50-69.

Another line, installed in 1982, transports low-level radioactive waste from TA-55 to manhole 72 via monitoring manhole 106 and manhole 78 (Fig. 2-4). The line is double (inner stainless steel pipe, outer PVC pipe) with leak monitors and vacuum testing capability in manhole 106. The outer PVC pipe does not hold a vacuum at the present time, indicating a potential for leaks if the stainless steel line were breached. The leak detection system and visual inspection for liquids at manhole 106 currently show no evidence of leaks in this line.

Three other waste lines run from TA-55 to TA-50, through leak-monitoring manhole TA-50-106, to tanks in the underground vault (TA-50-66) on the southwest corner of the treatment plant (Fig. 2-4). These 1.5-in. stainless-steel lines, each encased within a 3-in. PVC pipe, carry caustic and acid wastes with high radioactivity (as indicated in Chapter 6, one of these lines is a spare and has never been used; it is recommended for deletion as a component of SWMU 50-001[b]). The lines operate by gravity flow to TA-50-66. The annulus of each is monitored continuously at TA-55, at manhole 57, and at TA-50-66 by a drip tray and a conductivity probe system wired to a computer for continuous read-out. There is no regular schedule for testing these lines for leakage, but when all four were vacuum-tested in 1987, none held a vacuum. The lines were constructed in 1982 and are scheduled for replacement in March 1992, at which time extensive soil sampling will determine whether contaminants have leaked from the pipes.

A single drainline carried all the influent from manhole 72 into the grit tank in TA-50-1 until a leak was detected around the grit tank in 1990. The line now bypasses the grit chamber and connects directly to the TA-50-2 tank farm. It is double, consisting of an inner 8-in. schedule 40 stainless-steel pipe and an outer 10-in. schedule 10 stainless-steel pipe.

Manhole 7 (TA-50-7), another component of the influent waste system (Fig. 2-4), is connected to the waste line from the tank truck unloading station (structure TA-50-77). This manhole, placed in operation in 1963, is no longer in use, and a plan to remove it and clean up any associated soil contamination is under way.

2.2.1.4.2 Tanks and Drainlines: 50-002(a), (b), (c), and (d)

2.2.1.4.2.1 50-002(a)

The Radioactive Liquid Waste Treatment Facility includes three locations with underground storage tanks and associated drainlines. The first is the tank farm, designated 50-002(a), known collectively as TA-50-2, WM-2. It is a concrete underground vault containing an equipment room bounded on three sides by five concrete process tanks (Fig. 2-5): two 25,000-gal. tanks on the east, one 25,000-gal. tank and one 75,000-gal. tank on the west, and one 25,000-gal. tank on the south. Two of the tanks handle the influent or raw waste, one is for sludge, and the other two are for storing treated liquid waste before discharge. Liquid wastes and sludges are transported from TA-50-1 to TA-50-2 via a system of 17 drainlines.

The floor of the vault is about 17 ft below grade. The floors of the east and west tanks are 12 to 18 in. deeper, as the floors slope to form a sump in the center of each tank. The floor of the south tank is also shaped like an inverted pyramid, but its apex is 7 ft 6 in. below the floor of the vault.

2.2.1.4.2.2 50-002(b) and (c)

The second location consists of two acid and caustic waste tanks, TA-50-67 (SWMU 50-002[b]) and TA-50-68 (SWMU 50-002[c]), contained in an underground vault (TA-50-66) about 18 ft x 16 ft x 14 ft deep (Fig. 2-5). The tanks and vault are located about 30 ft from the southwest corner of Building 1. They were constructed exclusively to handle radioactive acid and caustic waste from TA-55. These transuranic wastes are processed separately from other wastes. (Before construction of these tanks and vault, the TRU waste from TA-55 was mixed with industrial waste from other technical areas, all of which had to be processed as transuranic waste with its inherent high disposal costs.

Four double stainless-steel-and-PVC influent lines from TA-55 enter the west end of the south wall of the vault. One line is a spare that is capped inside the vault wall. The second line carries radioactive acid waste to the acid tank. The third line carries radioactive caustic waste to the caustic tank. These acid and caustic wastes are transferred from the tanks via two double stainless-steel lines to Room 60 in the TA-50-1 treatment plant. Because these liquids contain significant amounts of transuranics, the operation is monitored carefully for criticality hazards, and necessary adjustments are made before treatment. Ten to twelve barrels of treated transuranic waste are generated each year. The fourth line, which passes through the vault and through manhole 78, carries radioactive industrial wastes into manhole 72, where they are mixed with the other radioactive industrial wastes entering manhole 72. About 300 barrels of treated radioactive industrial waste sludge are generated each year. (In 1990,

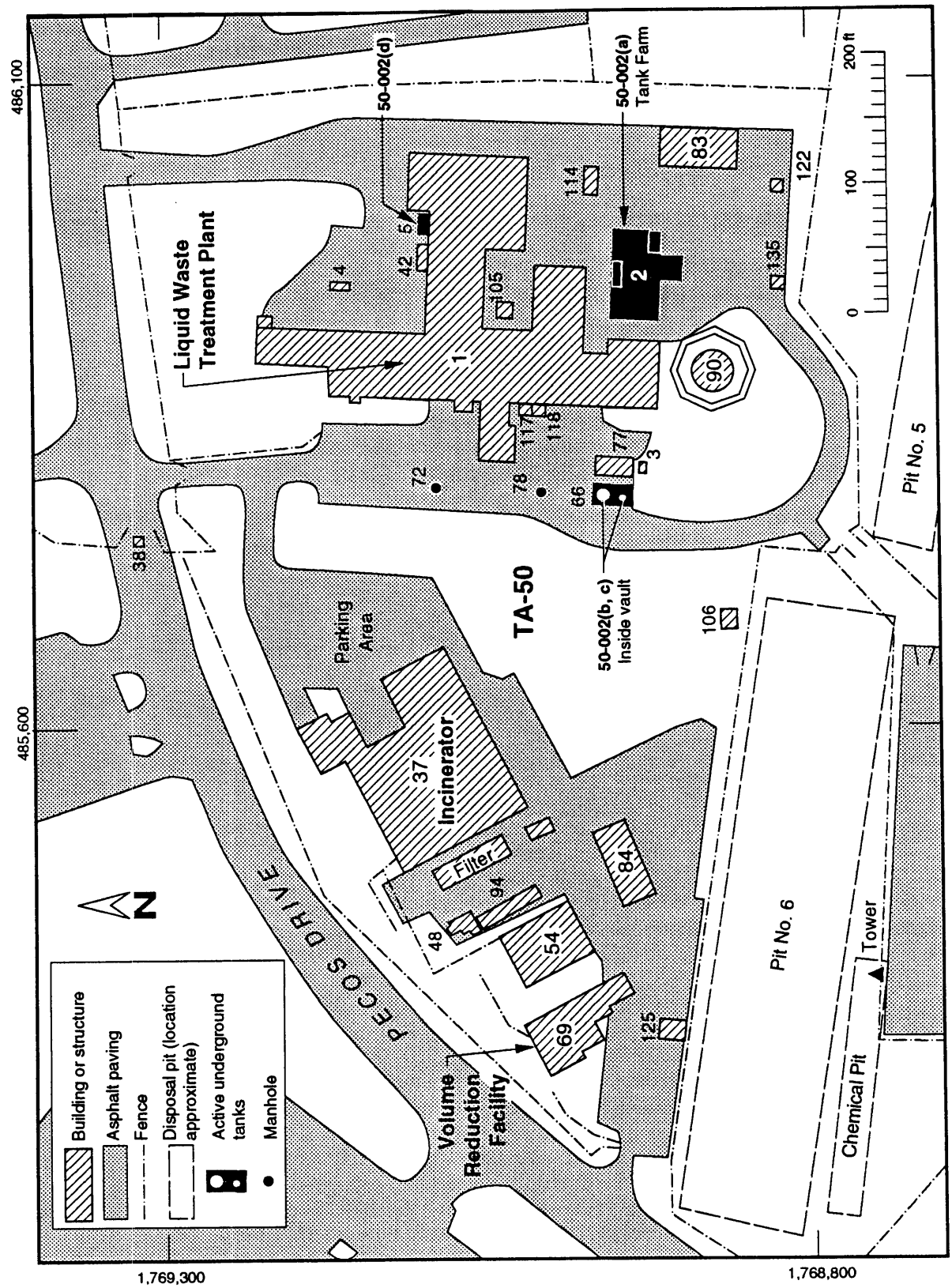


Figure 2-5 Location of active storage tanks at TA-50.

294 barrels were processed.) No evidence of leaks or contaminant migration has been reported or documented.

2.2.1.4.2.3 50-002(d)

The third location is an aboveground, 4000-gal., stainless-steel storage tank for nitric acid, designated TA-50-5 (see Fig. 2-5). It is located adjacent to the north wall of Room 60D of Building TA-50-1. The nitric acid was intended to recharge an ion-exchange column for removing radionuclides not removed by the clariflocculator system. The tank is supported by concrete saddles and is placed over a pit (TA 50-12) filled with limestone chips to neutralize any nitric acid fumes that escape the tank. The pit also has retaining walls to hold any spillage. The footings for the tank saddles are about 4 ft below grade and the bottom of the pit is about 2.5 ft below grade.

The concentration of radioisotopes in the radioactive industrial waste influent has always been below the accepted DOE limits. For this reason, the ion-exchange column and nitric acid tank have never been used as intended. At present, the tank is about one-quarter full. It is scheduled to be emptied and left empty unless the ion-exchange columns have to be operated. (In that event, the tank would be filled with sulfuric acid instead of nitric acid because of the nitrate problems that develop when nitric acid is neutralized.)

2.2.1.4.3 Transuranic Waste Storage Areas: 50-003(a), (b), (c), (d), and (e)

Five waste storage areas (Fig. 2-6) were originally identified as constituting SWMU 50-003. Four of these (50-003 [b], [c], [d], and [e]) are recommended for no further action (see Chapter 6); the remaining one is described below.

SWMU subunit 50-003(a) is a greater-than-90-day storage area located in Room 60D in the northeast corner of the east wing of TA-50-1. It contains TRU waste produced by treatment of the acid and caustic wastes from TA-55. The waste is mixed with water glass, vermiculite, and cement and then stored in drums, which are periodically hauled to TA-54. This waste will eventually be shipped to the WIPP site.

2.2.1.4.4 Decommissioned Tanks and Waste Lines: 50-004(a), (b), (c)

The three SWMU subunits (see Fig. 2-2) in this category are associated with the underground waste lines that used to carry influent industrial waste to TA-50 and the manholes to which it was routed. They were removed after the existing influent line became operational.

2.2.1.4.4.1 50-004(a)

This subunit (Fig. 2-7) is a 520-ft section of the original 6-in.-diameter vitrified clay pipe that carried industrial waste to TA-50. In 1975, the line was removed from TA-50 out to Pecos Drive to clear the site for construction of TA 50-37. Later, Buildings TA-50-54 and TA-50-69 were built over portions of this decommissioned line. It was replaced by acid waste line 45, which bypassed the TA-50-37 construction zone. In 1984, line 45 was also removed (see 2.2.1.4.4.3,

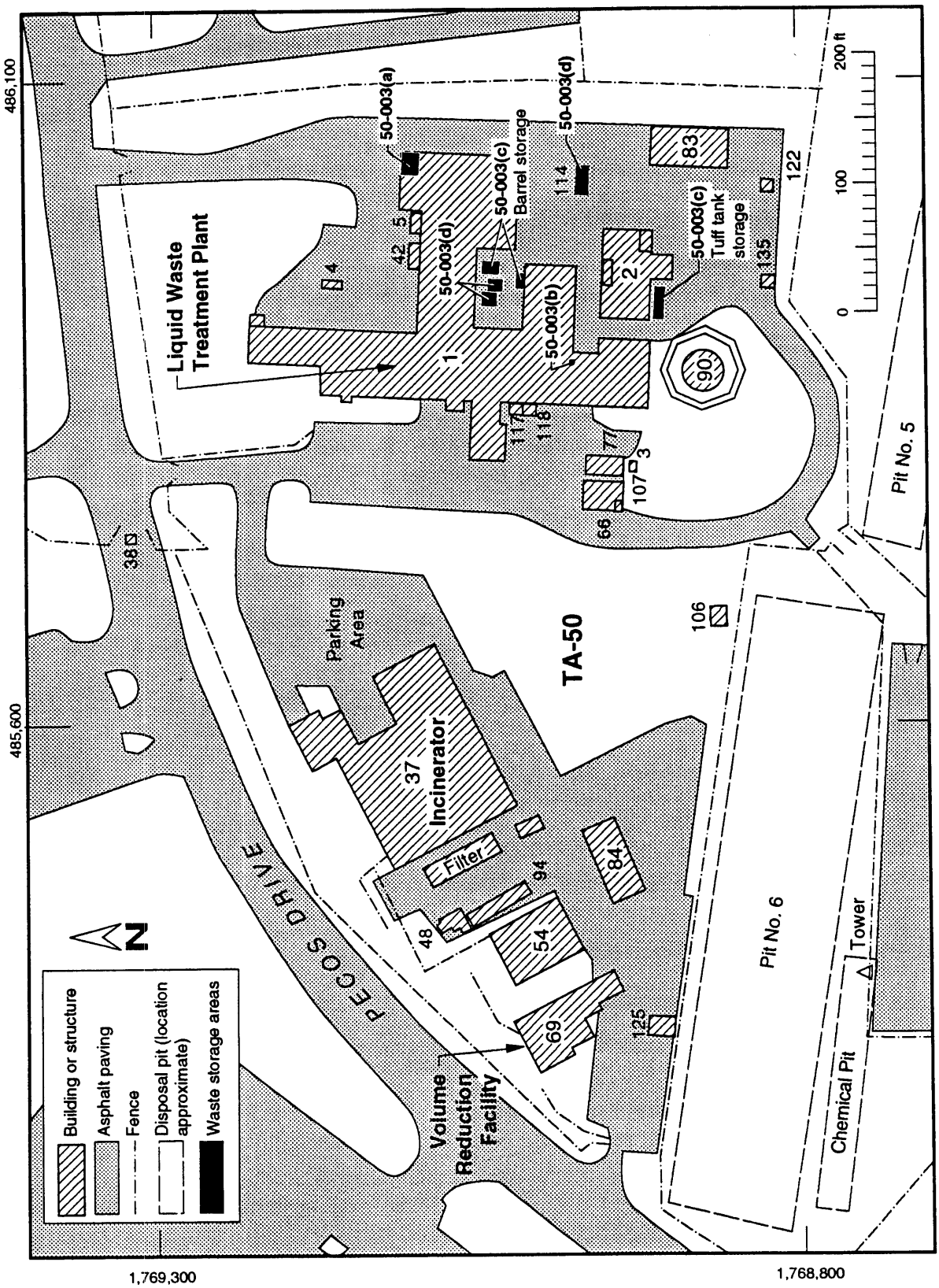


Figure 2-6 Location of waste storage areas at TA-50.

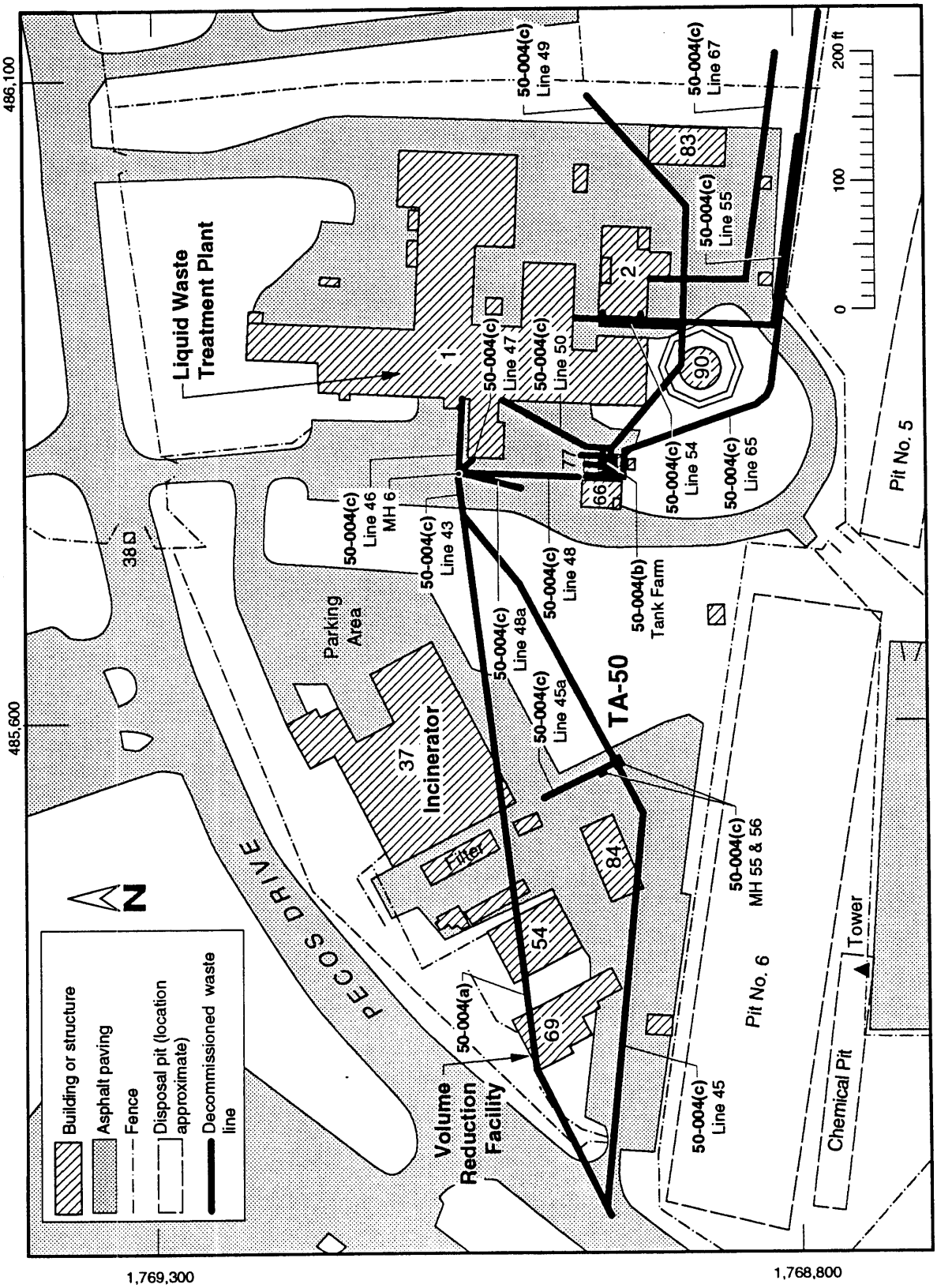


Figure 2-7 Location of decommissioned waste lines, manholes, and tanks at TA-50.

50-004[c]). A large portion of the original trench that carried the pipe is now under Buildings TA-50-37, TA-50-54, and TA-50-69. The clay pipe was known to have leaked. When it was removed, contaminated soil was also removed, and both were interred at Area G. Cleanup was done to levels dictated by the sensitivity of hand-held radiation detection instruments of the day. No measurements for nonradioactive constituents were ever made on the pipe or the soil.

2.2.1.4.4.2 50-004(b)

This subunit was an underground structure, designated TA-50-3 (Fig. 2-7), that contained three stainless-steel-lined concrete tanks used to store waste from the Omega Reactor and other sources. Tank no. 1 had a capacity of 1000 gal., tank no. 2 of 2000 gal., and tank no. 3 of 4500 gal. The structure was 13 ft 8 in. square, and its bottom was 9 ft. 6 in. below grade. Lines into the structure included line 49 from TA-35 and line 50, a stainless-steel line that carried waste from special experiments conducted in the treatment plant. The latter line was abandoned in place.

This subunit, which was the original tank farm, was removed in 1989. Soil around the outside walls of the vault was removed and the entire structure, with the tanks inside, was transported to Area G and buried. The soil from around and underneath the vault was screened for radioactive and chemical wastes, which were found to be below cleanup levels; the excavation was then backfilled with clean soil.

2.2.1.4.4.3 50-004(c)

This subunit consisted of sixteen drainlines and associated manholes that were removed between 1981 and 1989 (Fig. 2-7). The radioactive industrial waste lines listed as having been removed are nos. 44, 45, 45a, 46, 47, 48, 48a, 49, 54, 55, 56, 65, and 67. The manholes listed as removed are TA-50-6, TA-50-55, and TA-50-56. Except for line 56, all of these lines and manholes were verified as removed. Line 56 is still in service and connects a floor drain in Room 36 of Building TA-50-1 to an active, 10-in., cast-iron radioactive industrial waste line. The 10-in. line connects the liquid waste treatment plant to the current tank farm. The point of connection between line 56 and the 10-in. cast-iron line is under the floor slab of the Vehicle Decontamination Facility. The depths of these drainlines and manholes are given in Table 2-2.

Radionuclide contamination of soil, if discovered during waste line decommissioning, was cleaned up to ALARA levels by removing affected soil and pipe. Hand-held radiation-detection instruments were used to evaluate the need for soil cleanup. Sampling for chemical constituents usually was not done at that time.

2.2.1.4.5 Nonradioactive Waste Treatment Plant: 50-005

This subunit, the nonradioactive liquid waste batch plant in Room 24B of Building 1, is not being operated at this time. Most nonradioactive liquid waste from the Laboratory is sent to an off-site EPA-approved treatment facility, but a

TABLE 2-2
DEPTHS BELOW GRADE OF SUBSURFACE
AND PARTIALLY SUBSURFACE TREATMENT FACILITIES SWMUS
(Approximate, at Bottom of Unit)

50-002: Tanks and Drainlines	
50-002(a)	
Tank farm (TA-50-2) concrete tanks (except sludge tank)	17 ft
Sludge tank	25 ft, 6 in.
50-002(b) and 50-002(c)	
Vault containing these two tanks	14 ft
50-002(d)	
Footings of concrete saddles that support aboveground nitric acid storage tank.	5 ft
50-004: Decommissioned Tanks and Waste Lines	
50-004(a)	
Acid waste line	5 to 6 ft
50-004(b)	
Underground reinforced concrete tank farm containing three stainless-steel-lined tanks.	10 ft
50-004(c)	
Thirteen underground waste lines and three manholes (all removed except line 56):	
1. Waste line 44	5 ft
2. Waste line 45	5 ft
3. Waste line 45(a)	7 ft
4. Waste line 46	16 ft
5. Waste line 47	8 ft

TABLE 2-2 (cont'd)

6.	Waste line 48	6 ft
7.	Waste Line 48(a)	6 ft
8.	Waste Line 49	5 ft
9.	Waste Line 54	4 ft
10.	Waste Line 55	5 ft
11.	Waste Line 56	5 ft
12.	Waste Line 65	5 ft
13.	Waste Line 67	17 ft at exit from TA-50-2; 1 ft at canyon outfall
14.	Manhole TA-50-55	8 ft
15.	Manhole TA-50-56	8 ft
16.	Manhole TA-50-6	19 ft

50-008: Volume Reduction Facility (TA-50-69) 5 ft

50-010: Radioactive Decontamination Facility

Footing details for the extension walls have not been found. Drilling depth ~4 ft

50-011: Septic Systems

SWMU 50-011(a)

Decommissioned septic system leach field and main from septic tank 4 ft

very small amount is treated in open tanks at TA-54 (Area L). Mercury reclamation (also a part of SWMU 50-005) is done intermittently in a hood in Room 34. The hood has a discrete exhaust system that is not monitored. This SWMU is recommended for no further action (see Chapter 6).

2.2.1.4.6 Operational Releases/Outfalls: 50-006(a), (b), (c), (d), and (e)

2.2.1.4.6.1 50-006(a)

This SWMU subunit comprises the sites of two accidental releases of untreated radioactive wastes and unknown chemicals at TA-50, in July and September, 1974, to the head of Ten Site Canyon immediately to the southeast of TA-50-1 (Fig. 2-8). The cause of the releases was overflow of a sump in TA-50-2. The drainline (No. 67) from the floor drain in TA-50-2 was sealed with a flexible plug at the Ten Site Canyon outfall on February 28, 1975. A biased soil sample collected the same day at the outfall and analyzed on March 5, 1975, showed a gross alpha activity of 30,000 d/m-g. Analysis of soil samples collected on September 9, 1976 indicated that samples near the drainline 67 outfall contained as much as 50,000 pCi/g gross alpha contamination, and samples collected at distances ranging from 30 to 300 m from the outfall had gross alpha contamination up to 300 pCi/g; but of 27 soil samples collected on the canyon bottom, only one had gross alpha contamination greater than 20 pCi/g. (The concentration in that one soil sample was 70 pCi/g.) Drainlines 55 and 67 to the Ten Site Canyon outfall were completely removed in 1981 (Elder et al. 1986, 0456). Contaminants encountered during the removal were primarily plutonium-239, ruthenium-106, cesium-137, strontium-89, and yttrium-90. The outfall area east of TA-50 was partially decontaminated in 1981 by soil removal (70 m^3 total). Maximum surface contamination levels left after decontamination were 400 pCi/g of gross alpha activity and 40 pCi/g of gross beta activity. The contaminated area in Ten Site Canyon is marked with temporary signs and tape.

2.2.1.4.6.2 50-006(b)

This subunit is recommended for no further action (see Chapter 6).

2.2.1.4.6.3 50-006(c)

This subunit refers to the airborne contaminants that have been routinely released from the liquid waste treatment plant and other treatment facilities at TA-50 (Fig. 2-9) via stack emissions. The stacks provide ventilation for hoods or for specific operations within the liquid waste treatment plant, volume reduction facility, or incinerator complex. All the exhaust stacks on Buildings 1, 37, and 69 have monitoring systems that measure mixed fission products and plutonium. Samples are taken once a week. All stacks on the incinerator complex and the volume reduction facility, and some on the liquid waste treatment plant, have HEPA filtration systems to reduce emissions. The locations of the stacks and information on the filtration and monitoring system of each are summarized in Table 2-3. Extensive monitoring data on mixed fission products and plutonium from this source are summarized in Fig. 2-10 and Table 2-4.

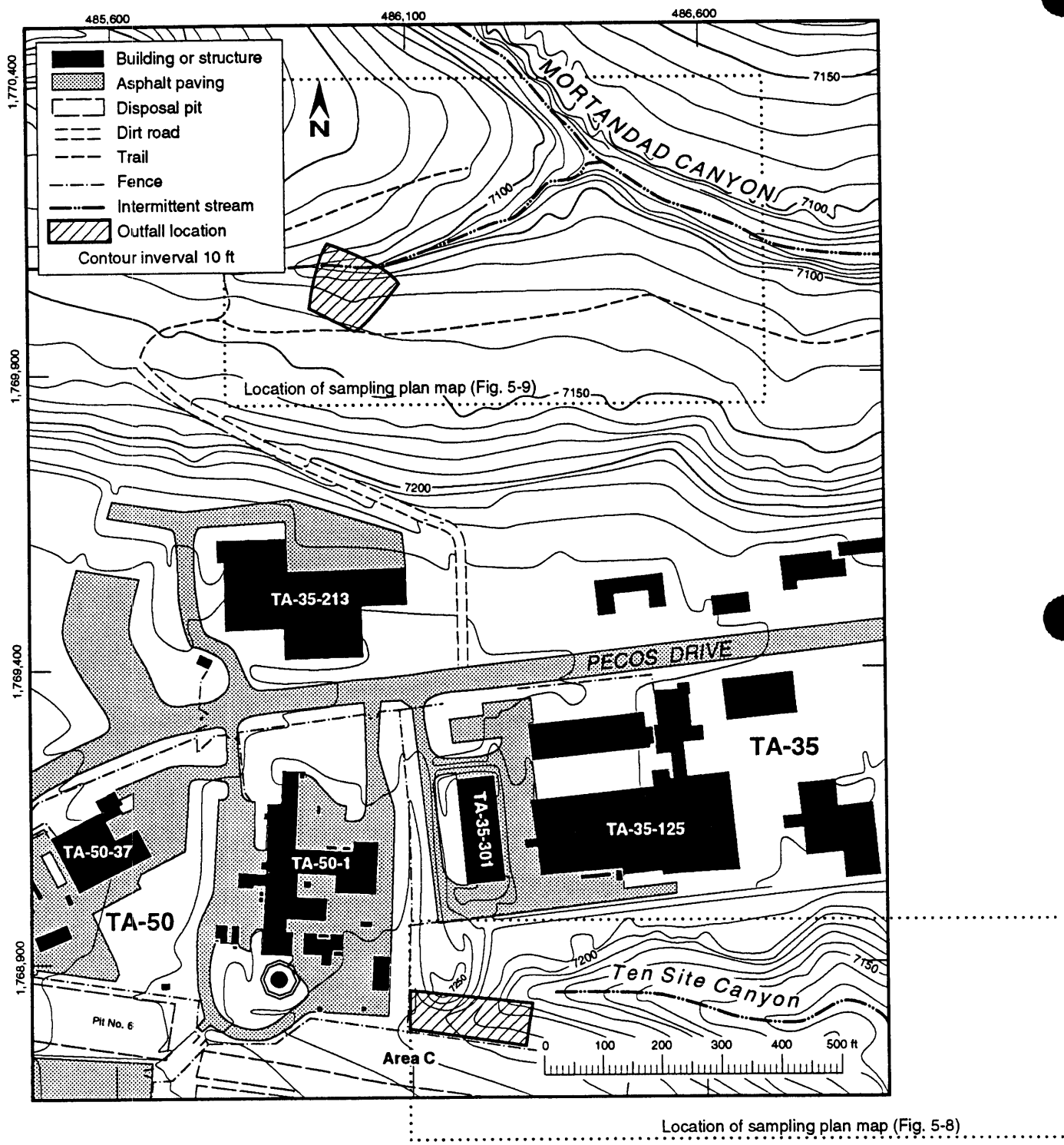


Figure 2-8 Location of outfalls at TA-50.

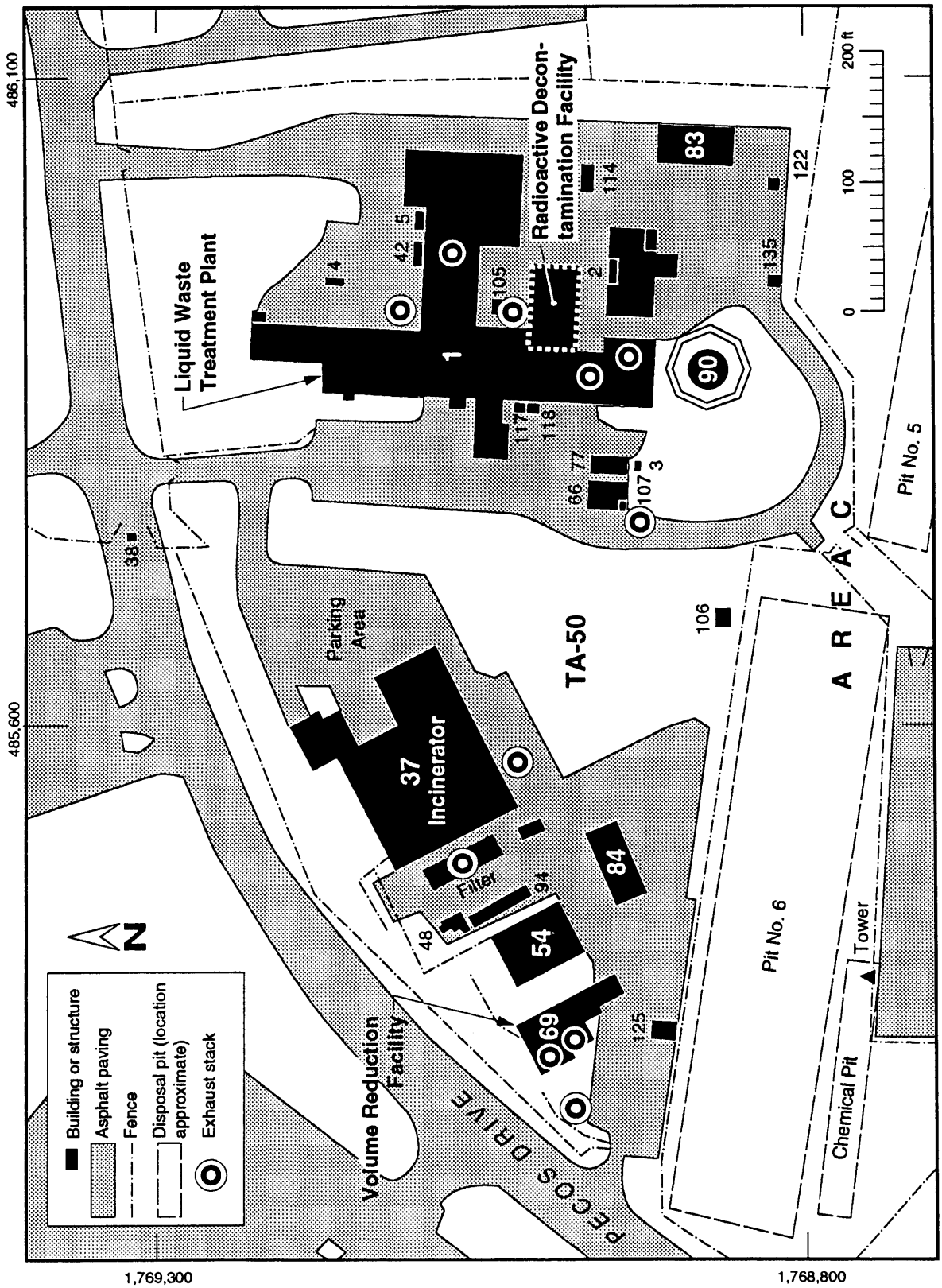


Figure 2-9 Location of stacks potentially releasing contaminants to TA-50 environs.

TABLE 2-3
SOURCES OF STACK EMISSIONS AT TA-50 TREATMENT FACILITIES

Facility	Station	Discharge Point	Source Operation	Filtering System	Monitoring System	Start-up Date	Frequency of Sampling
Liquid Waste Treatment Plant	1A	Northeast stack FE-1	Hoods	Medium- efficiency filters	HV-70 filter paper counted on impulse system	—	Weekly
	2A	Southeast hood FE-2	Hoods	Medium-efficiency filters	HV-70 filter paper counted on impulse system	—	Weekly
	3A	South stack FE-3	Hot cells, glove box, hoods	High-efficiency filters	HV-70 filter paper counted on impulse system	—	Weekly
	4A	FE-25	Plutonium sludge filtering	HEPA filters (one bank)	Sampling head with HV-70 filter media 2 ft from probe inlet. Filter counted on impulse system	—	Weekly
	5A	FE-17	Caustic and acid waste treatment	HEPA filters (two banks)	Sampling head with HV-70 filter media 4 ft from probe inlet. Filter counted on impulse system	—	Weekly
	9A	Room 60, FE-6	Pre-treatment of TRU wastes	HEPA filters	Air sampling during operation of plant, LB-5211	1983	Weekly
	10A	FE-27 (Room and hood exhaust for new decontamination area)	Decontaminati on of probes, respirators, etc.	HEPA filters	Air sampling, LB-5211	1983	Weekly
Incinerator Complex	6A	Bldg. 37, FE-1	Sorting and incineration of contaminated waste material	High-energy aqueous scrub system plus HEPA filtration	Sampling head with HV-70 filter paper 19 ft from probe inlet.Filter counted on impulse system	—	Weekly
Volume Reduction Facility	7A	FE-1 (Room exhaust)	Plutonium-239	HEPA filters	In-line filter (downstream from HEPA filters)	March 1982	Weekly
	8A	FE-3 (Process exhaust)	Plutonium-239	HEPA filters	In-line filter (down-stream from HEPA filters)	March 1982	Weekly
	11A	WM-69, FE-2 (Blower-stack exhaust)	Size reduction of plutonium-contaminated materials	Prefilters and HEPA filters	Continuous collection on filter paper disc	—	Weekly

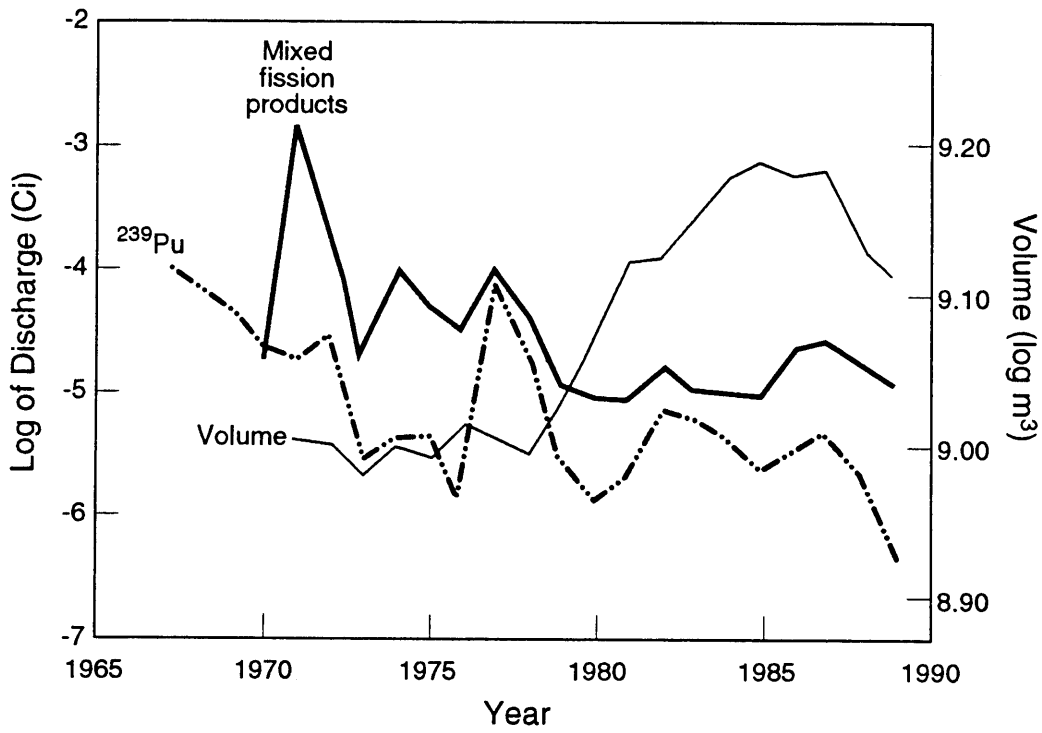


Figure 2-10 Concentrations of plutonium and mixed fission products in stack emissions from TA-50.

TABLE 2-4

ANNUAL DISCHARGES OF PLUTONIUM-239 AND MIXED FISSION PRODUCTS BY STATION (refer to Table 2-3)

	Station 1A			Station 2A			Station 3A		
Year	Volume (m^3)	MFP (Ci)	Pu-239 (Ci)	Volume (m^3)	MFP (Ci)	Pu-239 (Ci)	Volume (m^3)	MFP (Ci)	Pu-239 (Ci)
1963									
1964									
1965									
1966									
1967		--	4.2E-05		--	5.9E-05		--	--
1968		--	2.6E-05		--	4.1E-05		--	1.8E-06
1969		--	1.3E-05		--	2.8E-05		--	1.0E-06
1970		6.7E-06	7.9E-06		8.7E-06	1.2E-05		3.3E-07	4.8E-07
1971	3.100E+08	7.129E-05	4.029E-06	6.500E+08	1.105E-03	1.105E-05	5.500E+07	4.509E-06	9.348E-07
1972	3.100E+08	5.579E-05	1.116E-05	6.500E+08	8.448E-05	1.365E-05	5.500E+07	4.234E-06	2.365E-06
1973	3.900E+08	7.798E-06	1.092E-06	5.300E+08	9.008E-06	1.325E-06	4.200E+07	4.031E-07	9.238E-08
1974	3.075E+08	3.494E-05	6.671E-07	6.482E+08	5.269E-05	1.257E-06	5.449E+07	2.392E-06	2.812E-06
1975	3.700E+08	1.889E-05	1.091E-06	5.729E+08	2.541E-05	2.591E-06	4.376E+07	9.490E-07	4.611E-07
1976	3.564E-08	6.831E-06	3.959E-07	6.360E+08	2.000E-05	4.229E-07	4.717E+07	6.489E-07	2.830E-07
1977	3.497E+08	3.166E-05	4.311E-06	6.240E+08	4.307E-05	1.329E-06	4.628E+07	1.106E-05	6.399E-05
1978	3.497E+08	1.937E-05	5.510E-07	6.240E+08	1.850E-05	5.599E-06	2.136E+07	2.032E-06	1.627E-05
1979	3.497E+08	2.430E-06	4.108E-07	6.240E+08	7.736E-06	5.119E-07	2.492E+07	3.349E-07	1.910E-06
1980	3.497E+08	5.706E-06	2.749E-07	6.240E+08	1.827E-06	2.550E-07	4.628E+07	1.799E-07	5.090E-07
1981	3.497E+08	1.730E-06	3.819E-07	6.240E+08	4.999E-06	9.890E-07	4.665E+07	2.589E-07	7.861E-08
1982	3.560E+08	6.680E-06	1.100E-06	6.150E+08	4.380E-06	1.810E-06	4.540E+07	2.270E-07	2.800E-07
1983	3.500E+08	3.560E-06	2.360E-06	6.250E+08	4.530E-06	2.120E-06	4.640E+07	1.930E-07	9.200E-08
1984	3.490E+08	3.620E-06	1.360E-06	6.240E+08	4.270E-06	1.620E-06	4.620E+07	3.400E-08	2.500E-08
1985	3.580E+08	4.270E-06	1.040E-06	6.390E+08	3.520E-06	4.240E-07	4.740E+07	7.200E-08	4.700E-08
1986	3.480E+08	7.600E-06	1.530E-07	6.390E+08	9.210E-06	2.470E-06	4.690E+07	2.320E-07	7.000E-08
1987	3.140E+08	7.900E-06	2.700E-07	6.560E+08	9.500E-06	2.390E-07	4.740E+07	6.670E-07	3.620E-06
1988	2.540E+08	3.980E-06	1.460E-07	6.600E+08	7.370E-06	9.460E-07	3.610E+07	4.600E-07	1.300E-08
1989	2.440E+08	2.200E-06	1.370E-07	6.350E+08	6.930E-06	1.710E-07	3.150E+07	1.500E-08	5.000E-09

TABLE 2-4 (cont'd)

Year	Station 4A Volume (m^3)	Station 4A MFP (Ci)	Station 4A Pu-239 (Ci)	Station 5A Volume (m^3)	Station 5A MFP (Ci)	Station 5A Pu-239 (Ci)	Station 6A Volume (m^3)	Station 6A MFP (Ci)	Station 6A Pu-239 (Ci)
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972									
1973									
1974									
1975									
1976									
1977									
1978									
1979	3.296E+07	7.398E-08	6.798E-08	1.579E+07	2.299E-08	0.00E+00	3.300E+07	------	0.000E+00
1980	5.356E+07	2.350E-07	1.200E-07	2.821E+07	3.029E-07	3.999E-09	8.567E+07	-----	3.999E-19
1981	5.356E+07	5.096E-07	2.870E-07	2.821E+07	2.329E-07	4.499E-09	2.145E+08	-----	1.760E-07
1982	5.340E+07	2.570E-07	3.990E-07	2.820E+07	3.710E-07	2.870E-06	2.280E+08	2.540E-06	6.960E-08
1983	5.350E+07	1.690E-07	1.480E-07	2.830E+07	6.400E-08	1.590E-07	2.140E+08	5.450E-07	1.500E-08
1984	5.340E+07	1.950E-07	2.400E-08	2.820E+07	3.400E-08	1.930E-07	2.140E+08	1.350E-07	0.000E+00
1985	5.370E+07	9.100E-08	6.500E-08	2.830E+07	3.500E-08	1.230E-07	2.170E+08	1.750E-07	1.390E-07
1986	5.420E+07	2.720E-07	3.100E-08	2.860E+07	1.070E-07	9.400E-08	1.880E+08	1.880E-06	1.700E-08
1987	4.100E+07	3.170E-07	9.300E-08	1.730E+07	1.260E-07	6.600E-08	2.130E+08	1.580E-06	0.000E+00
1988	2.180E+07	1.300E-07	3.000E-09	1.050E+07	6.800E-08	1.000E-09	1.360E+08	7.590E-07	2.300E-08
1989	2.140E+07	3.200E-08	9.000E-09	8.100E+06	1.000E-08	1.000E-09	1.290E+08	4.990E-07	7.100E-08

TABLE 2-4 (cont'd)

Year	Station 7A Volume (m^3)	Station 7A MFP (Ci)	Station 7A Pu-239 (Ci)	Station 8A Volume (m^3)	Station 8A MFP (Ci)	Station 8A Pu-239 (Ci)	Station 9A Volume (m^3)	Station 9A MFP (Ci)	Station 9A Pu-239 (Ci)
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972									
1973									
1974									
1975									
1976									
1977									
1978									
1979									
1980									
1981									
1982	4.850E+06	-----	2.900E-09		-----	0.000E+00	-----	-----	-----
1983	1.480E+07	-----	-----	1.480E+07	-----	5.770E-07	4.560E+05	1.900E-08	1.500E-08
1984	1.480E+07	-----	1.000E-08	1.480E+07	-----	9.000E-09	1.570E+05	0.000E+00	0.000E+00
1985	1.450E+07	-----	7.000E-09	1.450E+07	-----	2.200E-08	8.100E+05	0.000E+00	1.000E-09
1986	1.350E+07	-----	1.200E-08	1.350E+07	-----	1.000E-09	6.570E+04	3.000E-09	1.100E-08
1987	1.520E+07	-----	8.500E-08	1.520E+07	-----	2.800E-08	3.620E+05	4.210E-07	0.000E+00
1988	8.760E+06	-----	9.200E-08	1.380E+07	-----	8.000E-09	2.010E+07	2.420E-07	3.000E-09
1989	8.420E+06	-----	4.000E-09	1.330E+07	-----	1.000E-08	1.970E+07	1.500E-08	4.000E-09

TABLE 2-4 (cont'd)

Year	Station 10A Volume (m^3)	Station 10A MFP (Ci)	Station 10A Pu-239 (Ci)	Station 11A Volume (m^3)	Station 11A MFP (Ci)	Station 11A Pu-239 (Ci)	Totals Volume (Log m^3)	Totals MFP (Log Ci)	Totals Pu-239 (Log Ci)
1963									
1964									
1965									
1966									
1967							-----	-----	-3.996
1968							-----	-----	-4.162
1969							-----	-----	-4.377
1970							-----	-4.803	-4.691
1971							9.006	-2.928	-4.796
1972							9.006	-3.840	-4.566
1973							8.983	-4.764	-5.601
1974							9.004	-4.046	-5.383
1975							8.994	-4.344	-5.383
1976							9.017	-4.561	-5.958
1977							9.009	-4.067	-4.166
1978							8.999	-4.399	-4.649
1979							9.033	-4.975	-5.537
1980							9.074	-5.083	-5.933
1981							9.120	-5.112	-5.717
1982							9.124	-4.840	-5.185
1983	6.370E+07	-----	6.400E-08				9.150	-5.042	-5.256
1984	1.500E+08	6.120E-07	4.260E-07				9.175	-5.051	-5.436
1985	1.540E+08	3.230E-07	1.490E-07				9.184	-5.071	-5.695
1986	1.530E+08	8.420E-07	2.000E-08				9172	-4.696	-5.541
1987	1.500E+08	1.120E-06	8.300E-08	3.800E+07	-----	2.500E-08	9.178	-4.665	-5.346
1988	1.410E+08	7.820E-07	-----	5.010E+07	-----	7.970E-07	9.131	-4.860	-5.692
1989	1.350E+08	8.400E-08	0.000E+00	4.910E+07	-----	2.000E-09	9.112	-5.010	-6.383

2.2.1.4.6.4 50-006(d)

This subunit is the treated liquid waste discharge line (No. 64) from the treatment plant to the stream channel outfall in Mortandad Canyon (Fig. 2-8). The 6-in.-diameter iron discharge pipe was rerouted in 1983 to accommodate the construction of TA-35-213, the Target Fabrication Facility. The release of treated waste into Mortandad Canyon since 1963 has resulted in an accumulation of chemicals, heavy metals, and radionuclides in stream channel sediments, bank soils, and underlying tuff. On February 12, 1985, USEPA Region VI issued an administrative order to DOE requiring modification of the outfall; the order was prompted by the ongoing erosion of the stream bank because the discharge pipe ended about 25 ft short of the stream channel. A letter submitted to EPA from DOE stated that corrective action was taken at outfall 051 (TA-50) by extending the pipe down into the stream channel. On October 15, 1986, USEPA issued notice to DOE that the administrative order was closed. This outfall is on record as having 13 NPDES outfall permit violations for iron and copper. Contaminants in Mortandad Canyon will be addressed by the ER Program as part of the Canyon Studies.

2.2.1.4.6.5 50-006(e)

This subunit is recommended for no further action (see Chapter 6).

2.2.1.4.7 Incinerator Complex: 50-007

The incinerator complex (TA-50-37; Fig. 2-9) was designed and constructed in 1975 to develop incineration methods for solid and liquid wastes containing chlorinated, fluorinated hydrocarbons, carcinogenic materials, and TRUs from the plutonium processing facility. The design feed rate for solid waste is 50 kg/hr. Between 1985 and 1989, the unit was converted from an R&D facility to a production facility. The incinerator is located in Room 112, and the solid and liquid waste feed system in Room 115, of Building 37. The liquid feed system prep room is bermed and contains no floor drains. The inventory permitted in this room is 600 gal.; the release containment system is designed to hold 110 percent of that maximum. An offgas treatment unit is associated with the incinerator complex. The exhaust air system from the incinerator includes two HEPA filters. Liquid effluent generated by the offgas aqueous scrub system is filtered to remove solids before transfer via a double, instrument-monitored pipeline to the TA-50-1 Industrial Waste Treatment Facility. Ash is immobilized in concrete before shipment to WIPP.

The incinerator is not operating at this time. The 5-yr plan originally called for incineration to resume in the latter part of FY93 but, because of delays caused by a funding shortage, the new scheduled start date is the latter part of FY94. Work is in process on an environmental assessment for the hours of operation, and a permit for incineration of toxics is being worked on by the EPA. A permanent work permit for handling mixed waste is expected to be issued in the near future (at present, the operating group has an interim work permit). A New Mexico state permit is not required to operate the incinerator.

Incinerator equipment is currently being upgraded. All process piping has been changed from fiberglass to CT76-Hasteloy. A sampling train (to take samples off the process line) and a gravity ash system have been designed, but construction has not yet been scheduled. Once begun, these two projects should take about 6 months to complete.

2.2.1.4.8 Volume Reduction Facility: 50-008

The Volume Reduction Facility (Fig. 2-9) in Building TA-50-69 is a prototype facility designed to reduce the volumes of and repackage various types of metallic waste contaminated with transuranics, such as metal ducts, plenums, and gloveboxes. These are cut up, compacted, and packaged for storage at TA-54. Operations were initiated in August of 1983. Through FY85, a total of 3,106 ft^3 of transuranic and metallic waste, including lead, has been reduced by a factor of 3.7 to 1. This facility is moderately contaminated with transuranics and associated radionuclides, but there is no evidence of release. There are no outfalls associated with this unit; all liquid wastes are processed at the radioactive waste treatment facility. Stack emissions are also monitored.

Because of the loss of key personnel, this facility has not been operated since January 1991. Operation is scheduled to restart as soon as January 1992 and will continue for the next 10 to 15 years. Long-range plans call for a larger unit to be set up at TA-54 by 1998, to cut up the waste at TA-54 and package it for shipment to WIPP.

2.2.1.4.9 Radioactive Decontamination Facility: 50-010

The vehicle decontamination pad (Fig. 2-9) is located between Buildings TA-50-1 and TA-50-2. This active site is used to clean radioactive contamination from vehicles and large objects. Only radioactive industrial waste (LLW) is brought to this area. Liquid wastes go to the tank farm (TA-50-2) via floor drain and line, and solid wastes go to Area G for burial. Contaminated acids from the "Tuff Tanks" hauled in from other technical areas are also pumped into the floor drain, either directly to TA-50-2 or to TA-50-1, where they are neutralized and then sent to TA-50-2.

The vehicle decontamination pad has been in use since 1963. In 1983, it was enclosed in a metal building. There is no evidence of routine or accidental releases at this facility.

All TRU-contaminated equipment is decontaminated in Room 36 of Building TA-50-1, not in the vehicle decontamination facility. For TRU decontamination, the floor drain in Room 36 is blocked and the equipment is manually wiped down. The wiping material and the waste are collected in plastic bags, which are then sealed in steel, 55-gal. drums.

2.2.1.4.10 Septic Systems: 50-011(a) and (b)

2.2.1.4.10.1 50-011(a)

This subunit is the original (now removed) septic system that was installed about 1964 at the south end of Building 1 and the existing tank farm (Fig. 2-11). It consisted of an effluent line from Building 1 to manhole TA-50-9 andthhaen to septic tank TA-50-10. The effluent line ran east from the septic tank to a distribution box, TA-50-11, and then into four parallel, perforated pipes running across a leach field. As TA-50 grew, the field would not handle all of the effluent, leaving standing water on the ground surface. To correct this problem, in 1978 a 4-ft-diameter hole was drilled 50 ft 9 in. deep at the east end of the leach field. A 4-in. perforated pipe was installed down the center of the hole, and the annulus was back-filled with 3/4-in. aggregate to within 4 ft of the surface. The east end of the four parallel pipes were then tied into the 4-in. perforated pipe. The entire septic system, with the exception of the 50-ft-deep hole, was removed in 1983. Currently, the leach field and a section of the effluent line between the septic tank and the field are the only portions of the old system that can be reached for core drilling.

Data on soil contamination that could be attributed to the septic system are not available. The leach field and seepage pits are located in an area of TA-50 where surface spills of liquid waste occurred (SWMU 50-006[a]). Consequently, obtaining unambiguous contaminant concentration data for this site may be impossible.

2.2.1.4.10.2 50-011(b)

This subunit is the new septic system (see Fig. 2-4), installed in 1983. Effluent lines exit near the southwest and the northwest corners of Building 1 and drain to lift stations. The sewage is pumped through 4-in. laterals at each lift station to a new 6-in. main on the west side of the building. The 6-in. main runs across Pecos Drive to a sanitary sewer manhole, then it joins the 5-in. gravity main to the disposal plant in the TA-35 area.

2.2.2 Existing Data

Data characterizing contamination levels associated with treatment facility SWMUs is very limited for radionuclides and nonexistent for hazardous chemicals. This section summarizes what is known about contaminant levels in soil at TA-50 (see also Chapter 4, Section 4.2.1.2).

50-001(a)—The only documented unintentional release from the liquid waste treatment plant was associated with the grit chamber (see Figs. 2-12 and 2-13). Sampling was done to depths of about 13 ft below the concrete floor; at 3-4 ft, wet soil containing contaminants typical of influents to the plant was encountered (Table 2-5). Very limited follow-up sampling (Table 2-6) showed the contamination was localized in a narrow (i.e., a few feet) vertical and horizontal band around and beneath the south side of the grit chamber. Input of waste to the grit chamber was stopped in July 1990 to eliminate further release of

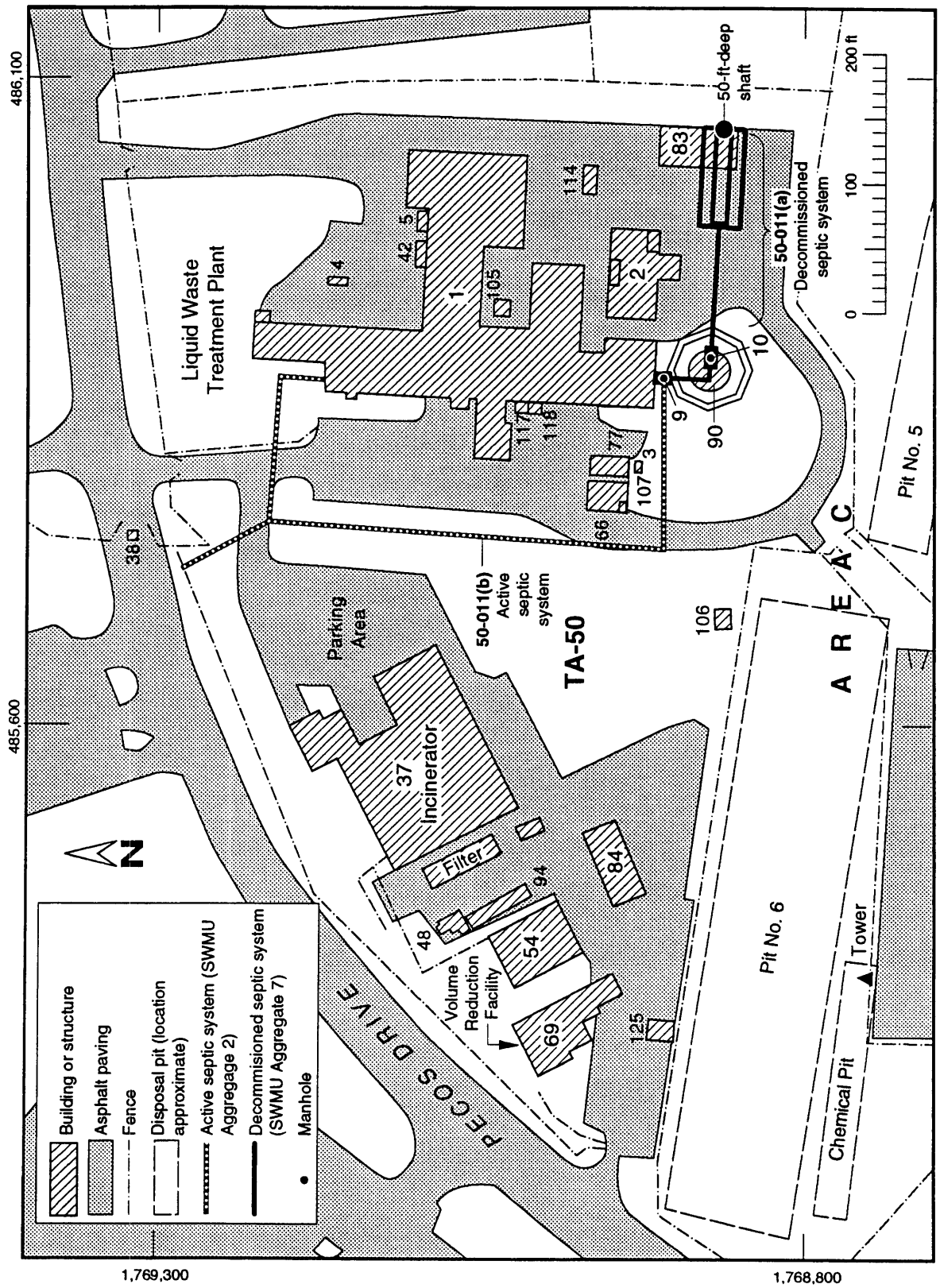


Figure 2-11 Location of septic systems at TA-50.

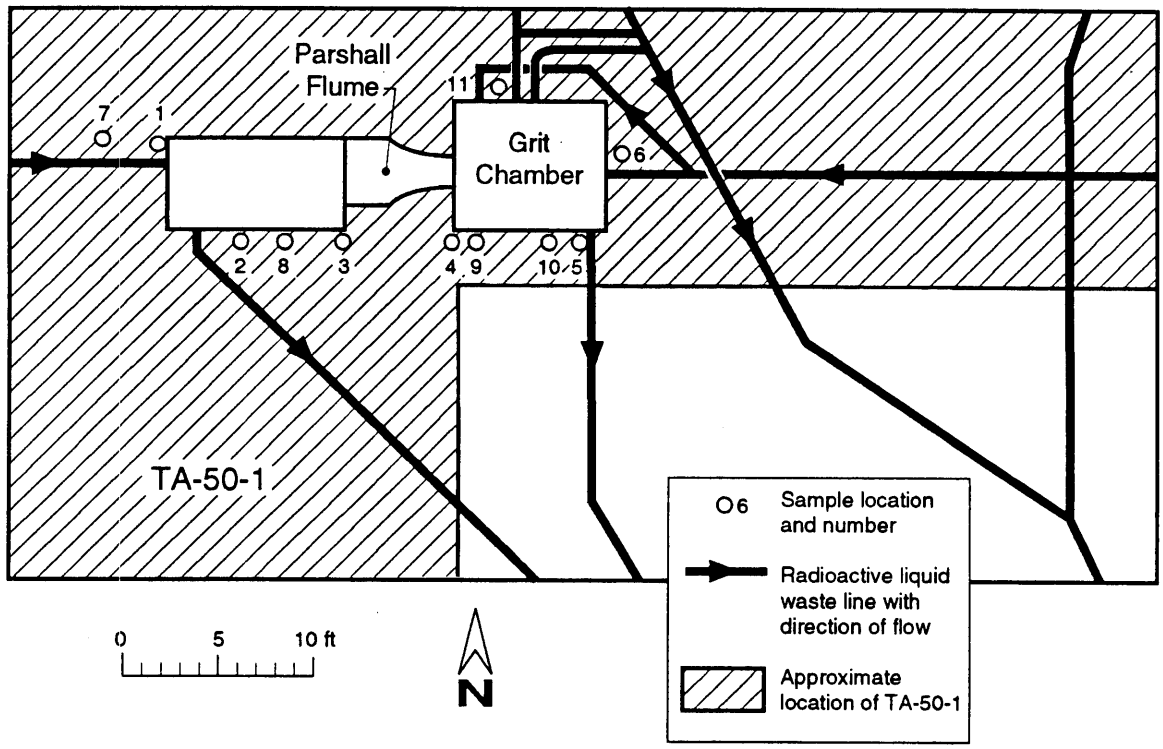


Figure 2-12 Location of IT Corporation samples around grit chamber in TA-50-1, Room 16.

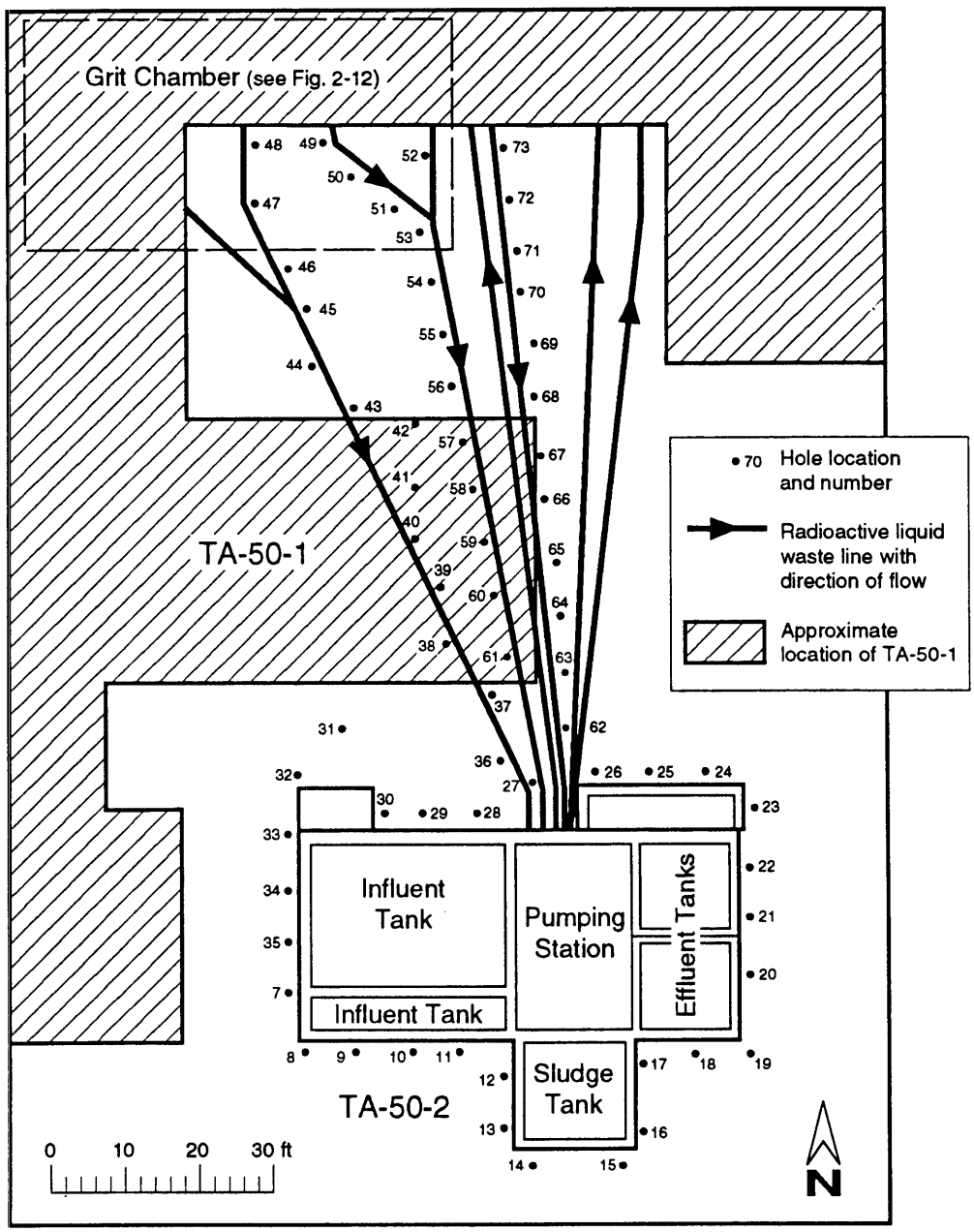


Figure 2-13 Location of IT Corporation sample boreholes in TA-50-1 and TA-50-2.

TABLE 2-5
ANALYTICAL RESULTS
FROM GRIT CHAMBER SAMPLES (SEE FIGURE 2-12)
TA-50-1, 7/31/90

Hole No.	Depth (ft)	Field Instrument Observations	Laboratory Analyses*
1	3.0	Dry, radionuclides at bottom of hole	Not done
2	3.3	Dry, no radionuclides detected	Not done
3	3.3	Dry, no radionuclides detected	Not done
4	13.3	Entered wet soil at 3 ft, exited wet soil at 6 ft; radionuclides detected in wet soil	Radionuclides
5	13.3	Entered wet soil at 4.5 ft; radionuclides detected in wet soil	Radionuclides
6	9.0	Dry, no radionuclides detected	Not done
7	9.0	Dry, no radionuclides detected	Hazardous waste and radionuclides
8	9.0	Dry, radionuclides detected at 4 ft	Hazardous waste and radionuclides
9	9.0	Entered wet soil at 3 ft; radionuclides detected	Hazardous waste and radionuclides
10	9.0	Entered wet soil at 4.5 ft	Hazardous waste

* Bis-2-Ethylhexyl phthalate — ppb levels
Methylene Chloride — 9 ppb sample
1,2,4-Trimethylbenzene — 6 ppb sample
Americium-241 — 26 nCi/g
Europium-152 — 0.8 nCi/g
Cesium-137 — 0.4 nCi/g
Gross Alpha — 60 nCi/g

TABLE 2-6
RADIONUCLIDE CONCENTRATIONS IN BOREHOLE SOIL SAMPLES COLLECTED AROUND THE GRIT CHAMBER (TA-50-1, ROOM 16) ON 8/6/90 AND 8/7/90

Location (see Fig. 2-12)	Radionuclide	Concentration
3	Gross Alpha	1.3 nCi/g
	Americium-241	640 pCi/g
	Europium-152	190 pCi/g
	Cesium-137	50 pCi/g
	Cobalt-60	140 pCi/g
	Plutonium-239	900 pCi/g
	Plutonium-238	110 pCi/g
5*	Gross Alpha	25/6.3 n/Ci/g
	Americium-241	13/1.8 nCi/g
	Europium-152	160/200 pCi/g
	Cesium-137	50/60 pCi/g
	Cobalt-60	40/40 pCi/g
	Plutonium-239	17/4.8 nCi/g
	Plutonium-238	1.1/280 pCi/g

*Two samples analyzed for radionuclides.

contaminants, but no cleanup of the contaminated soil around the chamber has been attempted.

50-001(b)—No releases from the current influent waste lines and manholes have been documented. Although the double (encased) waste lines from TA-55 do not pass a vacuum test for integrity, leak detection systems have never indicated the presence of liquids.

50-002(a), (b), (c), and (d)—No releases have been documented from the tanks and drainlines currently used to transport wastes between storage and treatment areas.

50-003(a), (b), (c), (d), and (e)—No releases from the drum storage areas have been documented.

50-004(a), (b), and (c)—The old influent waste line (50-004[a]) into TA-50 was known to have leaked, on the basis of samples taken when the line was removed in 1975. Soils surrounding the old line were cleaned to ALARA standards using portable radiation-detection instruments to guide the effort. The old tank farm (50-004[b]) was also known to have leaked, from two accidental spills to Ten Site Canyon (SWMU 50-006[a]) and from sampling during removal of the structures in 1989. Contaminated soil was cleaned up to ALARA standards. Finally, the lines and manholes making up the original waste transfer system were known to have leaked, from sampling done during structure removal (1981-1989). Again, cleanup was to ALARA levels. Levels of contaminants remaining after cleanup of these SWMUs ranged from a few pCi/g to a few nCi/g (Elder et al. 1986, 0456).

50-005—This SWMU is recommended for no further action (see Chapter 6).

50-006(a) is the site of two spills of raw waste into Ten Site Canyon, caused by overflows at the new tank farm (50-002[a]). Gross alpha levels up to 50,000 dpm/g were measured soon after the leaks were discovered and were probably due primarily to americium-241. A partial cleanup at the spill discharge area (i.e., a few feet from the overflow outfall area in Ten Site Canyon) reduced levels of alpha emitters to a few hundred pCi/g, within the range of background.

50-006(b) and 50-006(e) are the sites of suspected mineral oil and diesel fuel spills for which no evidence was found. They are recommended for no further action during this RFI (see Chapter 6).

50-006(c) relates to surface soil contamination (plutonium and mixed fission products) from stack emissions at the three treatment facilities (see Fig. 2-2). The sources of these emissions are given by facility in Table 2-3. Annual discharges of plutonium-239 and mixed fission products are summarized in Table 2-4 and Fig. 2-10. In general, the plutonium and mixed fission product releases in stack air have declined or remained steady over the years of operation, even though the volume of stack air has increased in recent years. Discharges are now regulated under an NPDES permit.

50-006(d) is the treated liquid waste effluent outfall from Building 1. The quantities of radionuclides in treated liquid waste discharged to Mortandad Canyon are given in Table 2-7, and concentrations of nonradioactive inorganic contaminants are given in Table 2-8. Figure 2-14 shows the quantities of several contaminants released as a function of time. The quantity of plutonium-238 in treated liquid effluent exceeded those of plutonium-239 and americium-241 during the early years of operations, then dropped below them when the plutonium production facility at TA-55 went on line in 1978. Some of the nonradioactive inorganic contaminants released to Mortandad Canyon were found at levels above drinking water standards. However, the water in Mortandad Canyon does not supply any industrial, agricultural, or municipal needs (ESG 1989, 0308).

50-007—The incinerator complex has had no documented releases that were unauthorized by the operating permit.

50-008—The volume reduction facility has had no documented unauthorized releases.

50-010—The decontamination facility has had no documented releases of contaminants.

50-011—The old and new septic systems have had no documented releases of radionuclides or hazardous chemicals.

In summary, most of the data that do exist on radionuclide levels in surface and subsurface soils associated with treatment facility SWMUs are of limited value in assessing contamination at the site, because they are qualitative (instrument readings) and poorly distributed in space, and the sampling locations cannot be reliably identified. Very little data exist on nonradionuclides around potential release sites.

2.3 Area C Landfill: SWMU 50-009

2.3.1 Description and History

The Area C Landfill at TA-50 (Fig. 2-15) was established in May 1948 as a replacement for Area B at TA-21. Area C is completely fenced, covers 11.8 acres, and consists of 7 pits, 107 shafts, and one unnumbered shaft that was used for a single strontium-90 disposal. The landfill was used from May 1948 to April 1974 but received waste only intermittently from 1968 to 1974. A chronology of the major events pertinent to Area C is presented in Table 2-9 and a list of interred contaminants (based on site logbooks) in Table 2-10.

The pits and shafts at Area C were excavated into the overlying soil and the Tshirege member of the Bandelier Tuff (a consolidated, but fractured, pyroclastic rock). About 1300 feet of unsaturated rock separates the trenches and pits from the main aquifer (Rogers 1977, 0216). Surface drainage is to the northeast into Ten Site Canyon, a branch of Mortandad Canyon (see Fig. 2-15).

TABLE 2-7
RADIONUCLIDES DISCHARGED IN TREATED LIQUID WASTE VIA MORTANDAD OUTFALL

Year	Volume (L)	Nuclides (curies)							
		Pu-239	Pu-238	Am-241	Sr-89	Sr-90	Alpha (unidentified)	Beta & Gamma (unidentified)	Cs-137
1963	2.738E+07	1.600E-03			1.486E-01	3.970E-02	3.708E-03	1.594E-01	
1964	5.139E+07	1.940E-03			6.074E-02	8.865E-02	1.198E-03	2.525E+00	
1965	4.899E+07	3.490E-03			4.229E-02	6.177E-02	1.886E-03	7.084E-01	
1966	5.280E+07	1.620E-03			2.436E-02	3.558E-02	2.092E-03	3.382E-01	
1967	5.967E+07	4.220E-03			5.350E-02	1.340E-02	3.420E-03	3.091E-01	
1968	6.028E+07	2.590E-03			3.260E-02	8.200E-04	2.570E-03	2.858E-01	
1969	5.447E+07	6.780E-03			5.460E-02	1.310E-02	6.600E-03	2.893E-01	
1970	5.317E+07	4.980E-03			1.360E-02	1.980E-02	3.300E-03	1.614E-01	
1971	4.567E+07	6.910E-03			1.253E-02	3.159E-02	3.940E-03	1.849E+00	
1972	5.707E+07	1.022E-03	7.687E-03		3.523E-03	5.500E-03	5.131E-03	3.747E-01	
1973	5.372E+07	5.810E-04	8.394E-03	1.356E-03	4.546E-03	7.098E-03	4.239E-03	9.586E-01	2.927E-01
1974	4.060E+07	3.880E-04	1.140E-02	1.660E-03	2.870E-03	1.590E-02		1.810E-01	1.560E-01
1975	3.972E+07	6.720E-04	1.480E-02	1.130E-03	1.700E-03	5.440E-03		1.200E-01	1.740E-01
1976	3.989E+07	1.050E-03	7.480E-03	1.140E-03	9.200E-04	4.170E-03		1.550E-02	1.930E-01
1977	4.209E+07	1.470E-03	2.570E-03	1.930E-03	2.260E-03	3.040E-02		7.630E-02	1.420E-01
1978	4.054E+07	1.830E-03	4.050E-03	1.730E-03	2.640E-03	1.040E-02		9.630E-02	3.170E-01
1979	4.858E+07	1.710E-03	5.500E-04	4.680E-03	6.070E-03	1.420E-02		7.070E-02	1.700E-01
1980	5.283E+07	8.200E-03	1.300E-03	5.700E-03	4.090E-02	1.800E-02			1.320E-01
1981	5.533E+07	5.500E-02	2.900E-03	2.300E-02	4.200E-02	2.300E-02			1.200E-01
1982	3.976E+07	1.660E-02	3.000E-03	1.780E-02	1.180E-02	1.280E-02			2.090E-01
1983	3.450E+07	4.200E-02	1.100E-02	3.800E-02	5.7000E-02	2.300E-03			
1984	3.503E+07	8.100E-03	6.100E-03	8.200E-03	2.600E-01	6.800E-03			
1985	2.860E+07	5.750E-03	3.930E-03	5.420E-03	9.040E-03	1.250E-03			
1986	3.050E+07	3.550E-03	1.500E-03	3.240E-03	9.200E-03	6.930E-04			1.800E-02
1987	2.660E+07	3.200E-03	1.400E-03	3.600E-03	6.400E-02	1.00E-03			8.100E-03
1988	2.930E+07	3.200E-03	1.100E-03	3.700E-03	8.100E-02	2.00E-04			3.100E-02
1989	2.280E+07	2.000E-03	5.100E-04	4.100E-03	1.800E-02	1.100E-03			3.900E-02
Total	1.1713E+09	1.905E-01	8.972E-02	1.264E-01	1.060E+00	4.647E-01	3.858E-02	8.524E+00	2.001E+00

TABLE 2-7 (cont'd)

Year	Nuclides (curies)								
	H-3	U-235	U-238	U-NAT	U-234	Mn-54	Co-56	Co-57	Co-58
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972	5.971E+00								
1973	1.747E+01								
1974	4.050E+00	1.920E-03							
1975	2.600E+01		6.430E-05						
1976	1.870E+02		3.097E-05						
1977	3.650E+01		3.596E-05						
1978	1.230E+01			5.861E-05					
1979	3.270E+01		2.000E-04		2.100E-04				
1980	4.490E+01				4.600E-04				
1981	1.700E+01				9.000E-04				
1982	1.420E+01				1.200E-03				
1983	8.700E+00				7.200E-03				
1984	1.300E+01				3.800E-03				
1985	6.940E+01				4.300E-04				
1986	7.250E+01				2.430E-03				
1987	1.000E+02				1.600E-03				
1988	2.100E+01				8.000E-04				
1989	1.600E+01				4.700E-04	2.700E-03	5.700E-03	2.000E-02	1.900E-02
Total	6.987E+02	1.920E-03	3.312E-04	5.861E-05	1.955E-02	2.700E-03	5.700E-03	2.000E-02	1.900E-02

TABLE 2-7 (cont'd)

	Nuclides (curies)					
Year	Co-60	Se-75	Rb-83	Rb-84	Sr-85	Total
1963						3.530E-01
1964						2.678E+00
1965						8.178E-01
1966						4.019E-01
1967						3.836E-01
1968						3.244E-01
1969						3.704E-01
1970						2.081E-01
1971						1.904E+00
1972						6.369E+00
1973						1.875E+01
1974						4.421E+00
1975						2.632E+01
1976						1.872E+02
1977						3.676E+01
1978						1.273E+01
1979						3.297E+01
1980						4.511E+01
1981						1.727E+01
1982						1.447E+01
1983						8.857E+00
1984						1.329E+01
1985						6.943E+01
1986						7.254E+01
1987						1.001E+02
1988						2.112E+01
1989	4.800E-03	1.100E-01	2.300E-01	2.600E-02	1.000E-01	1.658E+01
Total	4.800E-03	1.100E-01	2.300E-01	2.600E-02	1.000E-01	7.117E+02

TABLE 2-8

AVERAGE CONCENTRATIONS OF NONRADIOACTIVE INORGANIC CONTAMINANTS RELEASED TO MORTANDAD OUTFALL (mg/L)

	Volume (L)	Cd	Cs	Cl	Cr (total)	Cu	F	Hg	Mg
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972									
1973	5.370E+07	0.036	33	60	<0.027	<0.32	1.5	0.016	5
1974									
1975									
1976									
1977									
1978	4.058E+07	0.003	26	48.4	0.04	0.27	3.8	0.009	1.4
1979	4.858E+07	0.001	74.4	50	0.022	0.41	2.9	0.003	6.3
1980	5.283E+07	0.003	81	50	0.02	0.18	3.6	0.002	2.7
1981	5.533E+07	0.003	85	57	0.037	0.23	15.1	0.006	4.8
1982	3.976E+07	0.029	56	82	0.046	0.23	20	0.007	2.3
1983	2.873E+07	0.007	47	90	0.05	0.41	15.8	0.008	3.3
1984	3.500E+07	0.003	120	84	0.13	0.44	12	0.0013	4
1985	2.860E+07	0.001	47	100	0.06	1.0	28	0.001	1.6
1986	3.000E+07	0.00057	140	170	0.029	0.36	18	0.0022	0.55
1987	2.660E+07	0.0011	170	150	0.024	0.33	12	0.00049	1.1
1988	2.930E+07	0.00029	205	102	0.016	018	6	0.00042	0.4
1989	2.280E+07	0.011	201	182	0.032	0.15	10	0.0004	0.8

TABLE 2-8 (cont'd)

	NA	Pb	Zn	CN	COD	NO_3	PO_4	TDS	pH
1963									
1964									
1965									
1966									
1967									
1968									
1969									
1970									
1971									
1972									
1973	310	<0.41	<0.03		38	310	0.3	1148	7.1-11.7
1974									
1975									
1976									
1977									
1978	354	0.04	0.46	0.04	51	90	0.44	1345	6.8 -12.3
1979	489	0.04	0.22	0.04	60	156	1.07	2302	9.1 -12.8
1980	690	0.00	0.22	0.034	59	176	0.43	2060	6.8 -12.7
1981	645	0.02	0.25	0.032	44	262	1.5	2625	6.9 -12.6
1982	883	0.03	0.07	0.086	59	335	0.91	3400	10.9 -12.5
1983	1063	0.03	0.13	0.02	75	384	2.2	4060	7.0 -12.8
1984	972	0.02	0.24	0.082	73	331	0.62	3400	7.0 -12.8
1985	896	0.01	0.10	0.3	84	376	1.6	3570	6.9 -11.7
1986	850	0.01	0.16	0.26	180	410	0.29	3780	7.6 -12.7
1987	920	0.05	0.32	0.3	100	476	1.5	4150	6.98- 7.77
1988	693	0.04	0.08	0.26	38	384	0.24	3120	7.0 - 7.9
1989	833	0.02	0.11	0.27	44	488	0.29	4070	7.5 - 7.9

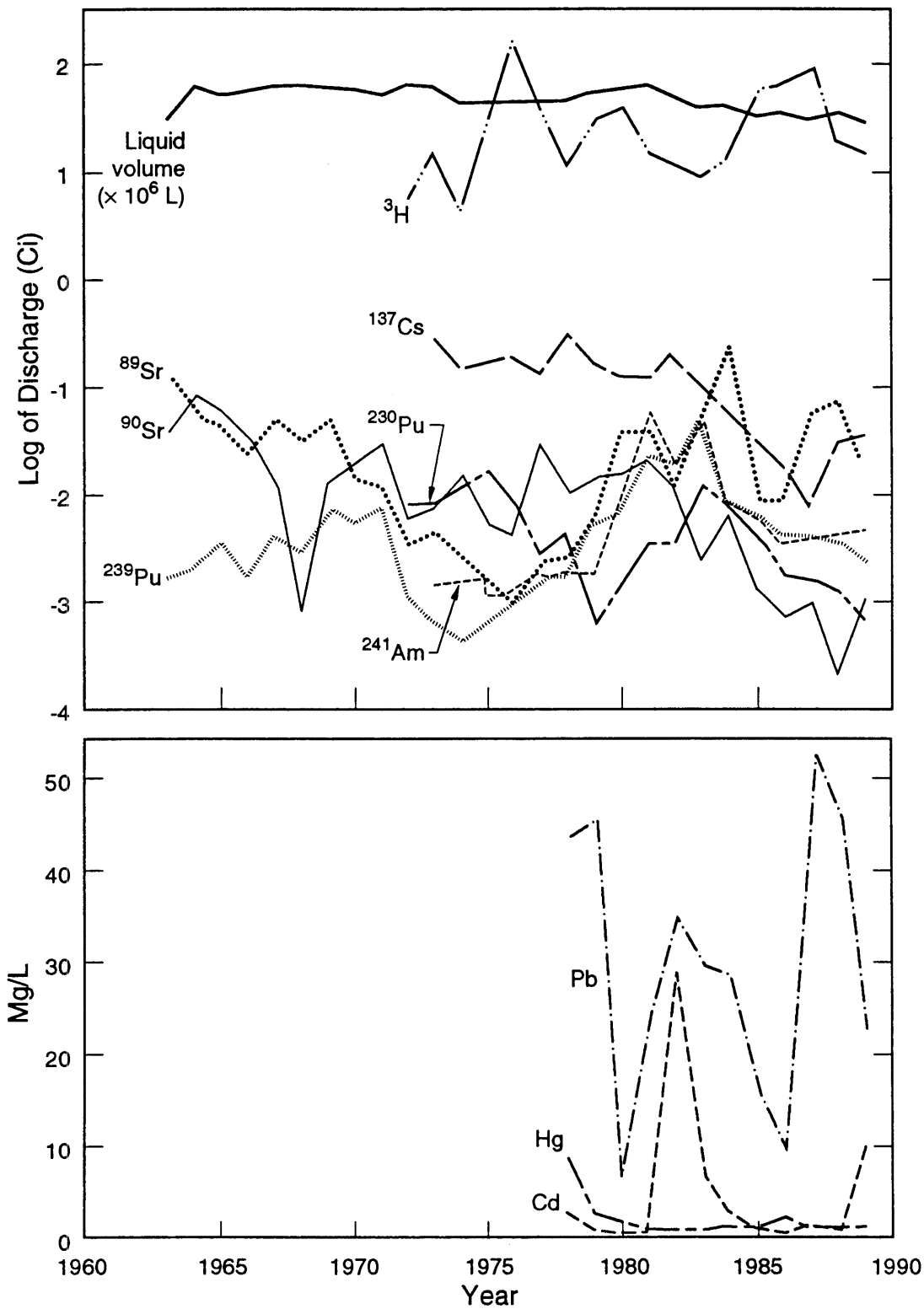


Figure 2-14 Concentrations of radioactive and chemical constituents in treated liquid effluent released to Mortandad Canyon.

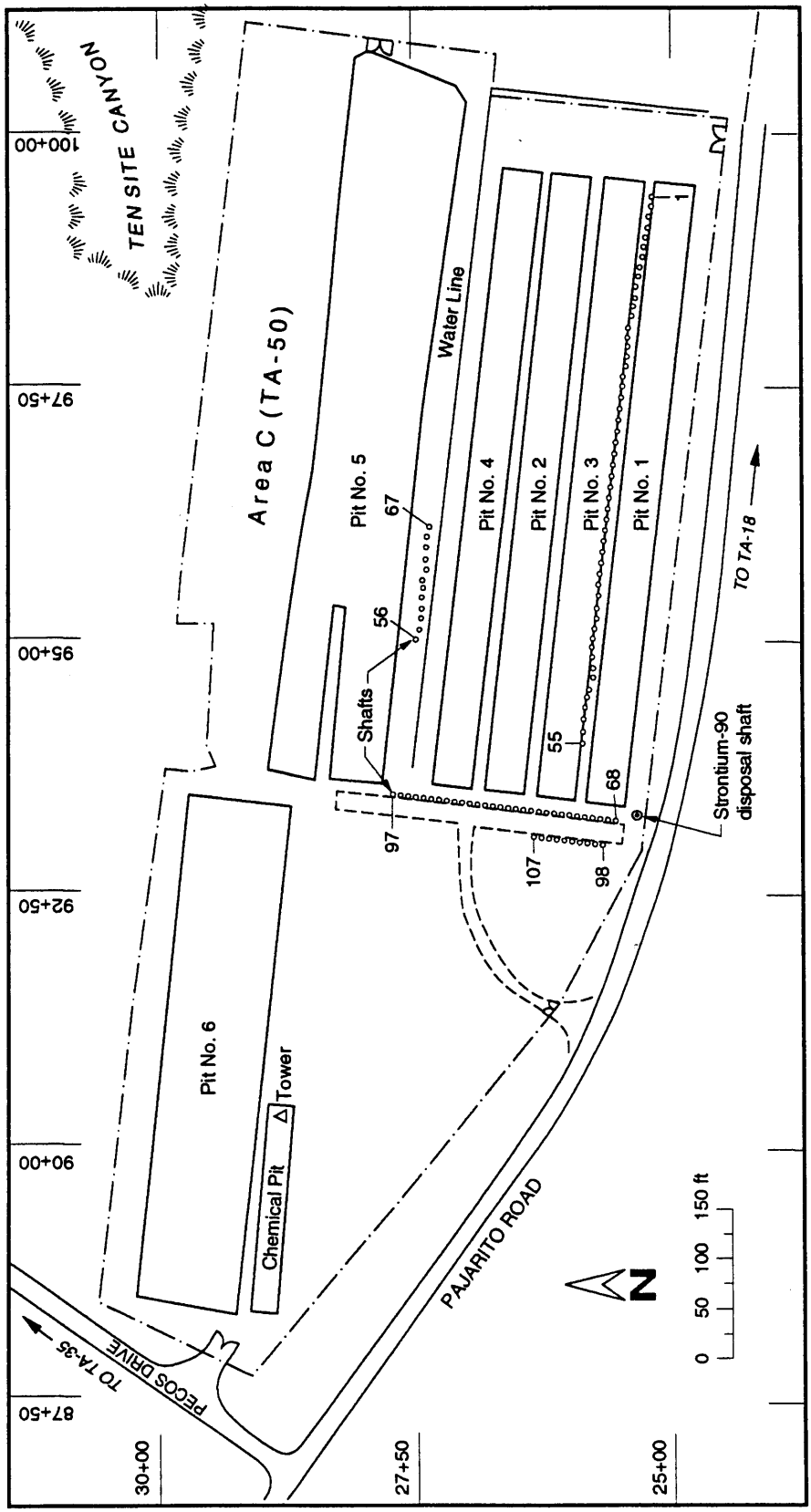


Figure 2-15 Location of shafts and pits at Area C, TA-50.

TABLE 2-9

CHRONOLOGY OF MAJOR EVENTS
DURING USE OF THE AREA C LANDFILL

Use of Pits

Pit No.	Became Active	Became Inactive
1	11/24/48	09/28/51
2	04/29/50	09/28/51
3	10/01/51	04/27/53
4	10/01/51	02/09/55
5	04/28/53	09/24/59
6	10/22/56	09/24/59
Chemical Pit	early 1960	06/01/64

Other Events

Shafts 56-67 drilled and used	02/28/58 - 10/20/59
Six Standard Operating Procedures for waste disposal operations prepared	1961
Idea of 60-ft-deep disposal shafts considered by USGS	1962
One infiltration test performed in Pit B, north of Pecos Drive (near Area C)	1966
Solid Waste Operations personnel proposed that H-1 seal the disposal shafts	1967
Shafts 1-55 drilled and used	11/10/59 - 05/26/67
Shafts 68-107 drilled and used	10/08/62 - 02/11/66
Strontium-90 shaft drilled and used	early 1950s
Five fires occurred	1950-1958
Infiltration tests performed in Pits A and B (near Area C)	09/56-1960

TABLE 2-9 (cont'd)

Other Events (cont'd)	
One infiltration test performed in Pit B, north of Pecos Drive (near Area C)	1966
Soil samples collected for geotechnical testing	04/14/71 - 04/15/71
Soil and vegetation samples collected at 86 locations	09/09/76 - 09/14/76
Soil samples collected for radiochemical analysis	1977
Animal intrusion into pits, other problems	Late 1970s
Phoswich and micro R meter survey at 5 locations along perimeter of Area C	1980
Soil samples collected at 18 locations within Area C	03/18/81
Gross alpha, gross beta, and gross gamma soil survey	1982
Soil samples collected at 2 locations within Area C	1983
Area C surface improved by adding a surface cover, recontouring, and seeding	1984
Soil samples collected at 161 locations	1985
Phoswich and RASCAL meter survey on soil and vegetation	1986
Soil gas survey at 18 locations	1988

TABLE 2-10

LIST OF CONTAMINANTS PRESENT IN AREA C

	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Chem Pit	^{90}Sr Shaft*	Shafts 1-55	Shafts 56-67	Shafts 68-107
Trichloroethylene	x	x	x	x	x	x					
Boron (Total)	x	x	x	x	x	x					
Tritium	x	x	x	x	x	x					x
Americium-241	x	x	x	x	x	x			x		x
Uranium (Total)	x	x	x	x	x	x	x		x		x
Sulfuric Acid	x	x	x	x	x	x	x				
Biological Waste	x	x	x	x	x	x			x		x
Graphite	x	x	x	x	x	x					x
Classified Material	x	x	x	x	x	x	x		x		x
Plutonium (Total)	x	x	x	x	x	x	x		x		x
Cyanide	x	x	x	x	x						
Mercury (Total)	x	x	x	x	x	x					
Actinium-227				x	x	x			x		x
Radium-226	x	x	x	x	x	x			x		x
Acids (unspecified)	x	x	x	x	x	x	x				
Lead (Total)	x	x	x	x	x	x		x	x		x
Zirconium (Total)					x	x			x		x
Waste Oil	x	x	x	x	x	x					
Silver (Total)				x	x	x			x		x
Beryllium (Total)			x	x	x	x			x		x
Strontium-90								x	x	x	x
Mixed fission products									x	x	x
R.S. (Radiation Sources)									x	x	x
I.A. (Induced Activity)									x		x

*This shaft received only a single strontium-90 source before being sealed with concrete.

2.3.1.1 Disposal Pits

Disposal Pits at Area C were used for burial of hazardous chemicals, uncontaminated classified materials, and radioactive materials. Enders (personal communication 1990, 07-0003) stated that TRU waste was buried in unknown quantities in these pits.

Pits 1-4 are located in the southwest quarter of the area (see Fig. 2-15). Enders (personal communication, 1990, 07-0003) recalled the dimensions of Pits 1-4 as about 610 ft long by 40 ft wide and no more than 25 ft deep (Table 2-11). On LANL Engineering Drawing ENG-R 1264, the pits are shown as scaled dimensions. However, there is no record that the Engineering Department ever surveyed these pits before they were dug or while they were open. (The Area C landfill was put into use with some urgency, because a serious fire had occurred at Area B.)

Pit 5, located to the north of Pits 1-4, measures 110 ft x 705 ft x about 18 ft at its deepest point; Pit 6, in the northwest quarter of Area C, is 100 ft x 505 ft x about 25 ft at its deepest point. The seventh pit, the chemical pit, is located south of Pit 6 and measures 25 ft x about 180 ft and is estimated to be 12 ft deep (Enders, personal communication 1990, 07-0003).

Pit 1 was used from 11/24/48 to 09/28/51. Notes from LANL Logbooks (LASL 1973, 07-0017) 2587 and 3478 indicate that trichloroethylene (TCE), boron, sulfuric acid, graphite, medical lab solutions (biological waste), and contaminated materials and trash (specific contaminants unknown) were interred in Pit 1 (see Table 2-10). The TCE originated from the TRU building, the boron from the Sigma Units, and the sulfuric acid from the Rat Lab. Pit 2 was used from 04/29/50 to 09/28/51. Notes from LANL Logbooks 2587 and 3478 indicate that TCE and contaminated materials and trash (specific contaminants unknown) were disposed of in this pit. Again, the TCE originated from the TRU building. Pit 3 was used from 10/01/51 to 04/27/53. Notes from LANL Logbook 4644 indicate that mercury teplers, tritium glassware, cyanide solutions, and contaminated materials and trash (specific contaminants unknown) were interred in this pit. Pit 4 was used from 10/01/51 to 02/09/55. Notes from LANL Logbooks 4644 and 6030 indicate that tritium-contaminated glassware, boxes, and urine samples, mercury teplers, actinium-227, vials of radium-226, cyanides and cyanide solutions, a 5-gal. can of actinium waste, empty bottles, and contaminated materials and trash (specific contaminants unknown) were disposed of in Pit 4.

Pit 5 was used from 04/28/53 to 09/24/59. Notes from LANL Logbooks 6030, 7277, and 9593 indicate that batteries (acids and lead), a 5-gal. can of actinium-227 waste, lead bricks, vials of radium-226, zirconium shavings, cyanides and cyanide solutions, "hot" (radionuclide-contaminated) waste oil, empty bottles, silver nitrate, beryllium chips, tritium-contaminated boxes and urine samples, and contaminated materials and trash (specific contaminants unknown) were disposed of in Pit 5.

TABLE 2-11
LOCATIONS AND DIMENSIONS OF PITS AND SHAFTS AT AREA C LANDFILL

	Location	Operation Dates		Pit Length/ Shaft Diameter (ft)	Width (ft)	Depth (ft)
		Start	End			
Pit 1	SW Quarter	May 1948	June 1949	610	40	NA [2]
Pit 2	SW Quarter	Apr 1950	Apr 1953	610	40	NA [2]
Pit 3	SW Quarter	Apr 1950	Apr 1953	610	40	NA [2]
Pit 4	SW Quarter	Apr 1950	Feb 1955	610	40	NA [2]
Pit 5	N of Pits 1-4	Apr 1953	Nov or Dec 1964	705	110	18
Pit 6	NW Quarter	Feb 1956	Aug 1960	505	100	25
Chemical Pit	S of Pit 6	Early 1960	Sum 1964	180	25	12
Shafts 1-55	Between Pits 1 and 3	Fall 1959	[1]	2	NA	15
Shafts 56-67	Between Pits 4 and 5	1959	[1]	2	NA	10
Shafts 68-107	West of Pits 1-4	1964	[1]	1 or 2	NA	20 to 25
Shaft 108	SW of Pit 1	NA	[1]	NA	NA	NA

[1] Last shaft plugged with concrete on April 8, 1974.
[2] Not more than 25 ft.
NA = not available.

Radioactive materials disposed of in Area C, and presumably in Pits 1-5, include uranium-233, -235, -236, and -238; depleted uranium; tritium; americium-241; and plutonium-238 and -239.

Pit 6 was used from 10/22/56 until late 1959. Notes from LANL Logbooks 9593, 11363, and 9293 indicate that "hot" oil, tritium-contaminated oil, copper sheets, cobalt chips, bottles of cadmium boron tungstate, tritium contaminated boxes and cans, a can of oil (specific type unknown), approximately 100 Ci of source-strength cobalt-60, a lanthanum source, 10 bottles of platinum chloride, beryllium chips, carbon-14-contaminated graphite, a plutonium slug, and contaminated materials and trash (specific contaminants unknown) were disposed of in Pit 6. Tungsten may also be present in this pit.

As pit use was being phased out in Area C and started in Area G, the idea of a separate disposal pit for hazardous (nonradioactive) chemicals was accepted. Through the years, chemical wastes were responsible for many fires at Areas B and C (Enders, personal communication 1990, 07-0003). A memo dated November 12, 1959 (Rogers 1977, 0216) proposes that part of Pit 6 be used as the "permanent chemical disposal area." Another memo (dated November 2, 1959), however, states that covering of Pit 6 to ground level began September 24, 1959, and was finished October 2, 1959.

It appears that the chemical pit was dug in early 1960 and was used from that time until 06/01/64. The pit was fenced off from the rest of Area C and was used for burial of a variety of chemicals, pyrophoric metals, natural uranium powders and hydrides, sealed vessels containing sodium-potassium alloy, compressed gases, and unspecified equipment. Undoubtedly, some plutonium- and uranium-contaminated objects were inadvertently placed in the pit. It should therefore be assumed that the pit is mildly alpha-contaminated. No high explosives were ever interred in this pit. Over the course of its use, low-level radioactive waste placed in the pit may have included cardboard boxes containing materials from the chemistry labs, as well as 55-gal. barrels of sludge from the waste treatment plants at Building 35, DP West, and TA-45. Hazardous chemical disposal at Area C ceased in 1964, when Area L at TA-54 became the new site.

2.3.1.2 Disposal Shafts

2.3.1.2.1 Group 1

The first disposal shafts at Area C were used from 02/28/59 to 10/20/59, for burial of beta- and gamma-contaminated waste derived from the CMB-DO-GS (known as the CMB dogs) at TA-35. (These shafts would later be used by other groups as well, for disposal and storage.) They are locarted between Pits 4 and 5, are on 7-ft-6-in. centers, and measure 2 ft in diameter by 10 ft deep. Originally numbered 1-12, the shafts were renumbered 56-67 by S. E. Russo, ENG-3, on 11/03/62, to keep the numbers sequential with those of other shafts that were subsequently constructed.

Notes from LANL Logbook 9593 indicate that shafts 56-67 received barium, tritium, radium, lanthanum-140, strontium-89 and -90, tantalum, cerium waste, two cerium sources, fission products, one lanthanum-140 static source,

phosphoric acid, depleted uranium, a charcoal trap, and pollonium-beryllium-fluorine compounds (see Table 2-10).

2.3.1.2.2 Group 2

Shafts 1-55, the second group drilled at Area C, were used from 11/10/59 to 05/26/67 for continued burial of beta- and gamma-contaminated waste derived from the CMB-DO-GS at TA-35 and elsewhere. These shafts were also used by other groups for disposal and storage. Located between Pit 1 and Pit 3, they are on 7-ft-6-in. centers and measure 2 ft in diameter by 15 ft deep.

Notes from LANL Logbooks 9593 and 11363 show that shafts 1-55 received barium-140, lanthanum-140, fission products from the Omega Reactor, uranyl phosphate, graphite slugs, a cobalt-60 capsule, radioactive graphite waste, radioactive tantalum, 1 g of irradiated plutonium, thallium, irradiated uranium graphite, lead-beryllium sources, thorium, cesium, strontium, plasma thermocouples, fuel elements (rods), cobalt-60 slugs and sources, sulfuric acid solution, zirconium carbide, a copper sphere, two "Rabbit" tubes of beryllium, reactor seals, alpha emitters in solution, acid solutions, actinium components, uranium (miscellaneous isotopes), depleted uranium, strontium, cerium-141, yttrium, silver-110, sodium-22, cerium-137 and -144, plutonium waste, oralloy, benzene, isopropol alcohol, neptunium-237, and contaminated materials and trash (specific contaminants unknown).

2.3.1.2.3 Group 3

The third group of disposal shafts drilled at Area C, numbers 68-107, were used from 10/08/62 to 02/11/66 for continued burial of beta-gamma-contaminated waste derived from the CMB-DO-GS (gamma sources for exposive shots) at TA-35 and elsewhere. These shafts were also used by other groups for disposal and storage. They are on 7-ft-6-in. centers and run south to north immediately past the western ends of Pits 1-4. The shafts include both 1-ft-diameter shafts lined with 12-in.-thick concrete (nos. 98-107) and unlined 2-ft-diameter shafts (nos. 68-97), with depths varying from 20 to 25 ft.

Notes from LANL Logbooks 11363 and 12442 indicate that shafts 68-107 received plutonium-contaminated trash, fission products, aluminum sheets and tubes, acids, cesium-137, sodium, cobalt-60, antimony, lanthanum-140, cobalt-60 sources, pollonium, beryllium, vacuum-pump oil, empty glass bottles, graphite, plutonium, beryllium, boron, fuel-element end caps, thermocouples, acetone, uranium, zirconium carbide, zinc and aluminum residues, barium, irradiated tantalum, tuballoy, shell waste, yttrium-91, "hot" (radioactive) chemicals, hydrochloric acid waste, plutonium in ether solution, zinc and mercury solutions, depleted uranium chips, radioactive organic solutions, miscellaneous sources, oralloy (enriched uranium) solution, iridium-192, tantalum, indium-114, animal tissues, solvents, a LAMPRE (plutonium recycle reactor) rod assembly, waste oil, detonator components, NRX (Navy experiment) reactor parts, TNT element samples, americium-242, aluminium-105, zinc-65, neptunium-237, and contaminated materials and trash (specific contaminants unknown).

Radioactive materials disposed of in all Area C shafts include tritium, sodium-22, cobalt-60, strontium-90/yttrium-90, radium-226, uranium (isotopes 233, 234, 235, 236, and 238), fission products, and activation products.

The strontium-90 disposal shaft (no number assigned) at Area C was used in the 1950s or 60s (exact time unknown) for burial of a single strontium-90 source. The shaft is located a few feet from the south fence near the entrance gate at Area C (see Fig. 2-15). It is assumed that the disposal shaft is approximaaely the same size as the other Area C shafts.

2.3.2 Existing Data

Over the years, various attempts have been made to document radionuclides in surface soils at Area C. Unfortunately, many of the results are of limited value because the methods and data were not properly recorded. In addition, data on radionuclide and hazardous chemical concentrations in subsurface soil and rock are nearly nonexistent. Records of solid radioactive waste going into Area C can be found in LANL Notebooks 2587, 3478, 4644, 6030, 7277, 8453, 9293, 9593, and 12442 (see Table 2-10). These official notebooks were used to log information on date, location, and type and volume of wastes disposed of in the area. Records of activity before 1954 are incomplete. The estimates shown in Table 2-12 were decay-corrected from original magnitudes to those as of January 1989. Rough estimates of the total number of curies are 196 for the pits and 20,280 for the shafts.

TABLE 2-12
SOLID RADIOACTIVE WASTE DISPOSAL AT AREA C (1954-1972) (decay-corrected to January 1989)

	Waste Material		Amount (Ci)
Pits	Uranium-234, -235, -236, -238		25
	Plutonium-239		26
	Americium-241		145
		Total	196
Shafts	Tritium		20,000
	Sodium-22		0.58
	Cobalt-60		2.4
	Strontium-90/Yttrium-90		21
	Radium-226		1
	Uranium-233		5
	Uranium-234, -235, -236, -238		<0.1
	Fission products*		50
	Activation products*		200
		Total	20,280

*Not corrected because exact compositions unknown.

Very little data exists on hazardous and toxic metal contaminants buried in Area C (other than the list garnered from the site logbooks—Table 2-10). The quantities of such materials present in Area C are unknown. Personal communications with the retired individual who operated the site (Enders 1990, 07-0003) suggest that many species of hazardous and metallic wastes were interred in Area C. Although some liquid wastes were buried at the site, the volume was "small"; there certainly were no large introductions of liquids to the site, as was the case at some other disposal areas (e.g., V and T at TA-21).

Those data judged to be useful (properly recorded and interpretable) for understanding contaminant distribution and transport at Area C are discussed below.

2.3.2.1 Infiltration Tests

From 1956 to 1961, the USGS conducted several studies of water infiltration into the soil and tuff at Area C and other areas at the Laboratory (Abrahams et al. 1961, 0015; Abrahams 1963, 0011). Infiltration pits were dug, and with a static head of water applied, a neutron moisture gauge was used to measure the distribution of water in the soil and tuff as a function of time, during and after the addition of the water.

The results of one of these studies (Fig. 2-16) led the authors to conclude that water would not percolate into the unweathered tuff (8 ft beneath the soil surface at Area C). In that study, a constant 0.75-ft head of water was maintained on the infiltration pit over a 99-day period, and the extent of infiltraton was evaluated by neutron moisture gauge measurements around the pit. Under constant head conditions, the wetting front moved 4.5 ft into the soil during the first 2 days and to 6.5 ft during the next 97 days; water did not move through the weathered tuff into the unweathered tuff. On the basis of soil moisture measurements made lateral to the infiltration pit, the authors concluded that after the first few days, water was probably moving laterally rather than downward. After 8 months of drainage (no head of water), soil moisture returned to pretest levels. The influence of snowmelt on soil moisture to depths of 6 ft was readily apparent (see data at 16 1/2 months into the drainage cycle—i.e., May 1961—in Fig. 2-16). After 21 months, soil moisture had again returned to pretest levels, probably as a result of evapotranspiration.

2.3.2.2 Radionuclide Surveys

2.3.2.2.1 1976-1984

Soil and vegetation sampling in 1976, 1977, and 1980-83 confirmed the presence of pCi/g levels of radionuclides in localized areas on the surface of Area C. Because most of these data were never published, it is difficult to evaluate the analytical quality of the data or to correlate them with sampling locations on the site.

In 1984, as part of an interim action to cover the contaminated soil surface, a new soil cover, consisting of 0.5 to 3 ft of topsoil over about 1.5 ft of crushed tuff, was placed over most of Area C (the northeast corner of the site was not

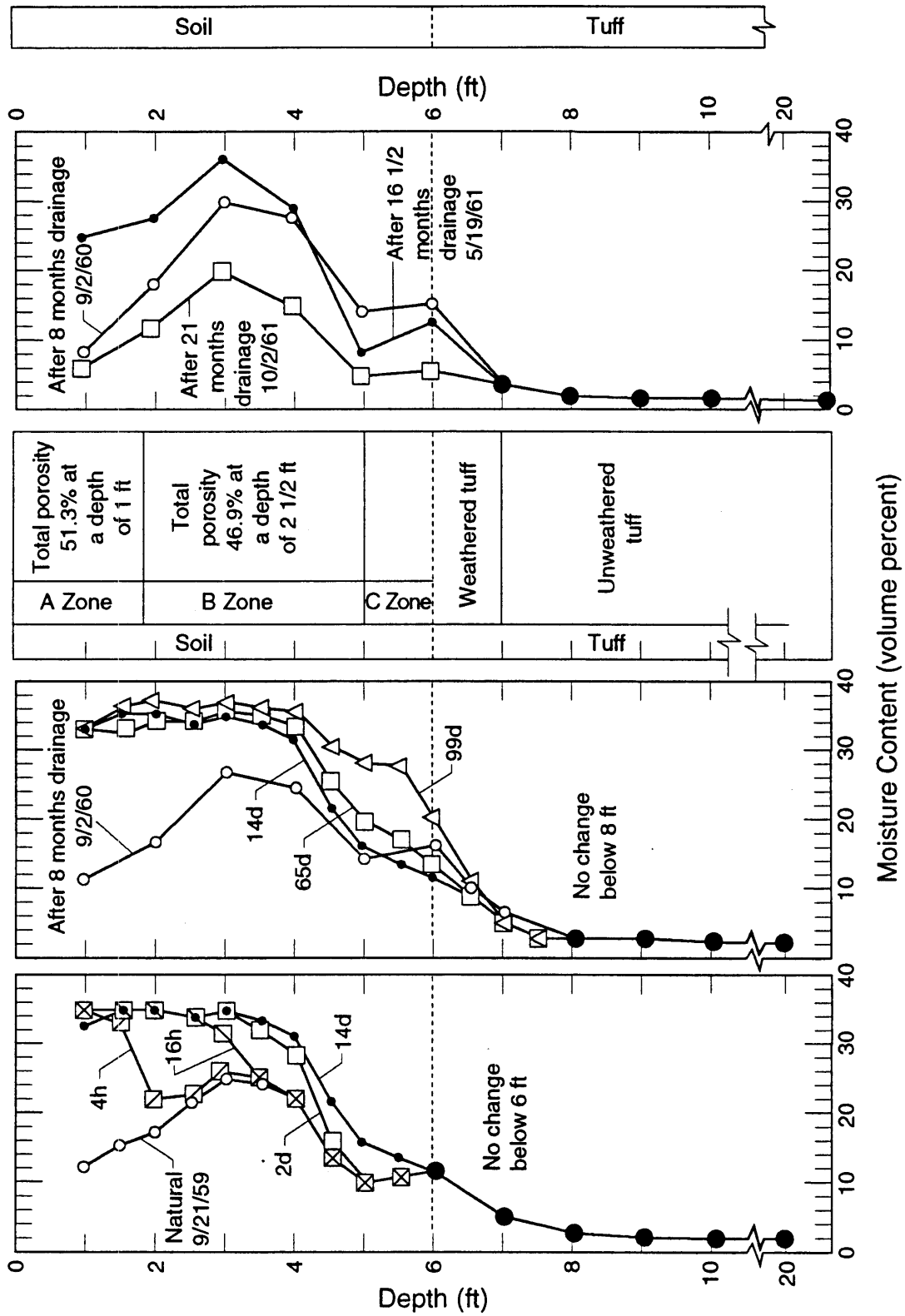


Figure 2-16 Changes in moisture content beneath the infiltration pit near Area C during 99 days of continuous infiltration (Sept. 21 through Dec. 29, 1959) and subsequent drainage for 21 months.

covered with new soil because this area contains no pits or shafts [ESG et al. 1986, 07-0004]). Following this interim action, radionuclide contamination in surface soil was most prevalent in the northeast quadrant of the landfill. This includes areas outside the perimeter fence, suggesting that at least part of the landfill surface had radionuclide contamination before the interim action and that some lateral migration had already occurred.

2.3.2.2.2 1985 and 1986

The most comprehensive information available on radionuclide concentrations in surface and near-surface soils and vegetation at Area C comes from an intensive field-instrument and soil-sampling effort conducted in 1985 (ESG et al. 1986, 07-0004) and a smaller effort in 1986 (ESG et al. 1987, 07-0005). Dosimeters and other field instruments were used to estimate external penetrating radiation doses at Area C. Readings taken in 1985 with thermoluminescent dosimeters (TLD), at 18 locations on the perimeter fence (Fig. 2-17), were all near background levels (about 125 mrem/year—see Table 2-13). The maximum and mean annual doses measured were 124 mrem and 118 mrem, respectively. Thus, perimeter TLD monitoring did not identify significant penetrating radiation source-areas within Area C.

A field instrument radiation survey was conducted on a 20-m-x-20-m (64-ft-x-64-ft) grid to detect the presence of x- and gamma-ray emitters on the soil surface. A Phoswich detector was used for the low end of the energy spectrum and a High-Pressure Ion Chamber (HPIC) for measuring radiation doses at the high end. Kriged (Journel and Huejbregts 1967, 07-0015) contour maps of the data are shown in Figs. 2-18 and 2-19.

The Phoswich data (Fig. 2-18), which show primarily low-energy x- and gamma-ray sources, indicate background conditions over most of the site, perhaps from the surface cover renovation in 1984. The low-energy x rays detected by this instrument are from alpha emitters such as plutonium, americium, and uranium. A very few measurements exceeded the background level of about 500 counts/200 sec, particularly in the north and east perimeter locations (outside of the area receiving the new cover in 1984). Recall that drainage from most of Area C is to the northeast, into Ten Site Canyon. The dose rates (μr/hr) measured with the HPIC (Fig. 2-19) were also at background, with the exception of a small area in the northeast quadrant (both inside and outside the perimeter fence). However, even in that quadrant the dose rates were at most a few percent above background levels.

The radionuclide data collected in 1985 for the 0-to-1-cm depth profile appear in Figs. 2-20 to 2-22. Tritium concentrations in soil water were at or below the average Laboratory background of about 4 pCi/ml in about half of the samples and above that level in the remaining samples (Fig. 2-20). Samples from the eastern half of the site were consistently low in tritium, whereas samples from the north and east perimeter and the west third of the site exceeded background levels. In many cases, tritium levels in soil water samples increased with sampling depth (ESG et al. 1986, 07-0004), suggesting that the tritium was emanating upward from a subsurface source. On a curie basis, most of the radioactivity in Area C is associated with tritium (Table 2-12).

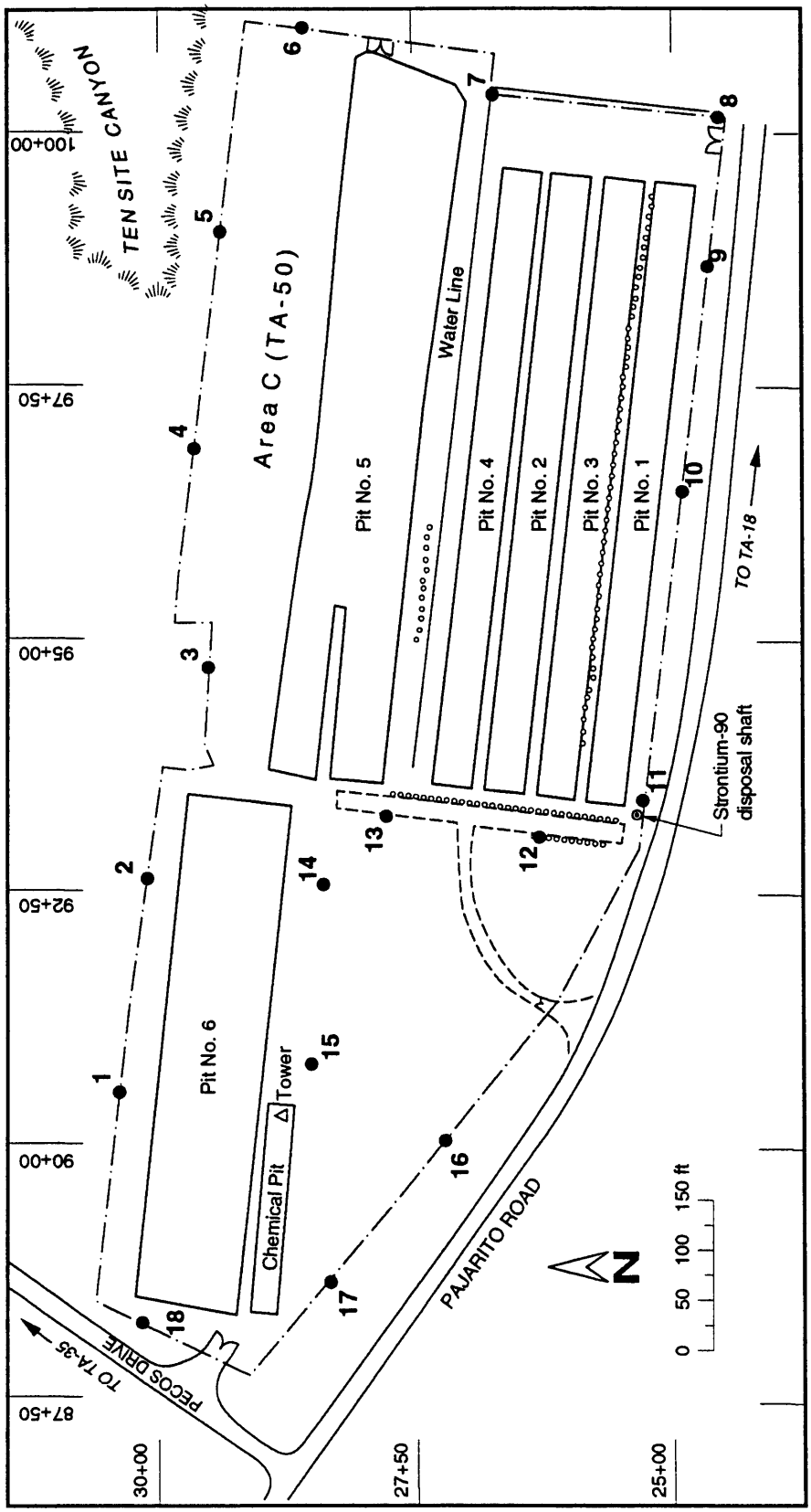


Figure 2-17 Thermoluminescent dosimeter perimeter sampling locations at Area C.

TABLE 2-13
ANNUAL EXTERNAL PENETRATING RADIATION DOSES
AT AREA C DURING 1985
AS MEASURED BY THERMOLUMINESCENT DOSIMETERS

Sampling Location	Dose (mrem)
1	113
2	121
3	120
4	124
5	123
6	112
7	119
8	116
9	117
10	121
11	117
12	113
13	120
14	118
15	108
16	110
17	117
18	118
	108 minimum
	124 maximum
	118 mean

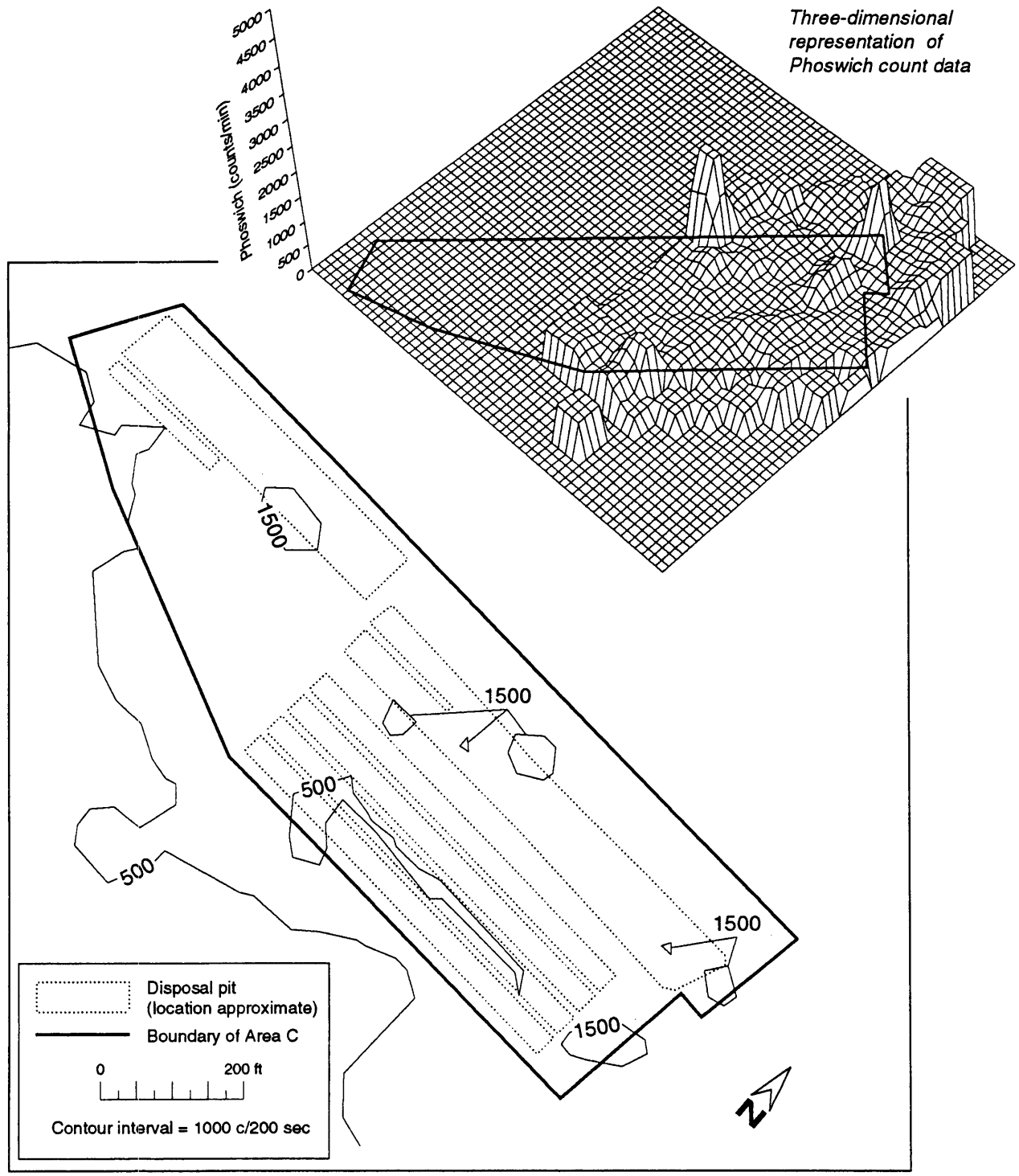


Figure 2-18 Phoswich counts/200 sec (uncorrected for background of about 500 c/200 sec) at Area C in 1985.

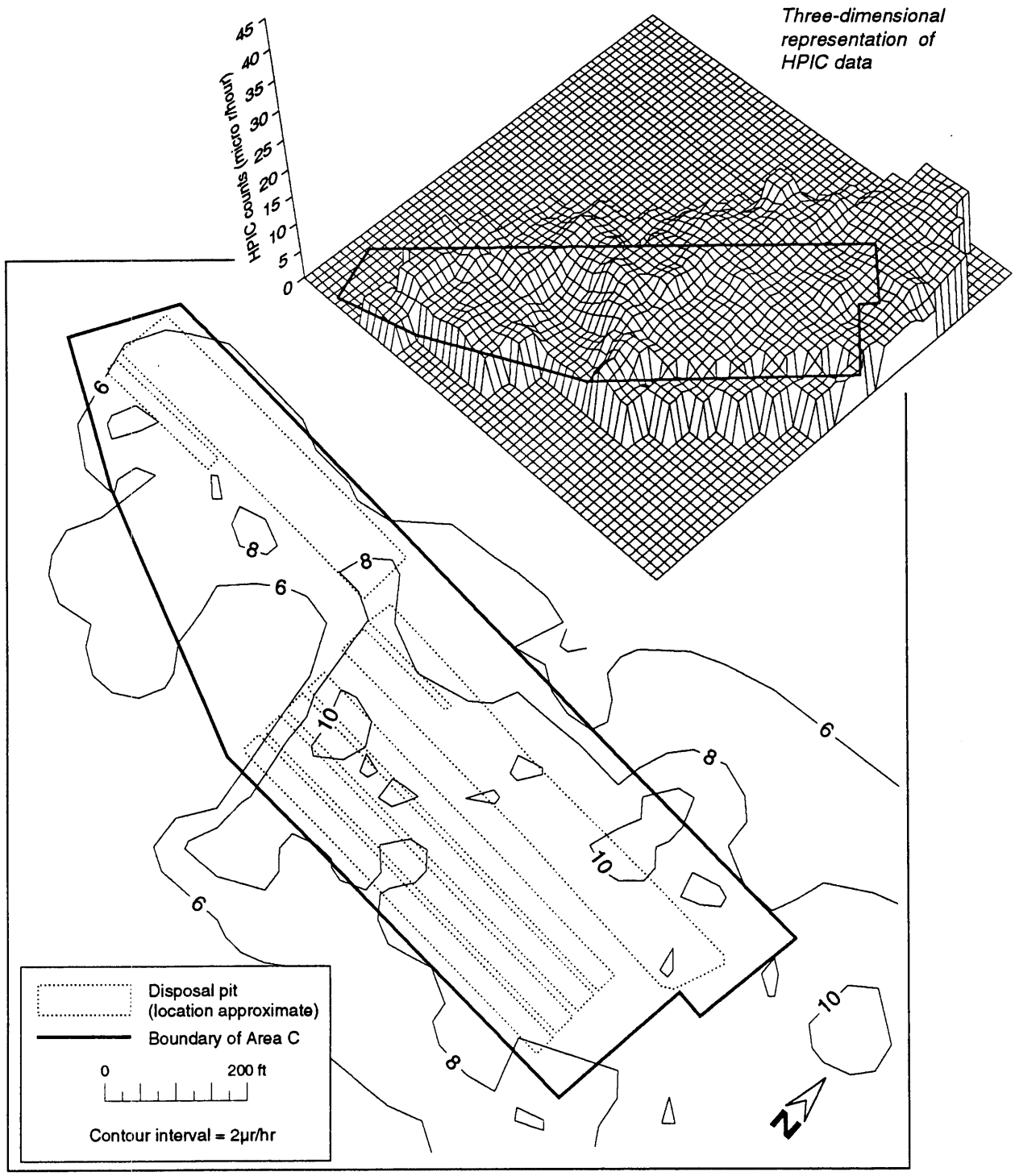


Figure 2-19 Contour map of HPIC-measured dose rates (µr/hr) across Area C in 1985.

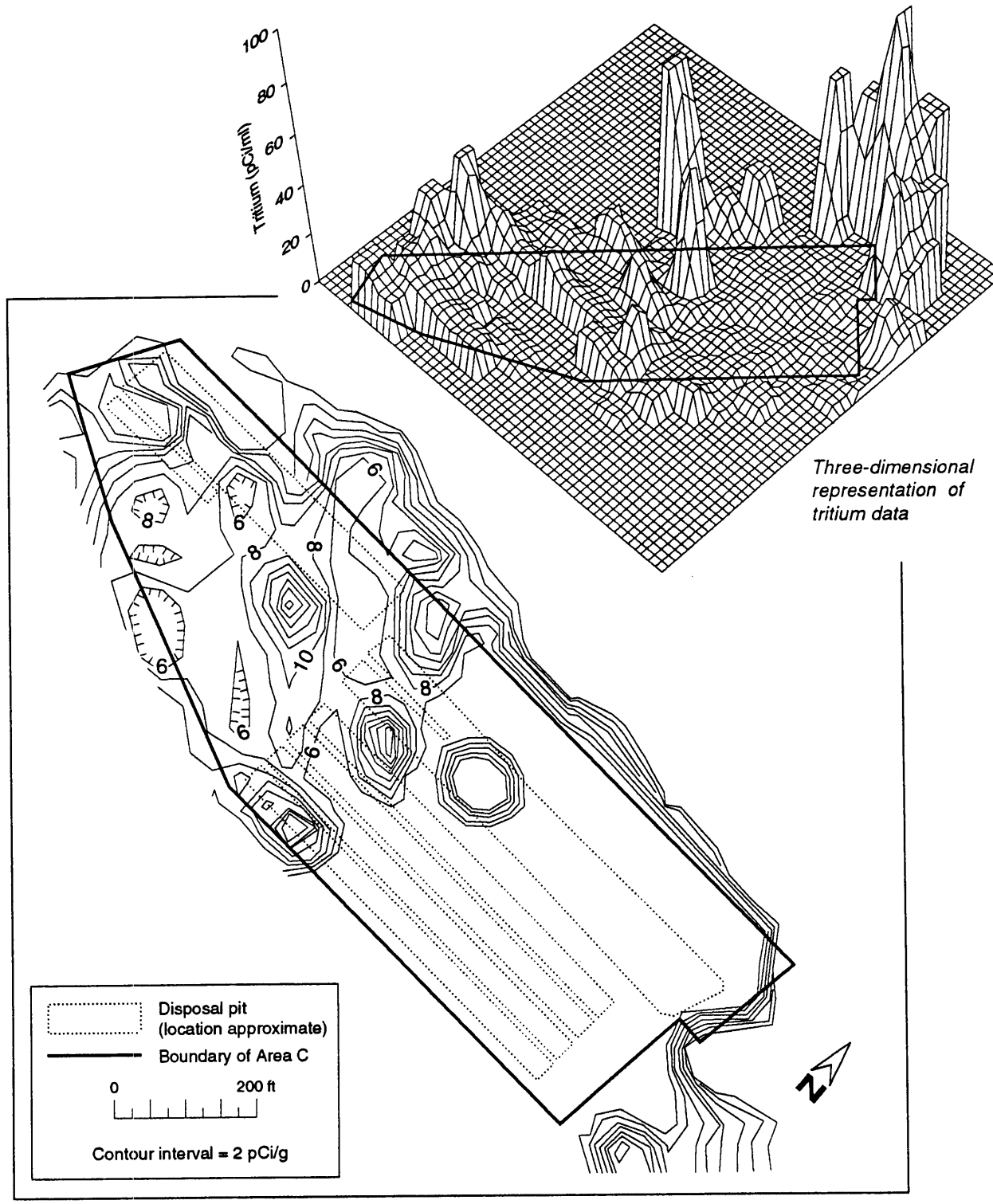


Figure 2-20 Tritium concentrations (pCi/ml) in soil solution (0–1-cm depth) from Area C in 1985.

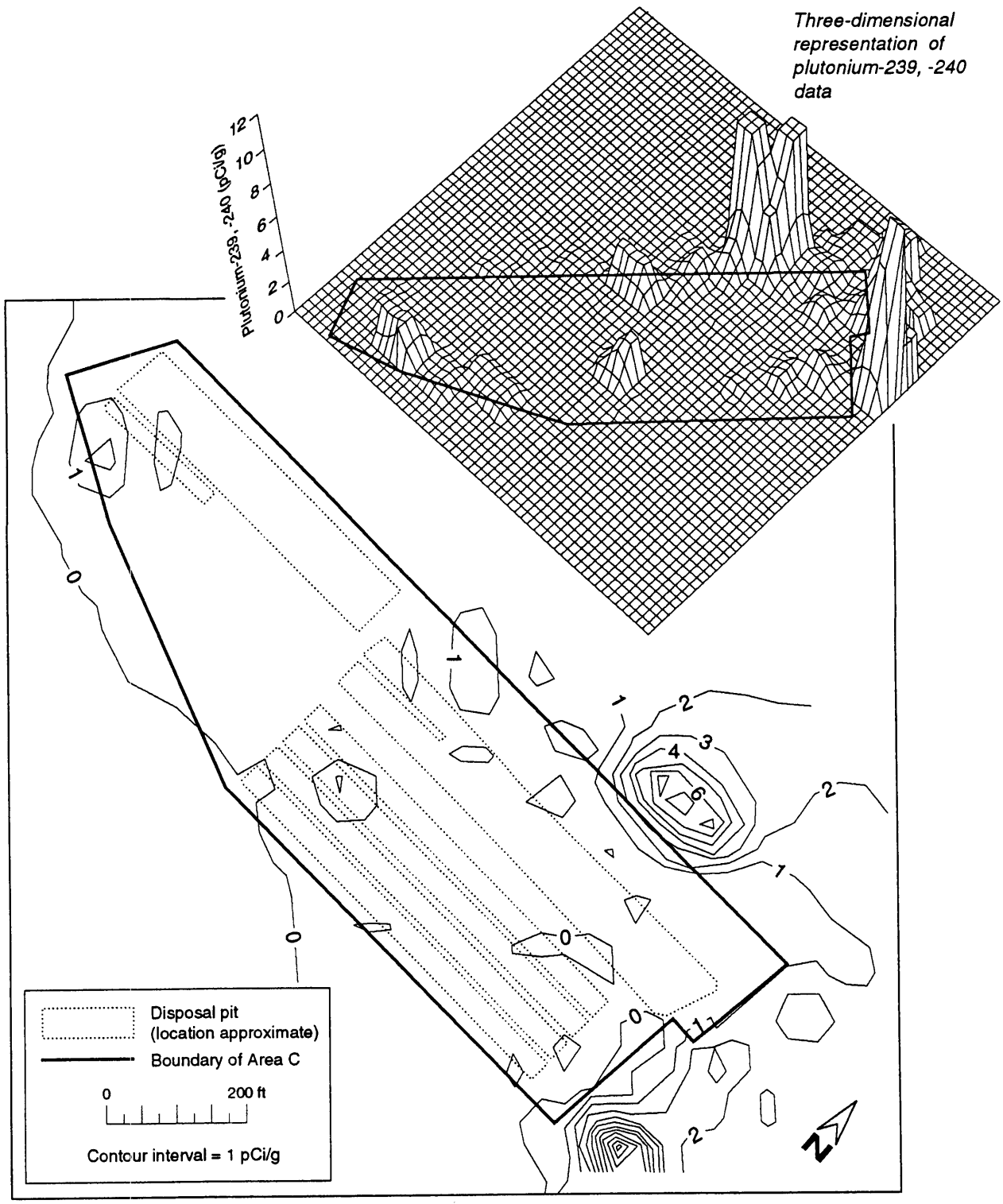


Figure 2-21 Plutonium-239, -240 concentrations (pCi/g) in soil solution (0–1-cm depth) from Area C in 1985.

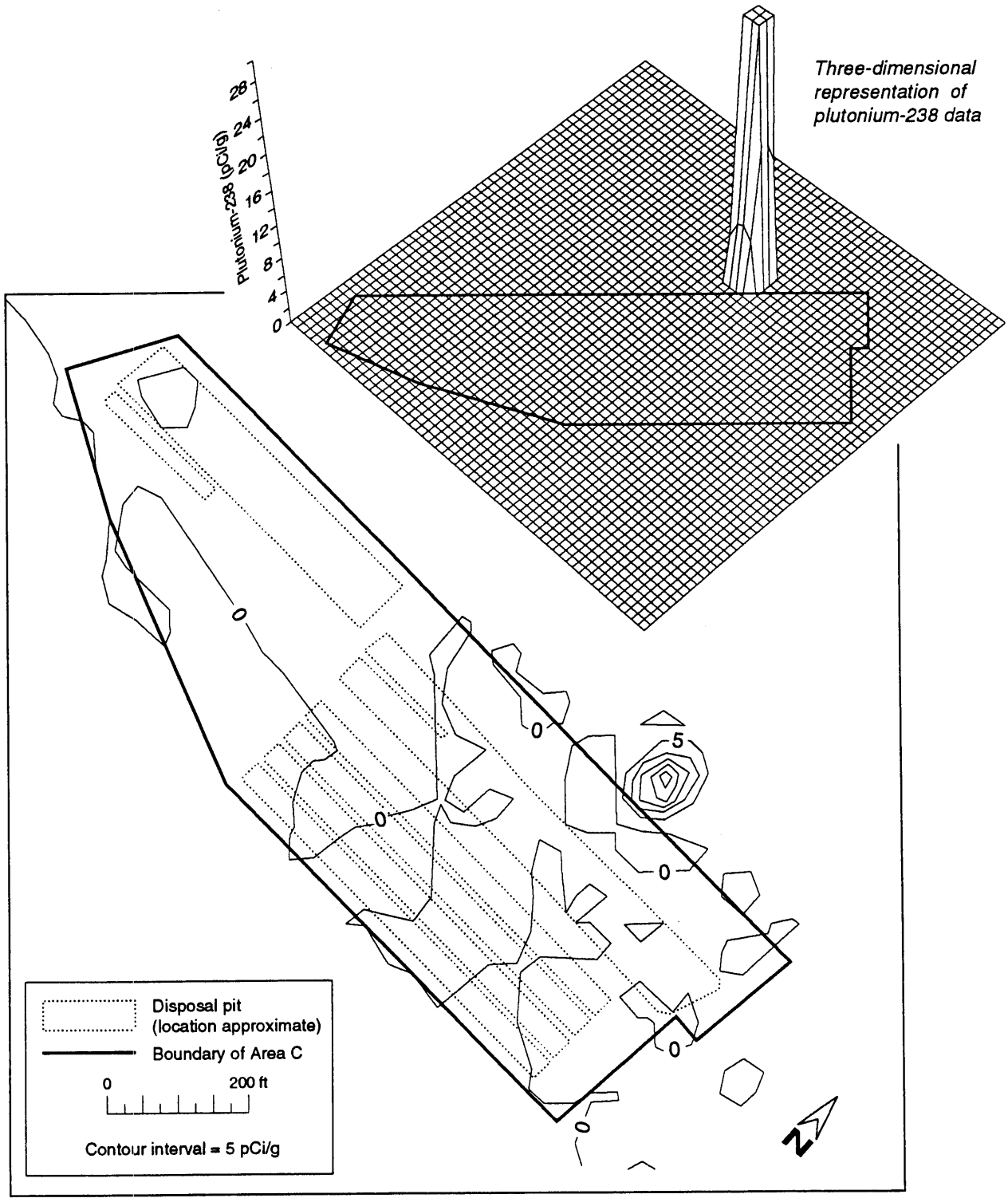


Figure 2-22 Plutonium-238 concentrations (pCi/g) in soil solution (0–1-cm depth) from Area C in 1985.

Relatively few samples from within the site showed concentrations exceeding the background levels of about 0.1 pCi/g for plutonium-239 and -240 (Fig. 2-21) and <0.01 pCi/g for plutonium-238 (Fig. 2-22). However, low-level contamination (up to 10 pCi/g of plutonium-239 and -240 and 30 pCi/g of plutonium-238) was present in perimeter soils on the north and east sides of Area C; and elevated concentrations were found on the west ends of Pits 2, 4, and 5 (and in the associated disposal shafts), in areas corresponding to those where elevated tritium levels were observed in soil water samples.

Concentrations of plutonium generally decreased with sampling depth (ESG et al. 1986, 07-0004), although in some cases this pattern was reversed. The reason(s) for the presence of plutonium on and near the surface of Area C within 1 year of the cover remediation have not yet been identified, but could include the mechanical disturbance associated with the remediation itself, stack emissions, and other environmental factors (including plant and animal mobilization).

Concentrations of uranium in the 0-to-1-cm soil samples from within the site boundary and most perimeter locations were all less than the 4-ppm background level. However, a very few samples on the north and east perimeter of the site yielded as much as 17 ppm (ESG et al. 1986, 07-0004).

The contour maps based on the kriging procedure identify several discrete source areas for tritium (Fig. 2-20) and only one, or perhaps two, for plutonium-238 and -239/240 (Figs. 2-21 and 2-22. Within the site boundary, the discrete sources of tritium appear to be at the west ends of Pits 1, 5, and 6, with more diffuse elevated levels across the western half of the site. A discrete source of both plutonium isotopes was identified on the northeast perimeter as well as one for plutonium-239/240 on the southeast perimeter. Plutonium concentration patterns within the site generally followed those observed for tritium, but were less discernible.

In 1986, more samples were collected from the 18 perimeter locations shown in Fig. 2-17. As shown in Table 2-14, these data confirmed the results obtained in 1985: the northeast corner of the site showed the highest field-instrument readings and concentrations of radionuclides. Some vegetation samples showed slightly elevated levels of cesium-137.

In summary, measurements made with the TLD monitoring array at 18 perimeter locations failed to detect significant sources of penetrating radiation. Field-instrument and radionuclide concentration data for soils, however, identified a consistent pattern of low-level contamination in the northeast quadrant of Area C, independent of the radionuclide measured. For example, slightly elevated concentrations of tritium, plutonium-239/240, plutonium-238, and uranium were found in soils on the north and east perimeter of the site, in an area that had been excluded from the soil-cover remediation of 1984. Within the site boundary, radionuclide levels in excess of background were associated largely with the west ends of Pits 2, 4, 5, and 6 and/or the associated disposal shafts.

Attempts to correlate field-instrument measurements with the concentrations of specific radionuclides, using only the soil data that exceeded background levels,

TABLE 2-14
FIELD INSTRUMENT AND RADIOCHEMICAL SURVEY OF AREA C (SEPTEMBER 1986)

SOIL

Grid loc.	H^3 (pCi/L)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)	Phoswich c/100 sec	RASCAL c/120 sec
1	11000.0	0.72	0.12	0.007	0.34	5319	1656
2	13000.0	0.78	0.21	0.006	0.60	6070	1649
3	3200.0	1.18	0.05	0.007	0.20	5986	1902
4	3400.0	0.29	0.07	0.030	0.80	6141	1755
5	7000.0	1.48	0.38	0.004	0.60	6736	2202
6	4000.0	1.07	0.28	0.096	7.30	6856	2139
7	7700.0	0.08	0.55	0.091	10.40	6333	1755
8	29000.0	1.36	N.D.	0.022	2.35	6458	1510
9	21000.0	0.39	0.09	0.005	0.36	5508	1625
10	41000.0	1.12	0.30	0.032	2.26	6169	1923
11	39000.0	1.10	0.13	0.070	15.10	5698	1474
12	21000.0	0.11	0.22	0.084	1.62	5488	1945
13	50000.0	1.21	0.03	0.0004	0.01	5887	1853
14	3000.0	0.22	0.03	0.003	0.06	4544	1208
15	23000.0	1.11	0.14	0.008	0.15	4391	1324
16	33000.0	0.19	0.30	0.011	0.13	5361	1440
17	44000.0	1.22	0.26	0.014	0.60	5272	1512
18	43000.0	1.31	0.07	0.013	0.78	4877	1554

VEGETATION

Grid loc.	H^3 (pCi/L)	Am-241 (pCi/g)	Cs-137 (pCi/g)	Pu-238 (pCi/g)	Pu-239 (pCi/g)
1	400.0	samples lost	N.D.	0.002	0.012
2	N.D.	samples lost	N.D.	0.005	0.069
3	N.D.	samples lost	0.35	0.014	0.203
4	N.D.	samples lost	0.25	0.012	0.078
5	N.D.	samples lost	1.97	0.004	0.040
6	N.D.	samples lost	1.87	0.002	0.333
7	N.D.	samples lost	1.83	0.005	0.450
8	1000.0	samples lost	0.20	0.006	0.259
9	1800.0	samples lost	N.D.	0.018	0.187
10	2100.0	samples lost	N.D.	0.003	0.057
11	N.D.	samples lost	0.02	0.014	0.174
12	N.D.	samples lost	0.69	0.007	0.059
13	3400.0	samples lost	3.73	0.002	0.011
14	N.D.	samples lost	0.08	0.022	0.121
15	500.0	samples lost	1.06	0.004	0.028
16	300.0	samples lost	1.75	0.003	0.026
17	N.D.	samples lost	0.83	0.006	0.248
18	N.D.	samples lost	0.45	0.005	0.022

were unsuccessful (ESG et al 1986, 07-0004). Correlation coefficients from least-squares regressions of field-instrument data versus radionuclide concentrations were all nonsignificant ($p < 0.05$). The lack of relationships between the Phoswich and plutonium concentration data could not be explained.

2.4 Current Conditions at TA-50

In general, operations continue at most of the facilities at TA-50. Table 2-15 gives the current status of the 25 SWMU subunits related to the treatment facilities, and Table 2-16 the short- and long-term plans for upgrading or replacing components of the solid and liquid waste treatment facilities. The liquid waste treatment plant, antiquated in light of present regulatory standards, will be replaced but is expected to continue to perform at least some treatment functions even after the new plant comes on line—probably at least until 2010. The incinerator complex meets all current regulatory requirements and is being modified to handle additional waste forms; it is expected to be back on line by 1994. The volume reduction facility will continue to be used for the foreseeable future but will gradually be replaced by a production-size facility, scheduled for construction at Area G beginning in 1998.

The Area C landfill will remain in its decommissioned state pending the outcome of ER activities at the site. The site is monitored by the Laboratory's Environmental Protection Group, under both the routine environmental surveillance program and the periodic intensive monitoring program funded by the Waste Management Group at Los Alamos. An in-depth resurvey of the Area C landfill by the Environmental Protection Group is scheduled for 1992, with a focus on radionuclides in surface soils. The Area C sampling plan for the surface of the landfill (see Chapter 5) will be based on the Environmental Protection Group resurvey, augmented to include analyses for nonradionuclides.

2.5 Potential Public Health and Environmental Impacts

The limited monitoring data from TA-50 (including the Area C landfill both inside and outside the perimeter fence) indicate the presence of radionuclides on and near the ground surface, but the levels measured are low—either because releases were small or the area was cleaned up after a release. Dosages to members of the public are estimated annually, on the basis of monitoring data from the general Laboratory area, and are reported in the annual *Environmental Surveillance Report*. (Although the estimates are not based on TA-50 data, they are considered representative of this site.)

According to the air-monitoring data from the Laboratory's current landfill, Area G, the maximum 50-yr dose relative to the DOE Radiation Protection Standard for the public was estimated to be less than 0.45 mrem/yr to the bone surface (ESG 1990, 0309). That dose represents 0.6% of the DOE's standard of 75 mrem/yr to any organ by the inhalation route. (It also represents the worst case dose by all possible routes.)

Possible doses via ingestion of contaminants from Laboratory operations were estimated to be less than 0.1% of the DOE's 100-mrem/yr Radiation Protection

TABLE 2-15
STATUS OF SOLID WASTE MANAGEMENT UNITS AT TA-50:
50-001 THROUGH 50-011

I. 50-001: Radioactive Liquid Waste Treatment Plant

50-001 (a). Treatment facilities:

1. Wiped film evaporator (Room 71, Building 1)

   The wiped film evaporator equipment was installed during the TA-50 Upgrading Program in 1984-1985. Its purpose was to remove salts, mainly nitrates, from the influent. It has never been used.

2. Two clariflocculators (Room 116)

   These clariflocculators are the mainstay of the liquid waste treatment process. They are always in use when the treatment plant is operating.

3. pH adjustment tank (Room 16)

   Before July 30, 1990, all radioactive industrial waste flowed into the 2000-gal. grit chamber in Room 16, where the pH was adjusted. On July 30, 1990, leaks were found in the grit chamber. Now the influent bypasses the grit chamber and flows directly to the 75,000-gal. raw waste tank in TA-50-2, where the pH is adjusted.

4. Evaporator storage tank (Room 70A)

   This 30,000-gal. tank was installed as a feed tank for the wiped film evaporator. It is now used to store treated waste.

5. Decant storage tank (Room 61)

   This 10,000-gal. tank is used in the TRU waste treatment process in Room 60. It is being modified to replace the sludge tank in TA-50-2.

6. Rotary drum vacuum filter (Room 116B)

   This filter is used to process all of the precipitates generated by the chemical treatment process.

7. Two gravity filtration devices (Room 116)

   All of the overflow from the clariflocculators goes through these filters.

8. One 100,000-gal. emergency holding tank (TA-50-90)

   This tank is located outside of and south of the Decontamination and Laundry Area in Building TA-50-1. It was constructed as part of the TA-50 Upgrading Program but has never been used.

TABLE 2-15 (cont'd)

9. Two waste mixers (Room 116)

   These mix chemicals with the raw waste before it goes to the clariflocculators.

10. Drum tumbler operation (Room 60A)

    This drum tumbler is used to mix water glass, vermiculite, and cement with the TRU waste from TA-55. The tumbler has its own enclosure and HEPA filter system.

11. Liquid effluent outfall (Mortandad Canyon)

    This is the only outfall for treated liquid waste from TA-50-2.

50-001 (b). Drainlines (for transporting liquid waste to the treatment facility) and manholes:

1. TA-55 to TA-50-66

   Four stainless steel lines encased in plastic connect TA-55 to TA-50-66. One line carries acidic radioactive liquid waste, one carries caustic radioactive liquid waste, and one carries radioactive industrial waste. The fourth line is a spare and has never been used. These lines will not vacuum-test and are scheduled to be replaced with double-encased polypropylene lines in March 1992.

2. Collector manhole TA-50-72 to grit chamber in TA-50-1

   This is the last manhole in the liquid radioactive industrial waste system that carries influent to TA-50. It is located in the parking lot on the west side of Building TA-50-1. (Since detection of leakage, the liquid waste flow has been rerouted. It now goes through TA-50-1, where a sample is collected and a caustic added if necessary, and then to TA-50-2, bypassing the grit chamber.)

3. TA-50-69 and TA-50-37

   Liquid radioactive industrial waste from TA-50-69 flows to manhole TA-50-72 via manholes TA-50-76 and TA-50-73. Radioactive industrial waste from TA-50-37 flows to manhole TA-50-72 via manhole TA-40-73.

4. TA-2, -3, -35, -43, -48, and -52 via manhole TA-50-72

   a. TA-2 — The radioactive industrial waste from TA-2 does not flow into manhole TA-50-72, but into the "cross-country" line that runs from TA-21 to TA-50. This line connects directly into TA-50-2.

TABLE 2-15 (cont'd)

b. TA-3 — The radioactive industrial waste from TA-3 flows into manhole TA-50-72.

c. TA-35 — A radioactive industrial waste line runs from Building TA-35-213, the Target Fabrication Building, to manhole TA-50-72 via manhole 71 on the north side of Pecos Drive. It has never been used. No other buildings in TA-35 are now connected to TA-50.

d. TA-43 — The effluent from TA-43 is nonradioactive sanitary sewage. It is pumped from TA-43 into a line that originally came from the (now demolished) Central Wastewater Treatment Plant, crossed Los Alamos Canyon east of TA-43, and furnished water to the cooling towers at the TA-3 power plant. At present, after crossing Los Alamos Canyon, the effluent from TA-43 is diverted to the TA-3 waste disposal plant via manhole No. 690 on the south side of East Jemez Road.

Liquid radioactive industrial waste generated by TA-43 is stored in small containers, usually less than 5 gallons, and is periodically picked up by EM-7 and brought to TA-50.

TA-48 — Radioactive industrial waste from TA-48 flows into manhole TA-50-72.

TA-52 — There is currently no radioactive industrial waste line from TA-52 to TA-50. Line No. 65, along with the pump station, was removed in 1989.

5. Manhole TA-50-7

This manhole, adjacent to and immediately east of TA-50-66, is not in use. Future plans include building a new unloading pad to replace TA-50-77, at which time manhole TA-50-7 will be removed.

6. TA-55, via monitor pit TA-50-57

The monitoring pit TA-50-57 is currently in use but has been renumbered TA-50-106. The four lines from TA-55 to TA-50-66 run through this pit.

7. Manhole TA-50-72

This is the final manhole on the radioactive waste collection system. From this manhole, all such waste flows into Building TA-50-1.

TABLE 2-15 (cont'd)

II. 50-002: Tanks and Drainlines

50-002 (a). Tank farm (TA-50-2)

TA-50-2, WM-2, is an underground reinforced concrete structure. The roof is a few inches above grade and the bottom of the floor slab is about 17 ft below grade.

1. Six flow-thru process tanks (maximum capacity 75,000 gal.):

   – two for incoming raw waste
   – one for sludge
   – two for treated waste storage
   – one for storing decontamination and decommissioning (D&D) wastes

2. Cast-iron transfer lines

   Six cast-iron lines connect TA-50-1 to the equipment room in TA-50-2: one 10-in. and two 6-in. influent lines, and one 8-in. and two 2-in. effluent lines. They were installed when the TA-50 waste plant was constructed.

3. Steel lines

   Four steel lines were added during the major upgrading project in 1984-1985, to connect Room 61 in Building TA-50-1 to the equipment room in TA-50-2. They comprise three influent lines (one 6-in., one 3-in., and one 1/2-in.) and one 6-in. effluent line.

4. Cast-iron lines from drains

   When the TA-50 waste plant was constructed, three cast-iron lines were installed to connect drains in Building TA-50-1 to the D&D tank in TA-50-2. They include one 3-in. and two 4-in. influent lines.

5. In addition to the above-mentioned radioactive industrial waste lines, the following lines are in place and active:

   a. A 3-in. cast-iron line from a sink in the Vehicle Decontamination Facility to the D&D tank in TA-50-2.

   b. A 4-in. cast-iron line from the Decontamination and Laundry Area in Building TA-50-1 to the D&D tank in TA-50-2.

   c. A 4-in. effluent line and a 6-in. influent line in a buried concrete trench connect TA-50-2 with the 100,000-gal. emergency holding tank, TA-50-

TABLE 2-15 (cont'd)

90. The 4-in. effluent line comes out of the equipment room in TA-50-2 and the 6-in. influent line dumps into the 25,000-gal. raw waste tank in TA-50-2. Neither line has ever been used.

d. A 3-in. cast-iron radioactive industrial waste line connects the Hot Cell Area in TA-50-1 to the D&D tank in TA-50-2.

50-002(b). Tank TA-50-67

This tank is located in the underground vault (TA-50-66) and is being used for caustic waste from TA-55.

50-002(c). Tank TA-50-68

This tank, also in the underground vault (TA-50-66), is being used for acidic waste from TA-55.

50-002(d). Aboveground storage tank designated TA-50-5

This stainless-steel, 5000-gal. nitric acid storage tank is located adjacent to the north wall of the east wing of Building TA-50-1. It is part of the ion-exchange column system, which was built to remove radioisotopes that were not removed by the clariflocculator system. Because the concentration of these radioisotopes in the radioactive industrial waste influent has always been below DOE limits, there has been no need to use the system. At present, the tank is about one-quarter full. Future plans are to empty the tank and leave it empty until the ion-exchange columns have to be operated. (The tank would then be filled with sulfuric acid instead of nitric acid, because of the nitrate problems that develop when nitric acid is neutralized.)

III. 50-003: Container Storage Areas

50-003(a). Primary drum storage area

This storage area, in Room 60D of Building TA-50-1, is used to store drums of TRU waste that has been mixed with cement, vermiculite, and water glass.

50-003(b). Satellite storage area

This area in Room 130 is used to store small amounts of radioactive industrial waste that is generated within the laboratories of Building TA-50-1.

50-003(c). Temporary (<90 days) storage area at TA-50-2

This SWMU is really in two storage areas. One is the paved area immediately south of TA-50-2. Polyethylene carboys, known as "Tuff Tanks," are stored here and eventually dumped into TA-50-2. The second area is a space on the asphalt paving between the

TABLE 2-15 (cont'd)

north wall of the Vehicle Decontamination Facility and the south wall of the east wing of TA-50-1. Here, 55-gal. drums containing radioactive industrial waste in the form of filter cake are stored.

50-003(d). Modular storage shed designated TA-50-114

This modular steel shed sits on a concrete pad. It is used for greater-than-90-days storage of various wastes from SWMU 50-003(c).

50-003(e). Four barrels under a tarp near TA-50-125

TA-50-125 is a small metal shed set against the perimeter fence south and west of Building TA-50-69. At the present time there are no barrels anywhere near the shed, and Robert Gonzales, the building engineer for TA-50-69, has no knowledge of any drums being stored under a tarp near TA-50-125.

IV. 50-004: Waste Lines

50-004(a). Radioactive waste line from Building 1 west under incinerator building

This 6-in. vitrified clay pipeline that came to TA-50 from the Pajarito Road sites was known to have leaked and was removed in 1975. Five hundred and twenty feet of it was removed from a point east of Pecos Drive to a point near the western edge of the parking lot on the west side of Building TA-50-1, to clear the construction area for Building TA-50-37. Later, Buildings TA-50-54 and TA-50-69 were constructed over the original line location. A new line was installed south of the future building construction areas. The removed pipe and contaminated soil were hauled to the disposal pits at TA-54.

50-004(b). Concrete vault and underground tanks from the TA-50-3 tank farm

TA-50-3 was an underground reinforced concrete structure divided into three stainless-steel-lined tanks having capacities of 1,000 gal., 2,000 gal. and 4,500 gal. In 1989 the earth was removed from around the outside walls of the tank farm and the structure was removed in one piece, loaded on a truck, and taken to TA-54 for disposal. The soil under the tanks was sampled after the structure was removed. Isaac Suazo does not recall any soil being removed deeper than the bottom of the slab after the structure was removed.

50-004(c). Drainlines and associated manholes

Thirteen radioactive industrial waste lines and three manholes were listed as being removed between 1981 and 1989: lines 44, 45, 45a, 46, 47, 48, 48a, 49, 54, 55, 56, 65, and 67; and manholes TA-50-6, TA-50-55, and TA-50-56. All of these lines and manholes were confirmed as removed except line 56. This line is in service and connects a floor drain in Room 36 of Building TA-50-1 to an active 10-in., cast-iron radioactive industrial waste line that goes to structure TA-50-2. (The point of connection to the 10-in. cast-iron line is under the floor slab of the Vehicle Decontamination Facility.)

TABLE 2-15 (cont'd)

V. 50-005: Nonradioactive Liquid Waste Treatment Plant

This treatment system is located in Rooms 24B and 34 of Building TA-50-1. The Room 24B facility, used for cyanide, chrome-plating solutions (copper and lead), acids, bases, and heavy metals, has been used very little and is not in operation at this time.

A mercury reclamation facility, located in Room 34, has been operated intermittently for the past several years. This facility is scheduled for regular operation in the near future, to reclaim mercury from solutions stored within the Laboratory.

VI. 50-006: Operational Releases

50-006(a). Upper Ten Site Canyon

This area was contaminated following a sump overflow at TA-50-2. Radioactive wastes were present in the released liquid.

50-006(b). Stained soil (mineral oil) beneath active radiator on the west wall of TA-50-37 (incinerator building)

This radiator cools the mineral oil that drives a fluid coupling between an electric motor and a blower. It is not on the west wall of Building TA-50-37, but mounted on a concrete foundation approximately 25 ft west of the wall. The radiator leaked some mineral oil on the asphalt paving around the concrete foundation.

On 9/18/90 a small-job ticket was issued. The area around the radiator was washed with a degreaser and steam, and the fluid was picked up with a vacuum cleaner. The spots were removed and the soapy fluid disposed of in the acid waste drain in Building 37. In the near future, the radiator, the fluid coupling, the concrete foundation on which the radiator is now secured, and the asphalt near the concrete foundation will be removed. A new direct-drive motor will be installed, on a new concrete foundation, and the area will be patched with new asphaltic concrete paving material.

50-006(c). Airborne releases (plutonium and mixed fission products) from radioactive waste plant (hoods, etc.)

50-006(d). Treated liquid effluent from TA-50-1 into Mortandad Canyon (NPDES permitted)

Monitoring done on a routine basis.

50-006(e). Soil around diesel fuel tank (aboveground) at the incinerator building (TA-50-37)

On May 15, 1990, work order 6-5737-17 was issued to Pan Am to remove both the diesel fuel tank and the supply and return lines as far as the concrete approach ramp to the

TABLE 2-15 (cont'd)

door at the southwest corner of Building TA-50-37. The diesel fuel tank was located a few feet from the paved area south of Building 37 and about 30 ft south of the building's southwest corner. The tank was removed, steam cleaned, and sent to salvage. The tank's foundations were removed, and the supply and return lines were dug up and capped near the building. There is no record of any leaks from this tank.

VII. 50-007: Incinerator Complex

This incinerator complex, for combusting both solids and liquids containing radionuclides and organics, incorporates many release controls. Liquid effluent from the offgas treatment system goes to the treatment plant and solid wastes to the Area L/Area G landfill. Exhaust air passes through the HEPA system. The only release is treated air.

The facility is not being used at present. Incineration was originally scheduled to resume in late FY93 but, because of funding shortages, a new date (latter part of FY94) has been set. An environmental assessment for the hours of operation and level of toxicity is being worked on by the EPA; a permanent permit for handling mixed waste is expected to be issued in the near future. The operating group currently has an interim work permit for handling mixed waste. (A New Mexico state permit is not required to operate the incinerator.)

Incinerator equipment is being upgraded: all fiberglass process piping has been replaced with CT76-Hasteloy. A sampling train (to take samples off the process line) and a gravity ash system have been designed (these two projects should take about 6 months to complete once construction has been scheduled).

VIII. 50-008: Volume Reduction Facility

This facility cuts up metallic waste containing TRU (ducts, plenums, gloveboxes, etc.), compacts them, and packages the waste for storage at TA-54. Liquids go to TA-50-1, and air emissions are monitored. Because of the loss of key personnel, this facility has been inactive since January 1991. Operations are scheduled to start again in early 1992 and to continue for the next 10 to 15 years.

Long-range plans call for a larger unit to be set up at TA-54 by 1998. This unit will cut up the waste and package it for shipment to the WIPP site.

IX. 50-009: Area C Landfill

This landfill for radioactive and mixed waste was in use from 1948 to 1969. It contains about 3.65×10^6 ft^3 of waste in pits and shafts, including a chemical waste disposal pit, covering a total of 11.8 acres. Waste includes radionuclides, metals, hazardous waste, liquids, solids, and gases.

TABLE 2-15 (cont'd)

X. 50-010: Decontamination Facility

This facility is on the south end of Building 1 and is used to clean radioactive contamination from vehicles and other objects. It was built in 1984 as part of the TA-50 Upgrading Program. Only radioactive industrial waste (LLW) is handled in this area. Liquids go to the tank farm (TA-50-2) via drain and line, and solid wastes go to Area G for burial. Wastes are primarily radionuclides. Contaminated acids, hauled in from other technical areas in "Tuff Tanks," are pumped either directly to TA-50-2 or to TA-50-1 for neutralization and then to TA-50-2.

XI. 50-011: Septic Systems

50-011(a). Decommissioned septic system, including tank (TA-50-10), manhole (TA-50-9), a sanitary distribution box (TA-50-11), and an infiltration shaft on the east side of the distribution box

The entire original septic system was removed in 1984 as part of the TA-50 Upgrading Program. In 1978, a 4-ft-diameter 50-ft shaft was drilled at the east end of the leach field to increase the capacity of the field to handle effluent from the septic tank. The shaft was filled with 3/4-in. aggregate and is probably still in place.

50-011(b). Active sanitary waste system of drainlines

According to a Ralph M. Parsons Company drawing, LA-RV-C5, Lab Job 5872-50, ENG-C-44430, the existing sanitary system was installed aspart of the TA-50 Upgrading Program. Sewage drains from Building TA-50-1, via 6-in. ductile iron drainlines, to lift stations. One station is located near the northwest corner of the building and one near the southwest corner. From the lift stations, 4-in. and 6-in. vitrified clay pipes carry the waste to a main west of Building TA-50-1, which runs to a manhole on the north side of Pecos Drive. This sanitary sewer system is not monitored.

TABLE 2-16
LONG-RANGE AND INTERIM PLANS FOR TA-50 SWMUs
50-001 THROUGH 50-005, 50-010, AND 50-011

I. 50-001: Radioactive Liquid Waste Treatment Plant

50-001(a). Treatment facility

This facility is to be replaced. The new facility will be located at the intersection of Pajarito Road and Puye Road (current site of TA-63). It will take over all of the functions now being carried out at TA-50 except the Room 60 transuranic waste treatment (to be discussed later). The new facility will be designed to meet the DOE 6431A requirements and the DOE 5480-11 As Low As Reasonably Achievable (ALARA) requirements (the latter ensuring that operating personnel will be protected to the greatest extent possible from radiation).

Present plans call for this facility to be a Major Systems Acquisition project in the 1995 presidential budget. Money is available for the preliminary (pre-conceptual design) work, and money has been allocated from the 5-year plan activity data sheet to proceed with Title I and Title II work.

Plans and projected funding for the principal distinct operations within the liquid waste treatment facility are described below.

1. Wiped film evaporator

   - Long-range plan: This operation will be included in the new facility.
   - Interim plan: The equipment has been inactive because of a lack of personnel. It is planned to start the operation so that the existing facility can meet the biological monitoring requirements.
   - Funding has been allocated in the 5-year plan, but operating staff can be acquired only when the funds are approved.

2. Two clariflocculators (Room 116)

   - Long-range plan: These will continue to operate until the new facility is constructed.
   - Interim plan: None
   - Funding: None

3. pH adjustment tank (Room 16)

   - Long-range plan: The existing tank (grit chamber) leaks and is being bypassed. The new facility will include a new unit for flow metering and pH adjustment.
   - Interim plan: The old grit chamber will be decontaminated but probably not decommissioned.

TABLE 2-16 (cont'd)

- Funding: This project is high on the GPP priority list. Money is expected to be available.

4. Horizontal-evaporator storage tank (Room 70A)

   - Long-range plan: This tank is part of the wiped film evaporator equipment and will come on line at the same time.
   - Interim plan: None
   - Funding: None required.

5. Decant storage tank (Room 61)

   - Long-range plan: This 10,000-gal. tank, used in TRU waste treatment, is being modified to replace the 25,000-gal. sludge tank at TA-50-2. It should be operable by January or February of 1992.
   - Interim plan: None
   - Funding: Funds are available.

6. Rotary drum vacuum filter (Room 116B)

   - Long-range plan: A sludge dewatering process of some type will be installed in the new facility.
   - Interim plan: None.
   - Funding: None required.

7. Two gravity filtration devices (Room 116)

   - Long-range plan: A filtration process of some type will be installed in the new facility.
   - Interim plan: None.
   - Funding: None required.

8. 100,000-gal. emergency holding tank (TA-50-90)

   - Long-range plan: None.
   - Interim plan: None.

TABLE 2-16 (cont'd)

- Funding: None.

9. Two waste (flash) mixers (Room 116)

   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.

10. Drum tumbler operation (Room 60A)

   - Long-range plan: This operation will be part of a new pre-treatment facility that will be constructed south and east of WM-66. The new facility will replace the existing TRU waste treatment operation in Room 60, which will be decontaminated and decommissioned.
   - Interim plan: None.
   - Funding: This project is a 1996 line item estimated at about $10,000,000. Title I is now complete.

11. Liquid effluent outfall (Mortandad Canyon)

   - Long-range plan: The present system will continue to be used as long as TA-50-1 operates. When the new facility near TA-63 is completed, a new double (encased) line will be used to carry treated waste to the outfall.
   - Interim plan: None.
   - Funding: The new line to the outfall in Mortandad Canyon is included in the 1995 line item money for the new plant near TA-63.

50-001(b). Drainlines (for transporting liquid waste to the treatment facility) and manholes

1. TA-55 to TA-50-66

   - Long-range plan: A new 8-ft-diameter utility tunnel is planned, from TA-55-PF4 to the new pre-treatment facility that will be built south and east of WM-66 at TA-50. (see I, 50-001(a), 10, above). This tunnel will carry the acidic and caustic TRU waste from TA-55; it will make possible both visual inspection and the addition of other lines, as needed, in a cost-effective manner. A preliminary estimate is $8 million to $9 million.

TABLE 2-16 (cont'd)

A new buried line is also planned, to carry the effluent from the TRU waste pre-treatment plant to the new facility near TA-63.

- Interim plan: The existing lines from TA-55 to TA-50-66 will not vacuum-test and are suspected of leaking. They will be removed and replaced with buried, double (encased) polypropylene lines in March 1992. Title I and Title II are complete.
- Funding: The interim plan has been funded as a line item and the money has been approved. The utility tunnel is to be funded as a 1997 line item in the presidential budget.

2. Collector manhole TA-50-72 to grit chamber in TA-50-1
   - Long-range plan: This line will remain active until the new facility near TA-63 comes on line. It will include a new radioactive waste line from manhole 72.
   - Interim plan: None.
   - Funding: The new line will be funded as a 1995 line item.
3. TA-50-69 and TA-50-37
   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.
4. TA-2, -3, -35, -43, -48 and -52 via manhole TA-50-72
   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.
5. Manhole TA-50-7
   - Long-range plan: This manhole will be decontaminated and decommissioned as part of a project to build a new unloading station to replace TA-50-77.
   - Interim plan: None.
   - Funding: Construction of the new unloading station will be funded as a part of the 5-year GPP plan.

TABLE 2-16 (cont'd)

6. TA-55 via monitor pit TA-50-57 (now designated TA-50-106)

   - Long-range plan: This pit will be eliminated when the utility tunnel from TA-55-PF4 to TA-50 is constructed.
   - Interim plan: The pit will be enlarged when the new buried lines between TA-55 and TA-55-60 are installed in March 1992.
   - Funding: Funds to enlarge the pit are included in the project to install the new lines.

7. Manhole TA-50-72

   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.

II. 50-002: Tanks and Drainlines

50-002(a). Tank farm (TA-50-2)

1. Flow-thru process tanks

   - Long-range plan: It is assumed that TA-50-2 is leaking. This structure will be phased out as storage for raw radioactive industrial waste and a new tank farm will be installed as part of the new plant near TA-63.
   - Interim plan: For the short term, the concrete top of the 25,000-gal. raw waste storage tank will be removed and the tank will be decontaminated. A 20,000-gal. steel tank will be installed and attached to the existing effluent and influent systems. The new top will include an access manhole. The 25,000-gal. sludge tank will also be replaced, with the 10,000-gal. decant storage tank in Room 61 (see I, 50-001(a), 5). The two 25,000-gal. treated waste tanks will continue to be used, as will the treated waste line to Mortandad Canyon.
   - Funding: Funds will have to come from the 5-year GPP plan. No priority has yet been assigned to these projects.

2. Cast-iron transfer lines

   - Long-range plan: Option 1 is to construct a utility tunnel between TA-50-1 and TA-50-2. Option 2 is to dig up the cast-iron lines and replace them with double (encased) lines.

TABLE 2-16 (cont'd)

- Interim plan: None.
- Funding: 5-year GPP plan. No priority yet assigned.

3. Steel lines from Room 61

   - Long-range plan: A dedicated utility tunnel will be constructed.
   - Interim plan: None.
   - Funding: 5-year GPP plan. Priority has not yet been assigned.

4. Cast-iron lines from drains in Building TA-50-1

   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.

5. Additional radioactive industrial waste lines (3-in. line from sink in the Vehicle Decontamination Facility, 4-in. line from Decontamination and Laundry Area, and 3-in. line from Hot Cell Area run to the D&D tank at TA-50-2; a 4-in. effluent line and a 6-in. influent line connect TA-50-2 to the 100,000-gal. emergency holding tank).

   - Long-range plan: The lines associated with the 100,000-gal. emergency holding tank will be rerouted to the new TA-50-2 if it is constructed.
   - Interim plan: The 6-in. influent line from the 100,000-gal. emergency holding tank will be connected to the planned 20,000-gal. steel tank.
   - Funding: 5-year GPP plan. No priority has been set.

50-002(b). Tank TA-50-67 (caustic waste holding tank in underground vault TA-50-66) and
50-002(c). Tank TA-50-68 (acid waste holding tank in underground vault TA-50-66)

- Long-range plan: Once the pre-treatment plant for TRU waste from TA-55 is constructed, these tanks will be used only for emergency storage.
- Interim plan: None.
- Funding: Line item in pre-treatment plant project.

TABLE 2-16 (cont'd)

50-002(d). Aboveground nitric acid storage tank (designated TA-50-5)

- Long-range plan: If it becomes necessary to use the tank, it will be emptied of nitric acid and refilled with sulfuric acid. This will eliminate the nitrate problem that occurs when the nitric acid is neutralized.
- Interim plan: None.
- Funding: None.

III. 50-003: Waste Storage Areas

50-003(a). Primary drum storage area (Room 60D)

- Long-range plan: This storage area will be replaced by a new area in the pre-treatment plant that is to be constructed (see I., 50-001(a), 10).
- Interim plan: None.
- Funding: None.

50-003(b). Satellite storage area for analytical laboratories

- Long-range plan: None.
- Interim plan: None
- Funding: None.

50-003(c). Temporary (< 90 days) storage areas

1. Area on asphalt paving immediately south of TA-50-2
   - Long-range plan: None.
   - Interim plan: None.
   - Funding: None.
2. Asphalt-paved area between north wall of Vehicle Decontamination Facility and south wall of east wing of TA-50-1.
   - Long-range plan: This area will be covered with a roof, and a drum elevator will be installed to the first floor of TA-50-1. The present chain hoist and cantilever monorail will be decommissioned.

TABLE 2-16 (cont'd)

- Interim plan: None.
- Funding: 5-year GPP plan.

50-003(d). Modular shed designated TA-50-114

- Long-range plan: None.
- Interim plan: None.
- Funding: None.

IV. 50-004: Decommissioned Tanks and Waste Lines

- Long-range plan: None.
- Interim plan: None.
- Funding: None.

V. 50-005: Nonradioactive Waste Treatment Plant (Rooms 24B and 34 of Building 1)

- Long-range plan: The operations of the nonradioactive waste treatment facility will be taken over by the new plant to be constructed near TA-63.
- Interim plan: None.
- Funding: Included as a line item in the 1995 project to build the new plant.

VI. 50-010: Radioactive Decontamination Facility

- Long-range plan: This facility will not be replaced as part of the new plant. It will remain in use at TA-50-1.
- Interim plan: None.
- Funding: None.

VII. 50-011: Septic Systems

50-011(a). Decommissioned septic systems

- Long-range plan: None.
- Interim plan: None.

TABLE 2-16 (cont'd)

- Funding: None.

50-011(b). Active sanitary waste system

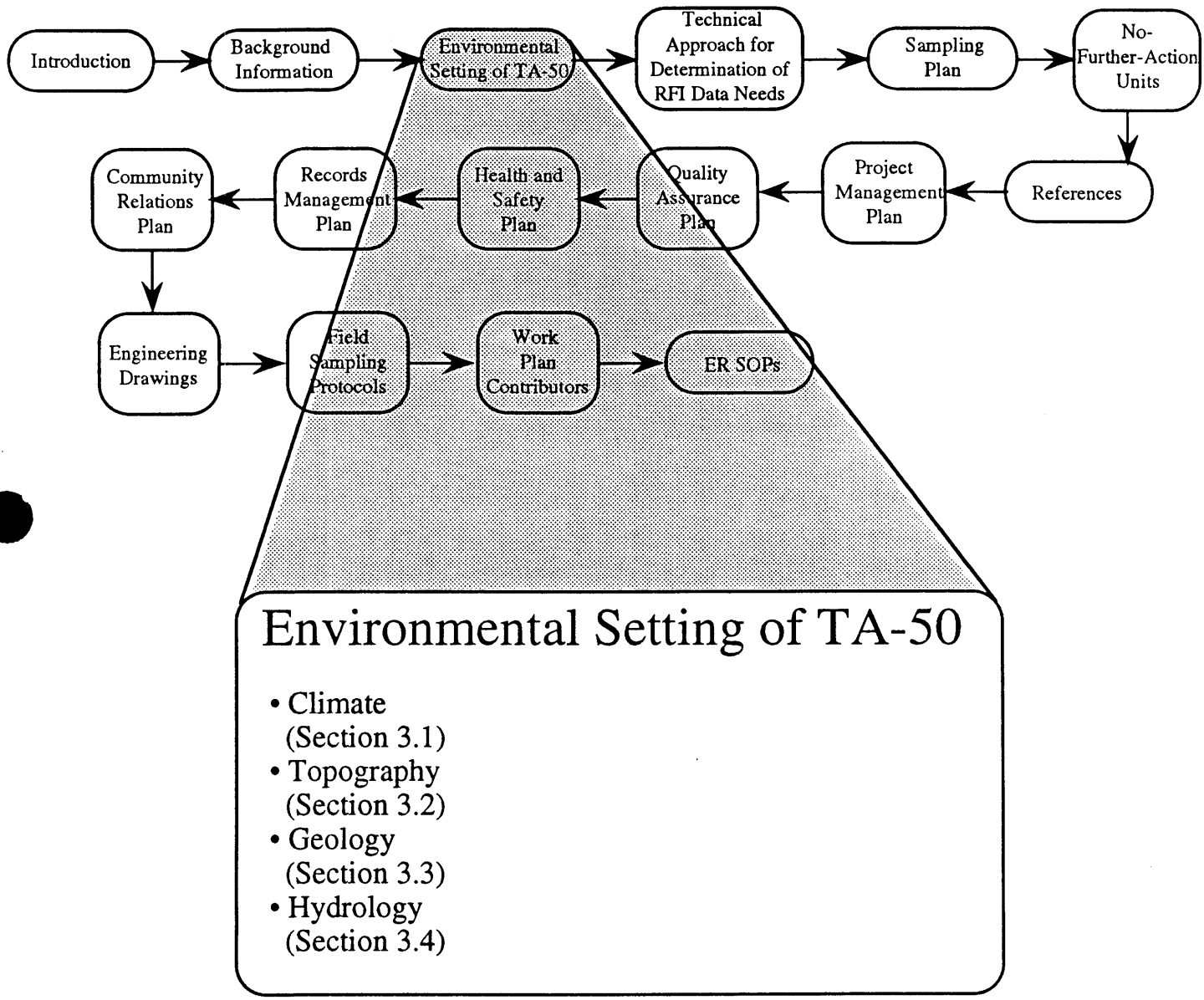
- Long-range plan: None.
- Interim plan: None.
- Funding: None.

Standard, which applies to all routes, including ingestion (ESG 1990, 0309). There is currently no evidence of any man-made radionuclides in Los Alamos drinking water (ESG 1990, 0309).

The current lack of data on hazardous waste constituents in environmental samples from TA-50 precludes any assessment of health and environmental impacts.

With regard to possible effects of the TA-50 RFI itself on public health and the environment, NEPA documentation is in process. The biological survey found no significant impacts on wetlands, critical habitat, or threatened or endangered species. The archaeological survey is not complete, but no significant findings are expected.

CHAPTER 3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3.0 ENVIRONMENTAL SETTING OF TA-50

The climate, geology, topography, stratigraphy, soil characteristics, and hydrology of TA-50 are discussed in this section. An understanding of these factors is essential for determining potential contaminant migration pathways.

3.1 Climate

Los Alamos County has a semiarid, temperate mountain climate. Detailed climate information, including frequency analyses of extreme events, is given in Bowen (1990, 0033) and summarized in Section 2.5.3 of the IWP. Climatic aspects of interest include

- atmospheric transport of contaminants: speed, frequency, direction, and stability of winds;
- surface water runoff, infiltration, and evaporation potential: precipitation form, frequency, and intensity.

3.1.1 Winds

Wind speed and direction are measured at five locations around the Laboratory (ESG 1989, 0308). Wind speeds are generally less than 2.5 m/s (5.5 mph) about 40% of the time and greater than 5 m/s (11 mph) about 20% of the time. Strong winds occur mainly in the spring. The predominant wind direction, especially for strong winds, is to the north-northeast.

3.1.2 Precipitation

Forty percent of the precipitation on the Pajarito Plateau occurs as brief, intense thunderstorms during July and August, which often produce significant runoff of surface water. Winter snowfall averages 130 cm (51 in.) annually (ESG 1989, 0308). The prevalence of short, intense precipitation events suggests that water-driven erosion of surface soils is an important mechanism in transporting surficial contaminants at TA-50.

3.2 Topography

The geographic setting of the Laboratory is described in Section 2.1 of the IWP. The Los Alamos National Laboratory is in Los Alamos County, north-central New Mexico, approximately 100 km (62 mi) north-northeast of Albuquerque and 40 km (25 mi) northwest of Santa Fe. The Laboratory and the adjacent communities of Los Alamos and White Rock are on the 111-km^2 (43-mi^2) Pajarito Plateau, which is a series of finger-like mesas separated by deep canyons oriented east-west to northwest-southeast. Mesa tops range in elevation from about 2400 m (7870 ft) on the west (eastern flank of the Jemez Mountains) to about 1800 m (5900 ft) at their eastern margins above the Espanola Valley and White Rock Canyon.

TA-50 is located along Pajarito Road in the central northern half of the Laboratory, on the Mesita del Buey; it is bounded by Two Mile Canyon, Canada

del Buey, Ten Site Canyon, and Mortandad Canyon. Mesa elevations range from 2194 to 2218 m (7200 to 7280 ft).

3.3 Geology

The geology of TA-50 reflects its position on the Pajarito Plateau, which extends east from the Jemez Mountains, and on the western margin of the Espanola Basin segment of the Rio Grande rift. The following discussion is specific to the geology in the immediate vicinity of TA-50 and is restricted to those rock units in the vadose zone and the upper saturated zone that are considered relevant to site characterization and remediation.

Numerous geologic maps cover regional and local areas, including those of Griggs and Hem (1964, 0313) for geohydrologic studies in the Los Alamos area and those of Smith et al. (1970, 07-0061) for volcanological mapping of the Jemez Volcanic Field. Kelley (1978, 0534) prepared a regional tectonic map of the Rio Grande rift in the Jemez Mountains area. Maps showing local stratigraphic and structural features include Galusha and Blick 1971, 0108; Aubele 1978, 07-0034; Dethier and Manley 1985, 0249; and Goff et al. 1990, 07-0041). There are also unpublished maps by D. E. Broxton and M. A. Rogers. The most recent maps have focused on the Pajarito fault system (Dransfield and Gardner 1985, 0082; Gardner and House 1987, 0110). Vaniman and Wohletz (1990, 0541) have produced a geologic map centered on TA-55 that synthesizes previous work with new studies of the structure of the Rendija Canyon and Guaje Mountain fault branches of the Pajarito Fault system (Color Plate 3-1).

TA-50 is underlain by Miocene through Pleistocene volcanic and sedimentary rocks. Figure 3-1 shows schematically the stratigraphy of the site, as well as anticipated depths of stratigraphic contacts and thicknesses of rock units projected from lithologic logs of drillhole EGH-LA-1 (Sigma Mesa) and Test Well 8 (Mortandad Canyon). Significant deviations may occur between projected and actual unit depths and thicknesses, particularly for the lower sedimentary units, because of the unique setting of TA-50. Factors that may affect the geometry of subsurface units include frequent and abrupt lateral and vertical facies variations in the lower sedimentary rock units, significant relief on paleotopographic surfaces on which rock units were deposited, and fault offsets in the older sedimentary units that are masked by younger volcanic rocks (which themselves show little or no displacement).

3.3.1 Stratigraphy

The stratigraphy of the upper rock units at TA-50 can be observed directly in exposures of outcrops on canyon walls and slopes south and north of the site (Vaniman and Wohletz 1990, 0541). The stratigraphy of lower units is inferred from some of the drillholes described above, from regional exposures to the north and east, and from regional geologic maps. Dransfield and Gardner (1985, 0082) combined well data with geophysical investigations to develop structural contours of the base of the Bandelier Tuff of the Pajarito Plateau; their paleogeology shows the pre-Bandelier rocks to be dominated by Polvadera Group dacitic rocks in the west, Puye Formation fanglomerates in the northeast,

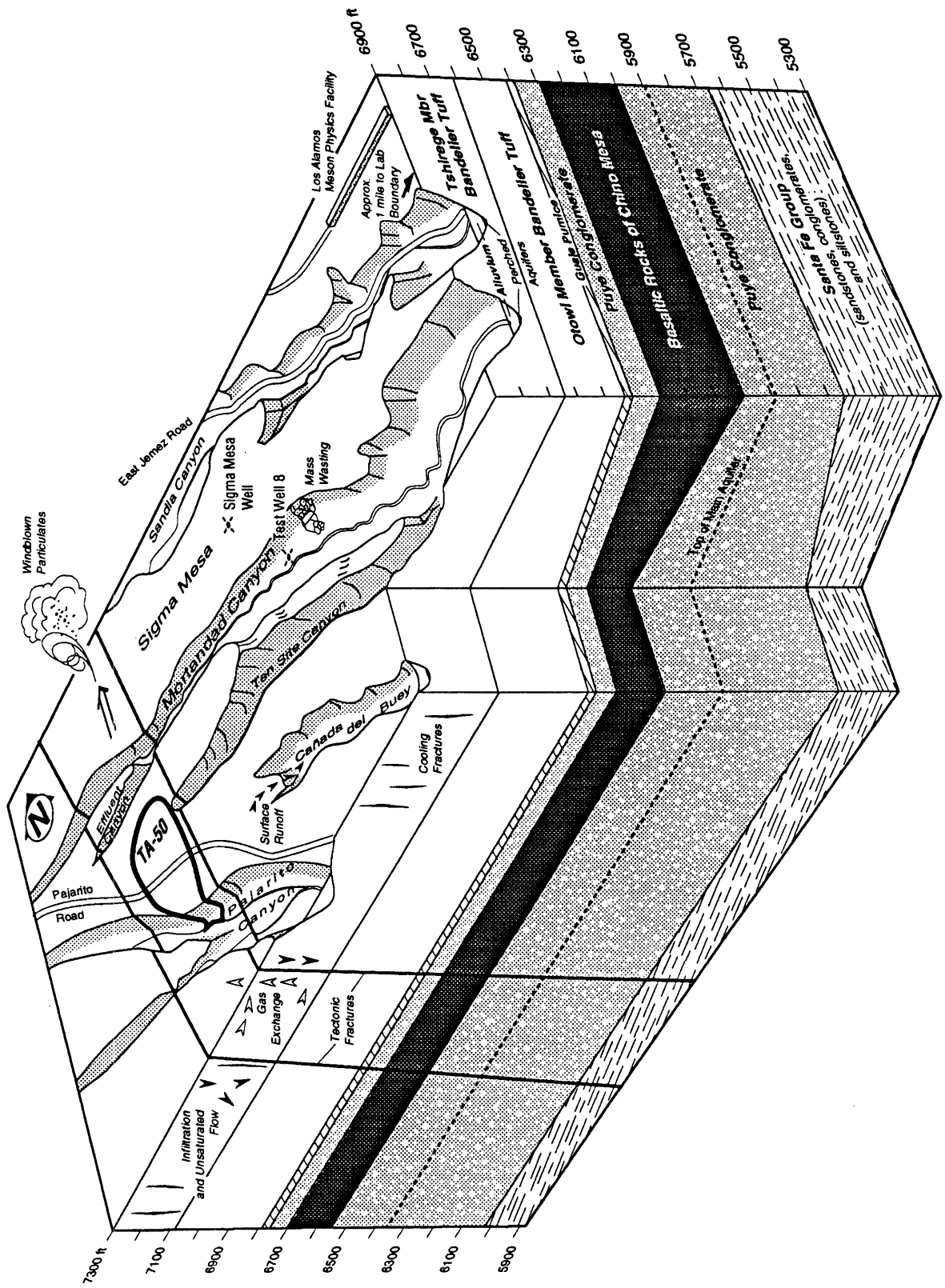


Figure 3-1 Conceptual block diagram of OU 1147.

and basaltic lava flows of the Cerros del Rio in the southeast. More recent work has modified this stratigraphy (Vaniman and Wohletz 1990, 0541).

Figure 3-2 shows the stratigraphy and lithologies of rock units encountered in Test Well 8. Formational assignments for subsurface units in these drillholes should be considered preliminary until detailed petrographic studies can be performed.

In the following paragraphs, we describe the major stratigraphic units at TA-50, from youngest to oldest.

3.3.1.1 Soils

The soils of the Pajarito Plateau are discussed in Section 2.6.2.3 of the IWP. Soils in the vicinity of TA-50 are poorly developed, as is typical of soils derived from Bandelier Tuff bedrock and formed under semiarid climate conditions. Soils in the vicinity of the Laboratory were mapped and described by Nyhan et al. (1978, 0161). Relevant soil data include

- presence/absence, disturbed/undisturbed;
- potential for wind and water erosion (particle size distribution and classification, vegetative soil cover); and
- contaminant retardation/neutralization capability: ion-exchange capacity, pH, K_d, clay content, permeability.

Soils on the mesa top surrounding TA-50 are mainly shallow, well-drained sandy loams of the Hackroy series. As described by Nyhan et al. (1978, 0161), "The surface layer of the Hackroy soils is a brown sandy loam, or loam, about 10 cm thick. The subsoil is a reddish brown clay, gravelly clay, or clay loam, about 20 cm thick. The depth to tuff bedrock and the effective rooting depth are 20 to 50 cm." Hackroy soils are classified as Alfisols, in part reflecting the clayey subsurface horizons. Intermixed with the Hackroy soils on the mesa tops are small areas of deeper loams of the Nyjack series and patches of bedrock. The Nyjack soils are texturally similar to Hackroy soils but are thicker (50 to 102 cm) and frequently exhibit pumice fragments in the lower levels (Nyhan et al. 1978, 0161).

Section 2.6.3.1.2 of the IWP describes a distinct clay layer often found beneath the Hackroy and Nyjack soils. This layer has been cited, perhaps erroneously, as a possible barrier against infiltration of soil water into the underlying bedrock (Abeele et al. 1981, 0009; Weir and Purtymun 1962, 0228). In areas where soils have been removed or disturbed (such as most of OU-1147), this barrier may no longer exist (Abrahams et al. 1961, 0015).

Within TA-50 there is limited natural or undisturbed soil cover because of building and parking lot construction. Soil on the surrounding mesa is approximately 0.9 to 1.5 m (3 to 5 ft) thick (Rogers 1977, 0216). At the Area C landfill, each pit was back-filled to ground level with crushed tuff after it had been filled to capacity with waste. In 1984, clean fill, comprising 0.5 m (1.5 ft) of crushed tuff and 1 m (3 ft) of topsoil, was brought in and used to cover a large part of Area C. The area was then seeded with a native gramagrass mixture.

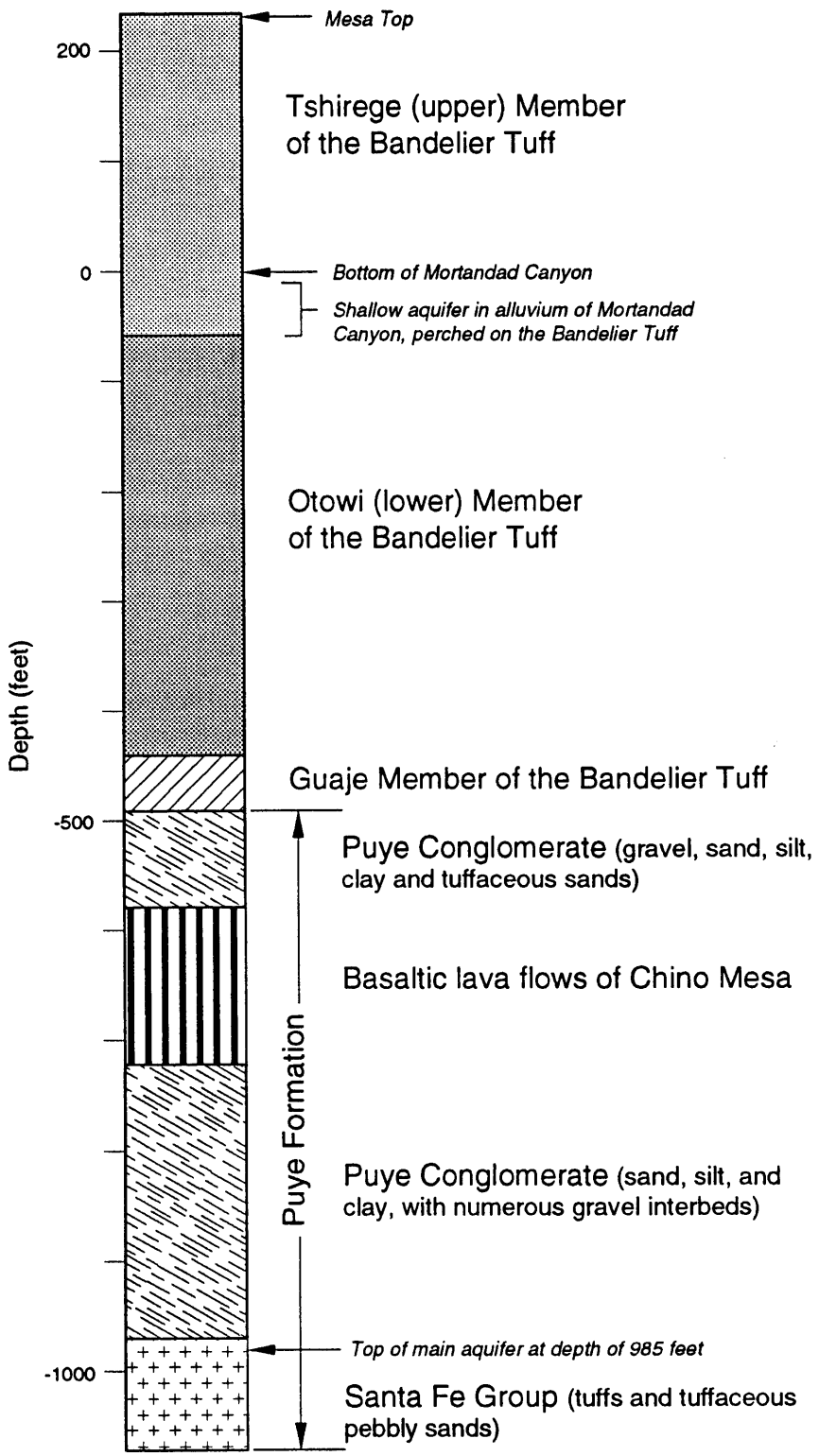


Figure 3-2 Simplified stratigraphy of Mortandad Canyon, based on cliff sections and Test Well 8 (from Baltz et al. 1963).

3.3.1.2 Tshirege Member, Bandelier Tuff (1.13 Ma)

The uppermost rock unit at TA-50 is the Tshirege Member of the Bandelier Tuff, which was erupted from the Valles caldera to the west (Smith and Bailey 1966, 0377). Figure 3-3 is a schematic stratigraphic section that shows the lithologic features of the Tshirege Member. It is a compound cooling unit composed of at least four flow units of pale orange, crystal-rich ignimbrite. Upper flow units tend to be more welded than lower units. Flow-unit boundaries are locally separated by surge deposits of fine-grained, cross-bedded crystal and pumice fragments (Fisher 1979, 07-0007; Self et al. 1986, 0375).

Vapor-phase alteration in lower flow units is caused by post-emplacement cooling and migration of entrained magmatic gases (Crowe et al. 1978, 0041). Individual flow units contain vertical cooling joints that may or may not cross flow-unit boundaries. The spacing of cooling joints varies primarily with thickness of unit, emplacement temperature, substrate temperature, and topography (Crowe et al. 1978, 0041). The locations and relative quantities of cooling joints in the Tshirege Member along the southern border of TA-50 are shown in Figure 3-4.

The Tshirege Member is composed of high-silica rhyolite with low concentrations of calcium, magnesium, iron, and high concentrations of incompatible trace elements (Gardner et al. 1986, 0310). It contains phenocrysts of sanidine and quartz and rare hypersthene and fayalite in a groundmass of shards, crystal fragments, and pumice. Lithic clasts consisting of Tschicoma dacites and andesites (Eichelberger and Koch 1979, 0083) are ubiquitous in the unit and commonly make up 1 to 2% of the rock.

The groundmass mineralogy of the Tshirege Member has not been systematically mapped and characterized. Some preliminary field and laboratory studies indicate that the matrix in the central part of the Member has been devitrified to a mixture of alkali feldspar, quartz, and cristobalite. Vapor-phase zones also occur and are characterized by the presence of tridymite. The upper and lower parts of the Member are not devitrified and generally contain abundant volcanic glass. No studies have been done to determine whether alteration of the glassy zones has produced potentially sorptive minerals, such as zeolites and clays. In addition, the nature of the minerals within the tuff is not well understood.

The Tshirege Member is only partially exposed in the Mortandad and Two Mile canyons near TA-50. Where exposed elsewhere on the Pajarito Plateau, the base of the Tshirege Member consists of 0.5 to 3 m (1.6 to 9.8 ft) of bedded ashfall tuff of the Tsankawi Pumice Bed (Bailey et al. 1969, 0019). The Tsankawi Pumice Bed consists of pumice lapilli and crystal fragments in a porous, massive-to-cross-bedded matrix of glass shards and pumice fragments. The unit is nonwelded and forms a thin, white, discontinuous marker bed near the break in slope in the canyons north of TA-50. This unit is generally poorly recognized in drill bit cuttings because rotary drills commonly pulverize the soft materials.

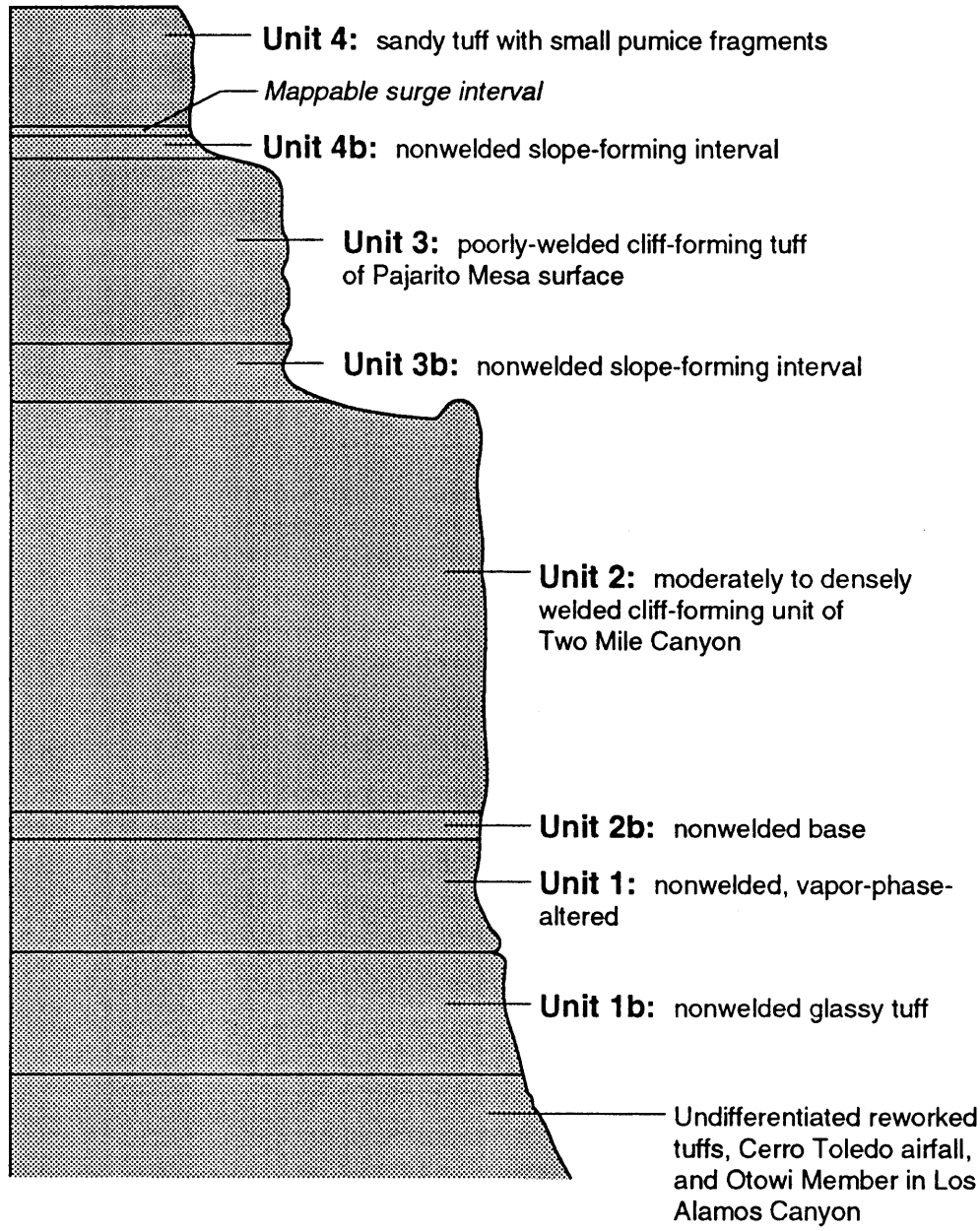


Figure 3-3 Schematic stratigraphy of the Tshirege Member in the TA-55 area.

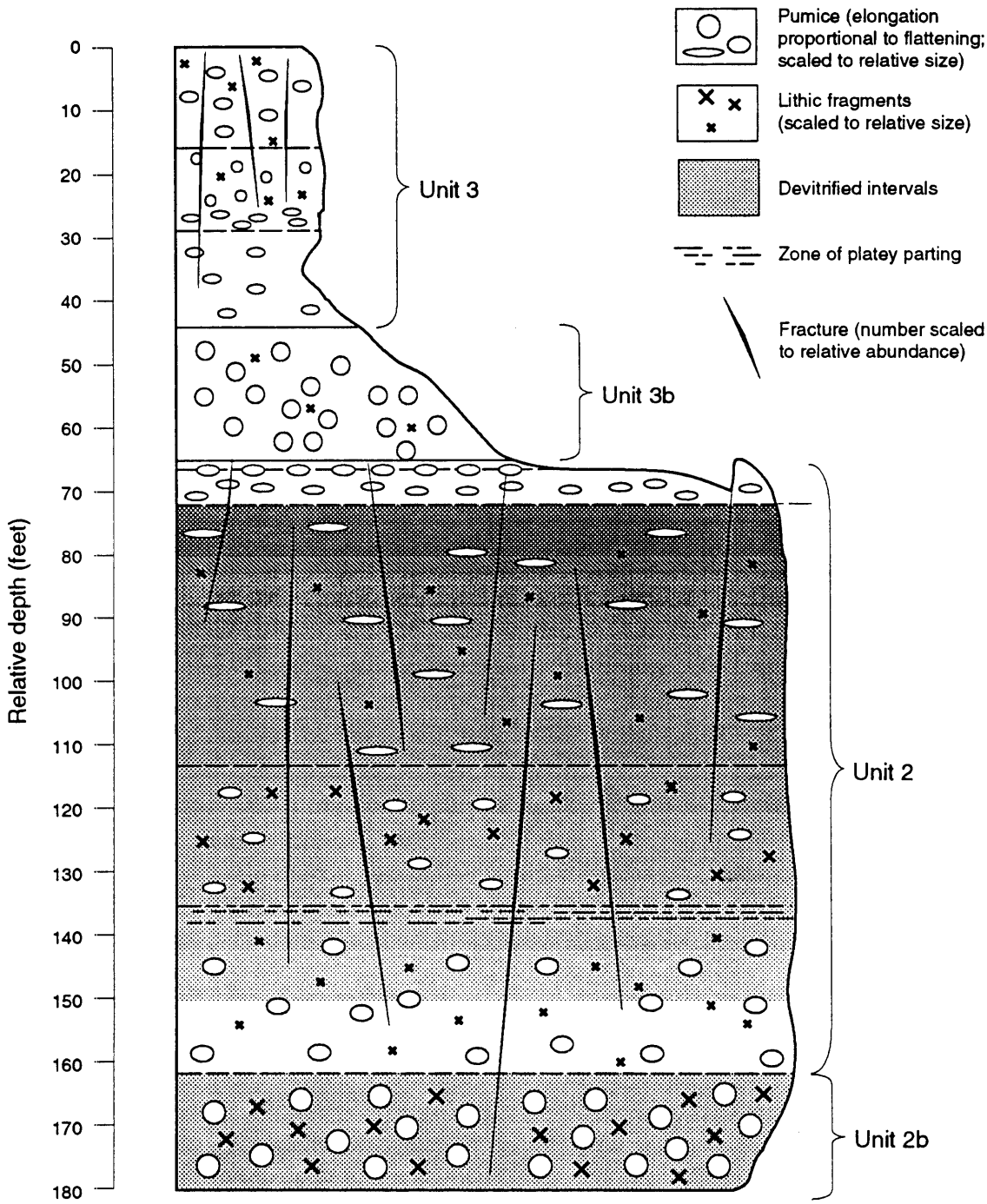


Figure 3-4 Schematic geologic cross section for TA-50 and TA-55.

3.3.1.3 Cerro Toledo Rhyolite (1.13 to 1.50 Ma)

Although the Cerro Toledo Rhyolite is present in channels north of Sandia Canyon (Heiken et al. 1986, 0316), it is not certain whether it is present beneath the Tshirege Member at TA-50. Because the Cerro Toledo Rhyolite is thin and its deposition was partially controlled by paleo-drainage patterns, it may not occur everywhere on the Pajarito Plateau. It was not found during drilling of well EGH-LA-1 (Sigma Mesa) just north of TA-50 but is well exposed in Pueblo Canyon north of DP Mesa. In that area, the Cerro Toledo Rhyolite consists of up to 10 m (32 ft) of interbedded ashfall tuffs, pumice beds, and epiclastic sediments in paleochannels. Pumice lapilli consist of high-silica rhyolite (Stix et al. 1988, 0218) and are typically aphyric except for rare, black biotite microphenocrysts. Sources of pyroclastic materials are rhyolitic vents, mostly in the Toledo embayment of the Valles caldera.

In lower DP Canyon, the Cerro Toledo Rhyolite consists of four to five Plinian beds intercalated with discontinuous, channelized fluvial sands and gravels. The fluvial matrix consists mainly of dacitic fragments and rhyolitic pumice; lenses of dacitic gravels and cobbles are also common. Thin, discontinuous soil horizons are seen at the top and bottom of the unit, which is about 10 m (33 ft) thick at this location.

On the north side of Los Alamos Canyon below TA-21, the Cerro Toledo Rhyolite consists of three ashfall (Plinian) beds with localized surge deposits. Lower horizons are reworked by fluvial processes and contain a high proportion of dacitic clasts derived from the Tschicoma Formation (Smith et al. 1970, 07-0061). The Plinian sequence is overlain by a discontinuous soil horizon marking the contact with the overlying Tshirege Member. The Plinian deposits are draped over a course conglomeratic bed that contains dacite boulders in a dacitic sand-and-gravel matrix. the contact of this boulder bed with the underlying Otowi Member is covered by talus. The entire Cerro Toledo sequence is exposed at this location, and is about 7 m (23 ft) thick.

3.3.1.4 Otowi Member, Bandelier Tuff (1.50 Ma)

The Otowi Member of the Bandelier Tuff was emplaced during the formation of the Toledo caldera, which is now known to be coincident with—but mostly obliterated by—the later Valles caldera (Nielson and Hulen 1984, 0151; Self et al 1986, 0375; Heiken et al. 1986, 0316; Potter and Oberthal 1987, 0182). At DP Mesa, where it is exposed, the Otowi Member is a nonwelded vitric ignimbrite (ashflow tuff) that is made up of several flow units. It is a highly porous, poorly indurated, slope-forming unit that is partially exposed in the lower part of the Los Alamos Canyon. Generally speaking, the Otowi Member is lighter colored and less welded than the overlying Tshirege Member and is more prone to forming conical mounds (called "tent rocks") during erosion (Crowe et al. 1978, 0041).

The phenocryst assemblage and rock chemistry of the Otowi Member are nearly identical to those of the Tshirege Member, and individual hand samples of the two units are difficult to distinguish. However, lithic clasts are typically more abundant in the Otowi Member. The matrix mineralogy of the Otowi Member has not been systematically studied and should be more fully characterized.

Preliminary field studies in the northeastern part of LANL indicate that the Otowi Member is vitric throughout. Zones of devitrification and vapor-phase alteration appear to be absent.

The base of the Otowi Member consists of the Guaje Pumice Bed (Griggs and Hem 1964, 0313), a pumice fall unit that reaches a thickness of about 7 m (23 ft) around the Pajarito Plateau. Pumices in the unit are as large as 15 cm (6 in), and the unit is extremely permeable. The Guaje Pumice is not exposed at TA-50, but excellent exposures can be found in deep canyons north and east of the site.

3.3.1.5 Puye Formation (1.5 to 7? Ma)

The Puye Formation is an extensive, volcanogenic, alluvial-fan complex that spreads eastward from the Tschicoma volcanic center in the Jemez Mountains (Griggs and Hem 1964, 0313; Turbeville et al. 1989, 0221). The Puye Formation is not exposed at TA-50, but its presence is known from nearby drill holes. In general, the Puye Formation is a conglomeratic unit consisting of dacitic to andesitic cobbles and boulders in a volcanic sand matrix. The volcanic clasts are usually porphyritic and contain abundant phenocrysts of feldspar, hornblende, biotite, pyroxene, and quartz. White ash beds of dacitic to rhyolitic composition are interbedded with the conglomerates and serve as useful stratigraphic markers; unfortunately, these ash beds are rarely recognized in cuttings from drillholes.

Puye deposits are commonly interbedded with basaltic lava flows and ashfalls of the Cerros del Rio near the top of the section, particularly on the east side of the Pajarito Plateau (Smith et al. 1970, 07-0061). In drillhole Otowi 4, a basalt flow 38 m (125 ft) thick is interbedded with gravels in the upper part of the Puye Formation. The lateral extent of this basalt beneath TA-50, and its possible correlation with basalts that occur at a similar stratigraphic level east of the site, cannot be determined without relatively deep drilling. The Puye Formation is 183 m thick beneath Sigma Mesa (well EGH-LA-1) and is interbedded with Tschicoma dacite/andesite flows and Cerros del Rio basalt flows. Similar lava flows could exist beneath TA-50.

The age of most exposed Puye deposits is bracketed between 1.9 and 3.5 Ma (Turbeville et al. 1989, 0221), but this age estimate is based largely on dating of the intercalated ash beds and volcanic clasts derived from the Tschicoma Formation. It is likely that fanglomerates of the lower Puye Formation interfingered with fluvial deposits of the upper Santa Fe Group as volcanic detritus shed from the Jemez Mountains into the developing Espanola Basin. These deposits may also be interbedded with axial gravels of the ancestral Rio Grande (Totavi Lentil), as indicated by the lithologic logs from EGH-LA-1.

3.3.1.6 Santa Fe Group (>12.4 to ~7 Ma)

Rocks of the Santa Fe Group consist of grey to tan to pale orange arkosic, fluvial sandstone, siltstone, and conglomerate with subordinate eolian deposits, ash beds, and lacustrine rocks (Galusha and Blick 1971, 0108; Manley 1979, 0349; Cavazza 1989, 0242; Aldrich and Dethier 1990, 0017). A true appreciation of the

complexity of this unit and its depositional history can be obtained only through a study of the literature. Deposits of the Santa Fe Group are interbedded with basalts of the Cerros del Rio and andesites and dacites of the Tschicoma Formation. Santa Fe rocks also interfinger with lower fanglomerates and the Totavi Lentil of the Puye Formation.

Present interpretation suggests that within the Pajarito Plateau area, Santa Fe Group rocks to the east belong to the Tesuque Formation and to the west to the Chamita Formation. The Tesuque Formation rocks are typically pale pink and have abundant Precambrian fragments from sources to the northern and eastern parts of the Rio Grande rift. The Tesuque Formation is well exposed east of the Rio Grande and is observable in drillhole Otowi 1 below 1738 m (5700 ft). In drillhole Otowi 4, a thin pink siltstone at an elevation of 1698 m (5570 ft) may be of Tesuque affinity.

3.3.1.7 Chamita Formation

Chamita Formation rocks are similar in appearance to Tesuque rocks but contain a higher percentage of limestone and volcanic fragments (Dethier and Manley 1985, 0249). Gravel and sand units in the bottom of drillhole Otowi 4 may be correlative with the Chamita Formation because they contain primarily porphyritic volcanic fragments and do not appear to be typical Tesuque rocks. On the other hand, these units may represent an unusually thick accumulation of the Puye Formation interbedded with the Santa Fe Group. Correct formational assignments will require detailed sedimentological and petrographic studies of these units in available cuttings and exposed outcrops. Irrespective of formational assignment, sedimentary rocks penetrated by Otowi 4 contain much more coarse sand and gravel than rocks at similar elevations in drillhole Otowi 1. The differences between the lithologies of the deep sedimentary units in Otowi 1 and 4 indicate that frequent and abrupt lateral facies variations are an additional complication that must be considered in site characterization.

Two lava flows interbedded with the upper Santa Fe Group have tentatively been identified in drillhole Otowi 4. Hand lens examination suggests that these units are porphyritic andesites or dacites of the Tschicoma Formation. Additional work is required to determine their compositions and stratigraphic assignments.

3.3.2 Structure

TA-50 is part of the Pajarito Plateau, which lies within the Espanola Basin of the Rio Grande rift. The plateau, which dips several degrees to the east and northeast, is cut by the Pajarito fault system. The Pajarito fault forms the western margin of the Espanola Basin and has had Holocene movement and historical seismicity (Gardner and House 1987, 0110). In addition to the main trace of the Pajarito Fault, two other faults rupture the surface of the Bandelier Tuff just west of TA-50: the Guaje Mountain and Rendija Canyon faults. Where exposed to the north, these faults are characterized by zones of gouge and breccia up to several meters wide and have produced a visible offset of stratigraphic horizons. Displacement on the Guaje Mountain and Rendija Canyon faults decreases south of DP Mesa, and discrete faults are replaced by zones of intense fracturing superimposed on the network of cooling joints in the

Bandelier Tuff. These fracture zones are more likely to cross the flow-unit and lithologic-unit boundaries than are cooling joints (Gardner 1990, 07-0010); thus, they may provide more continuous and more deeply penetrating flow paths for groundwater migration than cooling joints. Many of these fractures are filled with clay and/or caliche.

Dransfield and Gardner (1985, 0082) integrated a variety of geologic data to produce structure contour and paleogeologic maps of the pre-Bandelier Tuff surface beneath the Pajarito Plateau. Their maps reveal that subsurface rock units are cut by a series of normal faults that dip westward; the overlying Bandelier Tuff is not displaced by these buried faults.

Purtymun et al. (1978, 0207) drilled five semi-horizontal coreholes beneath the waste pits on Mesita del Buey, near the contact between subunits 2a and 2b of the Bandelier Tuff (see Fig. 1-1, Chapter 1). The holes range from 73 to 92 m (240 to 301 ft) long and are about 12 to 14 m (40 to 46 ft) below the mesa top. Numerous cooling joints (37 to 100 per 100 ft) were encountered; 19% are open with slight weathering of the joint face, 72% are filled or plated with brown clay, and 9% are filled or plated with caliche. Some joints are filled with clay beneath a thin layer of soil at the mesa top and are open at deeper levels. Major joints are vertical or with dips of >70°.

Fracture mapping by D. Vaniman and K. Wohletz (1990, 0541) for the LANL Seismic Risk program has shown that fracture frequency and aperture widths increase toward mesa margins, where large blocks tend to shift outward as the mesa erodes, and also increase over projected fault traces. One such fault trace passes along the eastern edge of TA-50 and another 580 m (1900 ft) west of the margin of the technical area (Color Plate 3-1 and Fig. 3-1). Numerous microstructures characterize the Bandelier Tuff. These include micrograbens up to 76 m (25 ft) across and 23 m (75 ft) long that present vertical displacements of up to 3 m (10 ft) and joint sets that in places form zigzag fracture patterns along which greater erosion is evident (Vaniman and Wohletz 1990, 0541). The fractures trend north and northeast and are nearly vertical. Such fractures are typical features of welded tuff and are usually attributed to contraction during cooling of the tuff. Vaniman and Wohletz (1990, 0541) found that the frequency and average width of these fractures were greater over subsurface projections of the Rendija Canyon and Guaje Mountain fault splays: vertical displacement is 1.8 to 2.7 m (6 to 9 ft) spread out over a distance of 274 m (900 ft) for the former and 487 m (1600 ft) for the latter. This indicates that tectonic movement has affected the nature of these fractures. Mesa-top and canyon-bottom topographic gradients show inflections supporting this conclusion. Characterization studies should determine whether the fault near the eastern margin of TA-50 plays an important part in the distribution of subsurface units and whether these faults are potential pathways for contaminant transport in the vadose zone.

3.3.2.1 Physical Properties of the Bandelier Tuff

3.3.2.1.1 Grain Size

Because of welding and vapor-phase alteration, traditional grain-size analyses by sieving are limited to nonwelded tuffs from pumice fallouts and surge deposits.

Samples from nonwelded zones within the Tshirege Member of the Bandelier Tuff ignimbrite are all poorly to very poorly sorted, with mean grain sizes of multiple samples ranging from 61 to 412 μm.

Pumice fallout deposits associated with the Bandelier Tuff have not been sized, but similar near-vent pumice fallout deposits in the Medicine Lake highland in California are all poorly sorted, with mean grain sizes ranging from 7 to 15 mm (Heiken 1978, 07-0012).

Some of the surge beds near the base of the Tshirege Member and within the Cerro Toledo Tuffs are very fine grained, with some beds having mean grain sizes of around 50 μm (Heiken et al. 1986, 0316).

3.3.2.1.2 Surface Area

The surface area of pyroclasts that will interact with vapor or fluids was calculated for nonwelded tuff of the Tshirege Member (Crowe et al 1978, 0041). The surface areas ranged from 521 to 713 cm^2 per cm^3 of rock. These would be much larger in the finer-grained surge beds.

3.3.2.1.3 Bulk Density

Bulk density has not been systematically measured for the Bandelier Tuff. Within nonwelded Bandelier Tuff (Tshirege Member) with porosities of 50-60%, bulk densities range from 1.0 to 1.7 g/cm^3 (Heiken 1979, 0600). Comparable nonwelded tuffs from the Kamchatka Peninsula have bulk (dry) densities ranging from 0.89 to 1.38 g/cm^3 (Cherkasov et al. 1971, 07-0002). In contrast, densely welded rhyolitic tuffs, including a sample from the Jemez Mountains, have densities of 2.34 to 2.47 g/cm^3 (Ross et al. 1961, 07-0026).

The only systematic study of the relationship between the porosity and bulk density of tuffs was published in a monograph by Atsagortsian and Martirasian (1962, 07-0001). Their work shows variations, as a function of increasing welding, ranging from 60% porosity with a density of 0.95 g/cm^3 to 16% porosity with a density of 1.65 g/cm^3.

3.3.2.1.4 Seismic P-Wave Velocity

Gardner and House (1987, 0110) have determined seismic P-wave velocities for the Bandelier Tuff. These range from 2500 ft/sec for vapor-phase-altered Tshirege Member tuff to 15 000 ft/sec for densely welded tuff from an area immediately west of S-Site.

3.3.2.1.5 Thermal Conductivity

Partly welded tuff collected from the lower portion of the ignimbrites of the Tshirege Member have thermal conductivities of 0.2 to 0.4 W/m°K (Sibbett, personnel communication, 1978, 07-0031). In contrast, granite has a thermal conductivity of 3.5 W/m°K.

3.3.2.1.6 Crushing Strength

Nonwelded tuffs having a porosity of 50-60% show crushing strengths of 70-500 kg/cm^2 (Zalessky 1961, 07-0033). Data on welded tuffs could not be found (much of this information is in the building stone literature, and only the nonwelded to poorly welded tuffs make decent building stone).

3.3.2.2 Geochemical Studies

Whole-rock chemical analyses and electron-microprobe mineral analyses of the Bandelier Tuff are available from Smith and Bailey (1966, 0377), Crowe et al. (1978, 0041), Gardner et al. (1986, 0310), Kuentz (1986, 0602), Heiken et al. (1986, 0316), Stix et al. (1988, 0218), and Warshaw and Smith (1988, 07-0032). In SiO_2 content, the Otowi Member ranges from 75.8 to 77.9 wt% and the Tshirege Member from 72 to 77 wt%; other major constituent variations are summarized in the RFI work plans for the TA-33 and DP sites. Both Crowe et al. (1978, 0041) and Kuentz (1986, 0602) present trace element data showing uranium concentrations in the range of 4 to 18 ppm, lead from 6 to 49 ppm, and mercury <5 ppm. Phenocrysts constitute from 5 to 35% of the volume of the Tshirege Member, increasing as follows: sanidine> quartz> clinopyroxene> magnetite> fayalite (Smith and Bailey 1966, 0377). Lithic clasts occupy a volume of ≈25% in some parts of the tuff; the remainder of the volume is (or was) glass. In many parts of the Bandelier Tuff, glass has been altered to a mixture of clays, zeolites, and vapor-phase minerals. In many canyons, decimeter-thick zones of zeolitized tuff may mark paleogroundwater tables (Hawley 1978, 07-0014).

3.4 Hydrology

3.4.1 Surface Water Hydrology

Los Alamos area surface water consists primarily of intermittent streams. Springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons, but the amount is insufficient to maintain surface flow across the Laboratory site before it is depleted by evaporation, transpiration, and infiltration. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year. Effluents from sanitary sewage facilities, industrial waste treatment plants, and cooling towers are released to some canyons at rates sufficient to maintain surface flow for about 1.5 km (1 mi).

3.4.1.1 Runoff

Runoff in the ephemeral streams of Pajarito and Mortandad Canyons, adjacent to TA-50, arise from effluent releases, summer thunderstorms, and spring snowmelt. Effluent releases result in flow along limited stream segments. Runoff from summer storms reaches a maximum discharge in less than 2 hours and generally dissipates in less than 24 hours. The high discharge rate causes large masses of suspended and bed sediments to be carried for long distances—sometimes to the Rio Grande River. Spring snowmelt takes place over a period of several weeks to several months at low discharge rates. Although the long duration of flow results in the movement of significant masses of suspended and

bed sediments, the total mass transported by snowmelt runoff is small compared to that carried by summer runoff (Purtymun et al. 1990, 0215).

Other data on naturally occurring surface runoff from mesa tops at Los Alamos are lacking. Experimental data from a rainfall simulator study at TA-51, approximately 1 mile east of TA-50 (Nyhan et al. 1984, 0167; Nyhan and Lane 1986, 0159), indicate that runoff is more than three times greater from an area of back-filled soil than from natural, vegetated soil. Studies needed to obtain additional data include mapping of disturbed and undisturbed soil areas, drainage areas, and channels; and estimates of erosion and sediment transport rates. These data needs are discussed further in Chapter 5.

3.4.1.2 Infiltration

The context of infiltration information is important because differences may exist depending on whether the infiltration takes place

- through native soils,
- where the native soil profile has been disturbed or removed, or
- from deeper in the geologic profile (e.g., liquid waste pits or leaking sumps excavated into the tuff).

Studies summarized in several IWP sections indicate that for native soil profiles, infiltration of water into the tuff bedrock is not a significant mechanism for the movement of contaminants. (Even with the prolonged presence of a water source, transfer of moisture to the tuff is limited; strong evaporative potential coupled with transpiration in vegetated areas quickly removes water from the soil and upper tuff profiles.)

- IWP Section 2.6.3.1.2, *Movement of Fluids Through Tuff*, notes that much infiltrating water is quickly lost through evapotranspiration, that a natural clay layer in native soil profiles may form an infiltration barrier, and that clay filling of joints and fractures in the tuff may inhibit infiltration.
- IWP Section 2.6.3.3.1, *Pit Infiltration Studies*, reports on a study in which a continuous supply of water to a pit dug in soil above the natural clay layer did not significantly increase the moisture content of the underlying tuff.
- IWP Section 2.6.3.4.2, *Fracture Orientation Patterns*, describes jointing and fracturing of the tuff and notes that many joints are filled with caliche, brown clay, or limonitic material, which can block flow along fractures.
- IWP Section 2.6.3.4.3, *Moisture Studies*, indicates that little precipitation passes through undisturbed soil profiles, whereas a greater amount penetrates to the tuff in areas where the soil has been disturbed. Moisture from a single storm has been found to penetrate as deep as 6.5 ft through disturbed fill, but is rapidly depleted by evaporation. Evidence of seasonal moisture fluctuations has been detected both in the bedrock tuff and in fill to depths of 13 ft.

- IWP Section 2.6.3.4.6, *Vadose Zone Studies*, indicates that precipitation moisture does not penetrate more deeply than 10 to 22 ft into tuff.

Studies of water balance where the native soil profile has been destroyed are being conducted as part of the capping design pilot studies at MDAs B, F, and G at the Laboratory. Moisture profiles need to be done in soil and tuff at TA-21, in areas of present and historical liquid releases, to evaluate infiltration depths.

3.4.2 Groundwater

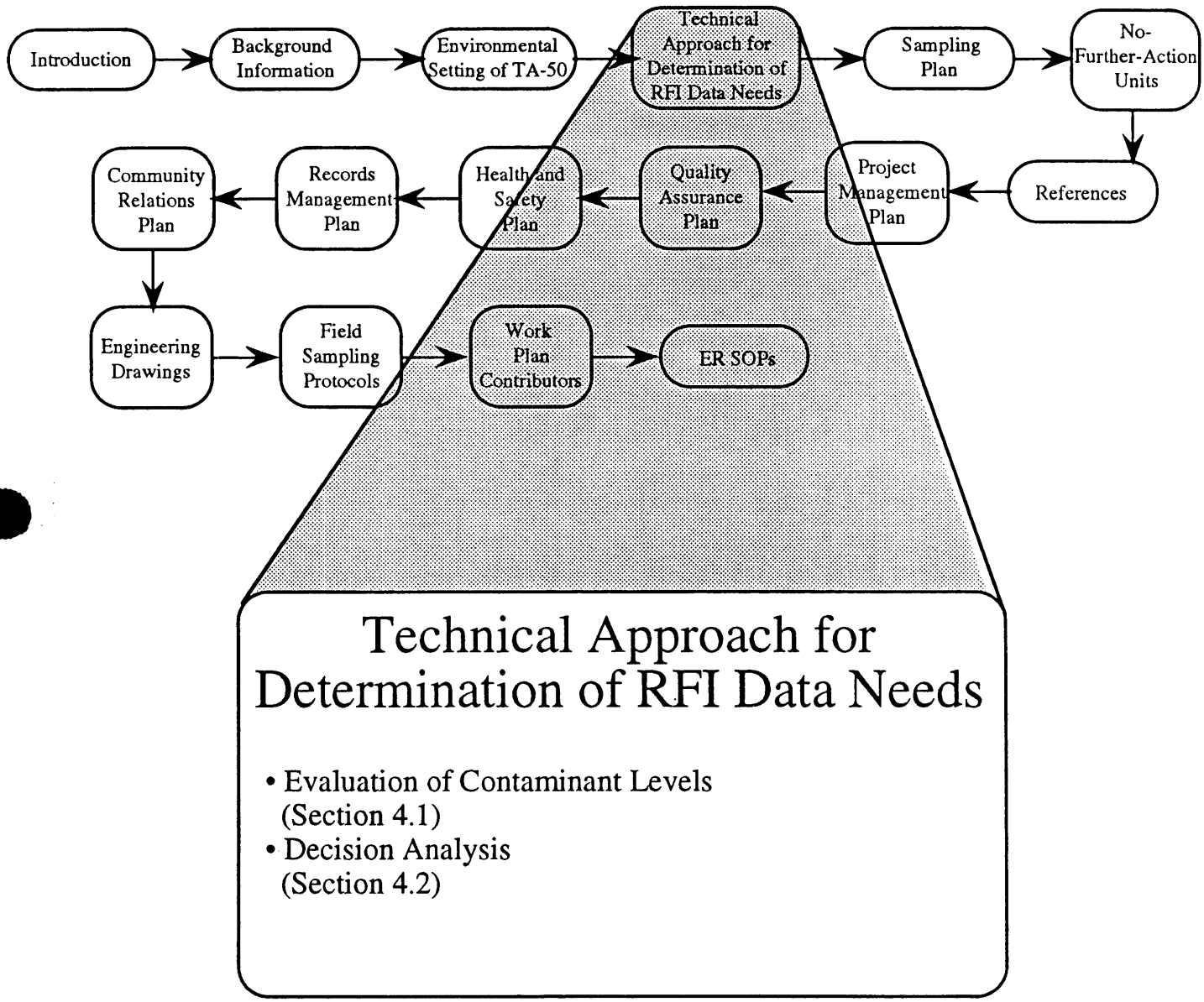
Groundwater exists in three modes in the Los Alamos area: (1) water in shallow alluvium in canyons, (2) perched water, and (3) the main aquifer of the Los Alamos area. The alluvium is quite permeable, in contrast to the underlying Bandelier Tuff, which impedes infiltration and causes downgradient movement of water in the alluvium. Perched water is found in limited areas beneath the lower Pueblo and Los Alamos canyons and is not known to exist below TA-50.

The main aquifer, which is mostly in Santa Fe Group clastic rocks, is the only aquifer capable of serving as a municipal water supply. The aquifer surface rises westward from the Rio Grande within the Tesuque Formation into the lower part of the Puye Formation beneath the central and western parts of the plateau. The depth to this aquifer decreases from 365 m (1200 ft) along the western margin of the plateau to 180 m (600 ft) at the eastern margin; it is isolated from alluvial and perched water by 34 to 207 m (110 to 680 ft) of dry tuff and volcaniclastic sediments with no hydrologic connection or potential recharge from these shallow groundwaters (see Fig. 3-1). Under the western and central portions of the plateau, the aquifer is under water-table conditions but is artesian in the eastern part, along the Rio Grande. The Rio Grande receives groundwater from the main aquifer at the rate of 4300 to 5500 acre-feet per year along White Rock Canyon.

Pajarito Canyon, of which a branch (Two Mile Canyon) forms the southern boundary of TA-50, has a drainage area of 27.5 km^2 (10.61 mi^2), starting at the flanks of the Jemez Mountains. Alluvium in the canyon is derived from the Bandelier Tuff and the Tschicoma Formation. The alluvium is underlain by Bandelier Tuff and is 3 to 6 m (10 to 20 ft) thick. Seven test holes were completed through alluvium to the top of the Bandelier Tuff in 1985. The tuff cuttings were dry, indicating little infiltration of water from the alluvium. A small perched aquifer is confined to Pajarito Canyon and does not extend below Mesita del Buey. A test hole drilled in the canyon in 1947 to a depth of 91 m (300 ft) encountered no water in the underlying tuff or sedimentary rocks (Devaurs and Purtymun 1985, 0049).

Canada del Buey, which begins near the eastern boundary of TA-50, has a drainage area of 8.8 km^2 (3.4 mi^2) within the Laboratory boundary. Streams are ephemeral and flow only during storm runoff or periods of snowmelt. The alluvium is thin, ranging from 2.7 to 3.6 m (9 to 12 ft), and is derived from weathered Bandelier Tuff. It contains no perched water.

CHAPTER 4


Introduction
Background Information
Environmental Setting of TA-50
Technical Approach for Determination of RFI Data Needs
Sampling Plan
No-Further-Action Units
References
Project Management Plan
Quality Assurance Plan
Health and Safety Plan
Records Management Plan
Community Relations Plan
Engineering Drawings
Field Sampling Protocols
Work Plan Contributors
ER SOPs
Technical Approach for Determination of RFI Data Needs
• Evaluation of Contaminant Levels (Section 4.1)
• Decision Analysis (Section 4.2)

4.0 TECHNICAL APPROACH FOR DETERMINATION OF RFI DATA NEEDS

The technical approach to designing a remediation plan for TA-50 focuses on meeting site characterization requirements in a cost-effective manner. This approach incorporates a health-risk-based decision-making process (consistent with the IWP and proposed Subpart S to 40 CFR 264) for recommending SWMUs or SWMU aggregates for No Further Action (NFA) or for further study of possible remediation alternatives under a CMS. It also incorporates a phased site-characterization methodology that follows EPA and IWP guidelines.

The basic elements of this technical approach are as follows:

- Existing data are used as the initial basis for understanding the processes and events that produced each SWMU and the contaminant(s) that may be present at each.

- The data are evaluated to identify those SWMUs or SWMU aggregates for which no potential hazard exists, as a means of reducing the number of sites that must undergo field investigation.

- The SWMUs or SWMU aggregates that do require field investigation are assessed on the basis of the existing data on each, to decide how extensive the Phase 1 investigation should be.

- Phase 1 field investigations are carried out for each SWMU or SWMU aggregate for which a potential for significant contamination, however small, cannot be categorically ruled out. Phase 1 is designed to ascertain or verify the presence or absence of contaminants and to supplement the existing data on known contaminants and site conditions.

- Phase 1 data are used to decide which SWMUs or SWMU aggregates need further characterization and which may be recommended for NFA. For those that require further study, Phase 1 data become a guide for designing Phase 2 sampling and analysis plans. The RFI work plan will be amended and submitted for EPA review and approval when all required Phase 2 investigations have been completed. Interim Phase Reports will be submitted at least quarterly as work proceeds.

- Phase 2 field investigations are conducted where appropriate to fully characterize the nature and extent of contamination and to obtain the data necessary for assessing the risk posed by that contamination.

- A quantitative risk assessment is conducted for each SWMU.

- The results of the field investigations and the recommendations for SWMUs or SWMU aggregates (arrived at via the decision analysis process described below) are presented in detail in a final RFI report.

4.1 Evaluation of Contaminant Levels

The primary potential contaminants at TA-50 are believed to be limited to a small set of radionuclides and metals. As discussed in Chapters 2 and 5, there is a high probability that minor contaminants will also be present and will be associated with the primary contaminants. For this reason, we believe that the nature and extent of contamination at TA-50 SWMUs or SWMU aggregates can most efficiently be characterized through a limited number of analyses for particular indicator contaminants. The primary analytical methods for identifying indicator contaminants at TA-50 are the following:

- alpha spectrometry (which detects plutonium-238, plutonium-239/240, and americium-241),
- gamma spectrometry (which detects gross gamma radioactivity, americium-241, and cesium-137),
- inductively coupled plasma/mass spectroscopy (ICP/MS) or delayed neutron counting (total uranium),
- gas-flow proportional counting (Gross alpha/beta radioactivity), and
- RCRA-regulated metals (SW846 6010)

For specific SWMUs or SWMU aggregates discussed in Chapter 5, it may be appropriate to lengthen or shorten this list (e.g., volatiles, semi-volatiles, PCBs, and isotopic uranium might be added).

4.1.1 Action Levels

Action levels are decision criteria used to determine whether any action is required at a known release site. The philosophy underlying the application of action levels is described in proposed Subpart S and in Section 3. 5. 2. 2 of the IWP (LANL 1991, 0553). For areas where action levels are exceeded, a Corrective Measures Study (CMS) may be required, but remedial action may not always be necessary. For example, for the Area C landfill, long-term institutional control will probably be required for the foreseeable future, regardless of other corrective measures that might ultimately be applied.

Table 4-1 shows background and previously proposed action levels (see reference in footnote a, Table 4-1) for indicator contaminants for TA-50 soils and sediments (the dominant contaminated media at TA-50). The action levels are based on extremely conservative exposure scenarios, such as residential use (a much more conservative scenario than that assumed for the TA-50 OU). A baseline risk assessment using such conservative criteria is likely to yield some measured site concentrations exceeding lifetime risks of 10^{-6}. (The specific concentrations of particular contaminants that will be considered representative of this risk level, and that will therefore trigger Phase 2 investigations, are currently being developed by the Laboratory ER Program's Risk Assessment Technical Team and will be available in time for analysis of Phase 1 data from the TA-50 RFI.)

TABLE 4-1

ACTION LEVELS, BACKGROUND LEVELS, ANALYTICAL METHODS, AND DETECTION LIMITS FOR TA-50 INDICATOR CONTAMINANTS

Indicator Contaminant	Action Level (Soils and Sediments)	Background Level [a] Soil	Sediment	Minimum Detection Limit[b]	Method
Total U	35 pCi/g[c]	3.8 µg/g	3.2 µg/g	0.5 µg/g	ICP/MS or delayed neutron counting
Cs-137	80 pCi/g[d]	0.88 pCi/g	0.28 pCi/g	0.1 pCi/g	Gamma spectrometry
Am-241	e	--	--	0.002 pCi/g	Alpha spectrometry
Gross gamma		10 pCi/g	2.6 pCi/g	0.1-2 pCi/g	Gamma spectrometry
Pu-238	e	0.003pCi/g	0.006 pCi/g	0.01 pCi/g	Alpha spectrometry
Pu-239	e	0.019 pCi/g	0.006 pCi/g	0.01 pCi/g	Alpha spectrometry
Gross alpha		--	--	4-10 pCi/g	Gas-flow proportional counter
Gross beta			--	5-12 pCi/g	Gas-flow proportional counter

a) Soil and sediment background levels for radionuclides are taken from Table G-32 of the 1989 ESG report (ESG 1990, 07-0049). The values given are maximum observed values. (Because soil and sediment are derived from tuff, these values also represent upper limits for tuff.)
b) Detection limits and methods are as specified in the Generic QA Project Plan.
c) A level of 35 pCi/g corresponds to about 50 ppm for natural uranium.
d) Cs-137 ref.
e) TRU action levels proposed for unrestricted (residential) site use have ranged from 17 to 100 pCi/g.

In this work plan we make no attempt to establish action levels for TA-50 indicator contaminants, but instead use those listed in Appendix F of the IWP, which were used during past cleanup efforts at other sites. For total uranium, a surface soil action level of 35 pCi/g (or approximately 50 ppm for natural uranium) has been adopted as appropriate for unrestricted site use at numerous locations throughout the United States (NRC 1981, 07-0045). This action level was developed from the Nuclear Regulatory Commission (NRC) Branch Technical Position on uranium mill tailings sites, and similar action levels for uranium have been developed by DOE for its Formerly Utilized Sites Remedial Action Program (DOE 1987, 07-0040).

For the sum of all TRU constituents, a surface soil action level of about 17 pCi/g was proposed (but not finalized) by EPA in 1977 for unrestricted (i.e., residential) site use (EPA 1977, 0661). Recently issued guidance from EPA indicates a soil action level for plutonium-239 of about 39 pCi/g for 10^{-5} lifetime risk for residential use (EPA 1991, 07-0048). Both of these action levels probably are overly conservative for the site worker/visitor exposure scenarios that are proposed for estimating risk at TA-50. Indeed, higher values have been proposed or actually used in TRU site cleanups (Healy 1977, 07-0042; Healy et al. 1979, 07-0020 and -0021). For example, for cleanup of Eniwetok Island, a TRU action level of 35 pCi/g was used for residential-use areas, whereas substantially higher values were used for agricultural and recreational areas.

Judging from available information, the RFI is very likely to show that contamination at some TA-50 SWMUs or SWMU aggregates is very localized and discontinuous. For this reason, the proposed field investigation will evaluate the spatial heterogeneity of hot spots, particularly on the ground surface. The maximum number of geographical areas and contaminant concentrations for which it is appropriate to average hot spots may be specified as part of risk assessment following the RFI. For example, for the Area C landfill, the area might be the size of a trench or of a small cluster of disposal shafts. A TRU concentration of ten times the action level set by risk assessment might be proposed as an appropriate maximum for an individual sample, which can then be used for area averaging.

4.1.2 Screening Levels

Screening levels are analytical survey levels, established at or below the action levels set for the exposure scenario selected for the site; they are used to determine whether action levels are exceeded over the areas being examined.

Screening and survey techniques for radioactive constituents in soils and subsurface samples will be used heavily during the TA-50 RFI. Appendix B describes the hand-held and tripod-mounted survey instruments that will be used for radiological surveys. These instruments detect gamma and low-energy x-ray emissions characteristic of TRU and fission products. The screening level chosen for TA-50 is 10 pCi/g. This value is below reasonable action levels, well above background levels, and within the detection limits of the radiological survey instrumentation to be used (see Table 4-1). This screening level will be used as a criterion for sampling hot spots and for deciding whether to terminate the RFI, conduct Phase 2 sampling, or move directly to a CMS.

4.1.3 Background Levels

Background levels are the levels of contaminant elements or compounds that are expected to occur naturally (or at fallout levels, in the case of some radionuclides) in site media.

4.1.4 Applicable or Relevant and Appropriate Requirements

The HSWA Module establishes the basic "applicable or relevant and appropriate requirements" (ARARs) governing cleanup of radioactive and hazardous waste sites. ARARs can be divided into three categories:

- contaminant-specific requirements,
- location-specific requirements, and
- action-specific requirements.

Given the lack of adequate information about contaminant types and concentrations at the SWMUs or SWMU aggregates being investigated, identification of specific ARARs for TA-50 at this time would be premature. The full tabulation of contaminant-specific, location-specific, and action-specific ARARs will be provided in future technical reports as information is gathered and analyzed.

4.2 Decision Analysis

The decision analysis methodology for the Los Alamos ER Program is still being developed and cannot be fully documented in this work plan. The final protocol will be applied to TA-50 during the first year of field work and will be described in future documents on the RFI work at TA-50. (For a general discussion of how decision analysis will be used in the ER program, see Appendix I of the IWP.) Pending completion of the ER Program decision analysis methodology, the Data Quality Objectives (DQO) process (Fig. 4-1) will be used to identify possible remediation alternatives for TA-50 and to develop the criteria against which those alternatives will be evaluated.

The DQO process is a seven-step process developed by the EPA for planning effective and efficient data collection programs (EPA 1987, 0086). It is designed to ensure that the data collected will be of the type, amount, and quality needed to form a solid basis for defensible environmental decisions. The seven steps in the process are

(1) problem statement (defining the problem)
(2) remediation alternatives
(3) decision input
(4) decision domain
(5) evaluation logic

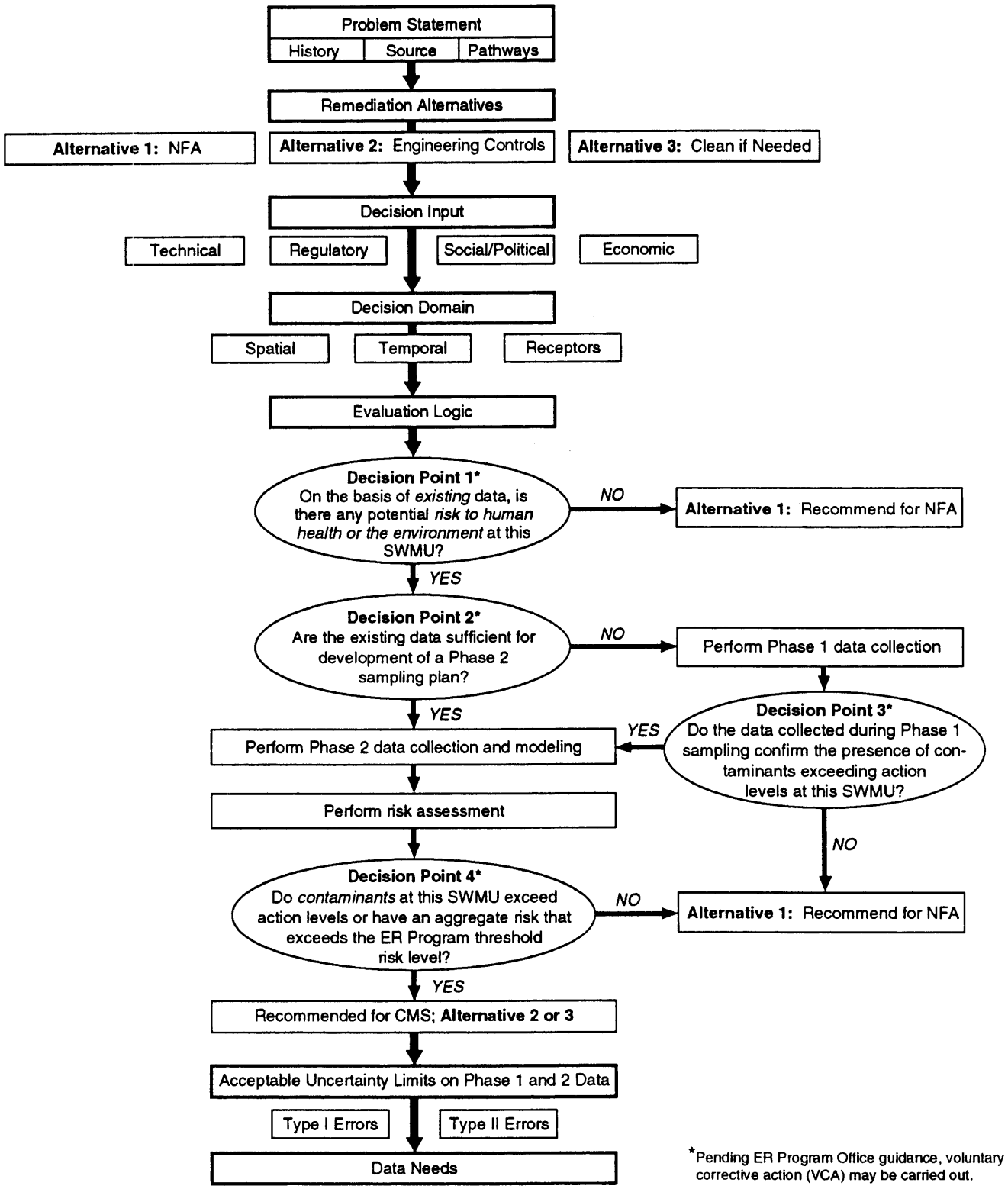


Figure 4-1 Identifying data needs through the Data Quality Objectives process.

DEFINITIONS OF TERMS IN FIGURE 4-1

Existing Data: Information collected to date, from published and/or unpublished records, pertaining to the history and operation of a SWMU. The data may include written communications (reports, memoranda, letters, notes, calculations) and verbal communications. Some existing data is of unknown quality.

Potential Risk: An estimate, based on existing data, of the risk that contaminants have been released to the environment at a SWMU and have entered a migration pathway leading to off-site receptors. No potential risk is associated with the SWMU if NFA criteria (see Table 4-2) are met.

Contaminants: Organic, inorganic, or radioactive solids, liquids, or gases that, due to quantity, concentration, and/or physical/chemical characteristics, may cause or contribute to causing a threat to human health or the environment. Contaminants may consist of one or more RCRA- or CERCLA-regulated constituents or of radioactive elements/daughter products.

Phase 1 Investigation: The initial phase of sampling and analysis for site assessment, aimed at collecting information to confirm the presence or absence of contaminants of concern in the environment. Phase 1 activities can also include restricted data collection to further define the extent of contamination or the site conditions that could lead to migration.

Phase 2 Investigation: The second, more detailed, phase of sampling and analysis for site assessment. Information from Phase 1 sampling and analysis will determine whether Phase 2 is necessary. For those SWMUs that do require it, the Phase 2 investigation will help determine the physical/chemical characteristics of the site and will attempt to delineate the nature and extent of contamination. Phase 2 data will be used for contaminant fate and transport modeling, risk assessment, and design of treatability and corrective measures studies, as required.

Human Health or Environment: Under RCRA, these terms pertain specifically to the health and environment of the general public (the health and environment of Laboratory employees is regulated by OSHA).

(6) acceptable uncertainty limits
(7) data needs

4.2.1 Problem Statement

4.2.1.1 Site History

TA-50 occupies about 21 acres and comprises a mixed waste landfill that was operated from 1948 to 1969 and liquid and solid waste treatment facilities that began operations in 1963 (Fig. 4-2). The treatment facilities have liquid, atmospheric, and solid waste effluent releases that are regulated under operating permits and a liquid waste transfer and storage system that has been documented to leak. Very little data exists on the distribution of radionuclides or chemicals in the surface or subsurface environment around the treatment facilities. The landfill (Area C) consists of 7 pits and 107 shafts that have been used to dispose of low-level radioactive, TRU, chemical, and mixed waste. Area C surface soils have been sampled for radionuclides (but not chemicals) several times over the years; the subsurface soils and rock of the landfill have not been investigated for either radionuclides or chemicals. What data does exist on chemical contaminants suggests that some vapor-phase transport of volatile wastes took place at Area C.

4.2.1.2 Potential Contaminant Sources

Past site activities involving hazardous and radioactive materials at TA-50 include solid waste disposal at the Area C landfill, from 1948 to 1969, and treatment of solid and liquid wastes, from 1963 to the present. Because radioactive liquid waste comes into TA-50 from diverse operations, including shops, chemistry laboratories, target-preparation facilities, and plutonium fabrication, recovery, and research facilities, the possibility exists that spills, leaks, etc. could contain solvents and other organics, heavy metals, low-pH liquids, and/or radionuclides. Constituents of the treated liquid effluent released to Mortandad Canyon are listed in Tables 2-7 and 2-8 in Chapter 2. Nearly all of the existing data on contaminant concentrations in the TA-50 area are for radionuclides.

Measured atmospheric releases of radioactivity from the stacks at TA-50 are summarized in Fig. 2-10 and Table 2-4 in Chapter 2. In 1989, for example, about 0.4 μCi of plutonium and 10 μCi of mixed fission products were released via stack emissions. Data from the 1970s on plutonium concentrations in surface soils around TA-50 (Purtymun et al. 1980, 07-0046) suggest that levels are above background but still average less than 2 pCi/g for plutonium-239 and less than 0.01 pCi/g for plutonium-238. Ten on-site soil and sediment samples collected in 1987 had average plutonium-238 and plutonium-239 concentrations of 0.002 pCi/g and 0.038 pCi/g, respectively (ESG 1988, 0408). Whether the plutonium in TA-50 soils is only from the site itself is debatable; plutonium-containing emissions from stacks in other, nearby OUs could be additional sources.

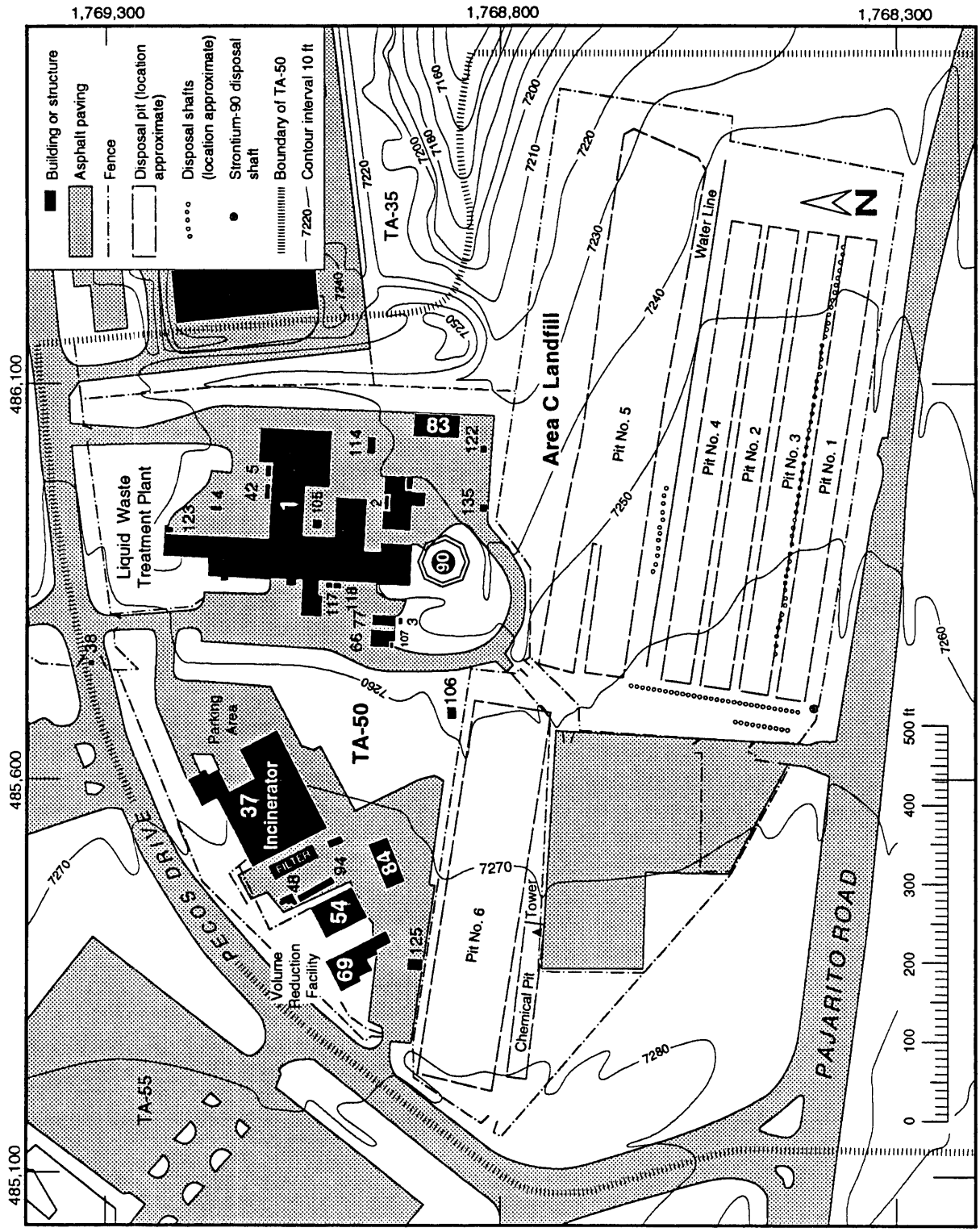


Figure 4-2 Technical Area 50 site map.

In 1974, raw waste overflowed from a storage tank in TA-50-2 (tank farm) into Ten Site Canyon. Discolored soil, sampled at the overflow outfall from the tank farm, registered about 30,000 dpm/g of gross alpha activity. Subsequent samples from within 30 m of the outfall showed gross alpha levels of as much as 50,000 dpm/g. The area was partially decontaminated in 1981.

The Area C landfill was used to dispose of a wide variety of chemicals, metals, and radionuclides in pits and shafts, most of which were unlined (a few of the shafts were lined with concrete). Contaminants associated with the waste are listed in Table 2-10 in Chapter 2.

In 1985, surface soils at Area C were intensively sampled for radionuclides. The results, described in detail in Chapter 2, indicate very low level radionuclide contamination (plutonium, cesium, tritium, americium, and uranium) in a few isolated locations within the Area C perimeter fence and slightly higher levels (up to a few tens of pCi/g) outside the northeast corner at the head of Ten Site Canyon. Thermoluminescent dosimeters placed around the perimeter of Area C were unable to detect radiation in excess of background.

Although data on the concentrations of chemical contaminants are very limited, the nature of the solid and liquid wastes received at TA-50 suggest the presence of a wide spectrum of inorganic and organic potential contaminants at the site.

4.2.1.3 Potential Migration Pathways

The conceptual migration model for the SWMUs at TA-50 is presented in Fig. 4-3. *Sources of contamination* at the treatment facility SWMUs include atmospheric emissions from stacks, liquid effluent outfalls, and spills and leaks from the waste transfer and storage system. In a localized area around the very head of Ten Site Canyon, radionuclide concentrations in the tens to hundreds of pCi/g were the result of spills from the liquid waste treatment plant and, possibly, erosional transport of surface contaminants from Area C. Sources of contamination at Area C are not understood. For the subsurface environment, aqueous and/or vapor-phase transport can occur. However, surface migration can involve not only buried contaminants but also contaminants that were on the surface when the landfill was decommissioned in 1974. The major *contaminant reservoirs* include surface soils and sediments, subsurface soil and rock, and biota. *Pathways* by which receptors can be exposed include direct contact, transport by wind and water erosion, transport by subsurface water percolation and vapor diffusion, and food-chain transport. The primary *human receptors* of potential releases from TA-50 would be workers, on site and in adjacent technical areas. Visitors are much less likely to be exposed, given the current ES&H requirements governing visitors to technical areas such as TA-50. (The public at large has an even lower probability of exposure because of the 3- to-4-km distances that separate TA-50 from both White Rock and Los Alamos. But non-human receptors—native fauna and flora—may be continuously exposed to contaminants from this site.

An assessment of the level of hazard associated with each of the pathways ranks erosional transport of soils and sediments as relatively high; direct

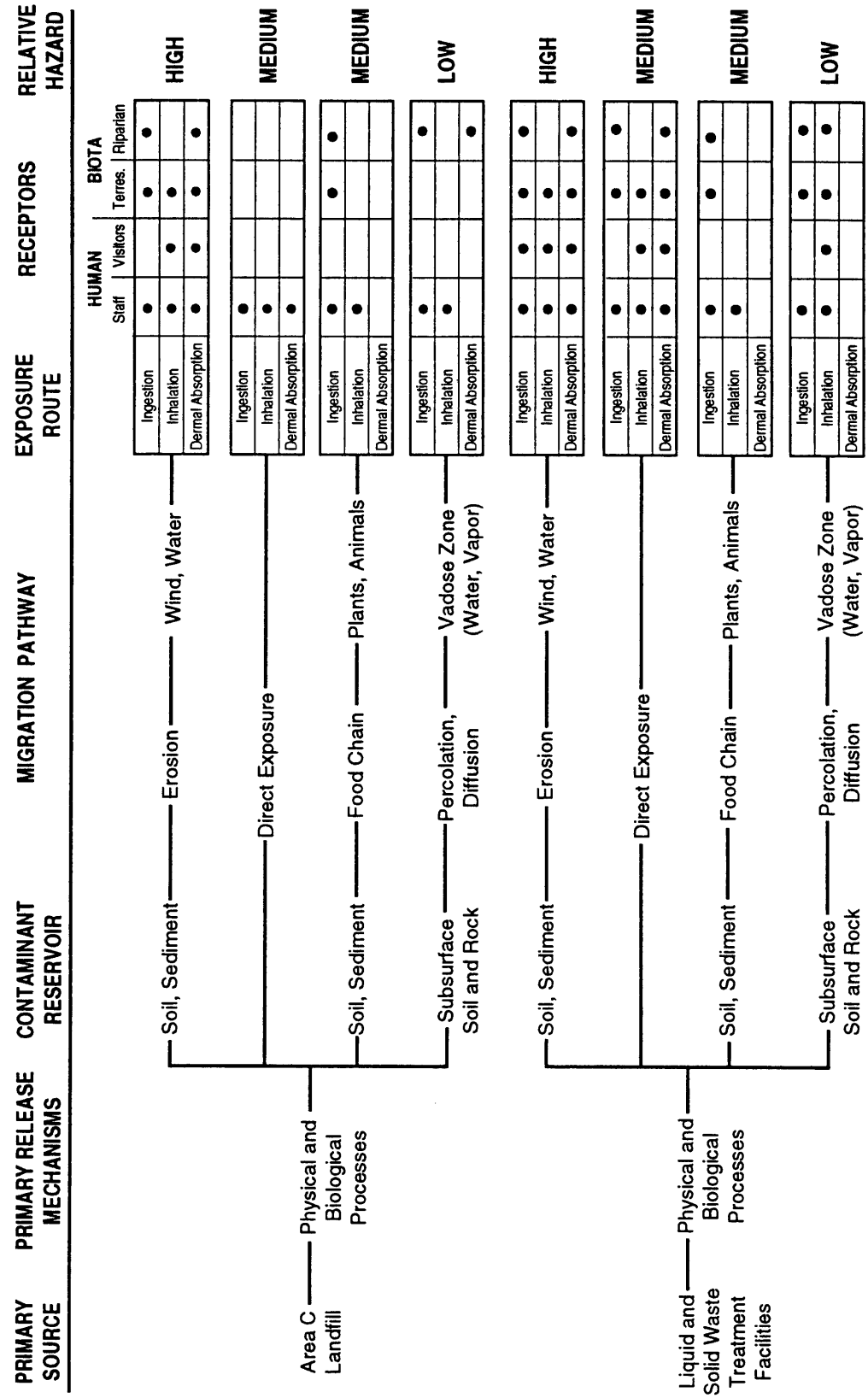


Figure 4-3 Conceptual model of contaminant migration at TA-50.

exposure and food-chain transport as medium; and percolation/diffusion of contaminants in the subsurface environment as low. (It is important to re-emphasize that this model is conceptual and that the elements and their relative importance will probably change during the RFI.)

4.2.1.3.1 Wind And Water Erosion

Erosion of soil and sediment can deliver contaminants to receptors both within and near the site and at considerable distances from the site. Most radionuclides bind tightly with soil particles, particularly fine-grained silts and clays; these can be inhaled, ingested, or deposited on the skin. They can also be carried by hydrologic erosion within the narrow confines of a stream channel to considerable distances downstream (Nyhan et al. 1982, 07-0023; Nyhan et al. 1976, 0160; Hakonson and Bostick 1976, 0679; Hakonson and Nyhan 1980, 0117; Essington and Romney 1986, 07-0050). Depending on the characteristics of the watershed and the distribution of the contaminant, concentrations can be higher in downstream areas than on the watershed containing the contaminant source (Mueller et al. 1981, 07-0029).

Wind can also transport fine-grained contaminated soil particles considerable distances, but because these particles usually mix rapidly with uncontaminated soil, the hazard typically decreases with distance downwind. Mechanical disturbances, such as caused by mowing, add to the importance of erosion as a migration pathway.

Assuming that chemical contaminants have a distribution similar to that of radionuclides in surface soils and sediments, they can be transported by the same erosional processes. It will be important to verify this assumption through data on the spatial distribution of chemical contaminants.

4.2.1.3.2 Direct Exposure

Workers at TA-50 and surrounding sites could be exposed to radiation through ingestion, inhalation, and/or physical contact with contaminants on the soil surface. At Area C, mechanical disturbance of the site, such as that caused by mowing of the vegetation cover, could resuspend contaminants, allowing them to be inhaled by workers. With the exception of tritium, the radionuclides at TA-50 are not readily absorbed through the skin. The waste does contain radionuclides to which workers could be exposed if they came into contact with the waste. All workers at TA-50 and surrounding areas wear dosimeters to record beta, gamma, and neutron exposures. In addition, all workers at TA-50 have pre-employment urinalysis to establish background body burdens of radionuclides, and those in the treatment facility are on a monthly urinalysis schedule. All workers entering Area C must have OSHA training for working at hazardous sites. Nonetheless, the wide variety of contaminants at the site, the monitored releases, and the known past spills and leaks reinforce the need for characterization data to evaluate this migration pathway.

Plants and small animals living in radionuclide-contaminated areas can be continuously exposed to surface and subsurface radiation sources. Studies using small mammals implanted with dosimeters (Miera et al. 1977, 0148) show

that doses can be several orders of magnitude above background for animals living in a contaminated area.

Workers at the site could be exposed to vapors and solids of acids, bases, and other chemicals (at the treatment facilities) or of organics, metals, and other chemicals (at Area C) co-existing with radionuclide contamination. Data are needed to evaluate this migration pathway for nonradionuclides.

4.2.1.3.3 Food-chain Transport

The importance of biological uptake of contaminants by plants relative to other transport pathways is largely unknown. Uptake of waste-site radionuclides by plants is known to occur (Klepper et al. 1979, 07-0016; Hakonson and Bostick 1976, 0679; Hakonson and Nyhan 1980, 0117), and modeling studies (McKenzie et al. 1984, 07-0018) suggest that it may be an important contributor to human exposure. Studies at Los Alamos show that most radionuclides in vegetation come from deposition of contaminated soil onto vegetation surfaces (Hakonson and Nyhan, 1980, 0117). The paucity of data on radionuclides in vegetation from TA-50 precludes any analysis of this pathway.

One known food-chain migration pathway for radionuclides to humans and animals is the soil water→plant nectar→honeybee→honey pathway for tritium (Hakonson and Bostick 1976, 0679). This pathway has been verified for tritium buried in Area C, released in treated radioactive liquid effluent, and emitted from stacks.

Very little is known about the environmental transport of chemicals through food chains at Los Alamos. The lack of information precludes any definite conclusions, but it is assumed that ingestion and/or inhalation would be the most important route(s).

4.2.1.3.4 Subsurface Water Percolation and Vapor Diffusion

The potential for movement of radionuclides to groundwater is considered low at TA-50 (Purtymun and Kennedy 1971, 0200). Many radioactive constituents of waste are retarded by the soil and rock that constitute the subsurface geology of the site. The role of fractures in retarding or enhancing contaminant migration at TA-50 is not yet documented.

With the exception of tritium, none of the radioactive waste constituents would be expected to move in vapor phase. (Tritium could emanate to the ground surface and be inhaled and/or ingested by both humans and animals.)

Volatile chemicals can diffuse much more rapidly in dry soil and rock than nonvolatiles, and vapors emanating from the ground surface could be inhaled by humans and biota. Given the several hundred feet of unsaturated rock beneath TA-50, diffusion of vapors to groundwater is less likely, but if it does occur ingestion of groundwater could also be a route for exposure to chemicals.

4.2.2 Remediation Alternatives

In the observational approach, an attempt is made to identify the most likely remediation alternatives ultimately to be carried out at the OU, given the current state of understanding of the release, so that the RFI/CMS can be focused as tightly as possible. A particular alternative will be selected strictly according to risk-based evaluation criteria, including the exceeding of action levels and/or calculated risk levels of 10^{-4} to 10^{-6}. The primary concern is exposure of workers, both on the site and in nearby technical areas. In considering the following three alternatives as the most likely ones, we assumed that institutional control will be maintained indefinitely. (If institutional control were lost, a new set of alternatives would need to be developed.)

4.2.2.1 No Further Action

If risk assessments based on RFI data demonstrate compliance with current standards (i.e., risk-based action levels conferring protection at the 10^{-4} to 10^{-6} level), all that may be required is a long-term monitoring and maintenance program on the site to ensure continued compliance with the standards. Although identification of migration pathways specific to TA-50 is tentative, it is certain that the potential for erosion of soil and sediment, vadose-zone transport of contaminants, and biological uptake of contaminants to the ground surface will largely determine the structure of the monitoring program.

Periodic visual inspections coupled with some vegetation sampling and surface and subsurface soil sampling for radionuclides (from monitoring holes, as is now done by the Laboratory's Environmental Protection Group) should be sufficient to effectively monitor the site. Tritium can be used as a surrogate for volatile and semi-volatile hazardous waste. If, in addition, both soil loss due to erosion and changes in vadose-zone moisture and contaminants are monitored, this information could provide early warning of contaminant transport at the site.

This alternative could be implemented immediately for any TA-50 SWMUs judged to pose no threat to worker health and the environment. It also would be the most cost-effective, because monitoring would require at most some supplementary activities.

4.2.2.2 Engineering Controls Coupled With Monitoring

Erosion of surface soils that contain contaminants exceeding action levels could result in the transport of contaminants and present inhalation hazards to workers. Erosion control can be important in limiting the migration of contaminants, thereby reducing its impact on health and the environment. Nyhan and Lane (1986, 0159) present a user's guide for designing soil covers to optimize stabilization and control erosion. Their technology combines an optimum surface slope and vegetation density with a thin gravel mulch cover to protect the soil surface. These three design features work together to reduce the velocity and volume of runoff and, hence, soil erosion.

On the other hand, reduced runoff volume results in increased infiltration of water into the soil. Special consideration may therefore need to be given to the

potential for increased movement of moisture through contaminated zones. Such movement can be controlled or eliminated through plant transpiration (evapotranspiration) of water back to the atmosphere, by optimizing the mix of vegetation species on the site (Barnes and Rodgers 1988, 0025; Lopez et al. 1989, 0146).

The principles governing hydrologic erosion control also apply to wind erosion control; the use of engineering techniques to counter hydrologic erosion, therefore, will also protect against wind erosion of soil.

For Area C, if additional control of hydrologic erosion is needed, an enhanced capping technology may be called for that controls both erosion of the cap and percolation of water into the contaminated zone. The technology not only controls erosion of cover soils as described above, but also provides both primary and secondary barriers to downward movement of water. The primary barrier consists of an optimum combination of soil, vegetation, surface slope, and gravel mulch. The secondary barrier is an engineered capillary or hydraulic barrier (either of which retards vertical flow by using the differences between the hydrologic properties of the materials in the primary barrier and those of the underlying secondary barrier.) An example of a hydraulic barrier is a layer of compacted clay. An example of a capillary barrier is a finer-grained soil over a coarser-grained sand or gravel. Such barriers make more of the water available for evapotranspiration. In addition, sloping the interface between the soil and the underlying capillary/hydraulic barrier can convert vertical water flow to lateral and carry more moisture off site.

Ten years of research at Los Alamos, funded by DOE and DoD, has resulted in an enhanced capping design (Hakonson et al. 1992, 07-0013; Hakonson et al. 1986, 0126; Nyhan et al. 1990, 0173; Nyhan and Barnes 1989, 0156; Nyhan et al. 1984, 0167) that effectively controls erosion, deep percolation and bio-intrusion, as demonstrated in field testing at TA-21 Area B, approximately 2 km north of Area C (Barnes and Rodgers, 1988, 0025; Lopez et al. 1989, 0146). This capping design offers advantages over EPA's RCRA cap design:

- it has been field-tested at pilot scale (the EPA design has not),
- it is relatively simple and cost-effective, and
- it controls both erosion and deep percolation of water.

Portions of the Los Alamos design have been included as an alternative to the EPA cap in the EPA document on landfill capping technology (EPA 1989, 0092).

The Los Alamos capping technology is also being field-demonstrated on a large scale as part of a LANL treatability study, to verify its appropriateness as a remediation alternative for Los Alamos sites. The results of this study will apply not only to Area C, but to many other Los Alamos waste disposal sites.

This alternative would take 1 to 2 years to implement and, depending on the course of action, would be much more cost-effective than the third alternative (see below). Estimated costs for stabilizing the ground surface against wind and

water erosion are less than $50 thousand/acre; for capping, they range from $500 thousand to $2 million/acre.

4.2.2.3 Removal of Contaminants Where Needed

If contaminant concentrations are found that exceed a risk-based action level, and subsequent assessments with more sophisticated risk-assessment models still find excess levels, the areas in question will be remediated by excavating the contaminated soil or rock and reburying or storing it, as appropriate. This remedy is particularly effective for tanks and short sections of drainlines.

In the case of Area C, the presence of TRU waste makes the issue of institutional control a critical one. Unlike other radionuclides, which will completely decay in 200 to 300 years, TRUs will be present for several millenia. This long life does not necessarily spell unacceptable hazard as long as the TRUs remain isolated from the biosphere; but such isolation can be guaranteed only as long as institutional control is guaranteed.

This alternative would require a minimum of 1 year and as much as 4 years to implement, depending on the number of SWMUs involved and the complexity of the approvals process necessary for the removal operation. While the specific costs of such an operation cannot yet be calculated, DOE estimates that the excavation, transport, and reburial of hazardous wastes would cost on the order of $500 to $1000 per cubic meter.

4.2.2.4 Voluntary Corrective Action

Some SWMUs or SWMU aggregates may be candidates for voluntary corrective action (VCA), which essentially means they can be removed, precluding the need for further investigations. Criteria for identifying and handling such SWMUs or SWMU aggregates are expected to be developed outside the work scope of the TA-50 RFI. Voluntary corrective actions are not addressed in this work plan except for those conducted by the operatonal group at TA-50 (see Table 2-16, Chapter 2).

4.2.3 Decision Input

Answers to the following questions will be needed as part of the information base for evaluating the three remediation alternatives.

4.2.3.1 Technical Input

- What are the concentrations of contaminants in soil, sediment, and rock within TA-50?
- Are health-risk-based criteria appropriate to support a decision for this alternative, or should DOE's dose-based criteria be used?
- Over what time frames should risks be calculated considering the presence of TRU wastes in Area C?

4.2.3.2 Regulatory Input

- Is the proposed RCRA Subpart S methodology acceptable to EPA as the decision criterion for chemical constituents at TA-50?
- Will EPA allow long-term institutional control of TA-50?
- What are the ARARs for TA-50?

4.2.3.3 Social Input

- Is the concept of health-based risk understood and accepted by the public?
- How would the public react to leaving TRU and chemical wastes in a landfill that does not meet current disposal requirements for these wastes?

4.2.3.4 Political Input

For how long can the Laboratory and DOE guarantee institutional control of the Area C landfill and the TRU waste contained therein?

4.2.3.5 Economic Input

- What will it cost to gather the data needed to support each alternative?
- Will potential changes to more stringent regulations require further investigation and remediation in the future?
- Will the cost of educating and informing the public about the remediation of TA-50 be significant?

4.2.4 Decision Domain

This step deals with the spatial and temporal limits of the TA-50 OU and the potential receptors of contamination at the site.

4.2.4.1 Spatial Limits

This OU is spatially delimited by a perimeter fence that encloses the waste treatment facilities and the Area C landfill. The treatment facilities occupy about half of the site's 21 acres (8.7 acres) and the Area C landfill occupies the other half (11.8 acres). Effluents and spills that go outside the perimeter fence are covered by the work plan for TA-35 and the Canyon Studies. Risk assessments and comparisons with ARARs will use 5000 sq ft as an exposure unit.

4.2.4.2 Temporal Limits

Many of the radionuclides handled in the TA-50 treatment facilities and/or buried in Area C have half-lives of 30 yrs or less. This means that the inventory of these materials in spill, effluent, and disposal areas is changing relatively rapidly compared with that of some of the TRUs at the site, and there would be a

concomitant potential change in the level of exposure of receptors to particular contaminants. For example, on a curie basis, tritium dominates in Area C and is probably one of the more important contributors of radioactive contamination to potential receptors. However, its 11-yr half-life ensures its fairly rapid disappearance from the waste in Area C. (Tritium interred in Area C in 1948 currently retains about 5% of its initial activity.)

The persistence of chemical wastes at the site is conjectural, but some are undoubtedly long-lived.

4.2.4.3 Receptors

For all three alternatives, receptors would consist of occupationally exposed workers at the site, anyone in the pathway of stack releases, and anyone affected by the erosion of soils and sediment at TA-50.

4.2.5 Evaluation Logic

All SWMUs or SWMU aggregates will be evaluated using the decision process illustrated under *Evaluation Logic* in Fig. 4-1. Each of the four ovals represents a point at which a decision will be made about the adequacy of the data for selecting a particular remediation alternative for the SWMU under consideration. To keep the process simple, each question posed has only two possible answers, "yes" and "no." The process is designed to identify those SWMUs or SWMU aggregates that can be recommended for NFA as early as possible and with the least expenditure of resources. Those SWMUs or SWMU aggregates that cannot be recommended for NFA after Phase 1 and Phase 2 investigations and risk assessment are complete, will be candidates for a CMS (on the basis of which the optimum remediation alternative will be selected).

4.2.5.1 Decision Point 1

On the basis of existing data, is there any significant potential risk to human health or the environment at this SWMU?

Section J of the LANL HSWA permit allows the Laboratory to apply for a permit modification when available information demonstrates that releases from a SMWU do not pose a threat to human health or the environment. The function of Decision Point 1 is to identify such SWMUs or SWMU aggregates and to separate them from those that will require further investigations. This decision requires professional judgment in interpreting the existing data and applying the criteria for NFA given in Table 4-2.

A "yes" decision means that the SWMU under consideration poses some degree of potential risk or that the existing data are insufficient to preclude the possibility of risk. All such SWMUs or SWMU aggregates are recommended for further consideration, and the process moves to Decision Point 2. A "no" decision means that the SWMU poses no potential risk and is recommended for NFA. Because of its judgmental nature, this decision cannot be made unless existing data and/or site inspections clearly show that no release of contaminants has occurred or, if a release is documented, that (1) contaminants are physically

TABLE 4-2

CRITERIA USED TO IDENTIFY NO-FURTHER-ACTION SWMUS AT DECISION POINT 1

a. The SWMU was never the location of hazardous or radioactive waste generation, treatment, storage, or disposal.

b. The SWMU was either never constructed, never installed, or never used.

c. No release has been observed or documented at the SWMU, and the design, construction, and/or institutional controls of the SWMU are such that a release to the environment and transport to off-site receptors is highly unlikely.

d. The SWMU is operating under a current facility permit, such as the RCRA Mixed-Waste Interim Status, the National Pollutant Discharge Elimination System (NPDES), or National Emission Standards for Hazardous Pollutants (NESHAP).

e. The SWMU has undergone or is scheduled to undergo remediation or VCA under the RCRA Operating Permit (subject to approval by the EPA).

f. Existing data indicate that contaminants at the SWMU are not present in concentrations that exceed health-risk-based action levels.

prohibited from migrating to on-site and/or off-site receptors, (2) the site has been adequately remediated, or (3) the release is permitted under current regulations.

Because existing data are used for Decision Point 1, all TA-50 SWMUs or SWMU aggregates have already been evaluated to this point. (See Chapter 6 for a discussion of those recommended for NFA.)

4.2.5.2 Decision Point 2

Are the existing data sufficient for development of a Phase 2 sampling plan for this SWMU?

At Decision Point 2, the set of SWMUs or SWMU aggregates requiring further characterization are sorted into those for which Phase 2 sampling can be done directly and those that will require a Phase 1 sampling plan. (Existing TA-50 data will not be used directly for action level comparisons or risk calculations, but only for NFA recommendations and sampling plan design.)

The objective of Phase 1 sampling is not complete characterization of the site, but detection of contaminants above action or screening levels, as a means of

defining the "worst case" condition of the site, and acquisition of the field and analytical data needed to make a defensible decision at Decision Point 3 (see below). The sampling points chosen for Phase 1 are those judged to have the greatest chance of yielding confirmatory results. Information on site history, physical site characteristics, chemical and physical behavior of suspected constituents, and other factors must all be considered in determining the appropriate locations and depths at which samples must be collected. Field survey methods and a field laboratory will be used as needed to expedite turnaround and speed evaluation of data needs for Decision Point 3. As analytical results become available, sampling plans will be revised as necessary to focus additional data collection.

To help determine whether Phase 1 or Phase 2 sampling is more appropriate, existing data are reviewed against several criteria:

- the probability that contaminants are present in concentrations exceeding action levels,
- the probability that contaminants were correctly identified,
- the probability that the lateral and horizontal extent of contamination are known with sufficient accuracy,
- the suitability of existing analytical data (in terms of both locations and analytes represented) for the design of a Phase 2 sampling plan, and
- the adequacy of knowledge concerning experimental or operational processes that contributed to the SWMU wastes.

For most TA-50 SWMUs or SWMU aggregates, the existing data provides limited insight into the nature and extent of contamination; in most cases, then, Phase 1 investigations would be called for and would be designed to lead either to a recommendation for NFA or to a more focused Phase 2 investigation. Further, much of the data that does exist is of unsubstantiated quality or is concerned only with radionuclides, so that some confirmatory field investigation and analysis would be needed going into Decision Point 2. For these reasons, at the present time we do not propose that any TA-50 SWMU or SWMU aggregate go directly into Phase 2.

4.2.5.3 Decision Point 3

Do the data collected during Phase 1 confirm the presence of contaminants exceeding action levels at this SWMU?

Decision Point 3 is designed so that SWMUs or SWMU aggregates for which Phase 1 sampling has confirmed the *absence* of contaminants exceeding action levels can be recommended for NFA. For those in which sampling confirms the *presence* of such contaminants, Phase 1 data will be used to develop Phase 2 sampling plans.

The absence of contaminants is considered confirmed if none of the suspected constituents is detected or none exceeds its established background level. The presence of contaminants is considered confirmed if (1) any sample contains any contaminant in a concentration that exceeds the detection limit for that constituent when the appropriate analytical methods are used, and (2) the concentration of that contaminant exceeds its established background level. (Regional background concentrations for naturally occurring constituents are available from Purtymun et al. [1990, 0215]). Data on background levels at specific Laboratory locations will be provided by the ER Program's Framework Studies effort in time for analysis of Phase 1 data.)

Decision Point 3 is the second point in the evaluation logic step at which a recommendation of NFA can be made. A "no" answer means that the absence of contaminants at the SWMU has been confirmed and that a recommendation of NFA is justified. A "yes" answer at Decision Point 3 means that the presence of contaminants at the SWMU has been confirmed by a technically sound and quality-assured (QA) sampling effort and that a Phase 2 sampling plan must be designed and implemented.

The purpose of Phase 2 sampling is to acquire a detailed picture of the nature and extent of contamination for a SWMU or SWMU aggregate, sufficient for risk assessment and CMS planning. The design of the Phase 2 sampling plan will vary significantly from one SWMU to another as a function of the amount and type of data available from previous work, including Phase 1 investigations and Framework Studies. (Framework studies are discussed in IWP Chapter 3, Section 3.3.11.)

Health-based risk assessment is integral to the Laboratory RCRA process and will be performed for all TA-50 SWMUs or SWMU aggregates that undergo Phase 2 investigation. The assessment will consider all data pertaining to the SWMU, from previously existing data to data acquired during Phase 1 and/or Phase 2 sampling activities. The methodology used for risk assessment will conform to that set out in proposed Subpart S to 40 CFR 264 and to that in the 1992 IWP (to be published). The risk assessment will serve as input to Decision Point 4.

4.2.5.4 Decision Point 4

Do contaminants at this SWMU exceed action levels or have an aggregate risk that exceeds the ER Program threshold risk level?

Decision Point 4 is the final point in the evaluation logic step of the decision process. At this point, SWMUs or SWMU aggregates that have undergone field investigation will be recommended either for CMS or NFA. The total set of validated data now available for each SWMU is evaluated in making this decision. Concentrations of contaminants are compared with action-level concentrations for all contaminants present, and the calculated aggregate risk from contaminants is compared with the acceptable aggregate risk values determined by the Laboratory ER Program Office. (It is assumed that risk calculations for sites with multiple contaminants will be cumulative.)

A recommendation of NFA at Decision Point 4 is justified for a SWMU if the following two criteria are met:

- no contaminant is found at a mean sample concentration in excess of the risk-based action level for that contaminant, and
- the aggregate health-risk-quantified value of the contaminants present does not exceed the threshold risk level established by the Laboratory ER Program Office.

A CMS (or alternative response action) is required for SWMUs or SWMU aggregates at which one or more contaminants is present at a level that exceeds the risk-based action level specified in 40 CFR 264 Proposed Subpart S or in the IWP for that constituent, or at which the cumulative risk posed by two or more contaminants exceeds acceptable levels. However (pending further Laboratory ER Program Office guidance), if additional site-specific risk assessment indicates that human health and the environment are not at risk (i.e., if there is no plausible pathway from source to potential receptors), NFA may still be appropriate. Criteria for this circumstance are expected to be promulgated by the ER Program Office.

4.2.6 Acceptable Uncertainty Limits

Qualitative and quantitative criteria were used to establish a range of acceptable uncertainties that enter into the decision to apply a particular remediation alternative to a particular exposure unit. These criteria specify the quality of sampling data and the consequences of errors in selecting the alternative (see Neptune et al. [1990, 0511] for a discussion of the effects of errors in decision making).

The potential consequences of deciding that a particular remedial alternative is not needed for a particular exposure unit when it really is required (Type I error—false negative) include

- not identifying unacceptable risks
- loss of credibility

The potential consequences of deciding that a particular action is required for an exposure unit when it really is not (Type II error—false positive) include

- waste of resources to impose remedial actions on areas that are not a health and/or environmental problem
- loss of credibility

Type I errors—failing to identify unacceptable risks—could have severe political, legal, and social consequences; Type II errors are judged to have moderate consequences. Acceptable probabilities for making Type I and II errors for given levels of risk (Neptune et al. 1990, 0511) are shown in Table 4-3.

TABLE 4-3
ACCEPTABLE PROBABILITIES FOR TYPE I AND TYPE II ERRORS

TYPE I ERRORS

Postulated True Risk Levels	Acceptable Probability of Error
$>10^{-4}$	0.05
$10^{-5} \rightarrow 10^{-4}$	0.15
$10^{-6} \rightarrow 10^{-5}$	0.25

TYPE II ERRORS

Postulated True Risk Levels	Acceptable Probability of Error
$<10^{-8}$	0.05
$10^{-8} \rightarrow 5 \times 10^{-8}$	0.15
$5 \times 10^{-8} \rightarrow 10^{-7}$	0.25
$10^{-7} \rightarrow 5 \times 10^{-7}$	0.30

Achieving a given level of uncertainty in estimating risk is easier said than done given the many causes of variation and the typically large variances associated with environmental contaminant data. The decision analysis protocol mentioned sample collection and analysis activities to be coordinated with the remediation alternatives being proposed, to ensure compliance with the regulations.

4.2.7 Data Needs

4.2.7.1 Contaminant Concentrations

Health and safety issues cannot be addressed until contaminant concentrations have been measured for each SWMU. The primary data needed are estimates of the radionuclide and hazardous chemical concentrations over the surface of the site and around and beneath the subsurface SWMUs, trenches, and pits. Recall that all treatment facility SWMUs have been aggregated for sampling because of the difficulty of interpreting data when SWMUs are close together (and particularly when they are under buildings). If a comparison of concentration data to action levels indicates it is warranted, further sampling will be done to better define the levels and distribution of contaminants in problem areas. However, if the pathway-based risk assessment indicates compliance

with health and safety requirements, further sampling will be deferred until the site is decommissioned, at which time comprehensive sampling will be possible.

4.2.7.2 Physical Characterization

According to the latest NEPA documentation on TA-50, no further data will be needed on the biological or archaeological impacts of this RFI. Some characterization of the physical setting (e.g., fractures, topography, erosion potential) will be needed to complement the field investigations.

4.2.7.3 Migration Pathways

Limited data will be needed to enable contaminant transport calculations to be incorporated into risk models in the event that concentrations of contaminants exceed action levels. For surface pathways, a water balance and erosion analysis, including flood frequency, will be needed to estimate parameters for existing hydrologic and erosion models (USDA models such as CREAMS [Chemicals, Runoff, and Erosion in Agricultural Management Systems] or WEPP [Water Erosion Prediction Project]) for TA-50 conditions; and a good topographic map of the site will be needed to define the watershed. Basic soil characteristics (particle size distribution, porosity, and bulk density) will need to be studied.

Finally, data on the physical and chemical characteristics of rock, from boreholes, will be needed to calculate aqueous and vapor-phase transport of contaminants: fracture patterns, porosity, stratigraphy, hydraulic conductivity, and mineralogy.

4.2.7.4 Potential Receptors

Workers at TA-50 are considered to be the primary human receptors of any potential release from the site, and adequate data on this subject already exists. Inhalation of contaminants associated with particulates is likely to be the primary route of exposure of workers to both radionuclides and chemicals.

Very little is known about the biological components of the TA-50 environs as receptors of contaminants. They will not be included in Phase 1 sampling activities, but may be in possible subsequent phases of the RFI.

4.2.8 Quality Levels for Field and Analytical Data

The level of quality of field and analytical data collected at TA-50 is governed by the need to make defensible, risk-based decisions for each SWMU. Five quality levels will be used in collecting Phase 1 and Phase 2 data. In general, Levels I and II are associated with on-site, portable field instrumentation or tests that yield "real-time" survey or screening data. Levels III and IV are associated with mobile or off-site laboratory facilities and documentation that will generate high-quality, defensible data. Level V covers all special analytical methods that are not covered by standard Level III or IV methods. The TA-50 RFI will use a combination of analytical levels, as appropriate for specific project needs.

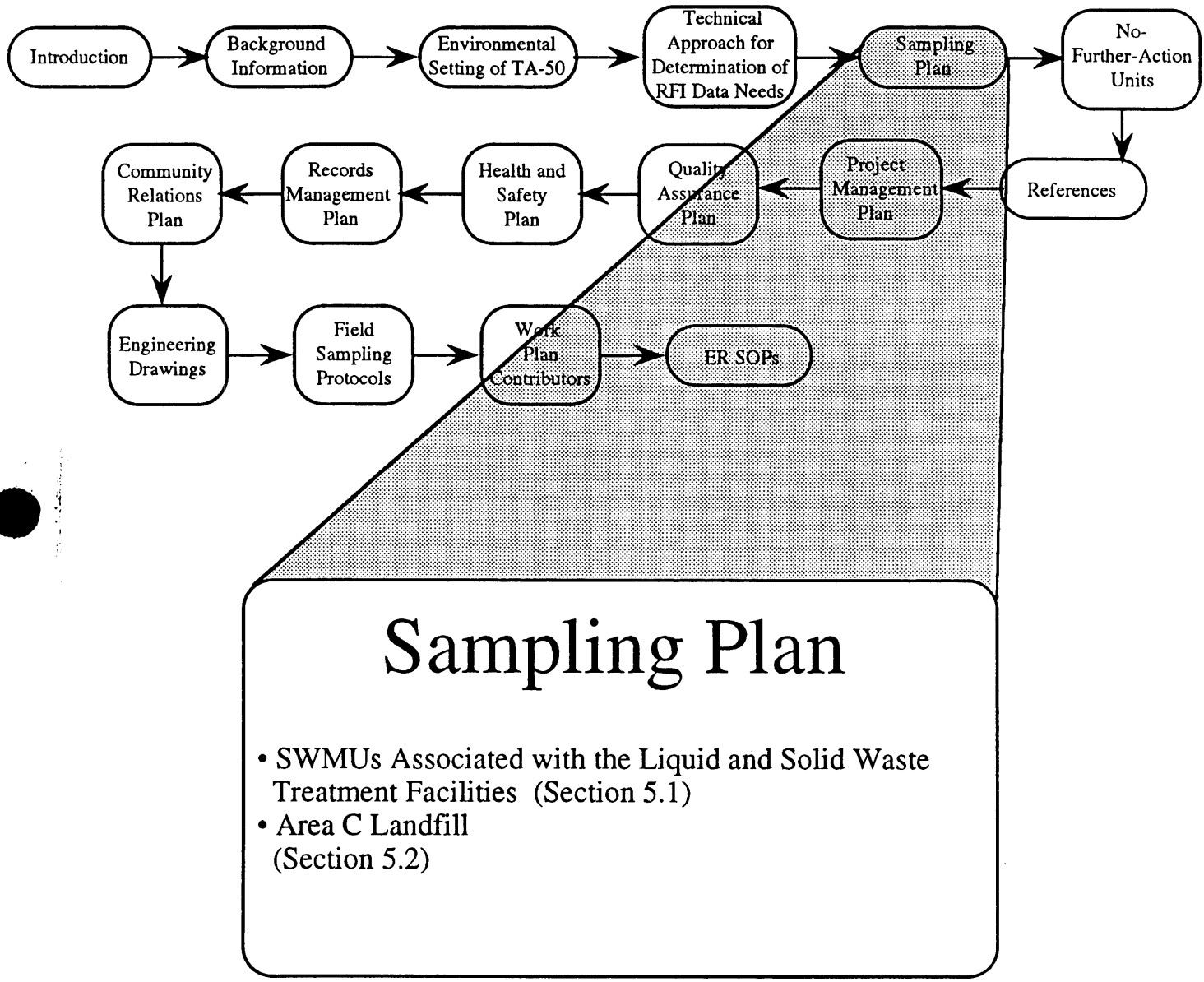
Phase 1 investigations will be performed under analytical Levels I, II, and III. Level I and II data will be collected as part of a field-screening program to enable qualitative, real-time evaluations of site conditions. Level I field screening and surveys employ a variety of portable field instruments and field test kits that can continually or periodically give information on site conditions (see Appendix B for details). Level I observations are also used as a critical part of the site health and safety plan and to determine proper shipping procedures for samples.

Level II data collection uses field survey methods and portable field laboratories (see Appendix B). Field surveys use geophysical techniques on the surface or in boreholes to assist in identifying subsurface features to help locate sampling points. Field laboratories can provide the rapid-turnaround, quantitative information needed to make field strategy decisions.

Mobile field laboratories or off-site laboratories will be used during Phase 1 to obtain the Level III-quality analytical data needed for making RFI/CMS decisions for each SWMU. In particular, the data used for an NFA recommendation must be in strict conformity with Level III QA/QC and sample documentation procedures (see Annex II).

In general, Phase 2 data collection will use quality levels similar to those used in Phase 1 (Levels I, II, and III), but some Level IV data will also be needed.

CHAPTER 5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Background Information
Environmental Setting of TA-50
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• Area C Landfill (Section 5.2)

5.0 SAMPLING PLAN

TA-50 is located on a mesa top formed over the Tshirege Member of the Bandelier Tuff, which slopes gently toward the east. The slope is related to the original depositional slope and thinning of the tuff to the east. The total thickness of the Bandelier Tuff in this area is between 650 and 700 ft (Baltz et al. 1963, 0024), as recently confirmed by drilling along the western edge of TA-55, where the thickness was 680 ft (Gardner 1990, personal communication, 07-0009).

Vaniman and Wohletz (1990, 0541) mapped faults and fractures crossing an area that includes TAs 48, 55, 50, 35, 63, 52, 66, and 41. The Rendija Canyon fault zone, some 800 ft east of the TA-50 boundary, and the Guaje Canyon fault zone, some 1900 ft west of the westernmost edge of TA-50, trend roughly north-south and enclose TA-50. Between the faults, the Bandelier Tuff is deformed. Structural features include rock fractures, micrograbens caused by the downdrop of blocks measuring up to several feet, and "zipper joints" (sets of joints incised by erosion). Most of the fractures are oriented NNW to NNE.

Vaniman and Wohletz (1990, 0541) measured fracture sets along Pajarito Road and East Jemez Road; they found fracture density (number of fractures per 100 ft) to range from 10 to 50, increasing near the faults. The measurement closest to TA-50, at the eastern boundary of the site, is 31/100 ft.

Baltz et al. (1963, 0024), measured joints within the walls of Mortandad Canyon, the canyon immediately north of TA-50. Irregular polygonal joints, an average of $1/yd^2$, break the upper Tshirege Member. Joint openings range from hairline cracks to fissures several inches wide. Many of the fissures have been filled with infiltrated sediment or clay from weathering of the tuff. Many joints in Mortandad Canyon can be classified as "major joints" (those that pass through several beds) and have dips of 85° to vertical (some dip from 40° to 70°). Many can be traced across all exposed tuff units. A number of these joints appear to have been caused by cooling of the tuff deposits, but others are related to faults crossing the plateau near TA-50. Although joints may allow infiltration of surface water, soil moisture measurements indicate that the thin soil cover on the tuff inhibits infiltration of precipitation.

Five semi-horizontal coreholes were drilled beneath the waste pits at TA-54 (Area G), 3.2 miles southeast of TA-50, near the contact between subunits 2a and 2b of the Bandelier Tuff (Purtymun et al., 1978, 0207). The holes are 12 to 14 m below the mesa top and range from 73 to 92 m in length. Numerous joints (37 to 100 per 100 ft) were encountered; 19% are open with slight weathering of the joint face, 72% are filled or plated with brown clay, and 9% are filled or plated with caliche. Some joints are filled with clay beneath a thin layer of soil at the mesa top and are open at deeper levels. Major joints are vertical or with dips of >70°.

From the studies cited above, we should expect to drill through nonwelded, vapor-phase-altered, massive rhyolitic tuff (Tshirege Member of the Bandelier Tuff). This massive block of tuff, perhaps 600-700 feet thick, may be broken by fractures trending more or less north-south and occurring at a frequency of 20 to 40 per 100 feet (measured perpendicular to the fault and fracture trends).

Fractures range in width from a few millimeters to tens of centimeters, with an average of 1.81 cm (Vaniman and Wohletz, 1990, 0541). The larger fractures may be filled with tuff rubble and the smaller ones with infiltrated clay and/or caliche. At TA-50, the tuff is likely to be uniform in physical properties but is probably cut by fractures—which, unless filled with clay or caliche, will be the most likely transport pathways for fluids from leaks or spills.

The primary purpose of the RFI characterization activities at TA-50 is to determine the current distribution of contaminants in soil, sediment, and rock and, from that data and ancillary data, to infer transport mechanisms and estimate risks. Specific objectives of the sampling are to

1. determine the concentrations of contaminants in soil, sediment, and tuff;

2. investigate the vertical and lateral distribution of contaminants in selected areas of the site;

3. using the distribution data, ascertain potential contaminant transport pathways in surface, near-surface, and subsurface zones;

4. measure selected physical, chemical, and biological properties of the site that may affect contaminant migration; and

5. use the contaminant concentration data to calculate risk (action levels), incorporating transport pathways data into the calculations if necessary to improve risk estimates.

Recall that the TA-50 RFI is structured to investigate two categories of SWMUs: (1) sites associated with the solid and liquid waste treatment facilities (ten units), and (2) the Area C landfill (one unit). Sampling activities around the treatment facilities are complicated by the dense network of underground utilities, drainlines, tanks, manholes, asphalt and concrete parking lots and roads, and the existence of several SWMUs in and under structures currently in use. To facilitate sampling, the SWMUs in this first cateogory are grouped primarily according to physical location, and boreholes are located to intercept as many of them as possible to minimize drilling.

Because of the ongoing interim actions to upgrade the treatment facilities at TA-50 and the plan to replace the liquid waste treatment plant beginning in 1995 (see Chapter 2, Table 2-16), only one phase of sampling is anticipated for the treatment facility SWMUs (two phases are described in the sampling plan). If it is verified that no releases from the site are occurring or that the releases are within regulatory limits, no further characterization will be done until the facility is decommissioned, enabling access to subsurface SWMUs.

In contrast, more than one phase of sampling may be required at the Area C landfill to arrive at a defensible remediation alternative. The objectives of sampling at Area C are (1) to ascertain whether contaminants have migrated from the site, and (2) if they have, to determine their concentrations and migration pathway(s). Sampling will be aimed at gathering data on

- concentrations and spatial distributions of contaminants, both radionuclides and nonradionuclides, in surface and subsurface soil, sediments, and rock; and, if concentrations exceed action levels,

- geotechnical and geomorphic surface and subsurface features, to support improved risk calculations.

Most of the sampling plans outlined in this chapter follow protocols established in the IWP (LANL 1991, 0553) and in *Environmental Restoration Standard Operating Procedures* (LANL 1992, 0688). A list of engineering drawings that will be needed to set up sampling locations at TA-50 is presented in Appendix A, and additional details on sampling specific to the TA-50 RFI and not described in this chapter are presented in Appendix B.

5.1 SWMUs Associated with the Liquid and Solid Waste Treatment Facilities

5.1.1 Approach

Surface and near-surface soils will be sampled by shallow vertical coring, to depths ranging from 1 in. to close to 10 ft, using tools such as scoops, ring samplers, and hand and power augers (see Appendix B for details). For subsurface sampling, the overall approach will be to sample multiple SWMU aggregates with a few strategically placed coreholes. (Because of the dense concentration of SWMUs near the Radioactive Waste Treatment Facility, sampling of individual units would be costly if not impossible.) Given the relatively uniform nature of the bedrock underlying TA-50, subsurface sampling can most effectively be done by multi-aggregate, shallow-angle drilling combined with geophysical surveying. The shallow-angle technique can (1) intersect fractures and faults in the underlying Bandelier Tuff that may be migration pathways; (2) efficiently intersect multiple SWMUs at subsurface to sample for the presence of contaminants; and (3) enable horizontal sampling beneath SWMUs. Two types of shallow-angle coreholes will be used.

5.1.1.1 East-to-West Horizontal Coreholes

Horizontal coreholes, or drillholes (HDH), are drilled more or less horizontally and will pass westward beneath the Radioactive Waste Treatment Facility from various points at the eastern boundary of TA-50 (to intersect the north-south faults of the Bandelier Tuff).

5.1.1.2 Radial Coreholes

Radial coreholes, or drillholes (RDH), are also drilled more or less horizontally but have a common point of departure from which they radiate in different directions. These coreholes will originate in the topographic low adjacent to the south end of Building TA-50-1.

5.1.1.3 Geophysical Surveying

The locations of some buried features (lines, etc.) at TA-50 are not precisely known. Where feasible, attempts will be made to establish these locations before drilling, by geophysical survey. In general, the best geophysical technique for mapping buried metallic lines is electromagnetic surveying. A second technique, useful for subsurface objects containing iron or other ferromagnetic material, is magnetic surveying.

Electromagnetic survey instruments use electromagnetic induction to locate conductive targets. Such instruments are available in a variety of configurations and operate at various frequencies. In general, instruments operating at higher frequencies offer better spatial resolution than lower-frequency systems, but have less penetration capability. Less penetration can be an advantage at cluttered sites, because the likelihood of interference from distant objects (such as fences) is also less.

A magnetic survey measures either the total magnetic field existing at a location or a component of the field (usually the vertical). Note that stainless steel may not be detectable with magnetic techniques.

The utility of both magnetic and electromagnetic methods at TA-50 is likely to be limited by interference from metallic objects and electrical fields. Ground-penetrating radar shows great promise, but results at Los Alamos (Gerety 1991, personal communication, 07-0019) and some other sites have not been good to date. Some buried objects, such as clay pipes, may present insufficient physical-property contrast with the material in which they are buried to be detectable with any of these techniques.

5.1.2 SWMU Aggregates

The field measurements and laboratory analyses for all treatment facility SWMU aggregates during the Phase 1 investigations are summarized in Tables 5-1 and 5-2. The strategy for field and laboratory analyses is presented in the flow chart in Fig. 5-1.

5.1.2.1 Aggregate 1: Radioactive Waste Treatment Plant

This plant, which covers 37,000 ft^2 of the 60,000 ft^2 of floor space in Building TA-50-1, is designed primarily to remove transuranics. Within this aggregate (Fig. 5-2), three of the SWMUs (50-001[a], 50-003[a], and 50-010) are within Building 1. The fourth, 50-002(d), is located adjacent to the northeast side of the building. These SWMUs are described in detail in Chapter 2.

5.1.2.1.1 Existing Information

Before July 30, 1990, all radioactive industrial waste flowed into the 2000-gal. pH adjustment tank, or "grit tank," in Room 16, part of SWMU subunit 50-001(a). On July 30, 1990, borings through the floor around the chamber produced wet cuttings, leading to the conclusion that the pipeline to the chamber, or the chamber, had leaked. (See Fig. 2-12 and Tables 2-5 and 2-6 in Chapter 2;

TABLE 5-1

SUMMARY OF SAMPLE SIZES FOR PHASE 1 BY AGGREGATE

SWMU Aggregate	Survey Areas			Surface Soil Samples	Near-Surface Soil Samples			Water Samples	Shallow-Angle Coreholes (HDH and RDH)		
	Land	Radio-logical	Geo-physcial		No. of Locations	Total Footage	No. of Samples		No. of Locations	Total Footage	No. of Samples
1—Radioactive Waste Plant	5			0							
2—Active Waste Lines	2		2	0					8	1340	715
3—Decommissioned Waste Lines	3		3	0	4	150	80				
4—Underground Tanks	2			0							
5—Incinerator, etc.	1			55				55			
6—Outfalls	2			71				213			
7—Decommissioned Septic	1				4	40	21		1	107	57
TOTAL	**16**		**5**	**126**	**8**	**190**	**101**	**268**	**9**	**1447**	**772**

TABLE 5-2

SCREENING AND ANALYSIS REQUIREMENTS FOR PHASE 1, TA-50 SWMU AGGREGATES

X= Every Sample
E= Every Third Sample

Sampling Method	Sampling Location	Interval	Aggregate No.	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)	Isotopic Thorium	Americum - 241
Air Core	RDH-1	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Air Core	RDH-2	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Air Core	RDH-3	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Air Core	RDH-4	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Air Core	RDH-5	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Auger	VIT-15 to VIT 28	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Auger	VM-1 to VM-2	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Air Core	HDH-4 1 to 3	Every 5 ft + at Fracture	1,2, 3, 4				X	X	X				X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E	E		
Core or Auger	NSS-1 to -55	6 inches	5				X	X	X					X	X	X		X				E	E	E	E	E	E		E	E	E		

TABLE 5-2 (cont'd)

Sampling Method	Sampling Location	Interval	Aggregate No.	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)	Isotopic Thorium	Americum - 241
Shallow Borehole	MCO-1 to	Surface,	6				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E		
	MCO-27	1' + 3'																													
Shallow Borehole	TSO-1 to	Surface,	6				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E		
	TSO-44	1' + 3'																													
Air Core	SP-1	Every 5' and	7				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E		
		at Fractures																													
Auger	VLL-1 to	Every 5' and	7				X	X	X		X		X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E		
	VLL-9	at Fractures																													

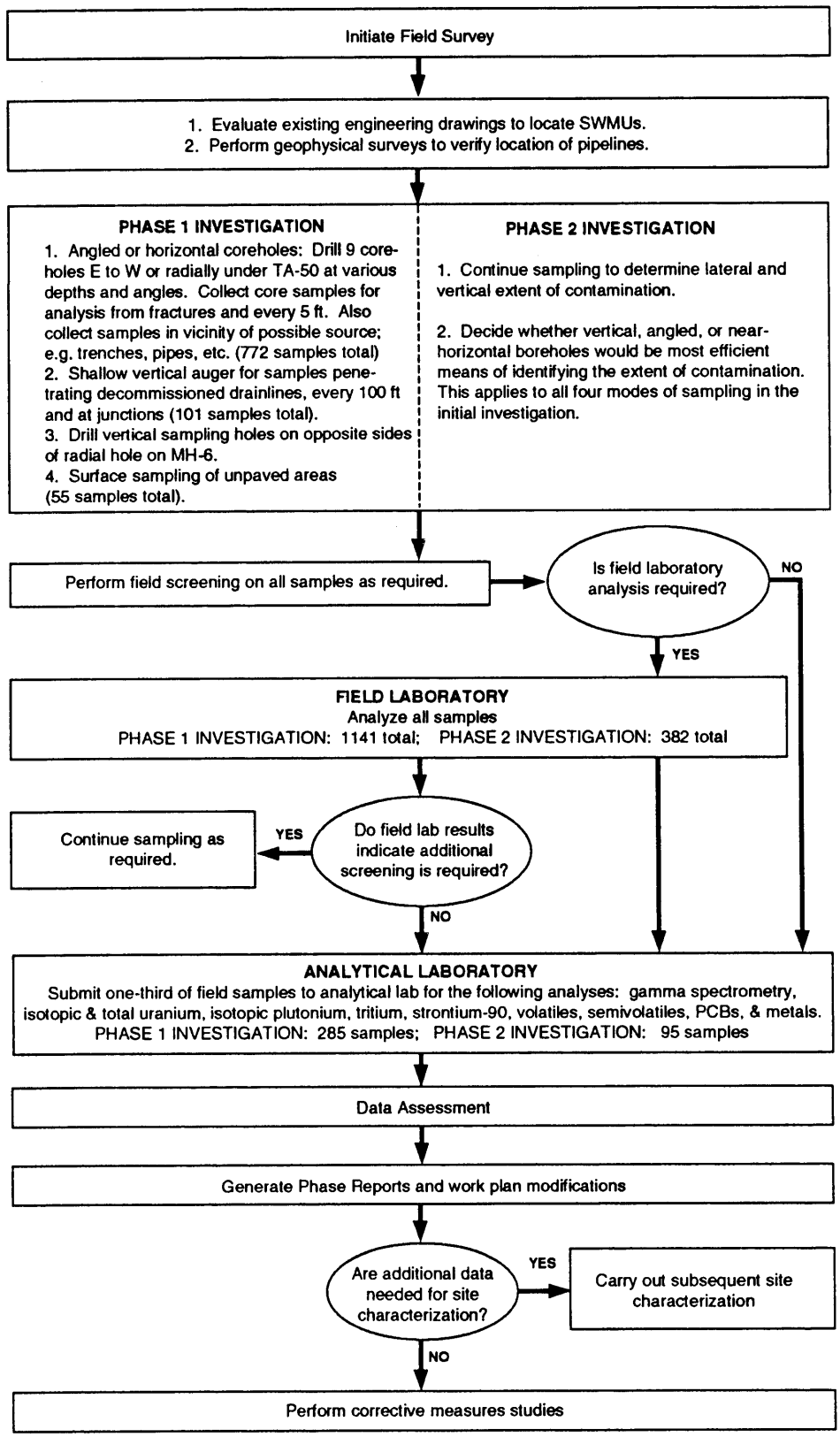


Figure 5-1 Logic flow for the field investigation of the Treatment Facility SWMUs at TA-50.

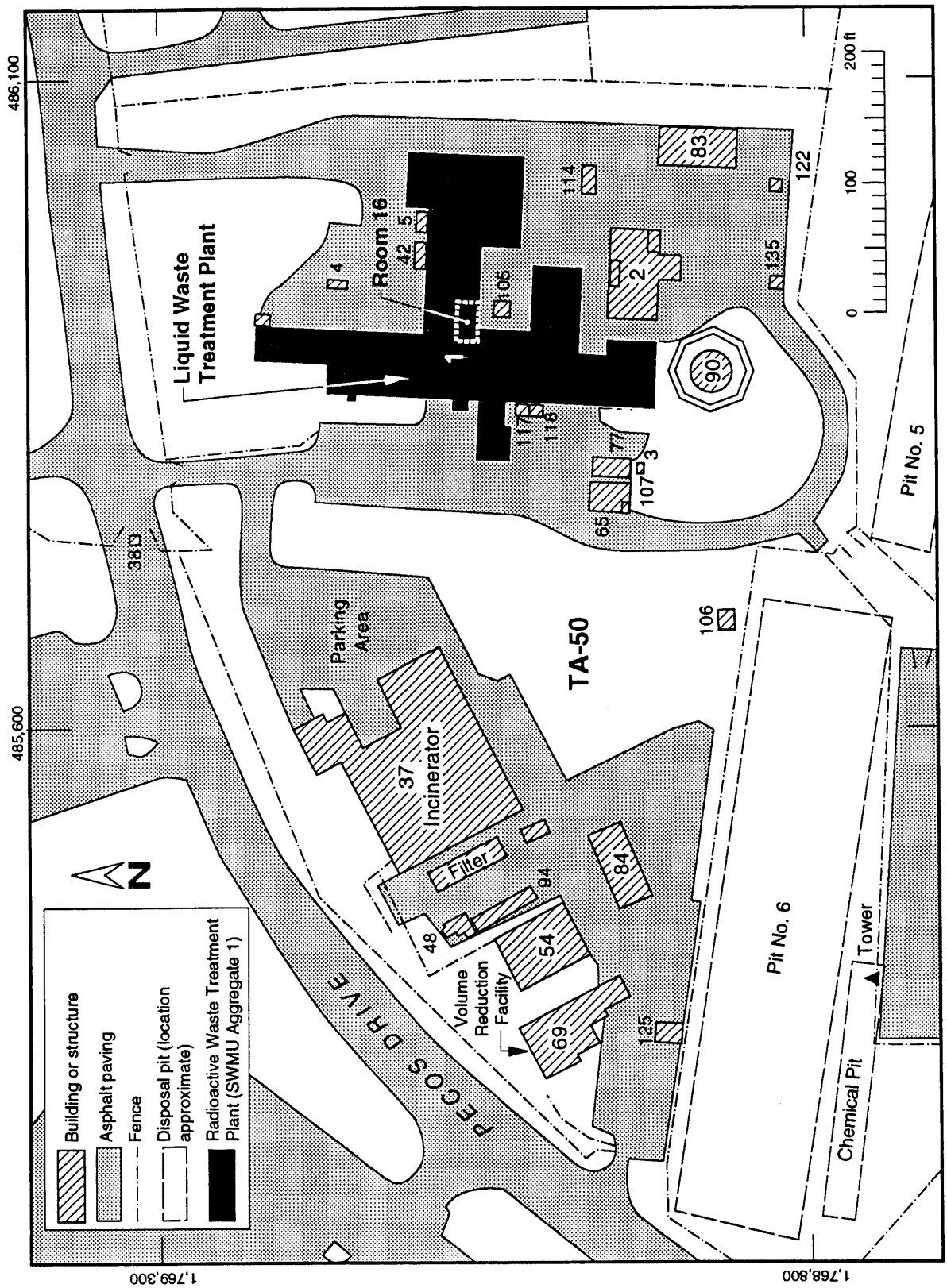


Figure 5-2 Location of SWMU Aggregate 1 (Radioactive Liquid Waste Treatment Plant) at TA-50.

Gardner 1990, 07-0010). IT Corporation investigated the comtaminated area (International Technology Corporation 1990, 0628) and identified nCi/g levels of alpha contamination, consistent with characteristics of raw influent wastes, on the north side of the grit chamber. Influent liquid wastes were rerouted to flow directly into the 75,000-gal. raw waste tank in TA-50-2 for pH adjustment.

This is the only known uncontrolled release from Aggregate 1 SWMUs. The sampling holes, which were closed and sealed, will be reopened for sampling during the RFI.

5.1.2.1.2 Field Investigation: Phase 1

Samples to be taken at Aggregate 1 are summarized in Table 5-3.

50-001(a)—Radioactive Waste Treatment Plant

Use of the existing IT holes (see Fig. 2-13 in Chapter 2) will allow new sampling without the risk of puncturing any *in situ* lines. Two of the holes (Nos. 28 and 15) will be reopened to sample for contaminants, and some holes will be deepened to enable additional investigations.

Because of the potential for leaks in the waste transfer and handling system in Building 1, three horizontal coreholes will be drilled westward from the east perimeter of TA-50. From north to south, these holes will be designated HDH-1, HDH-2, and HDH-3. They will pass under the general area (within 30 ft) of 13 SWMUs. In addition, two radial drillholes, designated RDH-1 and RDH-2, will be cut from the topographic low adjacent to the southwest corner of Building 1 (Fig. 5-3).

The locations for these five drillholes will be identified and surveyed following SOP [in preparation]. Geophysical survey methods (SOP 03.02, in preparation) and engineering drawings (Appendix A) will be used to confirm the locations of the various waste lines, conduits, and other *in situ* features that will be intersected by the HDH and RDH boreholes.

50-002(d)—Nitric Acid Storage Tank

The absence of any historically documented leaks, confirmed by an extensive records search (Francis 1991, 07-0036), supports the recommendation that SWMU-specific sampling not be performed. Moreover, the tank is above ground and contained within a concrete retaining wall and overflow tank. Hole HDH-1 will pass within 30 feet of the bottom of this tank.

50-003(a)—Container Storage Area

No specific sampling will be done in this area, which is operational and already actively monitored. Holes HDH-1 and HDH-2 will pass beneath the area.

TABLE 5-3

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 1

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Traverse Length	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method	Hole ID
RDH-1	W. LY [1]	10°	35°	170 ft	170 ft	[2]	1,2	Air core	≈4.25 in.
HDH-1	E. fence	7°	270°	224 ft	226 ft	[2]	1, 2, 3	Air core	≈4.25 in.
HDH-2	E. fence	7°	270°	224 ft	226 ft	[2]	1, 2, 3	Air core	≈4.25 in.
RDH-2	W. LY [1]	10°	71°	189 ft	192 ft	[2]	1, 2, 3	Air core	≈4.25 in.
HDH-3	E. fence	10°	270°	225 ft	228 ft	[2]	1, 2, 3, 4	Air core	≈4.25 in.

Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
WLCC [3]	2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [3]	2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [3]	2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [3]	2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [3]	2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft

[1] LY = Laundry Yard
[2] Angle hole—depth varies with lateral position
[3] Wire line continuous core

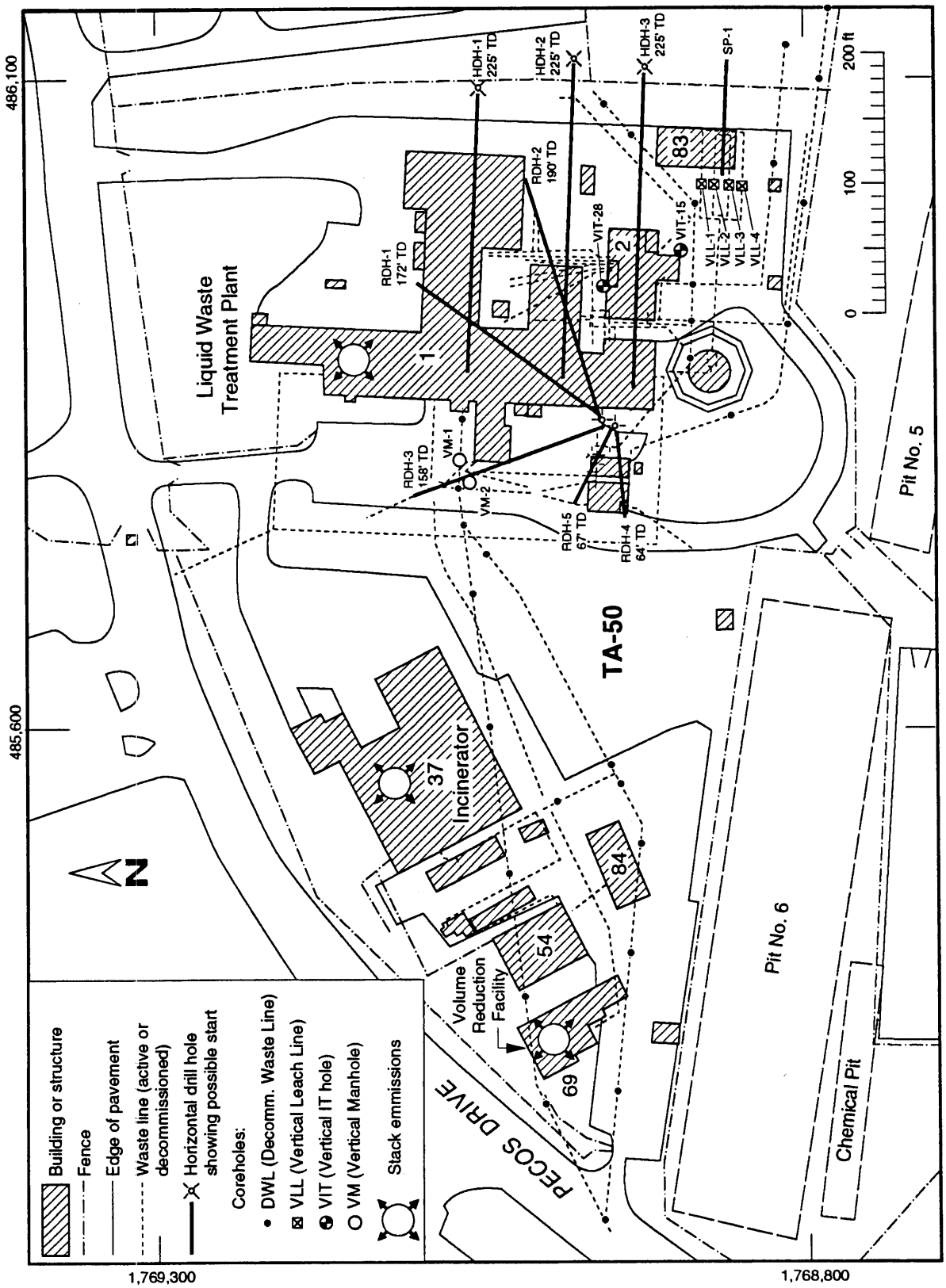


Figure 5-3 Corehole sampling locations at TA-50.

50-010—Radioactive Decontamination Facility

The subsurface area of the Radioactive Decontamination Facility will be sampled via hole HDH-2; hole RDH-2, near the southwest corner of Building 1, will pass beneath this SWMU.

5.1.2.1.3 Field Investigation: Phase 2

If contaminants exceeding action levels are identified under SWMU Aggregate 1, further sampling will be conducted in the target area(s) to better define the lateral and vertical concentrations of the contaminants. Most of the coreholes in Phase 2 would be vertical, oriented around the point at which contamination was identified. The work plan will be modified as needed to include Phase 2 sampling.

5.1.2.2 Aggregate 2: Active Waste Lines

The SWMU aggregate for active lines (Fig. 5-4) includes the radioactive waste influent lines, 50-001(b), and the active sanitary sewer line, 50-011(b). (These SWMUs are described in detail in Chapter 2.)

5.1.2.2.1 Existing Information

Four lines were constructed in 1982 to carry waste from TA-55 to TA-50-66. These lines pass from widely separated points of origin within TA-55 to Building TA-50-1 and to TA-50-2. Three of the lines, for highly radioactive caustic and acid wastes, are 1.5-in. steel pipe encased within 3-in. PVC pipe (one of the three is a spare that has never been used). The fourth line is for industrial waste, and is 2-in. steel within 3-in. PVC. Any leakage of the inner line is conveyed by the outer line to electronic detectors and drip pans in monitoring manholes. There is some concern about contamination from these lines because the original vacuum seals have lost their integrity, but the drip pans have never collected fluid indicative of a leak in the inner lines. (It is not known whether a leakage could occur that would not be detectable in the monitoring manhole.)

The area where these active lines run into Building 1 and the area to the west and north of the tank farm, TA-50-2, were sampled as part of the IT Corporation investigation in August 1990 (International Technology Corporation 1990, 0628). All samples from the areas of the Aggregate 2 SWMUs showed only background levels of radionuclides.

5.1.2.2.2 Field Investigation: Phase 1

Samples to be taken at Aggregate 2 are summarized in Table 5-4 (see Fig. 2-13, Chapter 2, for original IT sampling locations).

50-001(b) Radioactive Waste Influent Lines

Because there is no evidence of any releases associated with this SWMU aggregate, there is no need for specific vertical sampling. The horizontal

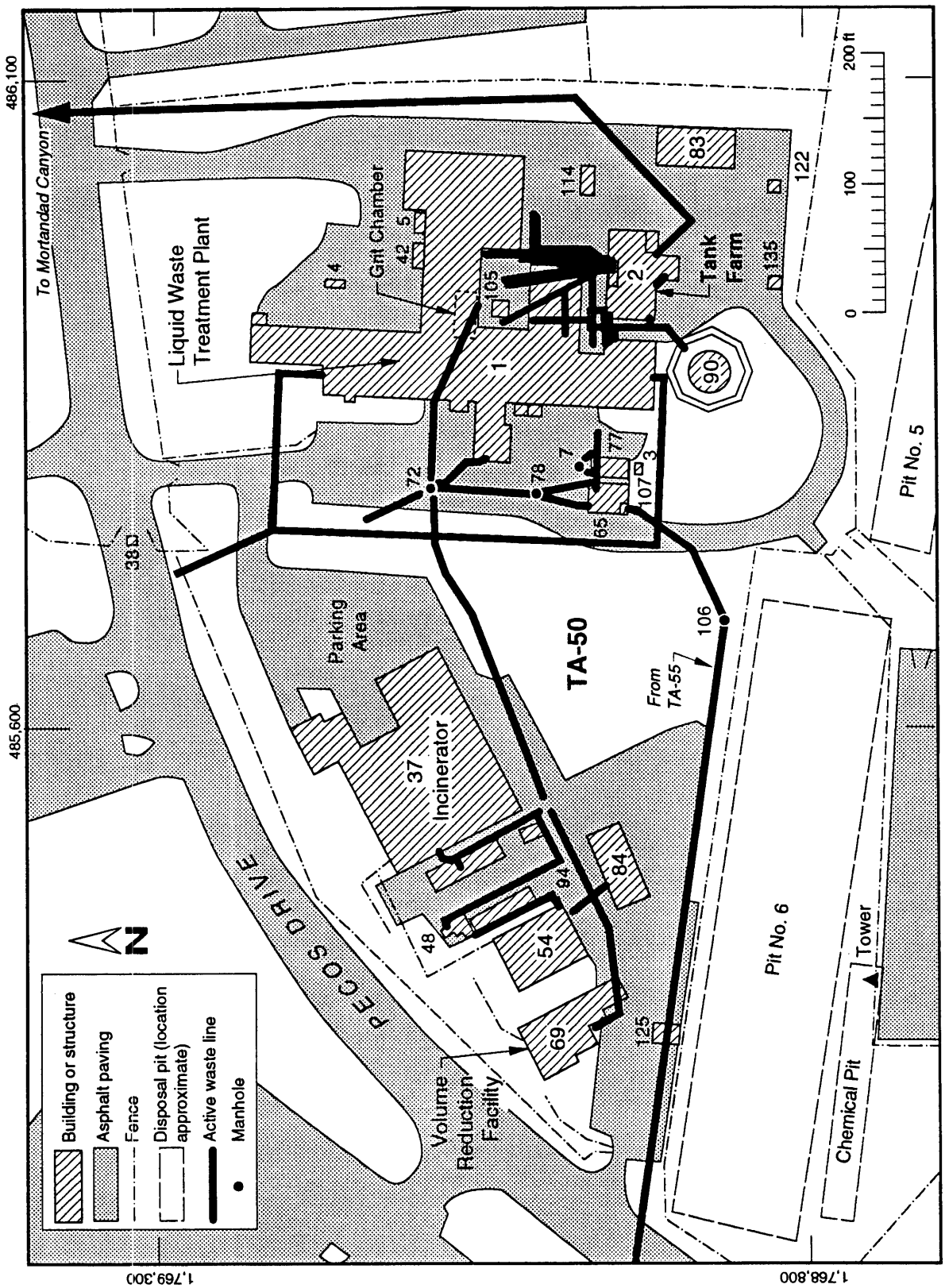


Figure 5-4 Location of SWMU Aggregate 2 (active waste lines) at TA-50.

TABLE 5-4

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 2

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Traverse Length	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method
RDH-1	W. LY [1]	10°	35°	170 ft	173 ft	[2]	1,2	Air Core
RDH-2	W. LY [1]	10°	71°	189 ft	192 ft	[2]	1, 2, 3	Air Core
RDH-3	W. LY [1]	8.5°	348°	157 ft	159 ft	[2]	2, 3,	Air Core
RDH-4	W. LY [1]	17°	263°	64 ft	67 ft	[2]	2, 3, 4	Air Core
HDH-5	W. LY [1]	17°	290°	66 ft	69 ft	[2]	2, 3, 4	Air Core
VIT-15	S.E. of 50-2	n/a	n/a	n/a	n/a	35 ft	2, 4	Reamed Core

Hole ID	Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in.	WLCC [3]	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft

[1] LY = Laundry Yard
[2] Angle hole - depth varies with lateral position
[3] Wire line continuous core

coreholes HDH-2 and HDH-3, which will pass under TA-50-2 and TA-50-1 (Fig. 5-3), will furnish information on this SWMU subunit; radial coreholes RDH-1 and RDH-2 will pass beneath the areas of greatest concentration of active waste lines under and on the west side of Building 1; and radial corehole RDH-3 will also pass beneath the active waste lines on the west side of Building 1. Finally, IT Corporation monitoring hole No. 28 (Fig. 2-13 in Chapter 2) will be deepened because its location—near many active lines and near the TA-50-2 tank farm—will provide information for this and other SWMU aggregates. This hole will be located using the IT Corporation August 1990 report and will be designated VIT-15. Geophysical survey methods (SOP 03.02, in preparation) will be used to confirm the locations of the various waste lines, conduits, and other *in situ* features that will be intersected by the horizontal and radial coreholes.

50-011(b) Active Sanitary Sewer Line

No specific sampling is planned for this active sanitary waste pipeline. This line has no documented history of releases and does not transport hazardous wastes. Radial hole RDH-3 will sample beneath portions of the line.

5.1.2.2.3 Field Investigation: Phase 2

If contamination is detected in the Phase 1 coreholes, additional information on the lateral extent of contamination may be required in specific target areas. The work plan will be modified to include this additional sampling program should it be needed.

5.1.2.3 Aggregate 3: Decommissioned Waste Lines

This aggregate includes numerous lines and a tank farm (SWMU subunits 50-004[a], 50-004[b], and 50-004[c]) that were decommissioned during the last 17 years. Their locations are shown in Fig. 5-5 and they are described in detail in Chapter 2.

5.1.2.3.1 Existing Information

Most of the decommissioned lines were removed, and the soil in the line trench was cleaned to ALARA standards. A few lines or portions of lines were left in place because of the difficulties or hazards involved in removing them. The decommissioned lines near TA-50-37, 50-004(a), were used to transport radioactive waste from Pajarito Road sites to TA-50. According to the SWMU report, these lines "were known to have leaked occasionally." Francis (1991, 07-0035) confirms this on the basis of a records search.

The decommissioned tank farm, TA-50-3 (50-004[b]), was used primarily to store waste from the Omega West reactor. In an emergency, the tanks could also be used to receive other wastes, and in fact received waste from experiments in TA-50-1 via lines from TA-35 and TA-50-1. According to the SWMU report, soil sampled during decommissioning was screened for both radioactive and chemical contamination but was found to be "below cleanup levels." The soil beneath the vault "contained background levels of radiation" and may not have been removed.

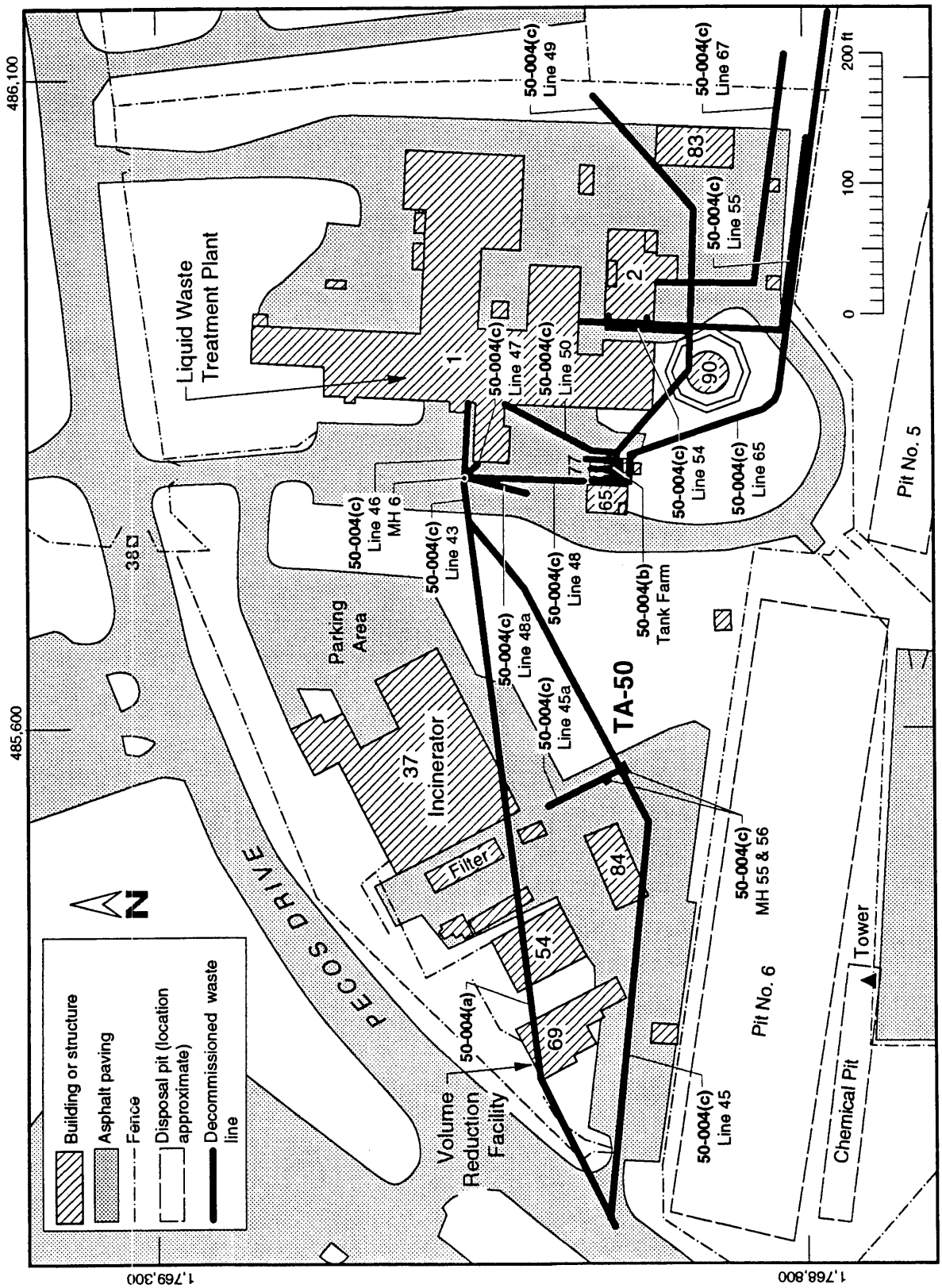


Figure 5-5 Location of SWMU Aggregate 3 (decommissioned waste lines) at TA-50.

SWMU 50-004(c) includes miscellaneous decommissioned lines (Nos. 44, 45, 45a, 46, 47, 48, 48a, 49, 54, 55, 56, 65, and 67), all of which were removed except No. 56; and manholes TA-50-6, TA-50-55, and TA-50-56 (Francis, 1991, 07-0037). The lines were used for the transport of various wastes. According to the SWMU report, decommissioning involved removing the lines, screening for radionuclides, and cleaning to ALARA standards.

Manhole TA-50-6 has a documented release of contaminants that may be above present acceptable limits. At the time of decommissioning in 1984, the manhole structure and about 20 yd^3 of soil were excavated to approximately 19 ft below grade, but the site was left with up to 3.8 nCi/g of alpha contamination in the soil at the bottom of the excavation.

In summary, many of the SWMUs in this aggregate have contaminated the soil surrounding them to some (unknown) extent, cleanup was to ALARA levels, and portable field instruments were the primary means of judging contaminant levels.

5.1.2.3.2 Field Investigation: Phase 1

Samples to be taken at Aggregate 3 are summarized in Table 5-5.

50-004(a)—Decommissioned Lines Near TA-50-37

The backfilled trenches left after decommissioning will be sampled via vertical holes drilled through to the contact between trench fill and trench bottom. These coreholes, designated DWL, will be approximately 100 ft apart (Fig. 5-3).

50-004(b)—Decommissioned Tank Farm

Sampling for this SWMU will be done via two multi-aggregate, shallow-angle radial coreholes, RDH-4 and RDH-5 (Fig. 5-3). These will begin at the low area on the southwest corner of Building 1. Corehole RDH-4 will pass beneath decommissioned acid waste lines 65 and 49, the decommissioned tank farm, and vault TA-60-66. Corehole RDH-5 will cross beneath several tank farm feed lines and directly beneath manhole WM-7.

50-004(c)—Miscellaneous Decommissioned Waste Lines

As in the case of subunit 50-004(a), sampling will be done via vertical holes (designated DWL) drilled through to the contact between trench fill and trench bottom and located approximately 100 ft apart (Fig. 5-3).

Corehole RDH-3 will sample specifically in the vicinity of manhole TA-50-6. Angled 8.5° downward, it will cross below the deepest point of previous excavation of the manhole. Several vertical coreholes (designated VM-1 and VM-2) will also furnish data on manhole TA-50-6: they will be located approximately 10 ft from a line perpendicular to RDH-3 and centered on the manhole. Phase 1 sampling depth will be 40 ft, about 20 ft deeper than the existing excavation.

TABLE 5-5

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 3

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Traverse Length	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method
HDH-1	E. Fence	7°	270°	224 ft	226 ft	[3]	1,2, 3	Air Core
HDH-2	E. Fence	7°	270°	224 ft	226 ft	[3]	1, 2, 3	Air Core
HDH-3	E. Fence	10°	270°	224 ft	228 ft	[3]	1, 2, 3, 4	Air Core
RDH-2	W. LY [1]	10°	71°	189 ft	192 ft	[3]	1, 2, 3	Air Core
RDH-3	W. LY [1]	8.5°	348°	157 ft	159 ft	[3]	2, 3	Air Core
RDH-4	W. LY [1]	17°	263°	64 ft	67 ft	[3]	2, 3, 4	Air Core
RDH-5	W. LY [1]	17°	290°	66 ft	69 ft	[3]	2, 3, 4	Air Core
VM-1	S.W. of MH 6 [2]	90°	n/a	n/a	40 ft	40 ft	2, 3,	Auger
VM-2	N.E. of MH 6	90°	n/a	n/a	40 ft	40 ft	2, 3,	Auger
DWL-1 to	Various	90°	n/a	n/a	15 ft	15 ft	3	Auger
DWL- 38	Various	90°	n/a	n/a	15 ft	15 ft	3	Auger

TABLE 5-5 (continued)

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 3

Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Depth Criterion
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
WLCC [4]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
Cont. Samp.	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
Cont. Samp.	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
Cont. Samp.	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
Cont. Samp.	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft

[1] LY = Laundry Yard
[2] MH = Manhole
[3] Angle hole–depth varies with lateral position
[4] WLCC = Wire line continuous core

Locations for all coreholes have been identified (Fig. 5-3 and Table 5-5) and will be surveyed per SOP (being prepared). Geophysical survey methods (SOP 03.02, in preparation) will be used to confirm the locations of the various waste lines, conduits, and other *in situ* features that will be intersected by the HDH, RDH, VM, and DWL coreholes.

5.1.2.3.3 Field Investigation: Phase 2

If contamination is detected in any of the Phase 1 coreholes, additional information on its lateral extent may be required. This information will be obtained via vertical boreholes around the target area. The work plan will be modified to include the additional sampling protocol if needed.

5.1.2.4 Aggregate 4: Active Underground Tanks

This aggregate consists of SWMU subunits 50-002(a), 50-002(b), and 50-002(c). Their locations are shown in Fig. 5-6, and they are described in detail in Chapter 2. The location of these tanks in accessible underground vaults facilitates leak detection.

5.1.2.4.1 Existing Information

50-002(a)—Tank Farm (TA-50-2)

These tanks (Fig. 5-6) have been used to store treated and untreated waste from TA-50-1. The tanks are 16 to 18 ft below grade (with the exception of the sludge tank, which extends to the south of the building; this tank is approximately 26 ft below grade). Although overflow from the raw waste tanks has contaminated Ten Site Canyon (see Chapter 2 and Section 5.1.2.6), no releases as a consequence of tank failure have been documented. The floor drains and overflow lines involved in the releases to Ten Site Canyon have been decommissioned.

50-002(b) and (c)—Underground Vault, Caustic Waste Tank, and Acid Waste Tank (TA-50-66)

These underground tanks and vault (see Fig. 5-6) have been used to temporarily store untreated caustic and acid wastes from TA-55. These wastes contain significant amounts of TRU and are monitored carefully for criticality before treatment. By segregating the acid and caustic wastes from other industrial waste entering TA-50, the volume of waste that must be treated as TRU waste is reduced from 300 barrels per year to 10 or 12. There are no documented reports of releases from these tanks.

5.1.2.4.2 Field Investigation: Phase 1

The TA-50-2 tank farm consists of an equipment room surrounded on three sides by concrete tanks: two for incoming raw waste, one for sludge, two for treated liquid waste storage, and one for liquid waste from the D&D facility. When the integrity of the tank farm and of the pipelines flowing to the grit chamber in Building TA-50-1 and vicinity was checked in August 1990 (International

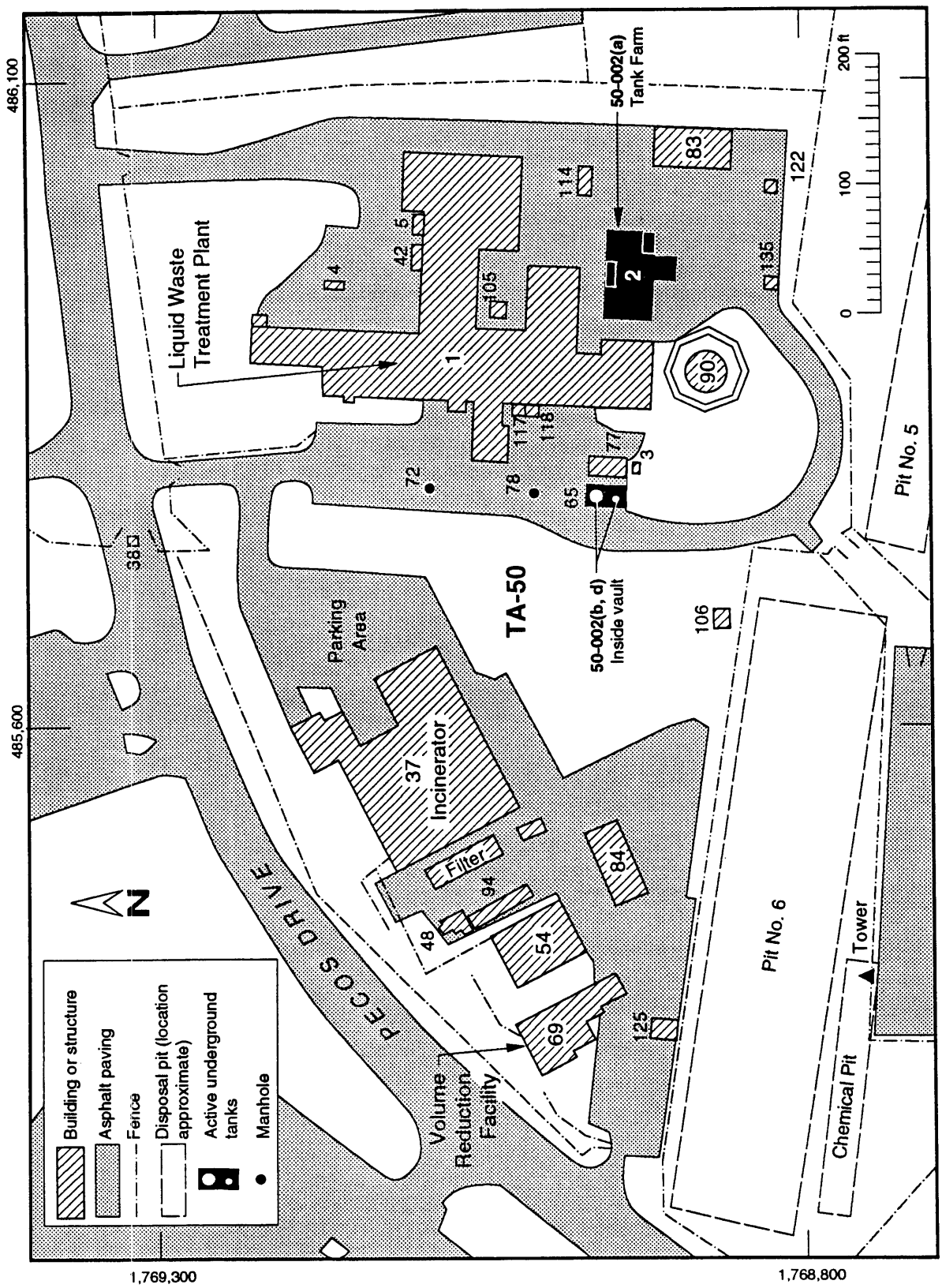


Figure 5-6 Location of SWMU Aggregate 4 (active underground tanks) at TA-50.

Technology Corporation 1990, 0628), no leaks were found (nor had any been documented previously).

To reduce the risk of damage to subsurface structures, Phase 1 sampling will re-use the IT Corporation vertical investigative/monitoring coreholes (Fig. 2-13, Chapter 2) located around the perimeter of TA-50-2. Holes 28 and 15 (designated VIT-28 and VIT-15) will be deepened to serve as north and south perimeter investigative holes. The IT Corporation report will be used to locate these holes. In addition, one of the east-west shallow-angle coreholes (HDH-3) will pass beneath TA-50-2.

The caustic and acid waste tanks, 50-002(b) and 50-002(c) respectively, are encased in a concrete underground vault (TA-50-66), so that no vertical perimeter sampling is possible. The multi-aggregate radial holes RDH-4 and RDH-5 will pass beneath the vault area in a near east-west direction.

Locations for the horizontal and radial coreholes have been identified (Fig. 5-3, Table 5-6) and will be surveyed per SOP (being prepared). Geophysical survey methods (SOP 03.02, in preparation) will be used to confirm the locations of the various waste lines, conduits, and other *in situ* features that will be intersected by the coreholes.

5.1.2.4.3 Field Investigation: Phase 2

If contaminants exceeding action levels are identified under Aggregate 4 SWMUs, additional drilling and sampling will be done to ascertain the lateral and vertical extent of contamination in the target area(s). Most of the Phase 2 coreholes would be vertical, oriented radially around the point at which contamination was identified. Other existing IT Corporation coreholes may be used to further expand sampling if needed. The work plan will be modified to include the additional work decided upon.

5.1.2.5 Aggregate 5: Sites Associated with Atmospheric Releases from the Radioactive Liquid Waste Treatment Plant, the Incinerator, and the Volume Reduction Facility

The SWMUs in this aggregate are 50-006(c), 50-007, and 50-008.Their locations are shown in Fig. 5-7, and they are described in detail in Chapter 2. This aggregate comprises surface sites contaminated by several stacks at TA-50: airborne releases from the Radioactive Liquid Waste Treatment Plant (TA-50-1) are identified as 50-006(c); those from the Incinerator (TA-50-37) are part of 50-007; and those from the Volume Reduction Facility (TA-50-69) are in 50-008. (The subsurface components of SWMUs 50-007 and 50-008 will be sampled as part of the field investigations for Aggregates 1 and 2.)

Much of the surface area around structures at TA-50 is paved (Fig. 5-7). The unpaved areas are largely disturbed, by past construction and decommissioning activities. In general, the entire area slopes gently to the east and south, draining toward Ten Site Canyon at the southeast corner of the paved areas.

TABLE 5-6

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 4

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Traverse Length	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method
HDH-3	E. Fence	≈–10°	≈270°	≈225 ft	228 ft	[2]	1,2, 3, 4	Air Core
HDH-4	W. LY [1]	≈17°	≈263°	≈64 ft	67 ft	[2]	2, 3, 4	Air Core
RDH-5	W. LY [1]	≈17°	≈290°	66 ft	69 ft	[2]	2, 3, 4	Air Core
VIT-15	S.E. of 50-2	90°	0	35 ft	n/a	35 ft	2, 4	Reamed /Cored
VIT-28	N. of 50-2	90°	0	35 ft	n/a	35 ft	4	Reamed/Cored

Hole ID	Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
≈4.25 in	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in	WLCC [3]	≈2.5 in.	100%	Fractures, features, & every 5 ft	Background level + 5 ft
≈4.25 in	WLCC [3]	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
≈4.25 in	WLCC [3]	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft

[1] LY = Laundry Yard
[2] Angle Hole–depth varies with lateral position
[3] WLCC = Wire line continuous core

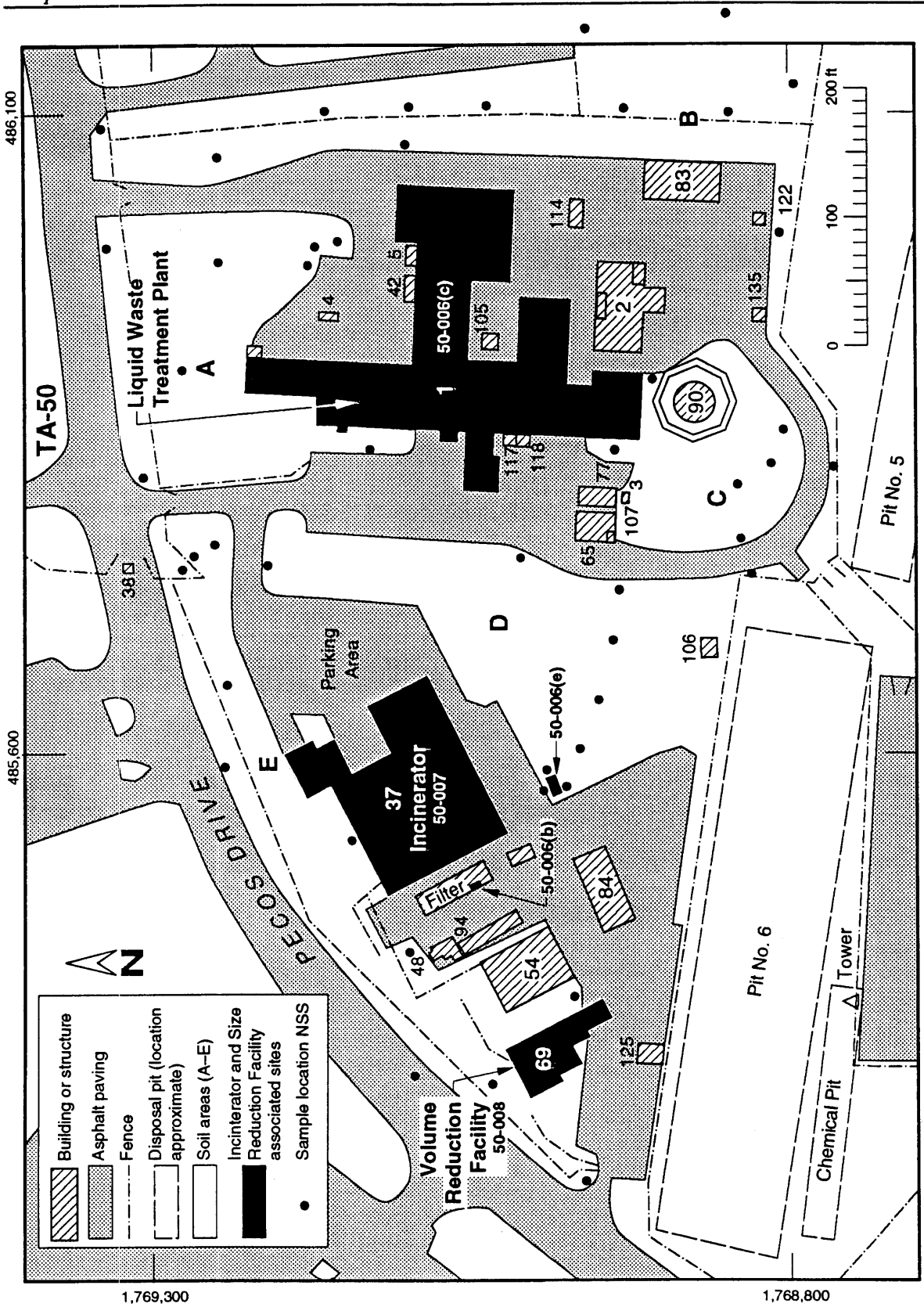


Figure 5-7 Location of SWMU Aggregate 5 at TA-50.

5.1.2.5.1 Existing Information

The activities associated with TA-50-1 are described under Aggregate 1 (Section 5.1.2.1). Several stacks (see Fig. 2-9, Chapter 2) serve the operations of this building; routine releases are monitored, and in certain cases filtered, before release.

The Treatment Development Facility in TA-50-37 includes a controlled-air incinerator with associated feed systems and an offgas treatment facility with two HEPA filters. It was designed and constructed to develop incineration methods for wastes containing transuranics and has also been used for other types of wastes, both radioactive and hazardous. At present it is not in operation, and is being upgraded for future use as a production facility. An environmental assessment is in process, as is an application to EPA for a permit to incinerate toxic waste.

TA-50-69 is a prototype facility for volume reduction and repackaging of radioactively contaminated metallic waste. Operations began in 1983. The facility is currently inactive, but should resume operations soon. Long-range plans call for the construction of a larger unit at TA-54.

Stack emissions from all three buildings are monitored, and many stacks have release controls. However, plutonium concentrations exceeding fallout levels have been measured in the nearby soils (Purtymun et al. 1990, 0215): up to 0.017 pCi/g of plutonium-238 (compared with fallout levels of 0.001-0.003 pCi/g) and up to 6.98 pCi/g of plutonium-239 (compared with fallout levels of 0.005-0.05 pCi/g).

The major source of radionuclides in stack gases at TA-50 is undoubtedly the liquid waste treatment plant, since the other two buildings have HEPA filtration systems on their stacks. But there are also other stack sources of radioactive emissions in the areas around TA-50, which will make it difficult to ascertain the specific source(s) of soil radioactivity at the site.

5.1.2.5.2 Field Investigation: Phase 1

Although the plutonium levels measured exceed fallout concentrations, they are still far below levels of concern. Phase 1 sampling will be designed to (1) confirm the information on radionuclide contaminant levels in surface soils in nonpaved areas, and (2) measure the levels of hazardous constituents, for which there is currently no data.

Sampling locations on the unpaved areas around the TA-50 buildings will be categorized as (1) adjacent to the pavement (within 5 ft), (2) within drainage channels, and (3) any other location within the area of the TA-50 treatment facilities where there is surface soil. Samples will be collected from soils in each of these categories, and from soils in each of the unpaved areas surrounding the buildings, to evaluate the dependence (if any) of contaminant distributions on location category and/or direction with respect to the source(s).

Five distinct unpaved areas have been selected for sampling; these are designated A, B, C, D, and E in Fig. 5-7. After the areas have been surveyed (SOP [being prepared]) to locate natural drainage channels, sampling locations will be selected in each. Two to five locations will be selected in category 1, along the edge of the pavement bordering the area. (This may be done systematically—one location every 500 ft—or randomly, provided locations are not less than 300 ft apart.) Two to six locations will be selected in category 2, in drainage channels. (The number will depend on the size of the area and the number of channels.) Finally, two to five locations will be selected in category 3, more than 5 ft from the pavement and outside drainage channels. (This may be done systematically—on 100-ft grids within each area—or randomly, provided locations are not less than 60 ft apart.) A total of 55 soil samples will be taken, using a 6-in.-diameter, stainless-steel coring tool, to a depth of 6 in. (Table 5-7).

5.1.2.5.3 Field Investigation: Phase 2

Analysis of Phase 1 samples, including spatial analysis using kriging, will be used to design follow-up sampling if it appears necessary. Locations in which contaminants exceed action levels will be sampled to greater depths within the soil profile to better characterize the distribution of contaminants.

5.1.2.6 Aggregate 6: Outfalls

This aggregate includes SWMU subunits 50-006(a), accidental spills from TA-50, and 50-006(d), intentional releases of treated liquids under an NPDES permit. They are described in detail in Chapter 2, and their locations are shown in Fig. 2-8.

5.1.2.6.1 Existing Information

50-006(a)—Ten Site Canyon

Ten Site Canyon is a small canyon off the southeast corner of the pavement at TA-50; it formerly had two outfalls (see 50-004[c]). A sump in TA-50-2 overflowed into the canyon on two occasions, releasing liquid waste containing radionuclides and an unknown quantity of hazardous constituents. The site was sampled and then partially decontaminated near the outfall by removing about 70 yd^3 of contaminated soil and covering the area with clean soil. Post-cleanup sampling indicated that residual contamination is no higher than 400 pCi/g of gross alpha activity and 40 pCi/g of gross beta activity.

50-006(d)—Mortandad Canyon

Mortandad Canyon contains an active, NPDES-permitted, outfall for the release of treated liquid wastes. The effluent line runs from the tank farm at TA-50-2 to the stream channel in the canyon. Known and suspected contaminants include chemicals, radionuclides, and heavy metals. Plutonium concentrations near the outfall measure a few hundred pCi/g (see Tables 2-7 and 2-8 in Chapter 2 for concentrations and total amounts released). Release standards for iron and copper have also been violated on occasion.

TABLE 5-7

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 5

Corehole Designation	Approximate Location	Vertical Depth	Coring Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
NSS-1 to NSS-55	Various Surface	6 in.	Stainless Steel Ring Sampler	6 in.	100%	Next to Pavement & Drainages, Spill Areas	See Phase 2

5.1.2.6.2 Field Investigation: Phase 1

50-006 (a)—Ten Site Canyon Outfall (TSO)

Two discrete outfalls, approximately 45 ft apart, empty into Ten Site Canyon near the southwest corner of the fenced yard of the Radioactive Waste Facility. Sampling will be done along two lines following the assumed discharge paths of the pipelines (Fig. 5-8), meeting at the convergence point of the paths, and thence becoming a single line following the assumed downgrade course.

One sample will be taken from each of the two discharge paths (near the month of the outfall) and three samples where the paths converge. From there, transects will be laid out at 100-ft intervals perpendicular to the stream channel, and samples will be taken at three points along each transect. Each vertical hole will be 3 ft deep and will be sampled at the surface, at 12 in., and at 36 in. (Table 5-8). (The specific lateral spacing of the three sampling holes will be determined by surface morphology; spacing will increase downstream because of the widening of the effluent as it flows down the canyon.) Sampling along the line of drainage will go as far as the break of the bottom of Ten Site Canyon, which is approximately 1,250 feet from the outfall of the pipelines. A total of 132 samples (3 from each of 44 locations) will be taken during Phase 1. The rest of the canyon will be evaluated for residual contamination as a part of the ER Program Canyon Studies.

50-006(d)—Mortandad Canyon Outfall (MCO)

The same sampling method will be used as for Ten Site Canyon. The transects, laid out at 100-ft intervals perpendicular to the stream channel, will extend along the line of drainage for 700 ft; samples will be taken at three points along each transect (Fig. 5-9). A total of 27 shallow holes (Table 5-8) will be required. Mortandad Canyon will also be investigated as part of the ER Program Canyon Studies.

The sampling sites will be surveyed according to SOP (being prepared) to determine drainage patterns so that optimal locations for the sampling transects can be selected. Hand auger and coring techniques (LANL 1991, 0553; LANL 1992, 0688; Annex II and Appendix B of this work plan) will be used to collect surface and near-surface samples.

5.1.2.6.3 Field Investigation: Phase 2

If contamination exceeding action levels is detected in the samples, additional sampling may be required to determine the lateral extent of contamination. All Phase 2 investigation holes will be vertical, using the same methods as in Phase 1, and the lateral spacing of samples will be increased or decreased on the basis of Phase 1 results. The work plan will be modified to include these additional sampling activities.

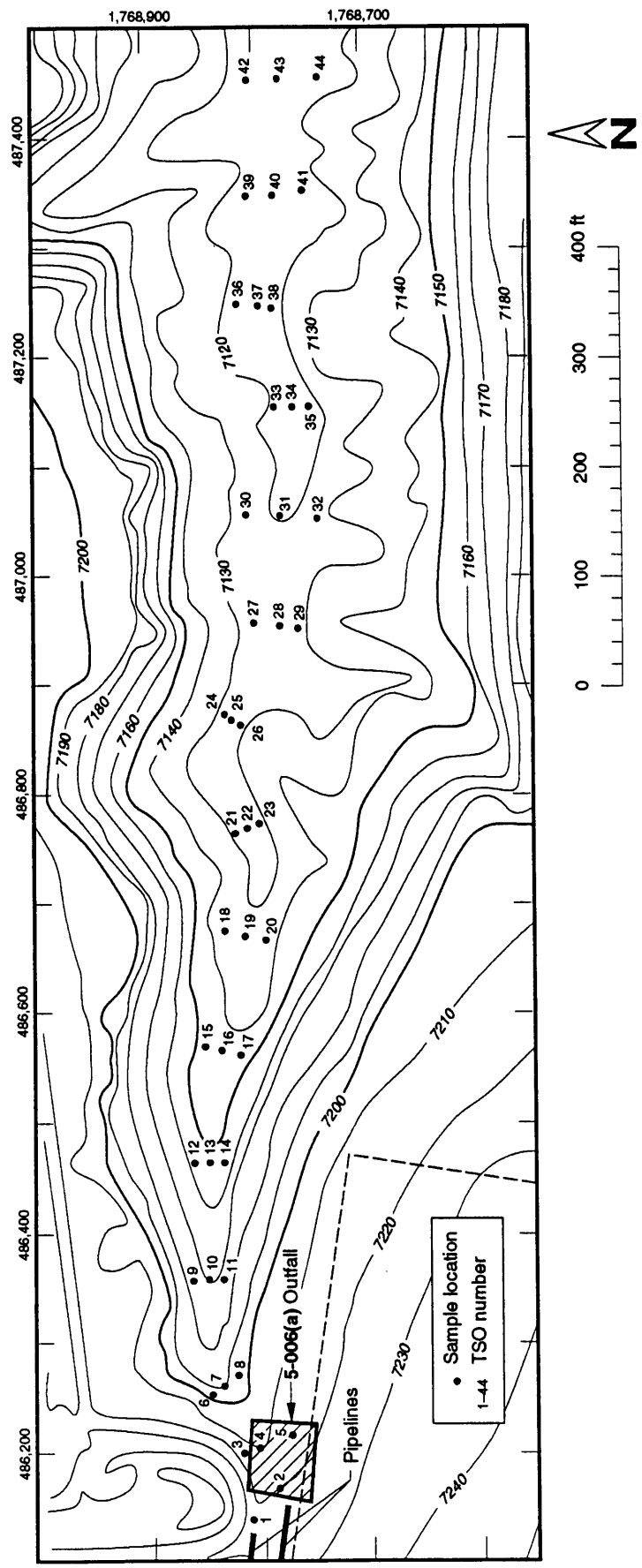


Figure 5-8 Locations of Ten Site Canyon Outfall (TSO) sampling holes.

TABLE 5-8

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 6

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method
TSO-1	Ten Site Canyon Outfall	n/a	90°	n/a	3 ft	6	TBD
TSO-44	Ten Site Canyon Outfall	n/a	90°	n/a	3 ft	6	TBD
MCO-1	Mortandad Canyon Outfall	n/a	90°	n/a	3 ft	6	TBD
MCO-27	Mortandad Canyon Outfall	n/a	90°	n/a	3 ft	6	TBD

Hole ID	Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
≥ 3.5 in	TBD	≥ 2.5 in	100%	Surface, 12 in & 36 in	See Phase 2
≥ 3.5 in	TBD	≥ 2.5 in	100%	Surface, 12 in & 36 in	See Phase 2
≥ 3.5 in	TBD	≥ 2.5 in	100%	Surface, 12 in & 36 in	See Phase 2
≥ 3.5 in	TBD	≥ 2.5 in	100%	Surface, 12 in & 36 in	See Phase 2

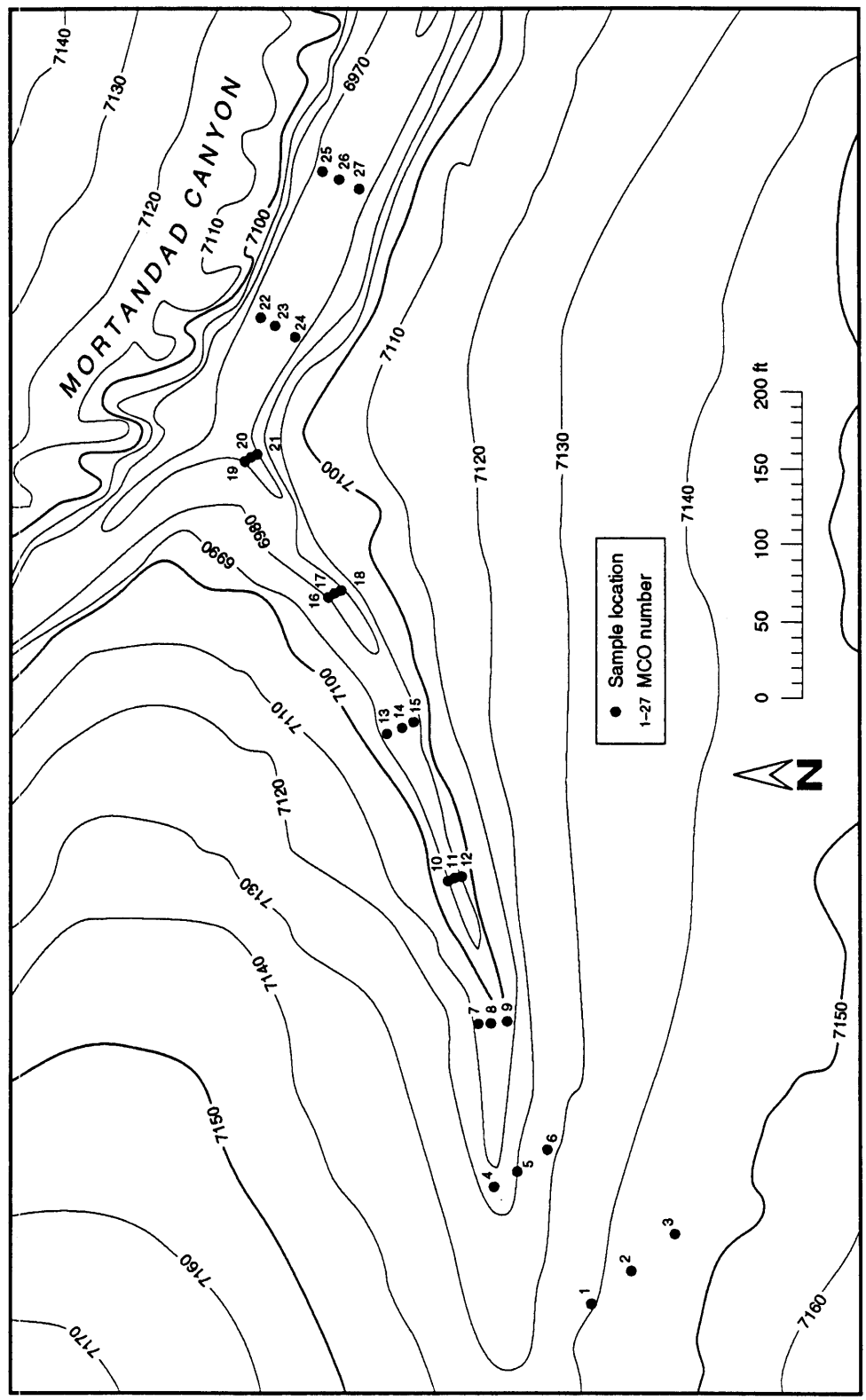


Figure 5-9 Mortandad Canyon Outfall (MCO) sampling locations.

5.1.2.7 Aggregate 7: Decommissioned Septic System

SWMU 50-011(a) consists of a decommissioned septic system, including a tank (TA-50-10), a manhole (TA-50-9), a sanitary distribution box (TA-50-11), and a leach field with a 50-ft-deep infiltration shaft on the east side of the distribution box (see Fig. 2-11 in Chapter 2). The leach field and the main from the septic tank are buried about 4 ft below grade. This system is located south and east of TA-50-1, near the perimeter fence.

5.1.2.7.1 Existing Information

This septic system, in use from 1963 to 1983, was decommissioned in 1984 as part of the TA-50 upgrading program; pipes, leach lines, and leach-field soil were removed. The 4-ft-diameter by 50-ft-deep shaft drilled in 1978 at the east end of the leach field, to increase the field's capacity, is probably still in place. Because the septic system was located in an area of TA-50 where there were surface spills of liquid waste from the tank farm (R. M. Parsons, Co. 1981, 07-0025), it will be difficult to positively identify the source of the contaminants known to exist in the area. (The spills of raw waste from the TA-50-2 tank farm, however, are likely to be the only important source.) There are no documented occurrences of hazardous material ever having entered the sanitary septic system. The system was decommissioned because of the poor absorption characteristics of the tuffaceous rocks. Clean fill replaced the soil over the leach field.

The location of the decommissioned leach field was discovered during the ER Program reconnaissance visit in 1989 (Roy F. Weston Inc. 1989, 07-0047). Erosion had exposed a length of perforated PVC pipe from the field.

5.1.2.7.2 Field Investigation: Phase 1

Sampling for this SWMU will be done via four shallow vertical holes approximately 10 ft deep, designated VLL-1 to VLL-4, and one 45° corehole, designated SP-1 (Fig. 5-3 and Table 5-9). The four vertical coreholes will sample the interface between the bottom and fill of the four leach-field pipe trenches. The 45° corehole will be drilled in an east-to-west direction through the center line of the 4-ft-x-50-ft infiltration shaft (Fig. 5-3) and will extend to a lateral point 15 ft west of the center line.

Locations for the VLL-1 to -4 and SP-1 coreholes will be identified and surveyed using the protocol in SOP [in preparation]. Geophysical survey methods (SOP 03.02, in preparation) will be used to try to confirm the location of the infiltration shaft and other features to be intersected by the coreholes.

5.1.2.7.3 Field Investigation: Phase 2

Results of the Phase 1 investigation will be used to develop the sampling plan for Phase 2 investigations, if Phase 2 is needed. The work plan will be modified to include a protocol for these further investigations.

TABLE 5-9

COREHOLE REQUIREMENTS FOR SWMU AGGREGATE 7

Corehole Designation	Approximate Location	Dip Angle	Degrees From North	Traverse Length	Actual Length	Vertical Depth	SWMU Aggregate(s)	Drilling Method
VLL-1	N. Leach Line	90°	n/a	0	10 ft	10 ft	7	Auger if Accessible
VLL-2	N.C. Leach Line	90°	n/a	0	10 ft	10 ft	7	Auger if Accessible
VLL-3	S.C. Leach Line	90°	n/a	0	10 ft	10 ft	7	Auger if Accessible
VLL-4	S. Leach Line	90°	n/a	0	10 ft	10 ft	7	Auger if Accessible
SP-1	E. of E. Fence	45°	≈270°	103 ft	107 ft	AH	7	Air Core

Hole ID	Sampling Method	Sample OD	Percent Sampled	Specific Sample Points Required	Maximum Sampling Depth Criterion
≈6.25 in	CS	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
≈6.25 in	CS	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
≈6.25 in	CS	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
≈6.25 in	CS	≈2.5 in.	100%	Fractures & every 5 ft	Background level + 5 ft
≈4.25 in	WLCC	≈2.5 in.	100%	Fractures & every 5 ft L	Background level + 5 ft

Angle Hole–depth varies with lateral position
CS = Continuous Sample
WLCC = wire line continuous core

5.2 The Area C Landfill

5.2.1 Surface Sampling

5.2.1.1 Approach

A phased sampling approach will be used to determine contaminant concentrations, and spatial analysis techniques such as kriging (Journel and Huejbregts 1967, 07-0015) to evaluate the level and extent of surface contamination.

The specific tasks of this phased approach include

- through chemical analysis, quantifying the concentrations and spatial distribution of contaminants;
- using this data to construct a probability-based model that will enable prediction of contaminant concentrations in unsampled areas;
- using field instruments to collect radionuclide survey data in unsampled areas, to verify the model's predictions;
- estimating prediction errors;
- using spatial distribution data to infer migration pathways.

The phased sampling approach uses the results of an initial sampling effort to decide whether further sampling is needed and, if it is, to guide the location and number of samples to be taken. The obvious benefits of this approach are that the level of sampling is matched to the level of contamination, and sampling is focused on key locations. (See Appendix H of the IWP for further information.) Sampling and analytical requirements for Area C are presented in Tables 5-10 and 5-11, and the strategy for sampling surface and subsurface soils and rock is depicted in the flow chart in Figure 5-10.

The construction of a model to predict the concentrations and spatial distributions of contaminants on the surface at Area C requires an understanding of the various components of total variance, including those associated with analytical techniques and sample collection techniques. If the combined contributions of these sources of variability can be estimated, they can be removed from the model, allowing the component of natural spatial variability of contaminant distribution to be more clearly estimated.

Estimates of the error contribution associated with sample collection and analytical techniques can be obtained from split samples, which we define as aliquots from a well-mixed sample. Estimates of natural variability in contaminant concentrations can be obtained from a combination of replicate and more widely spaced samples. The former are individual samples taken close to one another (which reflect variability on a local scale); the latter samples are farther apart (for example, from intersection points on a 60-ft-x-60-ft grid) and reflect natural variability on a larger scale.

TABLE 5-10

SAMPLE SIZES FOR PHASE 1 INVESTIGATION OF AREA C LANDFILL

Description	Survey Areas			Surface Soil Samples	Near-Surface Soil Samples	
	Land	Radio-logical	Geo-physcial		Soil Samples	No. of Locations
Surface Topography	1	1		240		
Field Instrument Survey						
Intensive Soil Sampling					48	48
Surface Soil					223	223
Soil Contingency					30	30
Field Duplicate					12	12
Rinsate Blank					8	8
Trip Blank					3	3
Field Blank					8	8
Split Samples					12	12
TOTAL	**1**	**1**		**240**	**344**	**344**

Description	Coreholes					
	Vertical			Shallow-angle		
	Number	Total Footage	Number of Samples	Number	Total Footage	Number of Samples
Core	6	480	96	4	2314	463
Core Contingency			30			140
Trip Blank			12			60
Field Blank			12			60
Equipment Blank			12			60
Field Duplicate			12			60
Split Samples			12			60
Fracture Contingency			32			140
TOTAL	**6**	**480**	**218**	**4**	**2314**	**1043**

TABLE 5-11

SAMPLE SIZES FOR PHASE 2 INVESTIGATION OF AREA C LANDFILL

Description	Survey Areas			Water Samples	Near-Surface Soil Samples	
	Land	Radio-logical	Geo-physcial		Soil Samples	No. of Locations
Surface Topography		1	1			
Surface Soil					100	100
Soil Contingency					30	30
Field Duplicate					10	10
Equipment Blank					5	5
Trip Blank					5	5
Field Blank					5	5
Split Samples					8	8
Field Instrument Survey					100	
TOTAL		1	1	163	100	163

Description	Coreholes					
	Vertical			Shallow-angle		
	Number	Total Footage	Number of Samples	Number	Total Footage	Number of Samples
Core	3	240	48	2	400	80
Field Duplicate			5			8
Equipment Blank			5			8
Field Blank			5			8
Trip Blank			5			8
Core Contingency			5			8
Fracture Contingency			5		8	
TOTAL	**3**	**240**	**78**	**2**	**400**	**128**

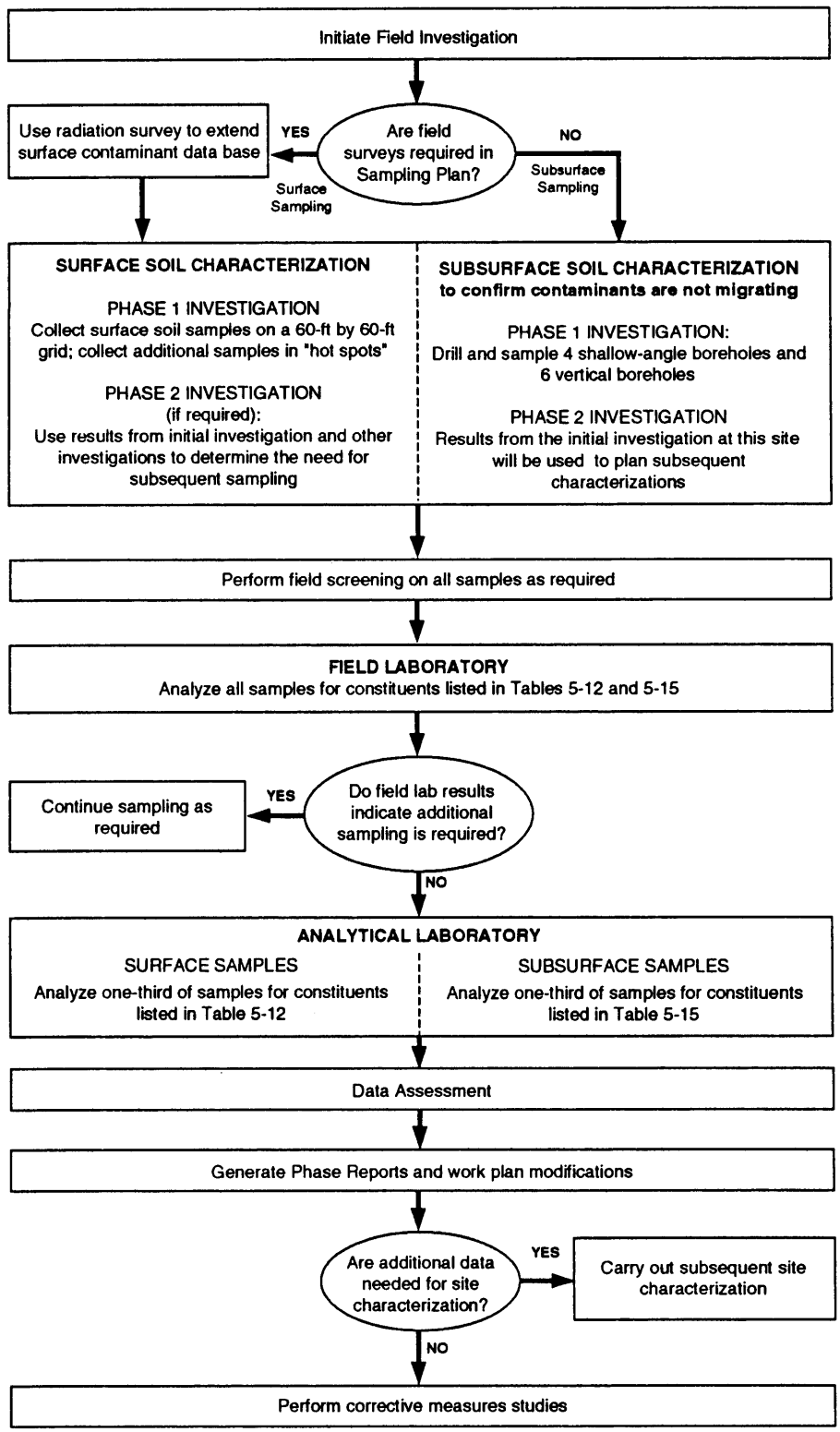


Figure 5-10 Logic flow for the Area C field investigation.

5.2.1.2 Field Investigation: Phase 1

About 223 surface soil and sediment samples will be collected at Area C, to a depth of 6 in. These samples will be analyzed for selected radionuclides, toxic metals, and hazardous chemicals during late FY93 and early FY94 (see Table 5-12). The sampling technique, described in detail in Appendix B, consists basically of using a 6-in. stainless-steel coring ring pushed into the ground. Sampling for *radionuclides* will be done by the Environmental Protection Group (EM-8) as a part of their routine decommissioned-waste-site surveillance activities (their sampling plan was unavailable for inclusion in this draft work plan but will be incorporated into the final version). EM-8 will analyze the samples for plutonium-239 and -240, plutonium-238, cesium-137, strontium-90, tritium, americium-241, gross gamma, and total uranium. We propose to add *semi-volatiles,* and *selected metals* to the list of contaminants that EM-8 will both sample for and analyze, to avoid the need for a separate surface sampling program (see Table 5-12).

Soil samples will be collected using a 60-ft-x-60-ft grid inside and just outside the Area C perimeter fence (Fig. 5-11). Recall that most samples collected in 1985 showed concentrations of several radionuclides within the fence as at or very near background, whereas elevated radionuclide levels were observed in soils in the northeast quadrant of the site (ESG et al. 1986, 07-0004). These results will be verified by the new data.

Two areas (to be selected on the basis of field instrument data) will be more intensively sampled using a 10-ft-x-10-ft grid, to provide data for existing local spatial variability (as a basis for assigning confidence limits to the surface concentrations). Ten samples will be randomly collected from each intensive sampling grid. As mentioned, split samples (see Table 5-12) will provide estimates of the errors associated with sampling and analysis techniques.

Radiation survey instruments will be used as a relatively inexpensive way to extend sampling to more of the site. Both Phoswich and HPIC measurements will be made on a 60-ft-x-60-ft grid offset 30 ft from the soil sampling grid (Fig. 5-11). These measurements will be the only source of data for these locations. (Soil samples for field laboratory and/or analytical laboratory analysis will come from those locations not sampled with field instruments.) Additional contingency soil samples have been allowed for, for areas exhibiting elevated instrument responses and requiring further characterization.

5.2.1.3 Field Investigation: Phase 2

The number and locations of additional samples, and the specific analyses to be done, will be decided on the basis of the initial sampling results. An estimate of the sampling and analytical needs is presented in Table 5-13. The work plan will be modified to include the detailed sampling protocol.

TABLE 5-12

SCREENING AND ANALYSIS FOR PHASE 1 SURFACE INVESTIGATIONS AT AREA C LANDFILL

X = All samples
E = Every third sample

Sample Method/Type	Sampling Location	Interval	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)	Isotopic Thorium	Americum - 241
Field Instrument Survey	1-240	Surface		X																											
Soil-Intensive Site	1-48	0-6 in					X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Surface Soil	1-223	0-6 in					X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Surface Soil Contingency	(30 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Field Duplicate	(12 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Equipment Blank	(8 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Trip Blank	(3 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Field Blank	(8 samples)												X	X	X		X	X									E				
Split Samples	(12 samples)												X	X	X		X	X										E	E		
							X	X					X	X	X		X	X			E	E	E	E		E		E	E		E

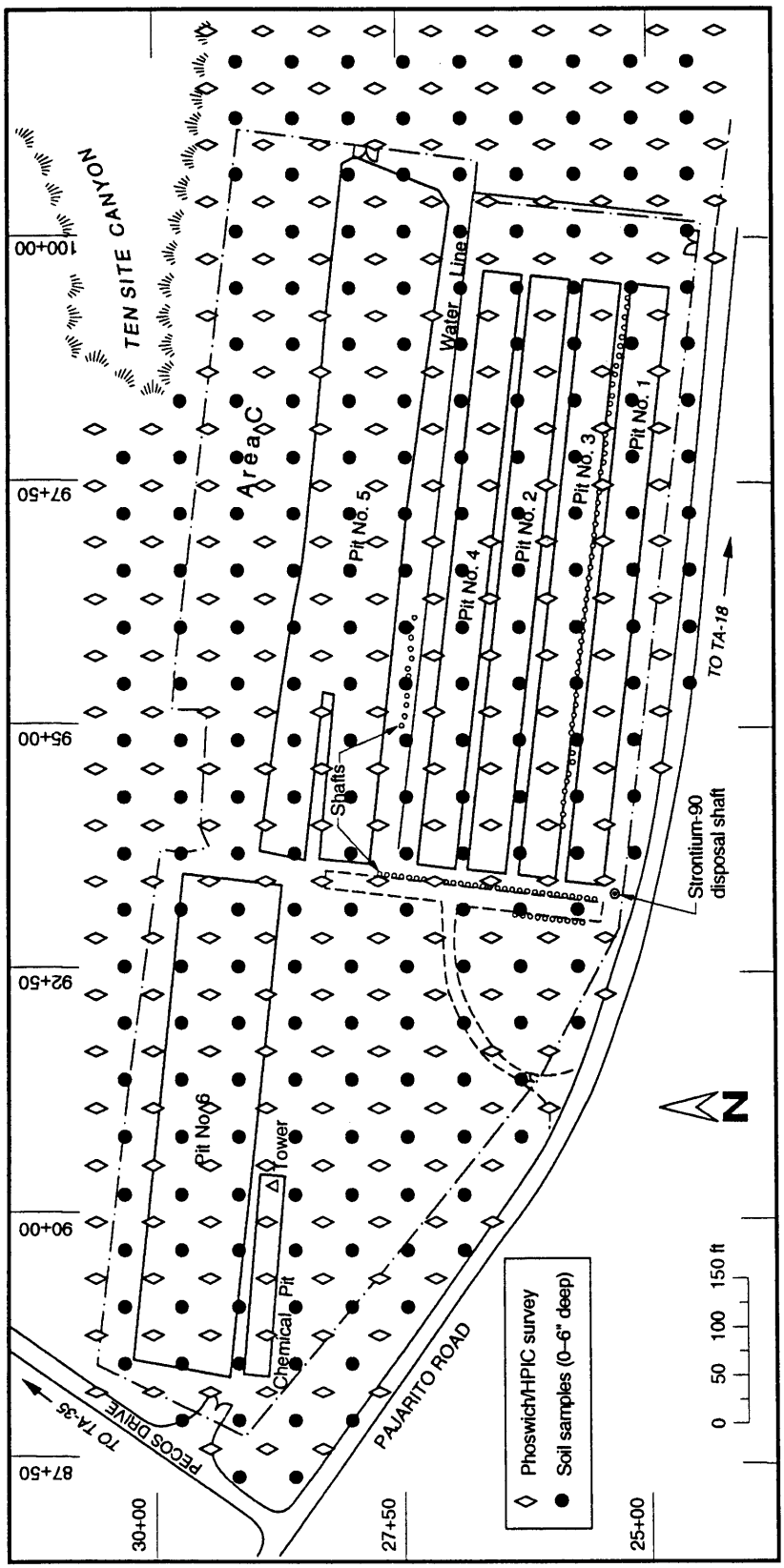


Figure 5-11 Surface field instrument and soil sampling locations at Area C.

TABLE 5-13

SCREENING AND ANALYSIS FOR PHASE 2 SURFACE INVESTIGATION AT AREA C LANDFILL

X = All samples
E = Every third sample

Sample Method/Type	Sampling Location	Interval	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)	Isotopic Thorium	Americum - 241
Field Instrument Survey	1-100	Surface		X																											
Surface Soil	1-100	0-6 in.					X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Soil Contingency	(30 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Field Duplicate	(10 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Equipment Blank	(5 samples)						X	X					X	X	X		X	X			E	E	E	E		E		E	E		E
Trip Blank	(5 samples)												X	X	X		X	X									E				
Field Blank	(5 samples)												X	X	X		X	X										E	E		
Split Samples	(8 samples)						X	X					X	X	X		X	X			E	E	E	E				E	E		E

5.2.2 Subsurface Sampling

5.2.2.1 Approach

Details of the subsurface sampling techniques to be used are given in Annex II and Appendix B. The basic approach is to use shallow-angle and vertical coring techniques to measure contaminant concentrations in soil and rock adjacent to and beneath Area C. Because of the dryness of the vadose zone, the low potential for percolation of water and solutes, and the solid (as opposed to liquid) form of most of the waste, no drilling is planned within the perimeter of the site. Extensive vadose zone monitoring by the Environmental Protection Group over the last 35 years has demonstrated the low probability of percolation of water into and through the waste. The major reason is evapotranspiration, the combined process by which moisture is removed from the soil surface (evaporation) and returned to the air through vegetation surfaces (transpiration). Studies at the Laboratory (Nyhan et al. 1990, 0173; Abrahams 1963, 0011) show that 75 to 100% of the annual precipitation at Los Alamos is returned to the atmosphere by this process.

5.2.2.2 Field Investigation: Phase 1

Drilling locations (Fig. 5-12), all outside the perimeter fence, were selected on the basis of proximity to burial pits and shafts to increase the probability of detecting horizontal and vertical migration plumes with a minimum number of boreholes. Soil and rock samples from four shallow-angle boreholes (3° to 11° from horizontal) will identify major contaminant plumes beneath the pits and shafts. Six vertical boreholes will be drilled around the site to detect lateral migration of contaminants (Fig. 5-12). Sampling details are presented in Table 5-14.

Vertical borehole depths will be determined by the depths of contaminant plumes, as indicated by field laboratory analysis (the depth will go two 5-ft intervals below the point at which laboratory measurements cease to detect contaminants). Drillholes will be dry-cored to minimize the chance of contaminant mobilization (by drilling fluids) and of disturbance of the moisture conditions in the tuff (Table 5-14). Holes will be completed and abandoned according to the drilling SOP, and drill cores not used for analytical samples will be archived for the duration of the RFI.

A lithologic log will be kept for each Area C drillhole (Table 5-15). It will record lithologic changes with depth; stratigraphic contacts; alteration features; welding characteristics; color; and phenocryst and lithic content. It will also include information on fracture density, the occurrence of fracture-lining minerals, and dip angles of fractures. The log will be prepared immediately after samples have been removed to test for volatile compounds. The core will then be photographed in color and, finally, sampled for analysis of remaining contaminants. In this way, a compete lithologic description of the drill core will be available for site characterization and for permanent TA-50 records.

Measurement of vertical variations in moisture content is important for evaluating transport of contaminants. (Previous studies at the Laboratory have shown that moisture content can vary greatly over short vertical distances.) Samples to be

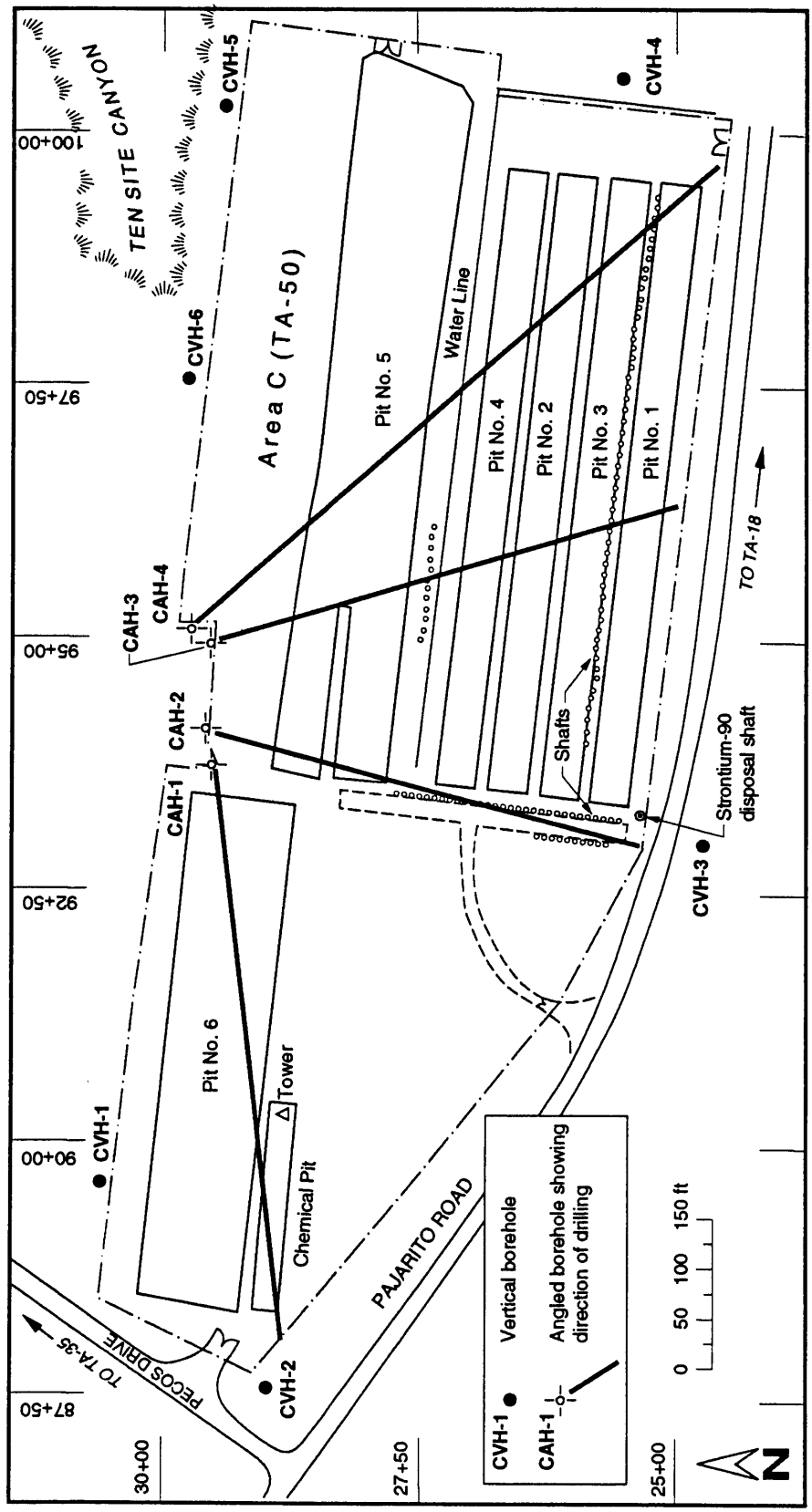


Figure 5-12 Locations of vertical and angled boreholes at Area C.

TABLE 5-14

DETAILS OF SUBSURFACE SAMPLING AT AREA C DURING PHASE 1 INVESTIGATION

Borehole No.	Location	Dip Angle	Degrees From North	Horizontal Length	Hole Length	Vertical Depth	Drill Method	Hole ID	Sampling Method	Sample ID	Sample Criteria	Maximum Sample Depth	Number of Samples
CAH-1	North Central Side	11°	262°	615 ft	627 ft	123 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	125
CAH-2	North Central Side	6°	200°	480 ft	483 ft	51.2 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	97
CAH-3	Northeast Side	6°	162°	495 ft	498 ft	52.8 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	100
CAH-4	East Side	3°	138°	705 ft	706 ft	37.6 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	141
CVH-1	Northwest Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
CVH-2	Southwest Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
CVH-3	South Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
CVH-4	Southeast Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
CVH-5	Northeast Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
CVH-6	North Side	Vertical	N/A	N/A	80 ft	80 ft	Air Core	4.25 in.	Wire Line, Continuous	2.5 in.	Fractures, Features every 5 ft	Background Level + 5 ft	16
												TOTAL	559

TABLE 5-15

SCREENING AND ANALYSIS FOR PHASE 1 SUBSURFACE INVESTIGATIONS AT AREA C LANDFILL

X = All samples
E = Every third sample

Sample Method/Type	Sampling Location	Interval	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)	Isotopic Thorium	Americum - 241
Vertical Core (6 locations)	CVH-1 to CVH-6	0-80 ft					X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
		(5-ft segments)																														
Trip Blank (2 samples)													X	X	X	X	X	X														
Duplicate (2 samples)													X	X	X	X	X	X	X		E	E	E	E		E	E	E	E			
Field Blank (2 samples)													X	X	X	X	X	X									E	E	E			
Equipment Blank (2 samples)													X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Core Contingency (5 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Fracture Contingency (5 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Split Samples (2 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Angled Core	CAH-1	0-630 ft					X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
	(11°)	(5-ft segments)																														
Field Duplicate (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Equipment Blank (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Field Blank (15 samples)													X	X	X	X	X	X									E	E	E			
Trip Blank (15 samples)													X	X	X	X	X	X									E					
Split Samples (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Core Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Fracture Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			

TABLE 5-15 (continued)

X = All samples
E = Every third sample

Sample Method/Type	Sampling Location	Interval	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)	Isotopic Thorium	Americum - 241
Angled Core	CAH-2	0-485 ft					X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
	(6°)	(5-ft segments)																													
Field Duplicate (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Equipment Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Field Blank (15 samples)													X	X	X	X	X										E	E	E			
Trip Blank (15 samples)													X	X	X	X	X										E					
Split Samples (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Core Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Fracture Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Angled Core	CAH-3	0-500 ft					X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
	(6°)	(5-ft segments)																													
Field Duplicate (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Equipment Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Field Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Trip Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Split Samples (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Core Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Fracture Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			

TABLE 5-15 (continued)

X = All samples
E = Every third sample

Sample Method/Type	Sampling Location	Interval	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)	Isotopic Thorium	Americum - 241
Angled Core	CAH-4	0-705 ft					X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
	(3°)	(5-ft segments																													
Field Duplicate (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Equipment Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Field Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Trip Blank (15 samples)							X	X		X	X	X	X	X	X	X	X				E	E	E	E		E	E	E	E			
Split Samples (15 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Core Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			
Fracture Contingency (35 samples)							X	X		X	X	X	X	X	X	X	X	X			E	E	E	E		E	E	E	E			

used for these measurements will be taken at 5-ft intervals from all Phase 1 coreholes.

A significant part of the subsurface investigation will be to evaluate the importance of fractures as preferential transport pathways. For this reason, any fractures encountered (particularly in shallow-angle boreholes) will be preferentially sampled (see Table 5-15). For a fracture encountered within a 5-ft interval, a sample will be taken from the fracture as well, for comparison with nonfracture samples. Up to five additional samples are allowed for per borehole for fracture sampling.

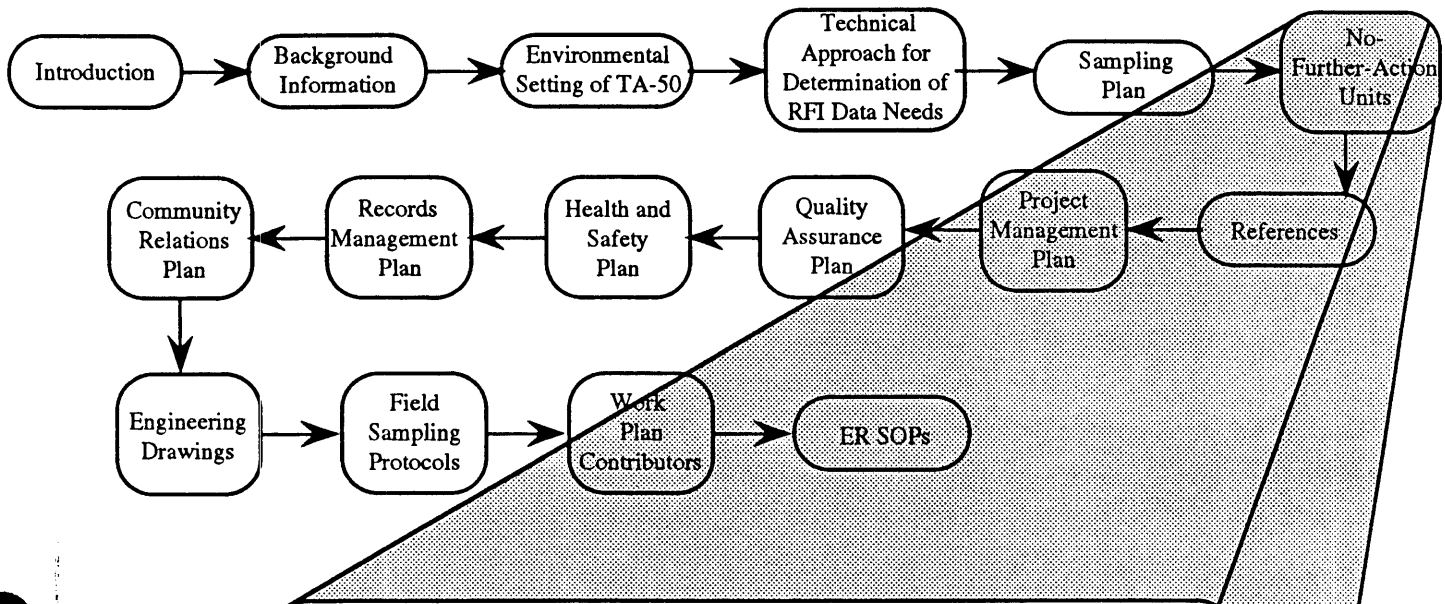
Fracture-lining minerals typically differ significantly from those found in the rock matrix, testifying to the flow of groundwater into fractures in the vadose zone. The number and locations of samples taken to characterize these minerals will depend on the number and nature of the fractures encountered during drilling, and samples appropriate for characterization will be identified by inspection of the drill core. Between three and nine fracture samples are allowed for per borehole (see Table 5-15).

Phase 1 samples for both contaminant characterization and soil moisture determination will be collected at 5-ft intervals, and one-third of the samples will receive a full suite of analyses (radionuclides, metals, volatiles, and semi-volatiles) in an analytical laboratory. The screening and analysis requirements are presented in Table 5-15.

5.2.2.3 Field Investigation: Phase 2

If the hypothesis is correct that no migration is occurring, then no Phase 2 investigation will be needed. However, if Phase 1 results do show contaminant migration, additional sampling may be required. The need for further sampling will be determined by evaluating Phase 1 results with respect to risk-based action levels, and the location(s) of any additional drillholes will be selected on the basis of the data from the Phase 1 drillholes. If there appears to be a need for more detailed contaminant characterization, surface geophysics will be used to try to locate the buried solid waste disposal pits (a method previously used at Area A; see Gerety et al. 1989, 0112). Phase 2 samples would receive a reduced analytical suite, tailored according to the needs indicated by Phase 1 (see Table 5-11).

CHAPTER 6



No-Further-Action Units

- 50-005: Nonradioactive Liquid Waste Treatment Plant (Section 6.1)
- 50-006(b): Stained Soil Beneath Outdoor Radiator (Section 6.2)
- 50-006(e): Stained Soil Around Diesel Fuel Tank (Section 6.3)
- 50-003(e): Four Barrels Under Tarp Near TA-50-125 (Section 6.4)
- 50-003(b): Small Storage Cabinet (Section 6.5)
- 50-003(c): Temporary Storage Area (Section 6.6)
- 50-003(c): Temporary Storage Area (Section 6.7)
- 50-003(d): Chemical Waste Storage Site (Section 6.8)
- Other SWMU Subunits (Section 6.9)

6.0 NO-FURTHER-ACTION UNITS

6.1 50-005: Nonradioactive Liquid Waste Treatment Plant

6.1.1 Site Description and History

This plant, for treating nonradioactive liquid waste, occupies about 150 ft^2 of floor space in Building 1, Room 24B, at TA-50. This SWMU is a batch-type operation that was designed to keep the nonradioactive liquid wastes separate from the radioactive liquid wastes and to treat the nonradioactive wastes to make them less hazardous. The stainless-steel treatment tank is Kynar-lined, and the associated piping system is double (Kynar pipe within stainless-steel pipe). The plant sits on a concrete floor in an area enclosed by a concrete berm. Both floor and berm are painted with a corrosion-resistant, strippable, white epoxy paint trade-named "Plasite," making leaks highly visible. (Leaks have never been observed from this plant.)

The plant was constructed in 1984-1985. It was part of a larger construction project and had funding problems from the start. Some items in the original design had to be deleted, including a dedicated exhaust system. The plant was put into operation in 1988, but only operated until 1989, when the operator was reassigned because of lack of funding.

A mercury reclamation operation, also a part of SWMU 50-005, is located in Room 34 of Building 1. Although it has been operated infrequently since its inception in 1983, again because of manpower shortages, it is scheduled to be re-started to reclaim mercury stored on site. (Mercury that can be certified clean will be packaged in DOT-approved containers and sold on the open market; the balance will be consigned for DOE use.)

6.1.2 Existing Information

Wastes that have been treated in the batch plant include cyanide, chromate plating solutions, solutions of acids and bases, and heavy metals. The Kynar-lined tank and associated Kynar-and-stainless-steel pipeline are used to treat electroplating waste containing copper and lead. A Kynar-lined blowdown tank in Room 24 has not yet been used.

The mercury reclamation operation is intermittent. Mercury is washed in acid and/or solvents and double-distilled. The capacity has been estimated at 35 lb/day.

6.1.3 Contaminant Source Term

No releases of contaminants that could have reached the environment have been documented from the nonradioactive liquid waste treatment plant. If any contaminants were released through the building's ventilation system, they will be identified during the RFI surface soil characterization activities (see Chapter 5, sampling plan for Aggregate 5).

6.1.4 Basis for Recommending No Further Action

The double-containment system of Kynar within stainless steel for the tanks and piping, plus the concrete berm underlying the treatment plant, provide triple-containment redundancy, rendering the probability very low that a leak could develop and transport contaminants out of the SWMU.

6.2 50-006(b): Stained Soil Beneath Outdoor Radiator

6.2.1 Description and History

This SWMU was described as "stained soil (probably mineral oil) beneath an active radiator on the west wall of Building TA-50-37" (the incinerator facility). This radiator cools the mineral oil that drives a fluid coupling between an electric motor and a blower. It should be noted that this radiator is not on the west wall, but on a concrete foundation about 15 ft west of that wall. In addition, the radiator leaked some mineral oil on the asphalt pad around the concrete foundation but did not "stain soil" as noted in the SWMU report (LANL 1990, 0145).

6.2.2 Existing Information

On September 18, 1990, a small-job ticket was issued to wash the area around the radiator with a detergent degreaser and steam and to pick up the fluid with a vacuum cleaner. The soapy fluid was disposed of in the acid waste drain in Building 37. The radiator, mineral-oil fluid coupling, concrete foundation, and asphalt pad are scheduled for removal in the near future. The area will then be patched with new asphaltic concrete paving material, and a new, direct-drive motor will be installed to power the blower.

6.2.3 Contaminant Source

The source of any possible contamination has been removed.

6.2.4 Basis for Recommending No Further Action

This SWMU no longer exists.

6.3 50-006(e): Stained Soil Around Diesel Fuel Tank

6.3.1 Description and History

Soil stained presumably with diesel fuel was noted around the diesel fuel tank on the southwest side of TA-50-37, the incinerator building. The tank was located about 5 ft off the paved area south of Building 37 and about 30 ft south of the building's southwest corner. The tank provided fuel to the furnaces in the incinerator complex. Because the tank had never been observed to leak, it is assumed that the soil stain resulted from careless filling by the fuel supply vendor.

6.3.2 Existing Information

On May 15, 1990, Work Order 6-5737-17 was issued to Pan Am to remove both the diesel fuel tank and the supply and return lines (up to the concrete approach ramp to the door at the southwest corner of the incinerator building). The fuel tank was removed, steam-cleaned, and sent to salvage. The tank's foundations were removed, and the supply and return lines were dug up and capped near their entrance to the building. The stained soil apparently was also removed; none was visible during an October 1991 site visit.

6.3.3 Contaminant Source

All structures that could have been sources of contamination have been removed.

6.3.4 Basis for Recommending No Further Action

This SWMU no longer exists.

6.4 50-003(e): Four Barrels Under Tarp Near TA-50-125

6.4.1 Description and History

The SWMU Report (LANL 1990, 0145) mentions four barrels (size unknown) under a tarp adjacent to a small metal shed (structure TA-50-125) located near the perimeter fence south and west of Building TA-50-69. There is no indication in the report whether the barrels contained anything or whether spillage was noted.

6.4.2 Existing Information

Visual inspection of this possible SWMU yielded no evidence of the barrels nor any indication of a spill in the area. The building engineer for TA-50-69 had no knowledge of these barrels ever being present. It is possible that what the SWMU Report was referring to were empties awaiting use in the volume reduction facility.

6.4.3 Contaminant Source

No source of contamination could be found in the reported location.

6.4.4 Basis for Recommending No Further Action

No evidence of this SWMU could be found.

6.5 50-003(b): Small Storage Cabinet

6.5.1 Description and History

This SWMU is a storage cabinet in Room 130 of Building TA 50-1. Room 130 is on the first floor and is in the southeast corner of the building. Mixed waste generated within TA 50-1 is brought to Room 130 and stored in small (quart-to-gallon-size) bottles. These bottles are periodically picked up for storage at TA-54.

6.5.2 Existing Information

There are no documented releases from this SWMU. Bottled waste has secondary containment, and the cabinet is checked daily.

6.5.3 Contaminant Source

There is no known source of contaminant release at this SWMU.

6.5.4 Basis for Recommending No Further Action

There is no evidence that this cabinet has ever leaked contaminants to the room or to the environment.

6.6 50-003(c): Temporary Storage Area

6.6.1 Description and History

50-003(c) is a temporary (less-than-90-day) storage area located on the asphalt paving immediately south of the tank farm. The waste is chemical and is hauled by truck to TA-50 in 200- to 300-gal. polyethylene tanks from other technical areas. These polyethylene tanks, enclosed in heavy-gauge steel and expanded metal cages, are trade-named "Tuff Tanks." The waste from these tanks is emptied into the tank farm.

6.6.2 Existing Information

This storage site is inspected weekly for leaks.

6.6.3 Contaminant Source

There are no documented releases from this storage site.

6.6.4 Basis for Recommending No Further Action

This site has had no releases.

6.7 50-003(c): Temporary Storage Area

6.7.1 Description and History

Another storage area listed as part of SWMU 50-003(c) is located between the north wall of the Vehicle Decontamination Facility and the south wall of the east wing of Building 1. This is a temporary storage area, completely paved with asphaltic concrete, for mixed wastes generated from the treatment of industrial waste from many technical areas. No TRU waste is stored at this site. The waste is processed in Building 1: it is mixed with calcium hydroxide and ferric sulfate and then dewatered by a vacuum and filtering process until it is in the form of filter cake. The filter cake is about 30% solids and 70% water and has the consistency of a damp clay. The filter cake is packed into 55-gal. drums, stored temporarily on site, and then hauled to TA-54 for landfill disposal.

6.7.2 Existing Information

The area is monitored periodically for contamination on the storage pad, and the drums are checked for any signs of leakage before they are moved onto the pad.

6.7.3 Contaminant Source

There have been no documented releases from this SWMU.

6.7.4 Basis for Recommending No Further Action

There have been no releases from this site.

6.8 50-003(d): Chemical Waste Storage Site

6.8.1 Description and History

SWMU 50-003(d) is used for greater-than-90-day storage of chemical waste, primarily acidic waste generated at the ICON facility. It comprises two structures: one is a canvas building about 12 ft wide and 14 ft deep, whose floor has an inflatable berm. The building is located on asphalt pavement and is against the south wall of the east wing of Building 1, adjacent to the filter-cake drum storage area.

The second structure is a modular 9-ft-x-24-ft steel shed set on a concrete pad. Designated TA-50-114, WM-114, this shed is located about 25 ft east of the northeast corner of the tank farm.

6.8.2 Existing Information

Both these storage areas are inspected frequently for possible leaks.

6.8.3 Contaminant Source

No contaminant releases have ever been documented from either of these sites.

6.8.4 Basis for Recommending No Further Action

There have been no releases from this site.

6.9 Other SWMU Subunits

Several other subunits of multi-component SWMUs should also be eliminated from further consideration; these are facilities that were built but never used:

50-001(a)

- The wiped film evaporator (Room 71, Building 1) was installed during the TA-50 upgrading program in 1984-1985. Its intended purpose was to remove salts, mainly nitrates, from the influent. This equipment has never been used.

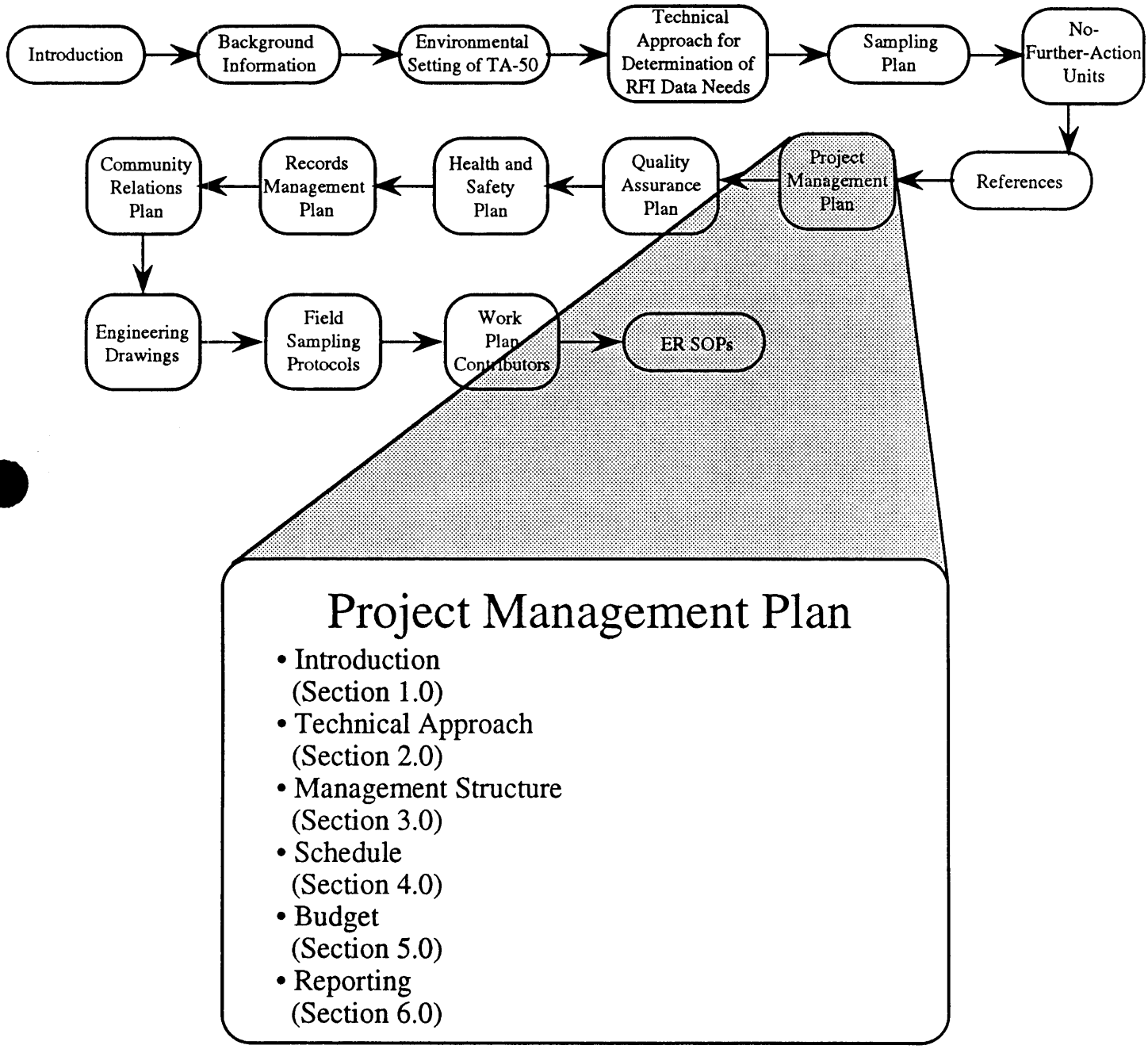
- The 100,000-gal. emergency holding tank (TA-50-90) has never been used.

50-001(b)

- This is one of four stainless-steel lines encased in PVC pipe, designed to bring liquid wastes from TA-55 to TA-50-66. It is a spare line and has never been used to transport wastes.

- Various influent lines drain into manhole TA-50-72. This one, designed to transfer radioactive industrial waste from TA-35 to TA-50, begins at TA-35-213 (the Target Fabrication Building) and connects with manhole TA-50-72 via manhole TA-50-71 on the north side of Pecos Drive. This line—the only one connecting TA-35 to TA-50—has never been used.

ANNEX I


Introduction
Background Information
Environmental Setting of TA-50
Technical Approach for Determination of RFI Data Needs
Sampling Plan
No-Further-Action Units
References
Project Management Plan
Quality Assurance Plan
Health and Safety Plan
Records Management Plan
Community Relations Plan
Engineering Drawings
Field Sampling Protocols
Work Plan Contributors
ER SOPs
Project Management Plan
• Introduction (Section 1.0)
• Technical Approach (Section 2.0)
• Management Structure (Section 3.0)
• Schedule (Section 4.0)
• Budget (Section 5.0)
• Reporting (Section 6.0)

1.0 INTRODUCTION

This annex presents the Project Management Plan—technical approach, management structure, schedule, budget, and reporting requirements—for implementation of the TA-50 RFI as set forth in this work plan. It is an extension of the ER Program management plan given in Annex I of the IWP (LANL 1991, 0553) and addresses the requirements of the HSWA Module (Task II-E, p. 39) of the Laboratory's RCRA Part B permit (EPA 1990, 0306)

2.0 TECHNICAL APPROACH

The technical approach for the TA-50 RFI is based on the ER Program's overall technical approach to the RFI/CMS process, described in Chapter 3 of the IWP (LANL 1991, 0553) and in Chapter 4 of this work plan. The following are key characteristics of the ER Program approach:

- an "observational" or "streamlined" overall philosophical framework,
- use of action levels as criteria for whether a CMS should be done,
- sampling as a means of site characterization, and
- use of decision analysis and cost effectiveness models to decide among remedial alternatives.

The methodology of this approach is to develop and iteratively refine a conceptual model for the RFI, through carefully planned stages of sampling, data analysis, and interpretation. Interim corrective measures, and/or a CMS, will be initiated using the minimum data necessary.

The technical objectives of the TA-50 RFI, presented in Chapter 1, are to

- identify the contaminants present at each SWMU;
- determine the vertical and lateral extent of contamination;
- identify contaminant migration pathways; and
- collect sufficient information for predicting transport and estimating risk.

3.0 MANAGEMENT STRUCTURE

Records of qualifications and training of all personnel doing TA-50 RFI field work will be kept (see Annex IV, Records Management Plan [RMP]). The responsibilities of the various positions are as follows:

3.1 Project Leader

- oversees day-to-day operations, including planning, scheduling, and reporting on technical and related administrative activities,

- ensures preparation of scientific investigation, planning, and procedures documents,

- prepares monthly and quarterly reports for the Project Manager (PM),

- oversees RFI field work and manages the field teams,
- oversees subcontractors, as appropriate,
- coordinates with technical team leaders,
- reviews interim and final reports,
- coordinates with the ER Quality Program Project Leader (QPPL) to resolve quality concerns and prepare for audits,
- complies with LANL ER Program Health and Safety (H&S), records management, and community relations requirements, and
- complies with LANL ER Program technical and QA requirements.

3.2 Technical Team Members

- provide technical input for their particular disciplines throughout the RFI/CMS process.;
- having contributed to the development of the TA-50 work plan and the individual field sampling plans, participate in the field work, data analysis, report preparation, planning of subsequent investigations, and work plan modifications as necessary;
- coordinate team contributions with the Project Leader (technical team leader).

The primary disciplines currently represented on the TA-50 technical team are geology, geophysics, hydrology, statistics, geochemistry, health physics, and radioecology. The composition of the team may change as the areas of technical expertise needed to implement the TA-50 RFI change. The qualifications of current members are presented in Appendix C.

3.3 Field Teams Manager

- oversees day-to-day field operations,
- plans and schedules RFI field activities,
- assigns field work to field team leaders, and
- manages field team members.

3.4 Field Team Leader

- directs field sampling activities
- organizes crews of field team members as appropriate for each activity

3.5 Field Team Members

Field team members carry out the activities detailed in the field sampling plans, under the direction of the field team leader:

- sampling
- site safety
- geology
- hydrology
- health physics

All teams will have, at a minimum, a site safety officer and a qualified sample taker. Field team members may be contractor personnel.

4.0 SCHEDULE

The schedule for the entire RFI/CMS process at TA-50, through completion of the final CMS report, is set out in the IWP Program Management Plan (Annex I, Table I-3) and detailed in IWP Appendix S. This schedule provides for surface and subsurface investigation of sites located in two distinct areas:

- the liquid and solid waste treatment facilities, and
- the Area C landfill.

A detailed implementation schedule and budget summary is presented in Table I-1. Implementation of the TA-50 RFI is contingent upon regulatory review and approval of this work plan and upon funding being available. (The work scheduled in the first two investigation years is constrained by the need to work within previously set DOE funding for fiscal years 1993 and 1994.) The current schedule is also based on the following assumptions:

- The TA-50 RFI work plan and supporting project plans will have been reviewed and approved by regulatory agencies by October 1992.
- An adequate number of support personnel (e.g., field technicians, trained drilling contractors) will be available to carry out plan tasks.
- EPA approval of technical memoranda/work plan modifications (including EPA comments, Laboratory revision, and final EPA approval) will take 2.5 months (1 month for EPA review and comment and 1.5 months for revisions).
- By starting RFI Phase 1 investigations with those SWMUs most likely to require some Phase 2 work, enough time should be available to assess Phase 1 results and to plan and carry out Phase 2.

TABLE I-1
RFI IMPLEMENTATION SCHEDULE AND BUDGET SUMMARY

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270015	250	250	0	1147: Manage ADS During FY-92 (LOE)	71340.00	.00	10CT91	30SEP92
270030	249	249	0	1147: Manage ADS During FY-93 (LOE)	368608.56	.00	10CT92	30SEP93
270040	250	250	0	1147: Manage ADS During FY-94 (LOE)	192110.72	.00	10CT93	30SEP94
270050	247	247	0	1147: Manage ADS During FY-95 (LOE)	202675.52	.00	30CT94	29SEP95
270070	249	249	0	1147: Manage ADS During FY-96 (LOE)	213825.60	.00	20CT95	30SEP96
270080	249	249	0	1147: Manage ADS During FY-97 (LOE)	225590.72	.00	10CT96	30SEP97
270090	249	249	0	1147: Manage ADS During FY-98 (LOE)	225590.72	.00	10CT97	30SEP98
270110	249	249	0	1147: Manage ADS During FY-99 (LOE)	225590.72	.00	10CT98	30SEP99
270112	248	248	0	1147: Manage ADS During FY 2000 (LOE)	.00	.00	10CT99	28SEP00
270115	76	76	0	1147: Develop LANL Internal Draft of RFI WP	23042.00	.00	20CT91	27JAN92
270125	20	20	0	1147: LANL/VE Review Internal Draft RFI Report	108615.00	.00	28JAN92	25FEB92

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270135	20	20	0	1147:Incorp LANL Rev Comments in Int Dft RFI WP	5457.00	.00	11FEB92	10MAR92
270145	10	10	0	1147: Publish DOE Draft of RFI Work Plan	10588.00	.00	11MAR92	24MAR92
270150	22	22	0	1147: Cond DOE Review of DOE Draft of RFI WP	1634.00	.00	25MAR92	23APR92
270155	20	20	0	1147: Incorp DOE Rev.Comments in DOE Dft RFI WP	32794.00	.00	21APR92	18MAY92
270160	5	5	0	1147: Publish EPA/NMED Draft of RFI Work Plan	65044.00	.00	12MAY92	18MAY92
270165	44	44	0	1147: Conduct NMED Review of RFI Work Plan	1723.81	.00	1OCT92*	7DEC92
270170	44	44	0	1147: Conduct EPA Review of RFI Work Plan	1634.00	.00	19MAY92	21JUL92
270185	245	245	0	1147: Conduct RFI PH1 Field Work	504515.74	.00	12AUG93*	4AUG94
270190	245	245	0	1147: Conduct RFI PH1 Sample Analysis	5042143.00	.00	12AUG93*	4AUG94
270195	245	245	0	1147: Conduct RFI PH1 Data Assessment	72857.16	.00	12AUG93*	4AUG94
270200	60	60	0	1147: Write RFI PH1 Tech Memo/WP Modification	51861.24	.00	5AUG94	31OCT94

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270205	20	20	0	1147: Demobilize RFI PH1 Field Work	8295.00	.00	5AUG94	1SEP94
270210	22	22	0	1147: EPA/NMED Rev PH1 Tech Memo/WP Modification	.00	.00	1NOV94	5DEC94
270215	22	22	0	1147: DOE Review PH1 Tech Memo/WP Modification	6049.39	.00	1NOV94	5DEC94
270220	20	20	0	1147: Write PH2 Contract; Mobilize for RFI	28861.80	.00	1NOV94	1DEC94
270225	245	245	0	1147: Conduct RFI PH2 Field Work	626894.61	.00	2DEC94	28NOV95
270230	245	245	0	1147: Conduct RFI PH2 Sample Analysis	6054211.00	.00	2DEC94	28NOV95
270235	20	20	0	1147: Demoblize RFI PH2 Field Work	8295.00	.00	29NOV95	28DEC95
270240	245	245	0	1147: Conduct RFI PH2 Data Assessment	114304.18	.00	2DEC94	28NOV95
270300	100	100	0	1147: Conduct RFI Report Facility Investigation	72605.03	.00	29NOV95	23APR96
270305	110	110	0	1147: Conduct RFI Report Investigation Analysis	299897.85	.00	29NOV95	7MAY96
270310	65	65	0	1147: Develop NEPA Documentation for RFI WP	42837.00	.00	1OCT91	8JAN92

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270320	132	132	0	1147: Prepare Internal Draft of RFI Report	314619.08	.00	3MAY96	14NOV96
270325	20	20	0	1147: LANL/VE Review Internal Draft of RFI Rpt	12581.61	.00	15NOV96	16DEC96
270330	40	40	0	1147: Incorp.LANL Rev.Comments Int Dft RFI Rpt	12160.79	.00	17DEC96	14FEB97
270335	20	20	0	1147: Publish DOE Draft of RFI Report	43531.82	.00	18FEB97	17MAR97
270340	22	22	0	1147: Conduct DOE Review of DOE Draft of RFI Rpt	5406.68	.00	18MAR97	16APR97
270345	40	40	0	1147: Incorp. DOE Rev. Comments DOE Drft RFI Rpt	5406.68	.00	17APR97	12JUN97
270350	20	20	0	1147: Publish EPA/NMED Draft of RFI Report	45703.76	.00	13JUN97	11JUL97
270355	44	44	0	1147: Conduct EPA Review of RFI Report	5472.01	.00	14JUL97	12SEP97
270360	44	44	0	1147: Conduct NMED Review of RFI Report	5472.01	.00	14JUL97	12SEP97
270365	245	245	0	1147:Cond Bench/Pilot Studies for CMS Plan (LOE)	.00	.00	14JUL97	7JUL98
270370	35	35	0	1147: Establish Current Situation for CMS Plan	2719.68	.00	14JUL97	29AUG97

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270375	35	35	0	1147: Establish CA Objectives for CMS Plan	4145.51	.00	14JUL97	29AUG97
270380	35	35	0	1147: Dev Screening Technologies for CMS Plan	3647.58	.00	14JUL97	29AUG97
270385	245	245	0	1147: Develop NEPA Documentation for CMS Plan	2579.86	.00	14JUL97	7JUL98
270390	15	15	0	1147: Develop Alternatives for CMS Plan	3647.58	.00	2SEP97	22SEP97
270395	10	10	0	1147: Develop Internal Draft of CMS Plan	1620.57	.00	23SEP97	6OCT97
270400	10	10	0	1147: LANL/VE Review Internal Draft of CMS Plan	.00	.00	7OCT97	21OCT97
270405	10	10	0	1147:Incorp. LANL REV Comments Intern Dft CMS PL	.00	.00	22OCT97	4NOV97
270410	5	5	0	1147: Publish DOE Draft of CMS Plan	846.88	.00	5NOV97	12NOV97
270415	22	22	0	1147: Conduct DOE Review of Draft of CMS Plan	.00	.00	13NOV97	16DEC97
270420	20	20	0	1147:Incorp. DOE Rev.Comments DOE Dft.of CMS Pl.	.00	.00	17DEC97	19JAN98
270425	10	10	0	1147: Publish EPA/NMED Draft of CMS Plan	7557.87	.00	20JAN98	2FEB98

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270430	44	44	0	1147: Conduct EPA Review of CMS Plan			3FEB98	6APR98
					.00	.00		
270435	44	44	0	1147: Conduct NMED Review of CMS Plan			3FEB98	6APR98
					.00	.00		
270440	245	245	0	1147: Conduct CMS Bench/Pilot Studies (LOE)			27MAY98	19MAY99
					584779.00	.00		
270445	30	30	0	1147:Conduct Technical Evaluation for CMS Report			27MAY98	8JUL98
					20586.33	.00		
270450	30	30	0	1147: Cond Envir Evaluation for CMS Report			27MAY98	8JUL98
					20212.74	.00		
270455	30	30	0	1147: Conduct Human Health Eval for CMS Report			27MAY98	8JUL98
					19044.15	.00		
270460	30	30	0	1147: Cond Comm Relations Eval.for CMS Report			27MAY98	8JUL98
					17722.77	.00		
270465	30	30	0	1147: Conduct Cost Evaluation for CMS Report			27MAY98	8JUL98
					18836.20	.00		
270470	30	30	0	1147: Develop NEPA Documentation for CMS Report			27MAY98	8JUL98
					37158.40	.00		
270475	10	10	0	1147: Prepare Internal Draft of CMS Report			9JUL98	22JUL98
					1538.21	.00		
270480	10	10	0	1147: LANL/VE Review Internal Draft of CMS Rpt			23JUL98	5AUG98
					588.11	.00		

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270485	35	35	0	1147:Incorp.LANL Rev Comments Intern.Dft CMS Rpt	588.11	.00	1APR99	19MAY99
270490	10	10	0	1147: Publish DOE Draft of CMS Report	2868.66	.00	20MAY99	3JUN99
270495	22	22	0	1147: Conduct Review of DOE Draft of CMS Report	316.27	.00	4JUN99	6JUL99
270500	10	10	0	1147:Incorp. DOE Rev Comments DOE Dft CMS Report	316.27	.00	7JUL99	20JUL99
270505	10	10	0	1147: Publish EPA/NMED Draft of CMS Report	2494.89	.00	21JUL99	3AUG99
270510	120	120	0	1147: Conduct EPA Review of CMS Report	316.27	.00	4AUG99	31JAN00
270515	120	120	0	1147: Conduct NMED Review of CMS Report	316.27	.00	4AUG99	31JAN00
270525	65	65	0	1147: Write PH1 Contracts for RFI;Mobilize	25930.96	.00	8JAN93	12APR93
270530	20	20	0	1147: Incorporate EPA/NMED Comments RFI WP	1723.81	.00	8DEC92	7JAN93
270535	10	10	0	1147: Publish Final RFI Work Plan	.00	.00	8JAN93	22JAN93
270555	20	20	0	1147: Incorporate EPA/NMED Comments on RFI Rpt	.00	.00	15SEP97	10OCT97

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
270560	20	20	0	1147: Publish Final RFI Report			14OCT97	11NOV97
					1241.60	.00		
270565	20	20	0	1147: Incorporate EPA/NMED Comments on CMS Plan			7APR98	4MAY98
					316.27	.00		
270570	10	10	0	1147: Publish Final CMS Plan			5MAY98	18MAY98
					15607.07	.00		
270575	5	5	0	1147: EPA Approves CMS Plan			19MAY98	26MAY98
					1840.12	.00		
270580	20	20	0	1147: Incorporate EPA/NMED Comments on CMS Rpt			1FEB00	29FEB00
					316.27	.00		
270585	10	10	0	1147: Publish Final CMS Plan			1MAR00	14MAR00
					1840.12	.00		
270590	12	12	0	1147: Scope RFI Work Plan			1OCT91	17OCT91
					34659.00	.00		
270595	40	40	0	1147: Analyze Existing Data & Deter. RFI Data Nds			1OCT91	27NOV91
					66432.00	.00		
270620	77	77	0	1147: Write RFI Sampling Plans			1OCT91	27JAN92
					135841.00	.00		
700000	189	189	0	2113: Remed - Conduct VCA (LOE)			2JAN97*	30SEP97
					42353.00	.00		
700005	249	249	0	2113: Remed - Conduct VCA (LOE)			1OCT97	30SEP98
					56874.00	.00		

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
27M005	0	0	0	1147: DOE DRAFT RFI WORK PLAN COMPLETED	.00	.00		24MAR92
27M010	0	0	0	1147: EPA/NMED DRAFT OF RFI WORK PLAN COMPLETED	.00	.00		18MAY92
27M015	0	0	0	1147: RFI WORK PLAN COMPLETED	.00	.00		22JAN93
27M020	0	0	0	1147: START RFI	.00	.00	13APR93	
27M025	0	0	0	1147: RFI FIELD WORK COMPLETED	.00	.00		28DEC95
27M030	0	0	0	1147: START DEVELOPING RFI REPORT	.00	.00	12AUG93	
27M035	0	0	0	1147: EPA/NMED DRAFT OF RFI REPORT COMPLETED	.00	.00		11JUL97
27M040	0	0	0	1147: RFI COMPLETED	.00	.00		11NOV97
27M045	0	0	0	1147: START DEVELOPMENT OF CMS PLAN	.00	.00	14JUL97	
27M050	0	0	0	1147: EPA/NMED DRAFT OF CMS PLAN COMPLETED	.00	.00		2FEB98
27M055	0	0	0	1147: START CMS WORK	.00	.00	27MAY98	

TABLE I-1 (cont'd)

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
27M060	0	0	0	1147: CMS WORK COMPLETED				19MAY99
					.00	.00		
27M065	0	0	0	1147: START DEVELOPMENT OF CMS REPORT			27MAY98	
					.00	.00		
27M070	0	0	0	1147: EPA/NMED DRAFT OF CMS REPORT COMPLETED				3AUG99
					.00	.00		
27M075	0	0	0	1147: ASSESSMENT COMPLETED				14MAR00
					.00	.00		
27M080	0	0	0	1147: EPA NOTIFICATION OF CMS REQUIREMENTS				11NOV97
					.00	.00		
27M085	0	0	0	1147: EPA APPROVED CMS PLAN				26MAY98
					.00	.00		
27M090	0	0	0	1147: EPA/NMED DRAFT PH1 TECH/MEMO COMPLETED				31OCT94
					.00	.00		
REPORT TOTAL					16499270.21	.00		

$ X 1000	
EST TO COMPLETION	$16,499
ESCALATION	$156
PRIOR YEARS	$570
TOTAL AT COMPLETION	$17,225

5.0 BUDGET

The fixed budget amounts for FY93 and FY94 are based on expected DOE funding levels. (Because DOE funding requests are set 2 years in advance, the first year in which the TA-50 RFI will not be constrained by past budget estimates is FY95.) Funding requests for FY95 and beyond will be based on careful analysis of the level of effort needed to efficiently complete the RFI. Following DOE guidance, the cost estimate shown in Table I-1 incorporates a contigency fund of 25% for tasks that may have to be added, depending on the initial results of the RFI. It does not include any provision for the event that full funding is not received in a given fiscal year.

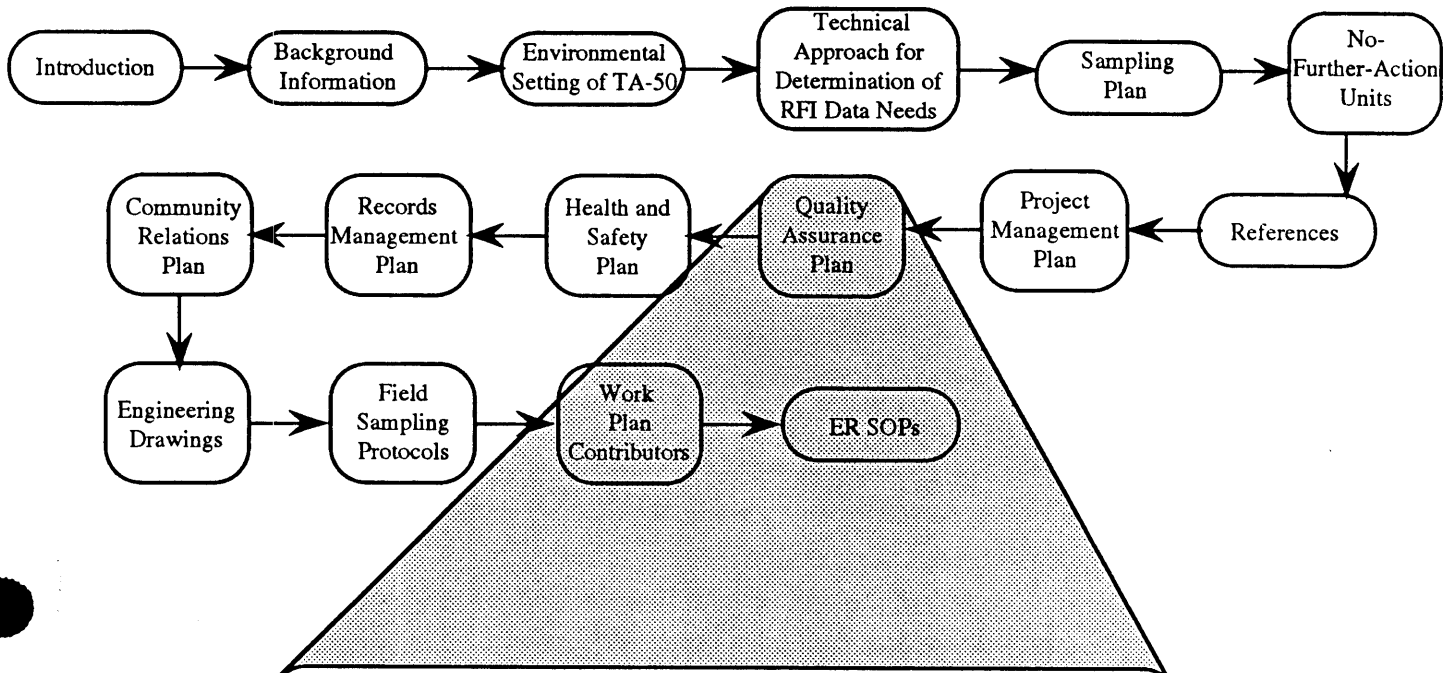
6.0 REPORTING

As the TA-50 RFI is implemented, quarterly progress reports will be issued, as required by the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, C, page 46). These reports will summarize day-to-day activities during the quarter.

Technical memoranda/work plan modifications will summarize the results of Phase 1 site characterization activities and describe follow-on activities being planned for Phase 2 (including modifications to field sampling plans suggested by initial findings).

As required by the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, D, page 46), the Laboratory will submit an RFI report within 60 days of completing the RFI. It will summarize the results of all RFI field investigations. Further, as directed in Section 3.5.7 of the IWP (LANL 1991, 0553), it will describe the procedures and methods used to conduct the field investigations and will furnish information on the type, extent, sources, and migration pathways of contaminants and on actual and potential receptors. Finally, the report will contain a thorough discussion of the evaluation and selection of remediation alternatives.

ANNEX II



Quality Assurance Project Plan

- Signature Page (Section 1.0)
- Introduction (Section 2.0)
- Project Description (Section 3.0)
- Project Organization and Responsibility (Section 4.0)
- Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability (Section 5.0)
- Sampling Procedures (Section 6.0)
- Sample Custody (Section 7.0)
- Calibration Procedures and Frequency (Section 8.0)
- Analytical Procedures (Section 9.0)
- Data Reduction, Validation and Reporting (Section 10.0)
- Internal Quality Control Checks (Section 11.0)
- Performance and System Audits (Section 12.0)
- Preventive Maintenance (Section 13.0)
- Specific Routine Procedures Used to Assess Data Precision, Accuracy, Representativeness, and Completeness (Section 14.0)
- Corrective Action (Section 15.0)
- Quality Assurance Reports to Management (Section 16.0)

1.0 SIGNATURE PAGE

Approval for implementation

1. NAME: Robert Vocke
   TITLE: ER Program Manager, Los Alamos National Laboratory

   SIGNATURE: _____ DATE:_____

2. NAME: Karen F. Warthen
   TITLE: Quality Assurance Project Leader, ER Program, Los Alamos National Laboratory

   SIGNATURE: _____ DATE:_____

3. NAME: Craig Leasure
   TITLE: Group Leader, Health and Environmental Chemistry Group (EM-9), Los Alamos National Laboratory

   SIGNATURE: _____ DATE:_____

4. NAME: Margaret Gautier
   TITLE: Quality Assurance Officer, Health and Environmental Chemistry Group (EM-9), Los Alamos National Laboratory

   SIGNATURE: _____ DATE:_____

5. NAME: Barbara Driscoll
   TITLE: Geologist, Region VI, Environmental Protection Agency

   SIGNATURE: _____ DATE:_____

6. NAME: Alva L. Smith
   TITLE: Chief of Office of Quality Assurance, Region VI, Environmental Protection Agency

   SIGNATURE: _____ DATE:_____

7. NAME: Thomas E. Hakonson
   TITLE: Project Leader, Los Alamos National Laboratory

   SIGNATURE: _____ DATE:_____

2.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for Operable Unit (OU) 1147 supplements the Los Alamos National Laboratory (Laboratory) Environmental Restoration (ER) Program's Quality Assurance Program Plan [Annex II of the Installation Work Plan for Environmental Restoration (IWP)] (LANL 1991, 0553) as specified in the ER Program's generic QAPjP (Appendix T of the IWP). Sections of this QAPjP for OU 1147 are incorporated by reference to the generic QAPjP and to the Resource Conservation and Recovery Act (RCRA) field investigation (RFI) work plan for OU 1147. In these cases, the appropriate document and section are given. The text in this QAPjP provides information specific to OU 1147, as directed by the generic QAPjP. To facilitate cross-referencing, the section titles and numbers in this QAPjP correspond directly to those contained in the generic QAPjP.

This QAPjP integrates the Environmental Protection Agency's (EPA's) guidance on preparing quality assurance (QA) plans (EPA 1980, 0552), as well as the American Society of Mechanical Engineers (ASME) Quality Assurance Program Requirements for Nuclear Facilities (ANSI/ASME 1989, 0018), as specified in Department of Energy (DOE) Order 5700.6B (DOE 1986, 0067).

A facility description of the Laboratory is presented in Chapter 2 of the IWP, and a description of the Laboratory's ER Program is presented in Chapter 3. Additional historical information on technical areas in OU 1147 is presented in Chapter 2 of this work plan.

3.0 PROJECT DESCRIPTION

3.1 Project Objectives

Project objectives are outlined in Chapter 1 of the RFI work plan for OU 1147.

3.2 Project Schedule

The schedule for the OU 1147 RFI appears in the project management plan, Annex I, of this work plan.

3.3 Project Scope

The technical approach for the OU 1147 RFI, using the data quality objectives process, appears in Chapter 4 of this work plan; a description of the RFI tasks and sampling plans appears in Chapter 5.

3.4 Background Information

Background information is presented in Chapter 2 of this work plan.

3.5 Data Usage

Data collected during the OU 1147 RFI will be used to determine whether a source of contamination is present and, if present, to define the extent of

contamination at solid waste management units (SWMUs), SWMU aggregates, or SWMU subunits, as described in the field sampling plans in Chapter 5. The investigation should provide sufficient data for a baseline risk assessment and corrective measures studies.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The overall organizational structure of the ER Program is presented in Section 2 of Annex II of the IWP, in which ER Program personnel are identified down to the level of technical team leader and personnel responsibilities and line authority are described. In addition, the QA organizational structure is presented, and personnel qualifications are described.

A Health and Safety Plan is currently being developed by the Los Alamos ER Program Office. When complete, it will be added to this work plan as Annex III. It will describe the responsibilities for health and safety issues of individuals ranging from deputy division leaders to field team members as well as the prerequisites for personnel involved in site work for OU 1147.

The records management plan, Annex IV of this work plan, describes the responsibilities for records- and data-handling and retention.

5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

These topics are addressed in detail in Section 5 of the generic QAPjP. Details on developing DQOs for OU 1147 appear in Chapter 4 of this work plan. Chapter 5 of this work plan presents specific sampling and analysis objectives for each SWMU in OU 1147.

6.0 SAMPLING PROCEDURES

The standard operating procedures (SOPs) cited in this section are taken from the ER Program's SOPs (LANL 1992, 0688).

Procedures for collecting samples of soil, water, volatile organics, and sludge will be selected, as applicable to the field investigation, from Volume II, Sampling Techniques (procedures with a -06 prefix), of the ER Program's SOPs (LANL 1992, 0688) and from Section 6 of the generic QAPjP.

Information on required sample containers, volume, preservation, and holding times is presented in LANL-ER-SOP-01.02, Sample Containers and Preservation, and in Section 6 of the generic QAPjP.

The collection, management, and handling of environmental media samples is described in LANL-ER-SOP-01.04, Sample Control and Field Documentation, and LANL-ER-SOP-01.03, Handling, Packaging and Shipping of Samples. Additional information on proper sample management and coordination is contained in Sections 6 and 7.5 of the generic QAPjP.

6.1 Quality Control Samples

A discussion of quality control samples for the ER Program is presented in Section 6.1 of the generic QAPjP and in LANL-ER-SOP-01.05, Field Quality Control Samples. During the RFI for OU 1147, the frequency and type of field quality control samples identified in the generic QAPjP will be followed for chemical analyses of samples.

6.2 Sample Preservation During Shipment

Information on sample preservation during shipment is presented in LANL-ER-SOP-01.02, Sample Containers and Preservation, and in Section 6.2 of the generic QAPjP.

6.3 Equipment Decontamination

Equipment decontamination is described in Section 6.3 of the generic QAPjP and in LANL-ER-SOP-02.07, General Equipment Decontamination. LANL-ER-SOP-01.06, Management of RFI-Generated Waste, provides information for proper handling and disposal of wash water and other materials generated during equipment decontamination and other RFI field activities.

6.4 Sample Designation

From the time of collection through analysis and reporting, samples will receive a unique alphanumeric identifier to provide chain-of-custody control while they are being transferred. This information is described in detail in LANL-ER-SOP-01.04, Sample Control and Field Documentation.

7.0 SAMPLE CUSTODY

7.1 Overview

Field and laboratory sample chain-of-custody procedures are described in Section 7 of the generic QAPjP. Sampling activities for the OU 1147 RFI will follow these procedures. The LANL-ER-SOP-01.04, Sample Control and Field Documentation, provides additional guidance for chain-of-custody procedures, including examples of chain-of-custody records and tags.

7.2 Field Documentation

Guidance for field documentation procedures can be found in Section 7.2 of the generic QAPjP and in LANL-ER-SOP-01.04, Sample Control and Field Documentation.

7.3 Sample Management Facility

Section 7.3 of the generic QAPjP and Appendix N of the IWP provide a discussion of the activities coordinated by the ER Program's Sample Management Facility.

7.4 Laboratory Documentation

Laboratory custody procedures associated with sample receipt, storage, preparation, analysis, and general security are described in Section 7.4 of the generic QAPjP.

7.5 Sample Handling, Packaging, and Shipping

Sample-handling, packaging, and shipping procedures are described in LANL-ER-SOP-01.03, Handling, Packaging and Shipping of Samples.

7.6 Final Evidence File Documentation

Records documentation is described in Section 7.6 of the generic QAPjP and in the Records Management Program Plan, Annex IV, of the IWP.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Overview

Section 8 of the generic QAPjP contains information on the requirements for the calibration of field and laboratory equipment. Additional information can be found in manufacturers' equipment manuals.

8.2 Field Equipment

A list of analytical and health and safety screening procedures that may be used in the field during environmental investigations is presented in Section 8.2 of the generic QAPjP and in Appendix L of the IWP.

8.3 Laboratory Equipment

Section 8.3 of the generic QAPjP contains general information on the calibration procedures and frequency of calibration for laboratory equipment.

9.0 ANALYTICAL PROCEDURES

9.1 Overview

Field and laboratory analytical measurements for RFI samples obtained at OU 1147 will be performed in accordance with the appropriate Laboratory ER Program SOPs.

9.2 Field Testing and Screening

Field testing and screening of samples during the OU 1147 RFI will follow appropriate ER Program SOPs. General information on the analytical levels desired in OU 1147 appears in Section 4.2.8, Chapter 4, and in Appendix B of the RFI work plan for OU 1147.

9.3 Laboratory Methods

The analytical methods to be used for the OU 1147 RFI are presented in Section 9.3 of the generic QAPjP.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Reduction

Reduction of field and laboratory data for the OU 1147 RFI will follow the protocols described in Section 10.1 of the generic QAPjP.

10.2 Data Validation

Validation of field and laboratory data for the OU 1147 RFI will follow the protocols described in Section 10.2 of the generic QAPjP.

10.3 Data Reporting

Reporting of field and laboratory data for the OU 1147 RFI is described in Section 10.3 of the generic QAPjP.

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Sampling Quality Control Checks

A discussion of field quality control samples for the ER Program is presented in Section 6.1 of the generic QAPjP.

11.2 Laboratory Analytical Activities

The types and frequency of internal quality control samples for the ER Program are presented in Section 11.2 of the generic QAPjP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of field and laboratory operations will be conducted during the OU 1147 RFI. These audits will be performed as identified and referenced in Section 12 of the generic QAPjP.

13.0 PREVENTIVE MAINTENANCE

13.1 Field Equipment

Preventive maintenance requirements for RFI field equipment used at OU 1147 will follow the specifications described in Section 13.1 of the generic QAPjP.

13.2 Laboratory Equipment

Preventive maintenance requirements for laboratory equipment used during the RFI for OU 1147 will follow the specifications described in Section 13.2 of the generic QAPjP.

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, REPRESENTATIVENESS, AND COMPLETENESS

14.1 Precision

Analytical precision for RFI data obtained at OU 1147 will be calculated according to the formula presented in Section 14.1 of the generic QAPjP.

14.2 Accuracy

Analytical accuracy of RFI data obtained at OU 1147 will be calculated according to the formula presented in Section 14.2 of the generic QAPjP.

14.3 Sample Representativeness

The field sampling plans in Chapter 5 of this work plan were developed to meet the criteria for sample representativeness described in Section 14.3 of the generic QAPjP.

14.4 Completeness

Completeness of analytical data for the OU 1147 RFI will be calculated according to the formula presented in Section 14.4 of the generic QAPjP.

15.0 CORRECTIVE ACTION

15.1 Overview

The procedures, reporting requirements, and authority for initiating corrective action during the OU 1071 RFI will follow those defined in Section 15.1 of the generic QAPjP.

15.2 Field Corrective Action

Responsibilities regarding the need for field corrective actions are defined in Section 15.2 of the generic QAPjP.

15.3 Laboratory Corrective Action

Responsibilities for laboratory corrective actions are defined in Section 15.3 of the generic QAPjP.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

16.1 Field Quality Assurance Reports to Management

The OUPL for OU 1147 or a designee will provide a monthly progress report to the Laboratory's ER program manager. This report will consist of the information identified in Section 16.1 of the generic QAPjP.

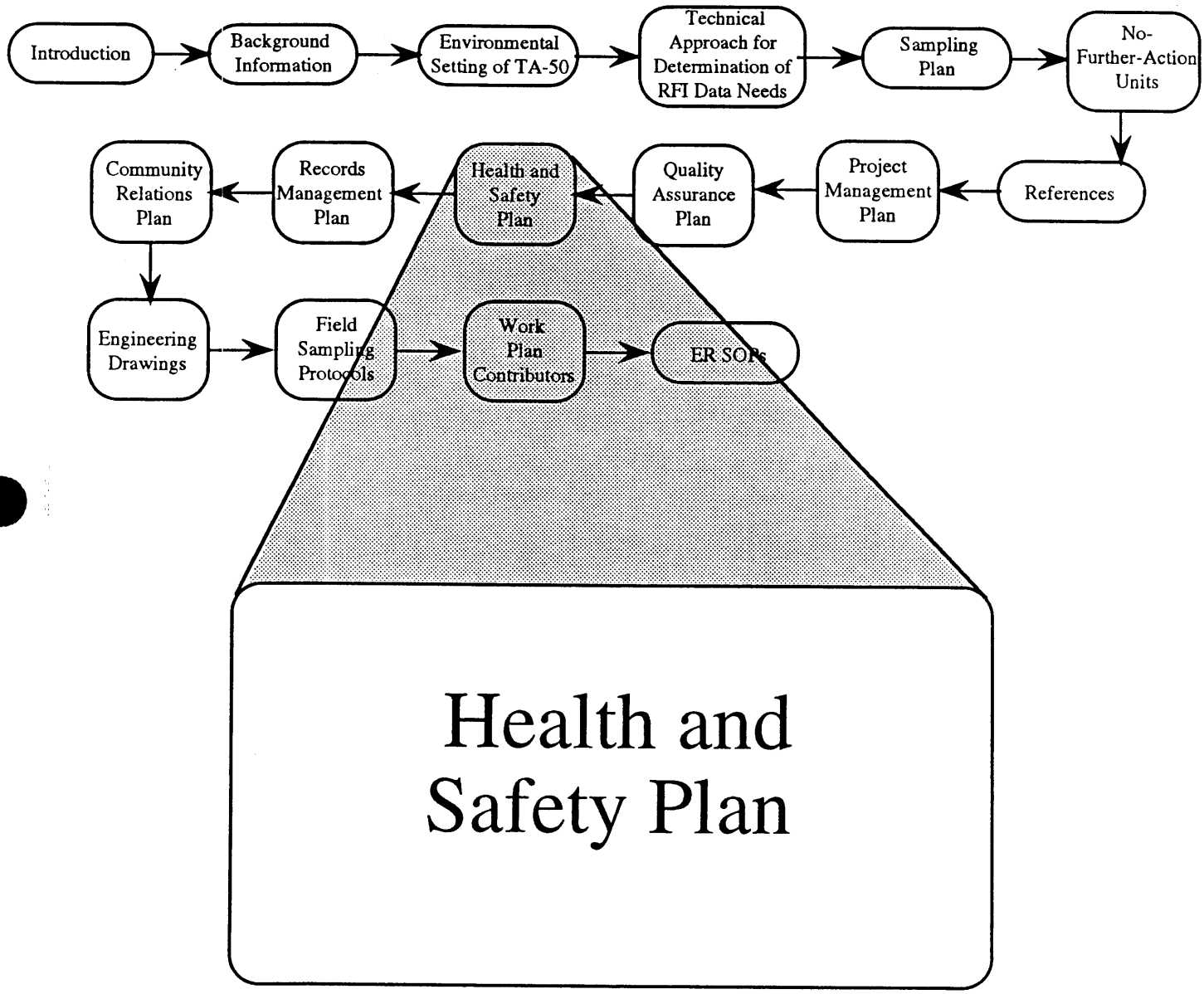
16.2 Laboratory Quality Assurance Reports to Management

RFI laboratory QA reports for OU 1147 will be prepared as outlined in Section 16.2 of the generic QAPjP.

16.3 Internal Management Quality Assurance Reports

Internal management QA reports, identified in Section 16.3 of the generic QAPjP, will be prepared during the OU 1147 RFI.

ANNEX III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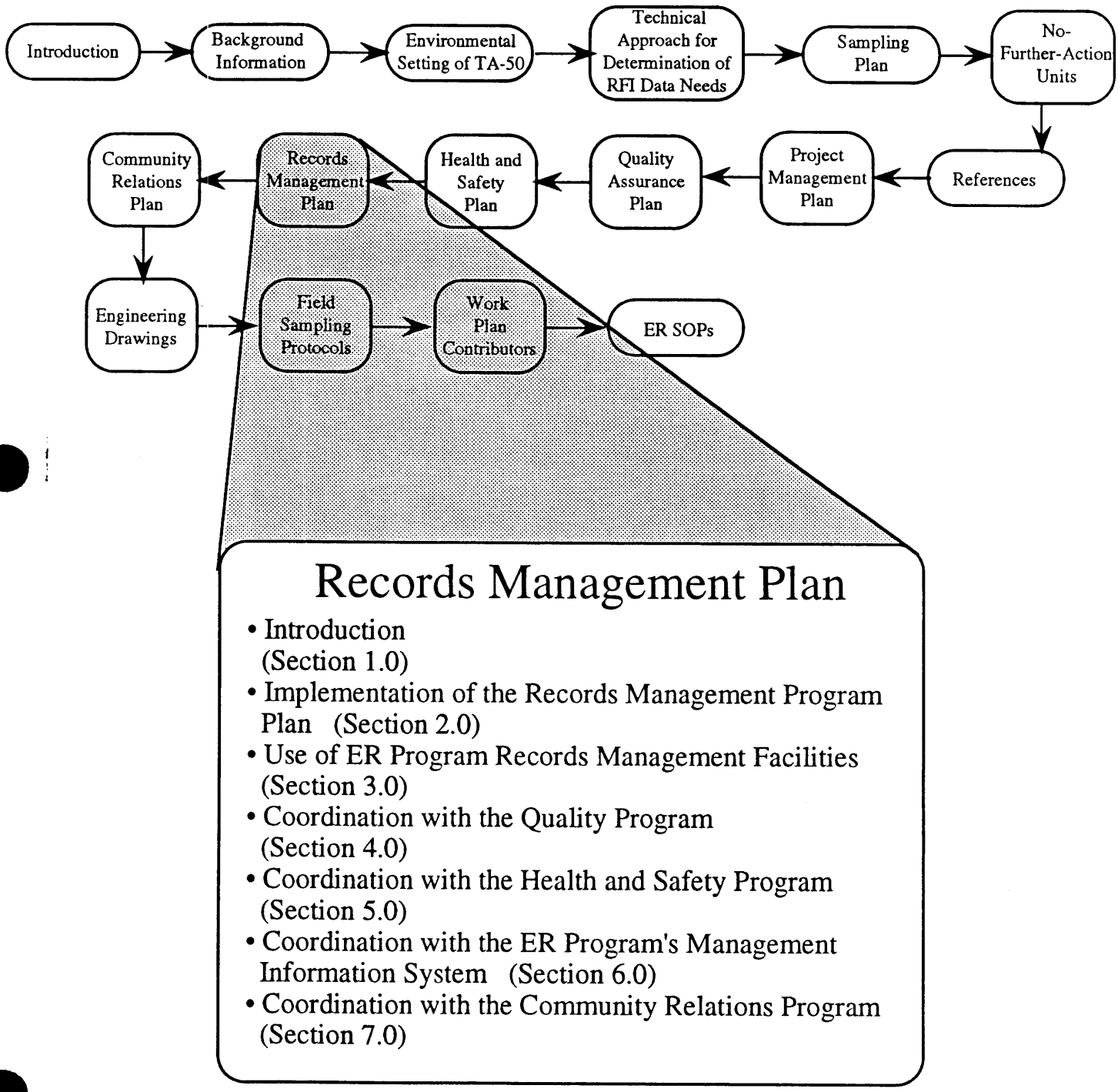
Work Plan Contributors
ER SOPs
Health and Safety Plan

For consistency across operable units, a generic Health and Safety Plan is being developed by the Laboratory's ER Program Office. This plan is not yet available, but will be added to this work plan as soon as it is complete.

ANNEX IV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• Implementation of the Records Management Program Plan (Section 2.0)
• Use of ER Program Records Management Facilities (Section 3.0)
• Coordination with the Quality Program (Section 4.0)
• Coordination with the Health and Safety Program (Section 5.0)
• Coordination with the ER Program's Management Information System (Section 6.0)
• Coordination with the Community Relations Program (Section 7.0)

1.0 INTRODUCTION

The Records Management Program Plan (program plan) for the ER Program at Los Alamos National Laboratory (the Laboratory) is described in Annex IV of the IWP. The purpose of the program plan is threefold: (1) to meet requirements for protecting and managing records (including technical data); (2) to provide ongoing support for ER Program technical activities; and (3) to provide a basis for management decisions over the life of the ER Program.

The ER Program uses the following statutory definition of a record (44 USC 3301):

> Records are defined as "...books, papers, maps, photographs, machine-readable materials, or other documentary materials, regardless of physical form or characteristics,...appropriate for preservation...because of the informational value of the data in them."

The program plan establishes general guidelines for managing records, regardless of their physical form or characteristics, that are generated and/or used by the ER Program. The program plan will be implemented consistently to meet the requirements of the Quality Assurance Program Plan (Annex II of the IWP) so that an auditable and legally defensible records management system is maintained. The program plan will also provide guidance for maintaining the publicly accessible administrative record required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

2.0 IMPLEMENTATION OF THE RECORDS MANAGEMENT PROGRAM PLAN

Section 2 of IWP Annex IV describes the implementation of the records management plan. Records management for the TA-50 (OU-1147) RFI will follow those procedures. As the program plan is developed further to meet changing ER Program needs, the IWP will be updated.

The program plan is based on a commitment to quality records control. ER Program records are those specifically identified in quality procedures (QPs), administrative procedures (APs), standard operating procedures (SOPs), ER program and project plans, management guidance documents, and records identified by ER Program participants as being essential to the program. All records are handled through a structured work flow and processing scheme governed by the records management procedure (LANL-ER-AP-02.1) and by other existing procedures, such as LANL-ER-AP-01.3 (Review and Approval of Environmental Restoration Program Plans and Reports), LANL-ER-AP-01.4 (Distribution of Controlled Documents Prepared for the Environmental Restoration Program), and LANL-ER-AP-01.5 (Revision or Interim Change of Environmental Restoration Program Controlled Documents). This ensures that all stages—records identification, submittal, review, indexing, correction, retrieval, and retention—use approved procedures and that an information base is maintained for reference.

Records will be protected in and accessed through the information base, which includes all the information systems maintained at the Records Processing Facility (RPF) and the Facility for Information Management, Analysis, and Display (FIMAD). RPF personnel receive ER Program records, assign an ER identification number,

and process records for delivery to the FIMAD. The RPF will complement FIMAD in certain aspects of data capture, such as scanning. The RPF also functions as an ER Program reference library for information that is inappropriate either in form (e.g., old records) or in content (e.g., Federal Register) for storage at the FIMAD. FIMAD provides the hardware and software necessary for data capture, display, and analysis. The information will be readily accessible through a network of work stations. Configuration management accounts for, controls, and documents the planned and actual design components of FIMAD.

3.0 USE OF ER PROGRAM RECORDS MANAGEMENT FACILITIES

The RPF and FIMAD will be used for managing records of work conducted at OU-1147. Interaction with these facilities is described in LANL-ER-AP-2.01, the program plan, and other program procedures and management guidance documents, as appropriate.

4.0 COORDINATION WITH THE QUALITY PROGRAM

Records will be protected throughout the process, as described in Section 4 of the program plan and in LANL-ER-AP-02.1. The originator is responsible for protecting records until they are submitted to the RPF. The level of protection afforded by the originator will be commensurate with the value of the information contained in the record. Upon receipt of a record, the RPF will temporarily store the original of the record in 1-hour fire-rated equipment and will provide a copy of the record to the FIMAD. The RPF will then send the original record to a dual-storage area for long-term storage in a protected environment.

5.0 COORDINATION WITH THE HEALTH AND SAFETY PROGRAM

The Laboratory's Occupational Medicine Group (HS-2) will maintain medical records because of their confidential nature. Training records will be maintained by appropriate custodians in coordination with Laboratory/DOE policy and will take into account the specific needs of the ER Program. The FIMAD will contain information about the completion of training, dates of required refresher training, and similar information, as well as the specific location of training records for program participants.

6.0 COORDINATION WITH THE ER PROGRAM'S MANAGEMENT INFORMATION SYSTEM

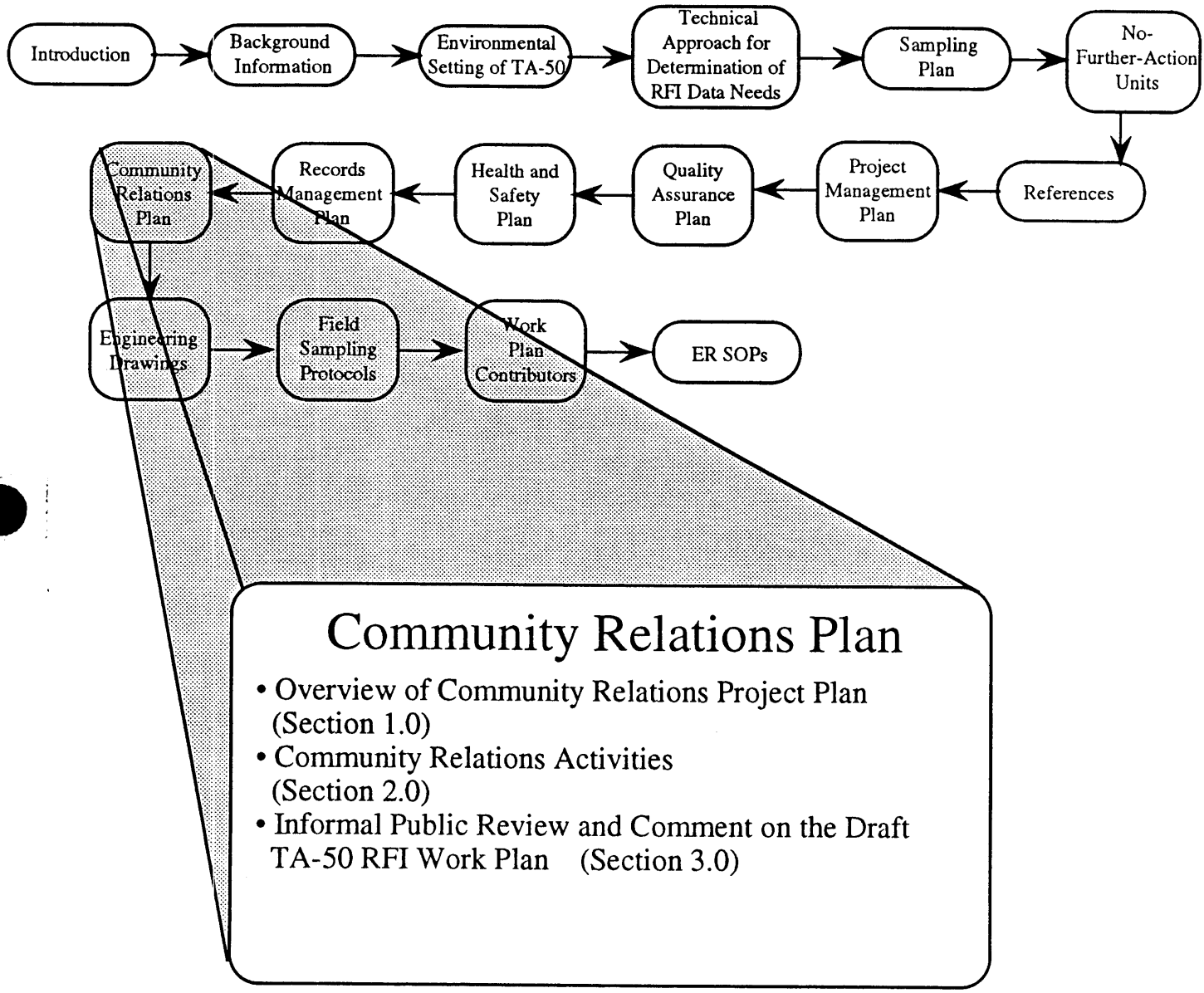
Specific reporting requirements are ER Program deliverables and, as such, are monitored through the ER Program's management information system. Records resulting from work conducted at OUs contribute to the development of these deliverables.

7.0 COORDINATION WITH THE COMMUNITY RELATIONS PROGRAM

In response to the RCRA requirement that records be made available to the public (and the CERCLA requirement that administrative records be made available), the

program plan provides for both hard copy and electronic access. Hard copies of relevant documents will be maintained in the ER Program Reading Room, and a work station and necessary data links are being prepared to allow public access to the FIMAD data base.

ANNEX V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ER SOPs
Community Relations Plan
• Overview of Community Relations Project Plan (Section 1.0)
• Community Relations Activities (Section 2.0)
• Informal Public Review and Comment on the Draft TA-50 RFI Work Plan (Section 3.0)

1.0 OVERVIEW OF COMMUNITY RELATIONS PROJECT PLAN

The Community Relations Project Plan specific to TA-50 follows the directives, goals, and regulatory requirements set forth in the Community Relations Program Plan (Annex V of the IWP for the ER Program (LANL 1991, 0553). This annex describes the community relations activities associated with the TA-50 RFI. These are based on current knowledge of public information needs and resources available to the Laboratory's ER Program staff.

As shown in Fig. V-1, public participation is required by regulation during the CMS; in addition, the Laboratory plans to provide opportunities for public participation throughout the 5-year RFI, as described in this plan and as illustrated in Fig. V-2.

All information concerning ER Program activities at OU-1147 will originate with or be provided to the public through the community relations project leader:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
2101 Trinity Drive, Suite 20
Los Alamos, New Mexico 87545
(505) 665-2127

2.0 COMMUNITY RELATIONS ACTIVITIES

The following activities are designed to respond to the requirements of the HSWA Module for community relations plans. The scope of each activity can be tailored to respond to public information needs.

2.1 Mailing List

The Community Relations office will add to the ER Program mailing list any residents and businesses identified as owning property on or adjacent to TA-50 and current and former workers at TA-50 to keep them informed of meetings, activities, and schedules pertaining to the OU.

2.2 Fact Sheets

The Community Relations Office has developed a fact sheet with a map inset that shows OU-1147. The fact sheet summarizes site history and use, known contaminants of concern, and planned activities (Attachment 1). Subsequent fact sheets, updating progress at TA-50, will be developed as the RFI proceeds and according to public information needs.

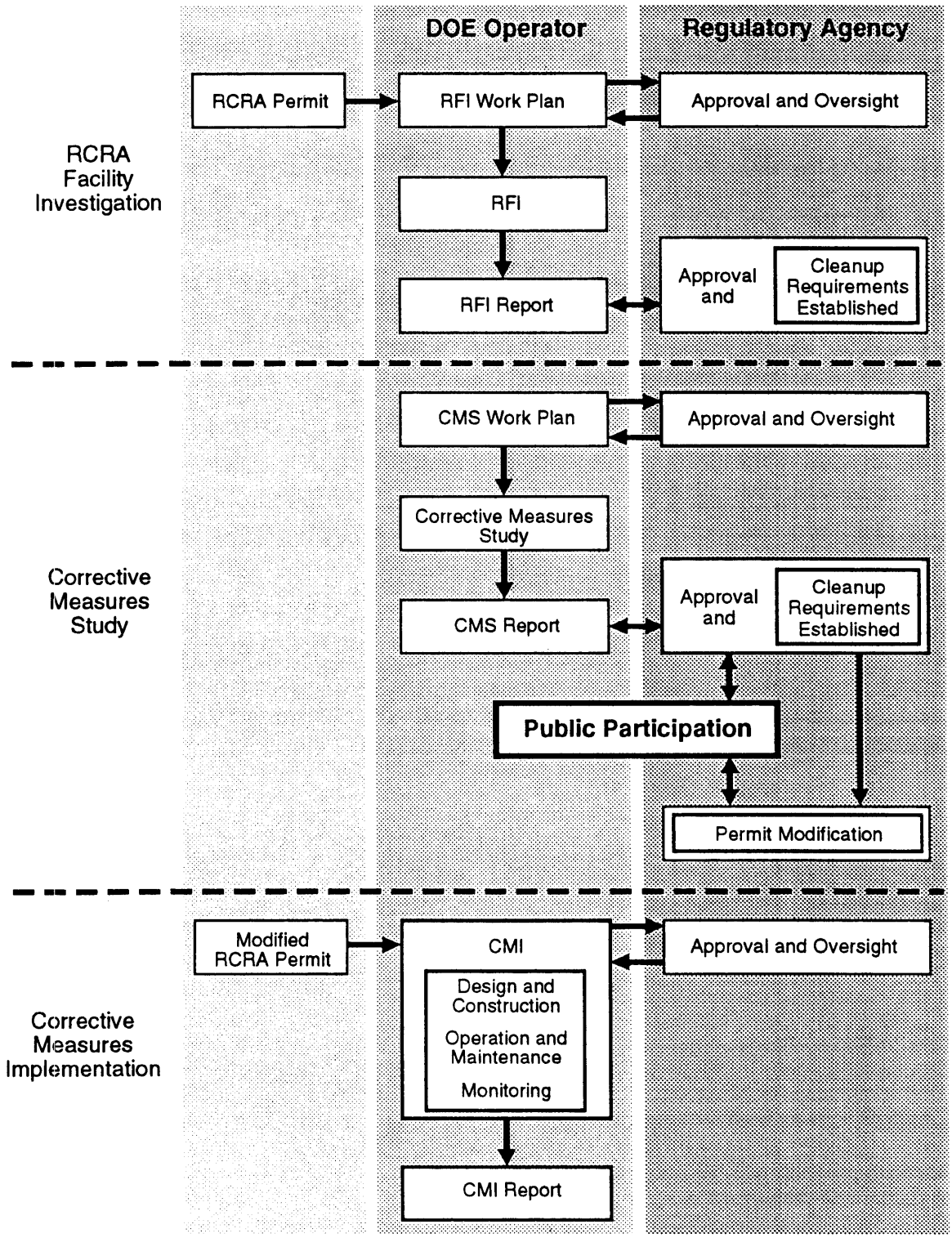


Figure V-1 Opportunities mandated by regulation for public participation during the RCRA corrective process.

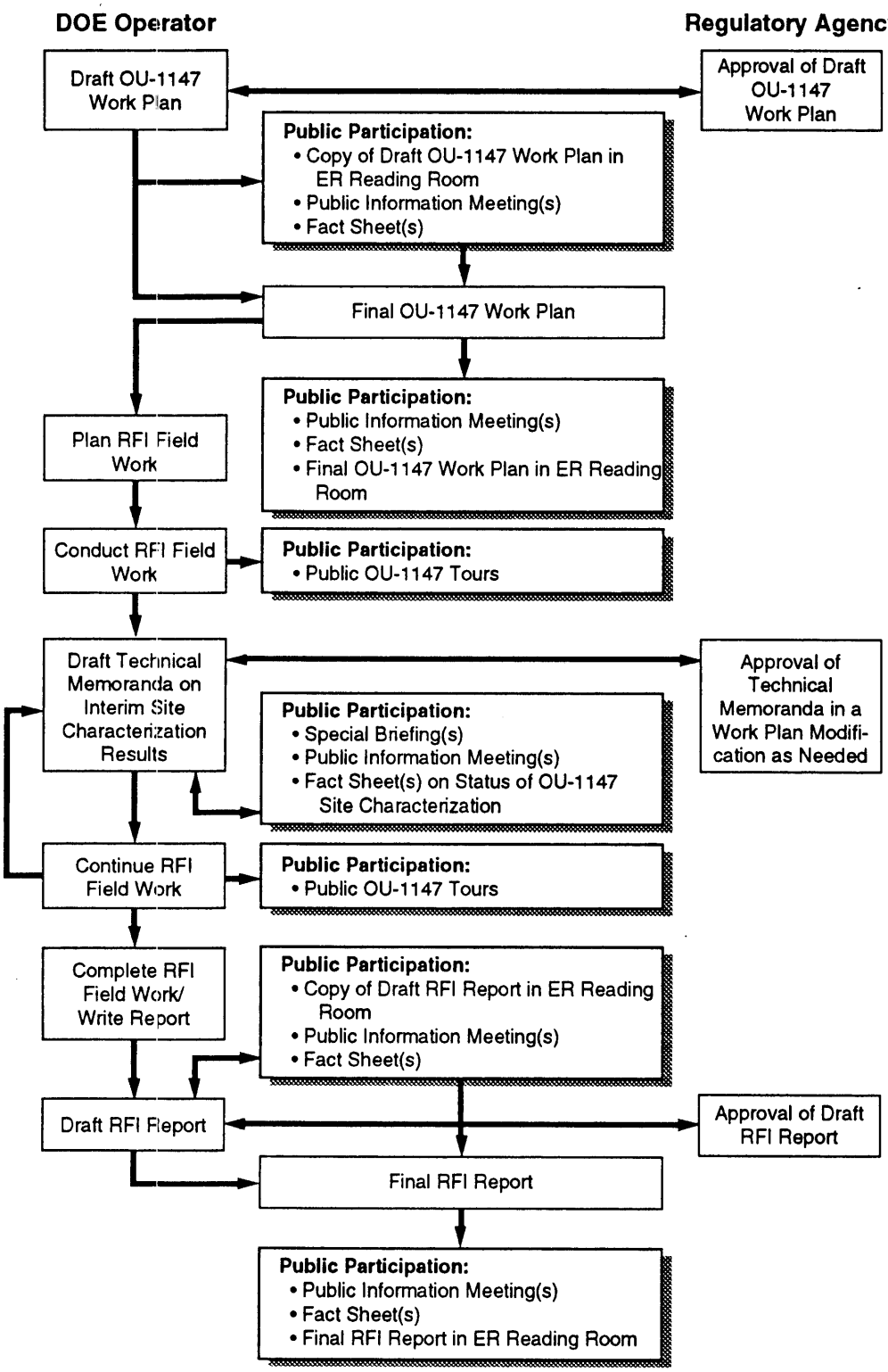


Figure V-2 Opportunities for public participation during the OU-1147 RFI.

2.3 ER Program Reading Room

As they are developed, documents and data associated with TA-50 (such as the RFI work plan, quarterly technical progress reports, a map showing SWMU locations, and the RFI report) will be made available to the public at the ER Program Reading Room from 9 am to 4 pm on Laboratory business days. A draft copy of the RFI work plan for TA-50 will be available at the reading room in May 1992.

2.4 Public Information Meetings, Briefings, Tours, and Responses to Inquiries

Public information meetings have been held in Los Alamos to introduce the community to the ER Program. The Laboratory and Department of Energy plan to hold quarterly public information meetings to discuss specific activities and significant milestones during the RFI. Tours will be conducted for interested parties upon request.

If an issue of concern but of limited interest is raised at a public information meeting, a subsequent special briefing or a one-to-one meeting may be necessary. The community relations project leader and the OU project leader will coordinate responses to such inquiries.

2.5 Quarterly Technical Progress Reports

As the TA-50 RFI progresses, the Laboratory will issue quarterly technical progress reports, as required by the HSWA Module (Task V, C, p. 46). These reports will be available at the ER Program Reading Room.

2.6 Procedures for Public Notice

The ER Program is preparing an administrative procedure to provide for notifying property owners and residents of any releases that might move off the Laboratory site.

3.0 INFORMAL PUBLIC REVIEW AND COMMENT ON THE DRAFT TA-50 RFI WORK PLAN

The Laboratory will encourage public comment on the field sampling proposed in the draft work plan after the Environmental Protection Agency has formally approved this document (submitted in May 1992). Public comment regarding numbers of samples, types of samples, and quality assurance samples (e.g., duplicate samples) will be incorporated, as appropriate, in the final RFI work plan.

ATTACHMENT 1

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM

FACT SHEET FOR OPERABLE UNIT 1147 (TA-50)

- An Operable Unit (OU) is a logical grouping of potentially contaminated sites called Solid Waste Management Units (SWMUs). OU 1147 consists of SWMUs identified in Technical Area 50 (TA-50), which occupies the area just northeast of the intersection of Pajarito Road and Pecos Drive.

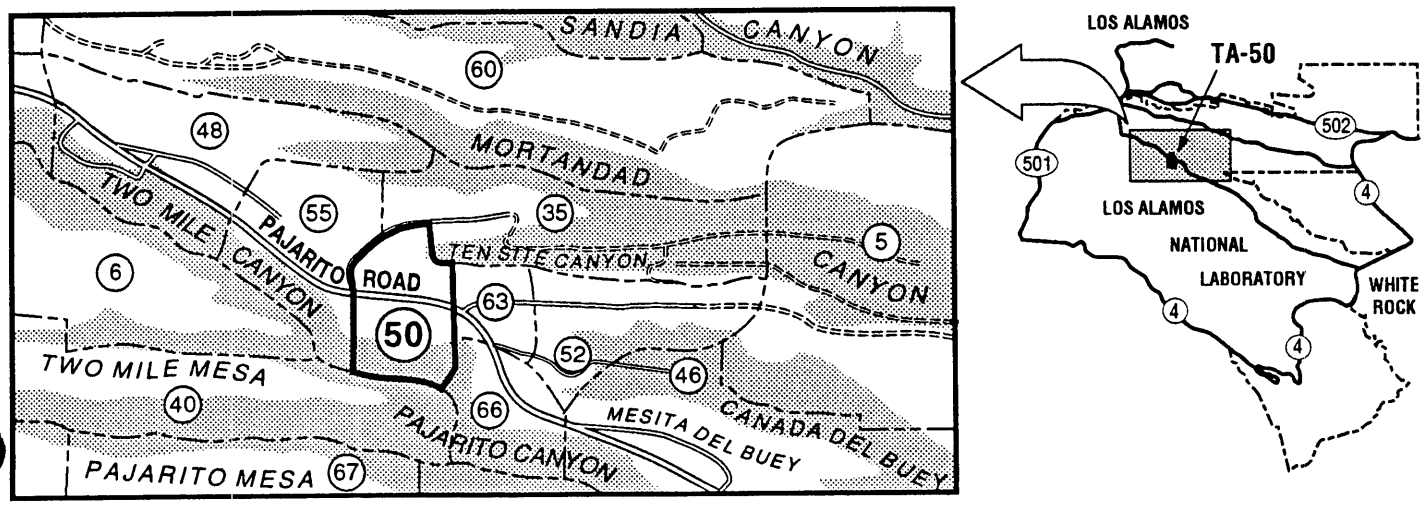
- TA-50 was established in 1948 to treat and dispose of liquid and solid radioactive and hazardous wastes.

- The TA-50 treatment facilities include a liquid waste treatment plant, associated waste transfer and short-term storage areas, equipment decontamination areas, and experimental solid waste volume reduction facilities. Operations began in 1963, and most of these facilities are still in use.

- Disposal facilities include an inactive solid-waste landfill (Area C), a treated liquid effluent outfall (into Mortandad Canyon), emission stacks on the liquid waste treatment plant, and a sanitary sewer system. There have been some accidental incidents of soil contamination from some of these facilities in localized areas on Laboratory property.

- For many years, the Laboratory has conducted a comprehensive environmental monitoring and surveillance program in Los Alamos County and throughout northern New Mexico. The program is designed to identify releases from Laboratory operations that could pose a health risk to individuals living in the communities surrounding the Laboratory. According to technical data gathered from the monitoring program, no releases have resulted in contamination on private property or that threatens the health and safety of local residents. If an imminent health threat is found, immediate action will be taken by the Department of Energy (DOE) and the Laboratory.

Operable Unit 1147 (TA-50) Locator Map



BACKGROUND OF OPERABLE UNIT 1147

Twenty-six potentially contaminated areas have been identified. Twenty-three of these are associated with the industrial liquid waste facilities for treatment, transfer, temporary storage, and disposal of radioactive and/or mixed waste. Two areas are experimental volume reduction facilities that treat radioactive and hazardous waste, both of which use highly redundant control systems. The Area C landfill is the twenty-sixth site. It encompasses 11.8 acres, containing a wide variety of waste forms, and is contaminated with radioactive and hazardous waste forms. The landfill operated from 1948 until 1969, and was shut down in 1974.

Some of the contaminants that may be prevalent in OU 1147 include the following radionuclides: plutonium, americium, uranium, cesium, strontium, and tritium. Hazardous waste constituents would include mercury, nitrates, cyanide, chromate plating solution, lead, chlorinated and fluorinated hydrocarbons, waste oil, and beryllium.

PREVIOUS CLEANUP ACTIVITIES AT OPERABLE UNIT 1147

In 1984 a new cap was placed over part of the inactive Area C landfill to mitigate erosion and contaminant transport across the ground surface. Current monitoring data demonstrate that the new cap has been effective in stabilizing the surface of the site.

FUTURE ACTION AND PROPOSED TIME FRAME

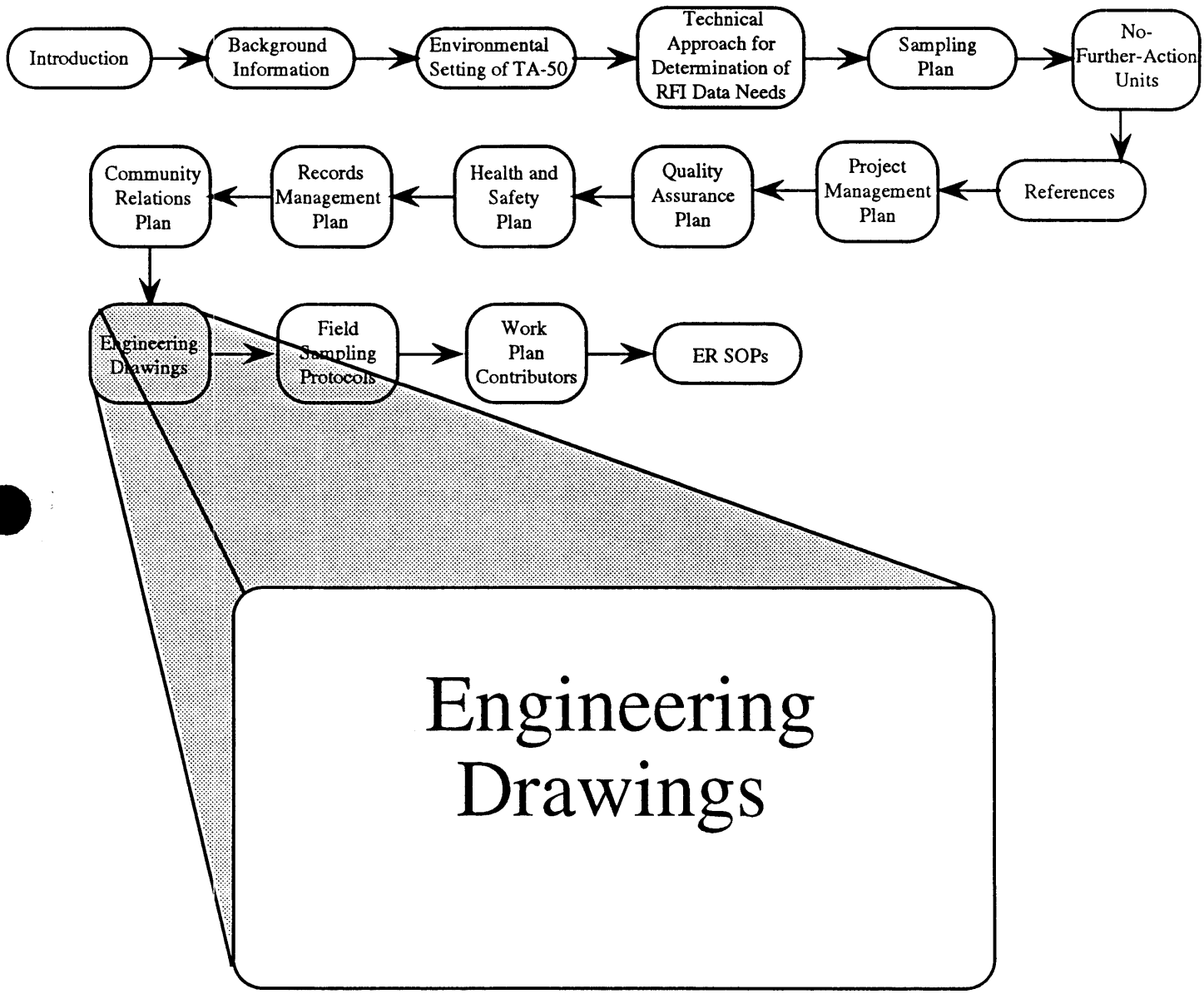
In accordance with the Resource Conservation and Recovery Act (RCRA), the Laboratory is developing a RCRA Facility Investigation (RFI) work plan. This plan will outline procedures to verify past cleanups and to determine the presence of residual contamination (if any). All of the sites within OU 1147 are currently being investigated to identify all contaminant sources, determine whether contaminant migration has occurred, and decide what corrective measures must be implemented to meet the RCRA requirements. This plan will also detail the steps to be taken if such contamination is found. These include defining the type and extent of contamination and identifying any potential receptors. Possible corrective actions range from long-term monitoring and institutional controls to dismantling of facilities and excavation of contaminated materials followed by treatment and/or approved disposal. The TA-50 RFI work plan will be completed by May 1992.

Implementation of the RFI work plan is scheduled to begin in late 1992 and will be completed in 1996. A Corrective Measures Study (CMS), to identify and evaluate remediation alternatives, is scheduled to begin in 1996 or 1998.

Recognizing that the safe management of past, present, and future wastes requires the cooperation of government, industry, and the public, the Laboratory is committed to informing the public, using tools such as this fact sheet, about actions taken throughout the entire RFI and cleanup process. If you have additional questions about OU 1147 or about the Laboratory's Environmental Restoration Program, please do not hesitate to visit, call, or write

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
Box 1663, Mail Stop M315
2101 Trinity Drive, Suite 20
Los Alamos, NM 87545
(505) 665-2127

APPENDIX A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ER SOPs
Engineering Drawings

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Jerry Buchholz, EM-7, MS E518

DATE: January 27, 1992

FROM: William C. Francis

MAIL STOP/TELEPHONE: J495/7-3331

SYMBOL: EES15-92-058

SUBJECT: **LIST OF DRAWINGS REVIEWED TO GATHER INFORMATION ABOUT UNDERGROUND LINES NEAR AND ENTERING SOLID WASTE MANAGEMENT UNITS AT TA-50**

The following list of drawings are categorized by Architect/Engineer and were used by me to compile the attached set of eleven drawings. The original purpose of these drawings was to locate underground lines near and entering the Solid Waste Management Units (SWMUs) at TA-50 that would be of concern when planning core drilling operations in the future.

1. The Ralph M. Parsons Company
Title--Upgrading of Industrial Liquid Waste Treatment Plant
Lab Job 5872-50 Eng C-44430

Drawing No. LA-RV-C-1	Sheet No. 2
Drawing No. LA-RV-C-4	Sheet No. 5
Drawing No. LA-RV-C-5	Sheet No. 6
Drawing No. LA-RV-C-6	Sheet No. 7
Drawing No. LA-RV-C-7	Sheet No. 8
Drawing No. LA-RV-C-10	Sheet No. 11
Drawing No. LA-RV-A-1	Sheet No. 14
Drawing No. LA-RV-S-1	Sheet No. 28
Drawing No. LA-RV-PR-1	Sheet No. 39
Drawing No. LA-RV-MP-1	Sheet No. 40
Drawing No. LA-RV-P-1	Sheet No. 46
Drawing No. LA-RV-P-2	Sheet No. 47
Drawing No. LA-RV-P-3	Sheet No. 48
Drawing No. LA-RV-P-4	Sheet No. 49
Drawing No. LA-RV-P-5	Sheet No. 50
Drawing No. LA-RV-P-7	Sheet No. 52
Drawing No. LA-RV-P-8	Sheet No. 53
Drawing No. LA-RV-P-10	Sheet No. 55
Drawing No. LA-RV-P-11	Sheet No. 56
Drawing No. LA-RV-P-14	Sheet No. 59
Drawing No. LA-RV-E-1	Sheet No. 67
Drawing No. LA-RV-E-4	Sheet No. 70
Drawing No. LA-RV-E-6	Sheet No. 72
Drawing No. LA-RV-E-7	Sheet No. 73
Drawing No. LA-RV-E-8	Sheet No. 74
Drawing No. LA-RV-E-9	Sheet No. 75

Title--Upgrading of Industrial Liquid Waste Treatment Plant. Thermal Liquid System Modification

Lab Job--None	Eng C-None
Drawing No. LA-SK-6182-1	Sheet No.--None
Drawing No. LA-SK-6182-2	Sheet No.--None
Drawing No. LA-SK-6182-3	Sheet No.--None
Drawing No. LA-SK-6182-4	Sheet No.--None

2. DMJM

Title--Radioactive Liquid Waste Collection System Improvements

Lab Job. 5662-0	Eng C-44249
Drawing No. LA-UA-C-03.3	Sheet No. 5
Drawing No. LA-UA-C-04.5	Sheet No. 6
Drawing No. LA-UA-M-21.2	Sheet No. 52
Drawing No. LA-UA-M-22.2	Sheet No. 53
Drawing No. LA-UA-M-27.5	Sheet No. 58
Drawing No. LA-UA-M-28.5	Sheet No. 59
Drawing No. LA-UA-M-29.4	Sheet No. 60
Drawing No. LA-UA-E-11.2	Sheet No. 96

3. Black and V each

Title--Contaminated Waste Plant

Lab Job 2243	Enc C-Various
Drawing No. LA-EI-2001	Sheet No. 2
Drawing No. LA-EI-6001	Sheet No. 79
Drawing No. LA-EI-6004	Sheet No. 82
Drawing No. LA-EI-6007	Sheet No. 85
Drawing No. LA-EI-6008	Sheet No. 86
Drawing No. LA-EI-6009	Sheet No. 87
Drawing No. LA-EI-6014	Sheet No. 92
Drawing No. LA-EI-6016	Sheet No. 94
Drawing No. LA-EI-7008.1	Sheet No. 108
Drawing No. LA-EI-7022	Sheet No. 122
Drawing No. LA-EI-5019	Sheet No. 138

Title--Target Fabrication Facility, TA-35

Lab Job 5934-35	Eng C-441
Drawing No. LA/T-C-4.0	Sheet No. 4

4. Los Alamos Scientific Laboratory
Title--Electrical Plot Plan, TA-0-440. Meteorological Tower.
Lab Job 4671-0
Drawing No. LA-JR-E1 Eng. C-None Sheet No. 4

Title--Acid Waste Sewer Removal. LD-37, TA-50
Lab Job 5150-50
Drawing No. ENG. C-426B3 Sheet No. C-1

Title--Contaminated Waste Line
Lab Job 3575-0
Drawing No. Eng. C-35008 Sheet No. 1
Drawing No. Eng. C-35011 Sheet No. 4

Title--LASL Underground Lines Contaminated and Industrial Waste
Lab Job--None
Drawing No. Eng. E 378 Eng. C-None
Drawing No. Eng. E 378 Sheet No. D2
Drawing No. Eng. E 379 Sheet No. D10
Sheet No. D11

Lab Job 5260-0
Drawing No. Eng. C-42660 Sheet No. C-4

Title--Emergency Drain From Pump Room, Mechanical, Bldg LD-2, TA-50
Lab Job. 2243 F-50
Drawing No. Eng C-21914 Sheet No. 1 of 1

5. Los Alamos National Laboratory
Title--As Built Program Building 50-37
Lab Job. 10901
Drawing No. C-4596D Sheet No. A1

6. W. C. Kruger and Associates
Title--UHTREX Facilities
Lab Jo. 2325 (Maybe 2825)
Drawing No. LA-EZ-2/1.1 Eng. C-31837
Sheet No. 2.1

7. Kruger, Lake and Associates
Title--Transuranic Contaminated Solid Waste Treatment Development Facility
Lab Job 4790-50

Drawing No. LA-NY-C-1	Eng. C-43068
Drawing No. LA-NY-M-1	Sheet No. 2
Drawing No. LA-NY-E-1	Sheet No. 16
Drawing No. LA-NY-E-8	Sheet No. 33
Drawing No. LA-NY-E-9	Sheet No. 40
	Sheet No. 41

8. Texas Automatic Sprinklers
Title--Transuranic Contaminated Solid Waste Treatment Development Facility
Lab Job. 4790-50
Drawing No. C-43068 Sheet No. 1 of 2

9. Gordon Herkenhoff and Associates, Inc.
Title--TDF Warehouse and Staging Area. Bldg. LD-54, TA-50
Job No.--None

Drawing No. LA-RM-A-4	Eng. C--None
Drawing No. LA-RM-A-6	Sheet No. 3
	Sheet No. 4

10. Burns/Peters Group--Architects and Planners
Title--Airlock Entrance-Size Reduction Facility, Bldg. WM-69, TA-50, and Egress Bay Addition, Building WM-37, TA-50
Lab Job.--None

Drawing No. LA-Z1-L-C1.1	Eng. C--None
Drawing No. LA-Z1-L-A1.1	Sheet No. 3
	Sheet No. 4

11. The Zia Company
Title--Utilities

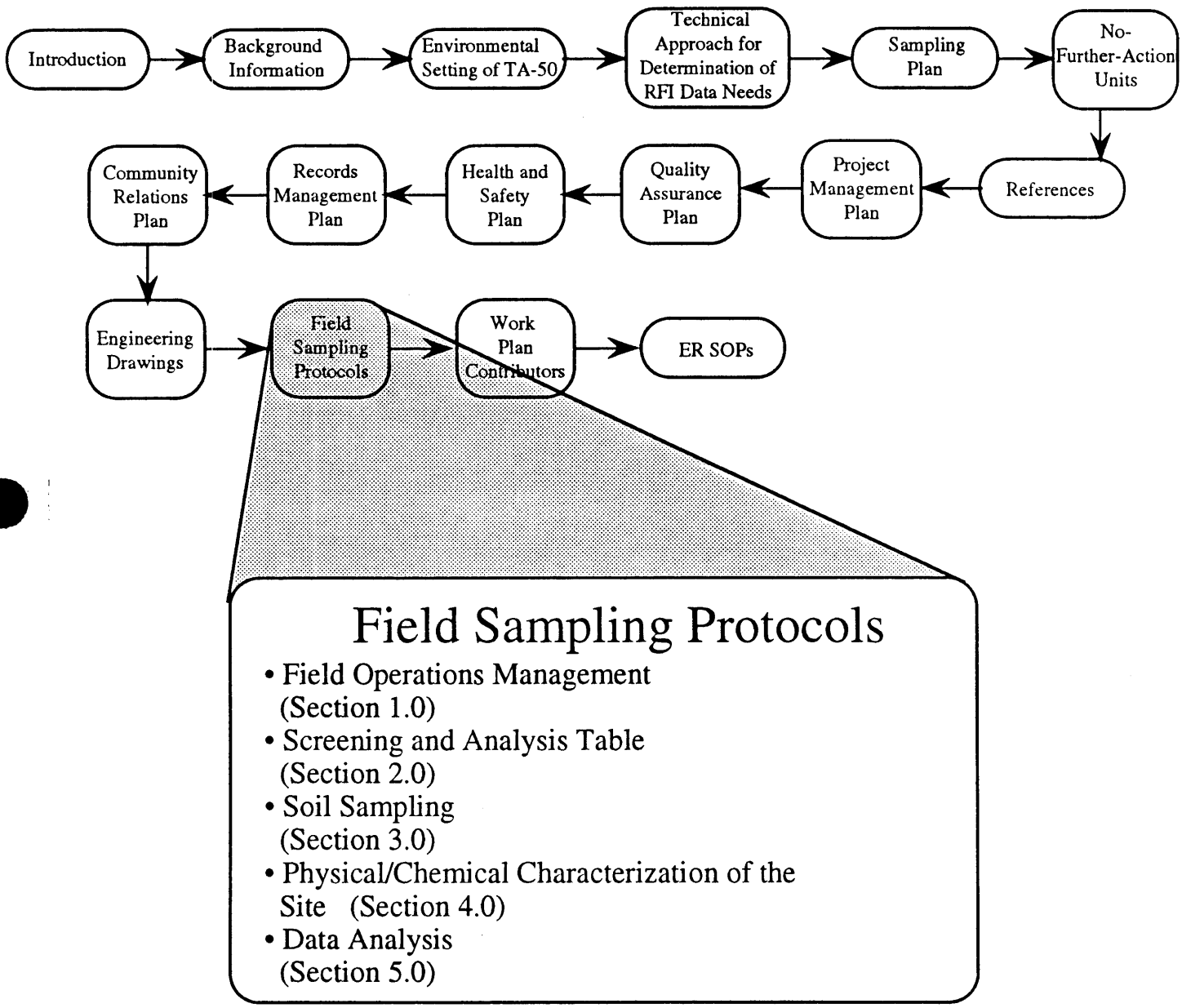
Drawing No. R-8000 (Water)	Sheet No. NE-2
Drawing No. R-8002 (Fire Protection)	Sheet No. NE-2
Drawing No. R-8003 (Fire Protection)	Sheet No. NE-2
Drawing No. R-8005 (Gas)	Sheet No. NE-2
Drawing No. R-8006 (Gas)	Sheet No. NE-2
Drawing No. R-8007 (Gas)	Sheet No. NE-2
Drawing No. R-8008 (Sewer)	Sheet No. NE-2
Drawing No. R-8009 (Electrical)	Sheet No. NE-2

Title--Seepage Shaft
Drawing No. Z-4586

12 Kruger, Lake, Hutchinson, Brown, Inc.
Title--Size Reduction Facility and Additions to Treatment Development Facility.
Lab Job.--None

Drawing LA-UB-C-1	Eng. C-44022
	Sheet No. 2
Drawing LA-UB-U-1	Sheet No. 3.1
Drawing LA-UB-U-2	Sheet No. 4.1

APPENDIX B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Background Information
Environmental Setting of TA-50
Technical Approach for Determination of RFI Data Needs
Sampling Plan
No-Further-Action Units
References
Project Management Plan
Quality Assurance Plan
Health and Safety Plan
Records Management Plan
Community Relations Plan
Engineering Drawings
Field Sampling Protocols
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ER SOPs
Field Sampling Protocols
• Field Operations Management (Section 1.0)
• Screening and Analysis Table (Section 2.0)
• Soil Sampling (Section 3.0)
• Physical/Chemical Characterization of the Site (Section 4.0)
• Data Analysis (Section 5.0)

1.0 FIELD OPERATIONS MANAGEMENT

As indicated in the Project Management Plan (Annex I), multiple field-investigation teams will be operating concurrently during the RFI. Each team will have individual responsibilities for health and safety, sample identification, sample handling and chain of custody, and related activities. Other responsibilities may be shared across field teams, such as operation of the field laboratory or of an equipment decontamination facility.

1.1 Health and Safety

The Los Alamos ER Program Office is developing a Health and Safety Plan for all RFI activities, which will be added to this work plan as Annex III. The plan will include OU-specific information on known or suspected contaminants and the personnel protection required for different activities. Samples acquired under this RFI work plan will be screened at the point of collection to identify the presence of gross contamination or conditions that may pose a threat to the health and safety of field personnel. The techniques listed in Section 2.2, *Field Screening,* will be used. In particular, gross alpha and gross gamma radiation surveys and organic vapor surveys will always be done. Open excavations and borehole headspace will also be monitored routinely, using organic vapor instruments and combustible-gas and oxygen detectors. (For information on applicable SOPs, see Appendix D.)

1.2 Archaeological and Ecological Evaluations

In accordance with NEPA regulations, archaeological and ecological evaluations will be performed in all areas where the surface or subsurface is to be disturbed or vegetation is to be removed. These evaluations will be done using the Laboratory's ES&H Questionnaire process. Depending on the results, a DOE Environmental checklist for either categorical exclusion or environmental assessment will be completed.

1.3 Support Services

Support services during the field investigations will be provided by Laboratory groups, including ENG-3, ENG-5, Johnson Controls, and contractors. Existing job-ticket procedures will be used. The services provided will include, but not be limited to, excavating with backhoes and front-end loaders, moving pallets of containerized auger cuttings and decontamination solutions, and setting up signs and other warning notices around the perimeter of the work area.

1.4 Excavation Permits

The Laboratory requires a permit before any excavation, drilling, or other invasive activity may be undertaken. HS-3 and Johnson Controls oversee the issuance of these permits. The project leader (or designee) will schedule the acquisition of excavation permits as appropriate for each phase of field work. Each area designated for excavation, drilling, or sampling deeper than 18 in. will be marked in the field for formal approval before work begins.

1.5 Sample Control, Documentation, and Coordination

Guidelines for sample handling are provided in Section 3.5.5 and Annex IV of the IWP. Sample packaging, handling, chain-of-custody, and documentation procedures are discussed in Annex II of this work plan and detailed in ER Program SOPs (see Appendix D).

The ER Program has established a sample coordination facility in EM-9, to provide consistency for all investigations. The system is described in Section 3.5.5 and Appendix O of the IWP.

1.6 Quality Assurance Samples

Field quality-assurance (QA) samples of several types are collected during a field investigation. Each type of sample, and the reason for its collection, are given in Annex II. The frequency of collection of field QA samples is detailed in Chapter 5.

1.7 Equipment Decontamination

Decontamination is a quality assurance measure and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for personnel. Equipment decontamination is done at the Vehicle Decontamination Facility: sampling tools are decontaminated by washing, rinsing, and drying, whereas large machinery, vehicles, auger flights, and coring tools used in borehole sampling are steam-cleaned. The effectiveness of the decontamination process is documented through laboratory analysis of rinsate blanks. Decontamination fluids, including steam-cleaning fluids, are processed in the liquid waste treatment plant. See Appendix D for the applicable SOP.

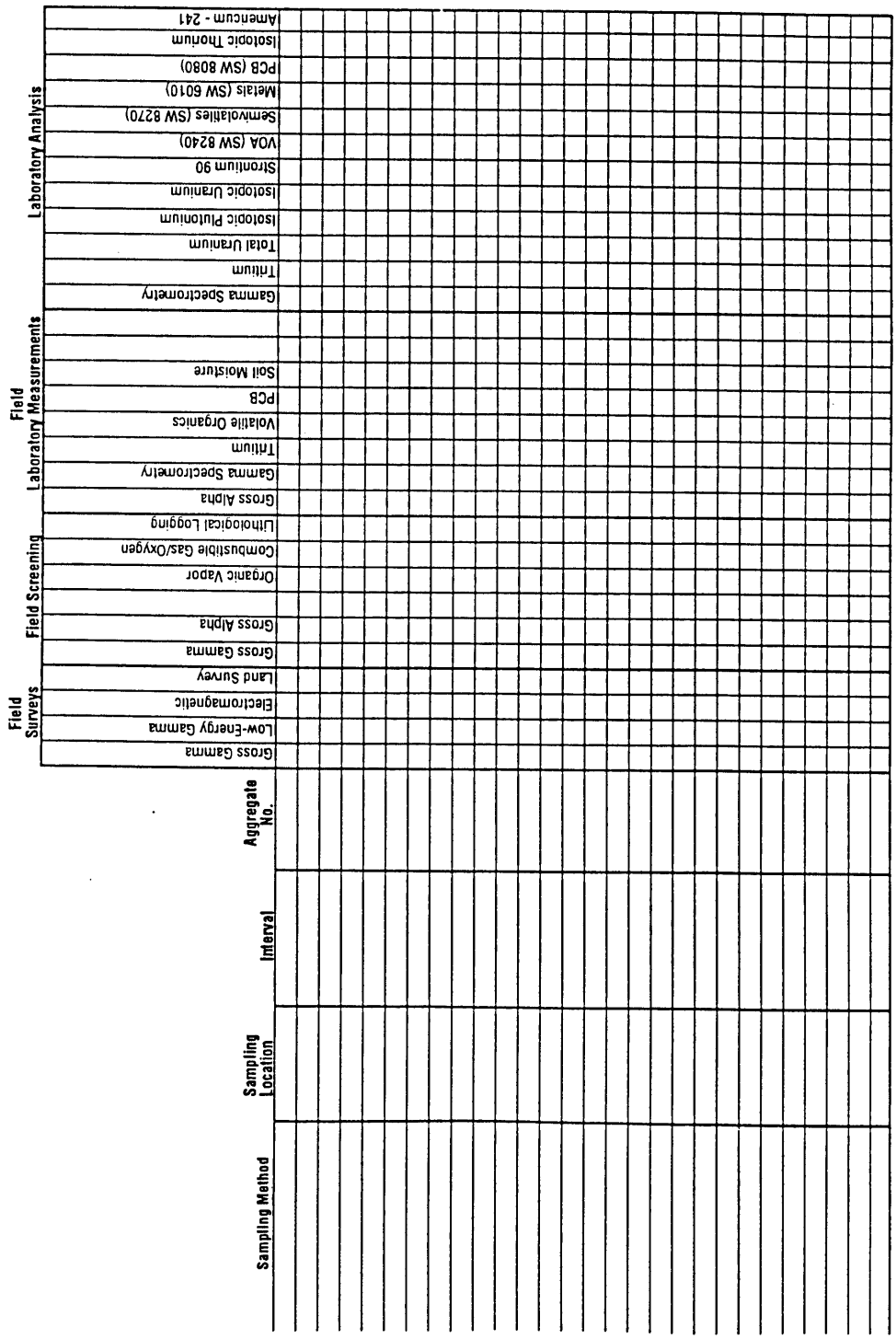
1.8 Waste Management

This discussion is based on Section 3.5.4 and Appendix B of the IWP. Wastes produced during sampling may include borehole auger cuttings, excess sample materials, excavated soil from trenching, decontamination and steam-cleaning fluids, and disposable equipment such as wipes, protective clothing, and non-reusable sample bottles. Any of the following waste categories may be encountered at TA-50: hazardous waste, low-level radioactive waste, transuranic waste, and mixed waste (either low-level or transuranic mixed waste). Requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste are provided in the applicable SOP (see Appendix D).

2.0 SCREENING AND ANALYSIS TABLE

A standard table is used in this work plan to identify screening and analysis requirements, including the number of samples and types of analyses needed. Table B-1 shows this standard table, which will be referred to in several other sections of this annex.

TABLE B-1
STANDARD SCREENING AND ANALYSIS TABLE



The three columns on the left side of the table show, for each SWMU or SWMU aggregate, the sampling method, the sampling location, and the depth interval (as appropriate). (The sampling methods listed in the first column are discussed below in Section 3.0, *Soil Sampling.*)

The other columns in the table provide measurement/analysis options. These are discussed below.

2.1 Field Surveys

These are primarily walking scans of the land surface, using direct reading or recording instruments. For TA-50, these surveys will include gamma radiation surveys and, possibly, electromagnetic geophysical surveys. Typically, these surveys provide Level I data. Although negative results from field surveys are not conclusive evidence of a complete absence of contaminants, positive results obtained at an early stage can enable sampling to be efficiently redirected. See Appendix D for information on applicable SOPs.

2.1.1 Radiological Surveys

2.1.1.1 Gross Gamma

Field instruments available for gamma surveys include micro R meters, NaI detectors of various sizes with ratemeters or scalers, and Geiger-Mueller detectors. The preferred instruments are micro R meters capable of measuring to 5 μR/hr, and 2-in. by 2-in. NaI detectors with ratemeters capable of resolving 100 cpm. The surveyor carries the instrument at waist height at a slow walking pace, observing and recording the ratemeter response. Measurements may also be made at fixed points at ground level to detect surface contamination.

2.1.1.2 Low-Energy Gamma

Two instruments commonly used for these surveys are the FIDLER and the PHOSWICH. Both are optimized for the detection of low-energy photons, such as the 60-keV gamma emission from americium-241 or the x rays that accompany the decay of most heavy radionuclides (uranium, thorium, plutonium, and other transuranic elements). Either instrument may be used for this work plan. The surveyor carries the instrument close to the ground surface while observing the ratemeter or scaler. Measurements may also be made at fixed points on the ground surface to detect localized contamination.

2.1.2 Geophysical Surveys

2.1.2.1 Electromagnetic Surveys

An electromagnetic instrument is used to confirm the location of buried structures that contain metal and to trace the path of buried metallic waste lines. The selected geophysical instrument will be able to detect all types of metal (ferrous and nonferrous) and will be able to detect a 2-in.-diameter metal line buried as deep as 5 ft. The instrument will provide a direct meter readout of changes in

the electromagnetic response and, by means of an RS-232 port, will record the response electronically in an automated data recorder. A surveyor typically locates buried metal lines by walking along traverse lines that cross the suspected trend of the buried line at a right angle, while continuously observing the instrument meter response. An appropriate spacing of the parallel traverse lines is 20 ft. To locate buried metal structures, the surveyor typically takes measurements on a grid established over the suspected location of the structure. The grid spacing is determined by the size of the structure; it may be as close as 2.5 by 2.5 ft.

2.1.2.2 Land Surveys

Land surveys will be used to (1) document all sampling locations and (3) locate former or buried structures where needed. Land surveys to locate former structures are included in the standard screening and analysis table (see Table B-1).

2.2 Field Screening

Field screening measurements are taken at the point of sample collection, in borehole headspace, and in excavations, to identify gross contamination and to assess conditions affecting the health or safety of field personnel. (Applications of screening for personnel health and safety are discussed in detail in Annex III, *Health and Safety Plan.* In general, every sample taken at TA-50 will be screened for gamma and alpha radioactivity, and all excavations and boreholes will be monitored for combustible gases, organic vapors, and tritiated water vapor. In addition, a noninstrument form of sample screening, lithological logging, will be performed for all borehole samples. In addition to the role of sample screening to identify gross contamination or situations of concern for health and safety, certain sampling plans use the screening information (Level I data) as a basis for deciding whether to do further sampling or what analyses should be done. See Appendix D for information on applicable SOPs.

2.2.1 Radiological Screening

2.2.1.1 Gross Gamma

Field samples will be screened for gamma radioactivity using a hand-held NaI detector probe and ratemeter. The detector, held close to the sample or core, is capable of identifying elevated concentrations of certain radionuclides (indicated by ratemeter readings above instrument background levels.) Quantification of the readings is difficult, and they are best interpreted as gross indicators of potential contamination.

2.2.1.2 Gross Alpha

Field samples are screened for gross alpha contamination using a hand-held alpha scintillation detector and a ratemeter. The detector is held close to (almost in contact with) the sample or core; for a damp soil sample, it is capable of detecting approximately 100-200 pCi/g but cannot identify specific radionuclides.

2.2.2 Nonradioactive Screening (Organic Vapors)

Organic vapor detectors will be used to screen borehole cores and soil samples at the point of collection, and a combustible-gas indicator (CGI) to determine the potential for combustion or explosion of unknown atmospheres during drilling and intrusive activities. To improve the probability of detecting a wide range of vapors, two types of detectors (or their equivalents) will be used:

- PID—A photoionization detector (PID) is a general survey instrument capable of detecting real-time concentrations of many complex organic compounds, and some inorganic compounds, in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish between compounds in a mixture of gases.

- FID—A flame ionization detector (FID), such as the Foxboro Model OVA-128, can be used as a general screening instrument for many organic vapors. Its response to an unknown vapor is proportional to its response to one of known composition to which the instrument has been calibrated.

A CGI, such as the Gastech Model 1314, will be used to determine the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or the lower flammability limit (LFL). The Gastech Model 1314 also contains an oxygen detector to determine whether an atmosphere is deficient or enriched in oxygen. The CGI will be used to monitor atmospheres during all intrusive activities.

2.2.3 Lithological Logging

Lithological logging is a description of the physical nature of borehole cores. It will be performed by a geologist capable of describing subsurface lithologies and differentiating the various strata of the Bandelier Tuff.

2.3 Field Laboratory Measurements

The field laboratory will be used to obtain fast-turnaround analysis of samples, using a limited number of relatively simple analytical methods. The techniques used in the field laboratory give primarily Level II data, although some are Level I (more qualitative) or near Level III (more quantitative). These techniques generally provide better quality information, including lower detection limits, than can be obtained with field screening. The three major uses of field laboratory data are

- *To aid in directing the course of field work,* thereby increasing the efficiency of field operations. As an example, field laboratory measurements can be used to determine when to cease drilling a borehole.

- *To focus more quantitative analytical efforts on the key samples.* Depending on the goals of the investigation, samples having particular characteristics can be selected—for example, those with no detectable contaminants to assess the edge of a plume; those with the highest levels of contaminants to ascertain sources.

- *To quickly and cost-effectively analyze a large number of samples for easily detectable contaminants.* This can reduce the number of samples that must be sent for more costly analysis by the analytical laboratory: the large number of lower-quality measurements provides a broad base of comparison for the few high-quality measurements, which helps in determining whether the latter are representative and sufficient for decision making.

See Appendix D for information on applicable SOPs.

2.3.1 Radiological Measurements

2.3.1.1 Gross Alpha

Measurements of gross alpha radioactivity can be used to ascertain the presence of plutonium, uranium, and thorium in samples, but not to identify individual radionuclides. A typical method uses dried soil samples in a fixed geometry. Level II measurements can detect alpha-emitting radionuclides at concentrations on the order of 25 to 40 pCi/g, sufficient for guiding field operations or selection of samples for further analysis. Typical measurement times are 15 to 20 min per sample using large-area, zinc-sulfide, alpha scintillation detectors and a scaler. A Model 43-10 alpha scintillation detector, or the equivalent, and a Ludlum Model 2200 scaler, are appropriate.

2.3.1.2 Gamma Spectrometry

Gamma-ray spectrometry can be used to quantify particular radionuclides present in soil samples, such as cesium-137, cobalt-60, and uranium-234, -235, and -238. It can also detect the 60-keV gamma ray from americium-241. Rapid-turnaround analysis can be Level II or close to Level III quality, using personal-computer-based, multichannel analyzers (MCA) and NaI or germanium photon detectors—for example, a Canberra MCA with a Ludlum 44-10 NaI detector. (Many equivalent instruments are available.) Dried soil samples in fixed geometries can be analyzed in 20 to 30 min with detection limits on the order of 5 pCi/g for radionuclides such as cesium-137.

2.3.1.3 Liquid Scintillation Counting

Liquid scintillation techniques can measure tritium in soil moisture or water samples at Level II quality. Moisture is distilled from soil samples in a ventilated hood in the field laboratory as part of the process of drying soil samples. The liquid scintillation counting will be done by either HS-1 or EM-9, using documented laboratory procedures (ESG 1989, 0308).

2.3.2 Organic Chemical Measurements

2.3.2.1 Volatile Organic Compounds

Rapid-turnaround analysis for volatile organic compounds at Level II quality is needed to guide field operations such as drilling. An instrument that can distinguish between compounds, such as the Laboratory's transportable purge-and-trap GC/MS, is preferred because it can provide qualitative and quantitative

analyses of most volatile organic compounds with low or slight solubility in water (boiling points below 200°C). Volatile water-soluble compounds can also be detected, with higher detection limits.

2.3.2.2 PCBs

An inexpensive, fast-turnaround technique that can measure PCB levels less than the regulatory limit (25 ppm), using numerous Level II analyses to minimize the need for Level III data from an analytical laboratory, will be needed to establish the areal extent of contamination. Field laboratory techniques are available that provide quick turnaround and detection down to 10 ppm. The DEXSIL L2000 PCB/Chloride Analyzer is an example. It uses a chloride-specific electrode to quantify PCBs in oil or soils. Samples are prepared by extracting the PCBs from the soil and reacting the sample with a sodium reagent; this transforms the PCBs into chloride, which can be quantified by the instrument. Oil samples take about 5 min to prepare, soil samples about 10 min. Documented field laboratory procedures for measurement of PCBs will be used.

2.4 Laboratory Analysis

In many of the sampling plans, the lack of existing data from a SWMU creates the need to verify the presence or absence of a wide spectrum of possible contaminants. Off-site analytical laboratories provide the highest quality (Level III/IV) data; all samples submitted to an analytical laboratory will be coordinated, handled, and tracked by the ER Program Sample Coordination Facility. (Most samples from this RFI will be submitted for Level III/IV analysis.)

The "full suite of anaytes" usually called for includes the following:

- *Gamma Emitters*—Quantification of radionuclides by measurement of photon emissions from homogenized, fixed-geometry samples.

- *Tritium*—Measurement of tritium in soil moisture using liquid scintillation counting.

- *Total Uranium*—Analysis using EPA method 3050.

- *Strontium-90*—Radiochemical separation and beta counting with a gas proportional detector.

- *Isotopic Plutonium*—Radiochemical separation of plutonium from soil followed by alpha spectrometry to quantify each isotope (plutonium-238 and -239/240). Another method would be to use modern detectors and software to count x-ray emissions from plutonium in soil and sediment.

- *Volatile Organics (SW 8240)*—The standard EPA method for quantifying volatile organic compounds.

- *Semivolatiles (SW 8270)*—The standard EPA method for quantifying semivolatile organic compounds.

- *Metals (SW 6010)*—The standard EPA method for quantifying metals and cyanide.

For certain SWMUs, non-routine laboratory analyses may be required. The following four are listed in selected field sampling plans:

- *PCBs* (SW 8080)—The standard EPA method for quantifying PCBs and pesticides. (Only the PCB results are of interest for this work plan.)

- *TCLP Metals*—The standard EPA method for defining a hazardous waste. The method also includes other compounds, but only the metals are of interest for this work plan.

- *Isotopic Uranium*—Radiochemical separation of uranium from soil is followed by alpha spectrometry to quantify each isotope.

- *Isotopic Thorium*—Radiochemical separation of thorium from soil is followed by alpha spectrometry to quantify each isotope.

3.0 SOIL SAMPLING

Soil samples, taken as described below, will be used for field screening, field laboratory, and analytical laboratory measurements and analyses. See Appendix D for information on applicable SOPs.

3.1 Surface Soils

Samples of disturbed surface soils are taken from the first 6 in., using a stainless-steel or Teflon scoop. Care will be taken to ensure that for each sample, the hole goes down a full 6 inches and the sides are cut vertically to obtain equal volumes of soil over the 6-in. depth.

Undisturbed surface soil samples will be gathered from the first 6 in. using a ring sampler (a 4-in.-diameter stainless steel tube that is driven vertically into the area to be sampled). The soil around the ring sampler is then excavated and the tube removed.

3.2 Near-Surface Soils

The spade-and-scoop method is used to obtain near-surface soil samples from depths to 30 in. Spades and shovels are used to remove surficial material to the required depth, then a stainless-steel or Teflon scoop to collect the sample. (Devices plated with chrome or other materials are not acceptable for sample collection.) Unless otherwise specified, the sample interval will be 6 in. Care will be taken to ensure that, for each sample, the full 6-in. depth is attained, and the sides of the hole are cut vertically to obtain equal volumes of soil over the 6-in. depth.

Small-volume soil samples can be recovered from depths approaching 10 ft by using a hand auger or a thin-wall tube sampler. The latter provides a less disturbed sample than that obtained with a hand auger. However, the hand

auger will need to be used for soils and tuff that are too hard for the thin-wall sampler.

3.3 Subsurface Soils and Rock

3.3.1 Vertical Coreholes

Soil samples will be collected from vertical coreholes with a 5-ft-continuous, split-barrel sampler driven by a truck-mounted hollow-stem auger. Each sampling plan gives a nominal depth for each corehole; the corehole will be sampled to at least that depth, at 5-ft intervals. If contamination is detected by field screening or field laboratory measurements in the last interval above the nominal depth, sampling will continue at 5-ft intervals until contamination has dropped to background levels. This "stop criterion" will be used for all coreholes sampled, to ensure complete information on contaminant depth. In addition, the analytical set specified in each sampling plan will be followed for the complete depth of the corehole.

3.3.2 Shallow-Angle Coreholes

Angle drilling is employed when the rig cannot be placed directly over the point of interest. A 5-ft core interval is specified as the standard, with the same stop criterion as for vertical coreholes. Such drilling cannot be done with the standard rig described above, but requires one having angle-drilling capability (mechanical specifications comparable to those of a Failing F-10 or CME-85). Either a hollow-stem auger or an air-rotary, continuous-coring drill may be used with the angle rig.

3.3.3 Deep Coreholes

Tuff coring deeper than 200 ft. requires a drilling rig with greater capabilities than those needed for the hollow-stem auger methods described above. Initial plans (see Chapter 5) call for no boreholes deeper than 200 ft unless a contaminant plume is detected. Selection of rig and drilling method are matched to the goals of the investigation.

3.3.4 Rock Coring

Rock samples can be recovered from indurated rock formations with the use of a diamond bit. A small-diameter core of rock, 5-10 ft in length, is cut and simultaneously pushed into an inner barrel of the drill string, to be retrieved by a wire-line apparatus. This method works best in rock that is hard and relatively free of bedding planes, lithology changes, and fractures. It will be used in the lower reaches of deep boreholes beneath the relatively soft Bandelier Tuff.

3.3.5 Trenching

In this work plan, trenching may be used to (1) locate buried structures before drilling, (2) expose buried structures to be sampled, and (3) expose deeper soils for investigation or sampling. A back-hoe or track-hoe capable of excavating to a depth of 15 ft will be used. (The bucket width and type will be decided by the

equipment operator on the basis of the structure to be exposed and the soil conditions.) The trench must be wide enough for soil sampling, field surveys, and screening to be safely performed. If the trench is 4 ft or deeper, OSHA standards 29 CFR 1926.650, for shoring and sloping, will be followed. Because the tuff at TA-50 is in stable rock, shoring and sloping will generally not be necessary; but each trench should be inspected by a competent engineer to ensure that there is no potential for cave-in. The maximum trench depth will be 15 ft.

4.0 PHYSICAL/CHEMICAL CHARACTERIZATION OF THE SITE

Undisturbed borehole cores or crushed core samples are analyzed as follows:

4.1 Hydrogeological Measurements

- *Gravimetric water content*—The water content of the undisturbed core is measured by weighing the moisture lost during oven drying (Method ASTM D-4531-86).

- *Bulk density*
- *Dry density*
- *Porosity*

  These values are calculated from the gravimetric water content data (Method ASTM D-4531-86).

- *Porosity (He injection)*—The porosity of the undisturbed core sample is measured quantitatively using the American Petroleum Institute Method (API 40, Section 3.58).

- *Saturated hydraulic conductivity*—This is quantitatively measured in the intact, undisturbed core sample (Method ASTM D-2434-68).

- *Moisture characteristic curve*—Wetting and drying cycles are characterized by measurements of the intact, undisturbed core sample. A psychrometer is used for verification when drying is complete. (Method: American Society of Agronomy, Chapter 24).

- *Air/water relative permeability*—The van Genuchten method is used to calculate the value from the saturated hydraulic conductivity and moisture characteristic curve data.

4.2 Geochemical Measurements

- *Mineralogy*—X-ray diffraction tests on powdered rock samples yield data on type and relative abundance of clay minerals (kaolinite, illite, and mortmorillonite); zeolite minerals; matrix minerals (silica polymorphs, alkali feldspars, and volcanic glass); carbonate minerals; and iron and manganese minerals.

- *Total organic carbon*—Total organic carbon in crushed rock samples is measured by combustion in a muffle furnace (Method: ASTM D-2974).

- *Cation exchange capacity*—The cation exchange capacity of core materials is measured on crushed samples by sodium absorption (EPA method 9080).

- *Slurry pH*—pH is measured in a crushed-core and deionized-water slurry (Method: ASTM DG657).

4.3 Environmental Isotopes Measurements

- *Chloride-35/chloride-37*—Isotope ratio measurement by accelerator mass spectrometer on soluble chloride leached with deionized water from crushed core samples.

- *Carbon-12/carbon-13*—Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

- St*rontium-86/strontium-87*—Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

- *Hydrogen/deuterium*—Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

- *Oxygen-18/oxygen-16*—Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

- *Tritium*—Measurement of tritium activity in pore water extracted under vacuum from crushed core samples by direct counting with the liquid scintillation method.

- *Carbon-14*—Isotope age determination by accelerator mass spectrometer analysis on pore water under vacuum from crushed rock samples. Analytical results are corrected for carbon-13.

- *Chloride-36*—Isotope age determination by accelerator mass spectrometer analysis on soluble chloride leached with deionized water from crushed core samples.

4.4 Straddle Packer Tests

- *In situ air permeability*—This is measured in the borehole by vacuum extraction over discrete depth intervals. Method: Donahue and Erekian (1982).

- *Volatile organic compounds*—These compounds are measured on *in situ* gas samples extracted from discrete depth intervals. Test Method: USEPA TO14.

- *Carbon dioxide*—Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals. Method: ASTM 1946.

- *Methane*—Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals. Method: ASTM 1946.

- *Carbon-12/carbon-13*—Isotope ratio analysis by mass spectrometer on *in situ* gas samples extracted from discrete depth intervals.

- *Sulfur hexafluoride*—Quantitative analysis of gas samples extracted from discrete depth intervals in an open borehole, to evaluate contamination of the subsurface environment by air from air rotary drilling. (Sulfur hexafluoride will be introduced as a tracer gas in the air supply.)

4.5 Open-Borehole Geophysical Measurements

- *Gamma gamma density log*—Rock properties that alternate and scatter gamma radiation are measured continuously using a 100-mCi cesium-137 source. (The measured values are directly related to the bulk density of the rock.).

- *Spectral gamma radiation log*—The natural gamma radiation is continuously measured in an open or a cased borehole. This spectrum is divided into three energy "windows" that differentiate quantities of uranium, thorium, and potassium. The log is used for stratigraphic correlation and to ascertain the presence of radioactive contamination.

5.0 DATA ANALYSIS

5.1 Sequential Sampling Approach

Sequential sampling consists of collecting a set of samples, analyzing them, and using the results to (a) decide whether additional samples are required; and (b) select the second set, if needed. Although unbiased results can be based on a single set of samples, it is more efficient and cost-effective to use the first set as a guide for additional sampling (e.g., determining optimum locations for sampling that will yield the required accuracy). The second and further stages can furnish a more detailed characterization of the area and confirm the results and predictions coming out of the earlier one(s).

Sequential sampling can also guide chemical analysis. Analytical results for the first set of samples will be used to determine whether further analysis is necessary and to focus any further analyses to minimize time and cost.

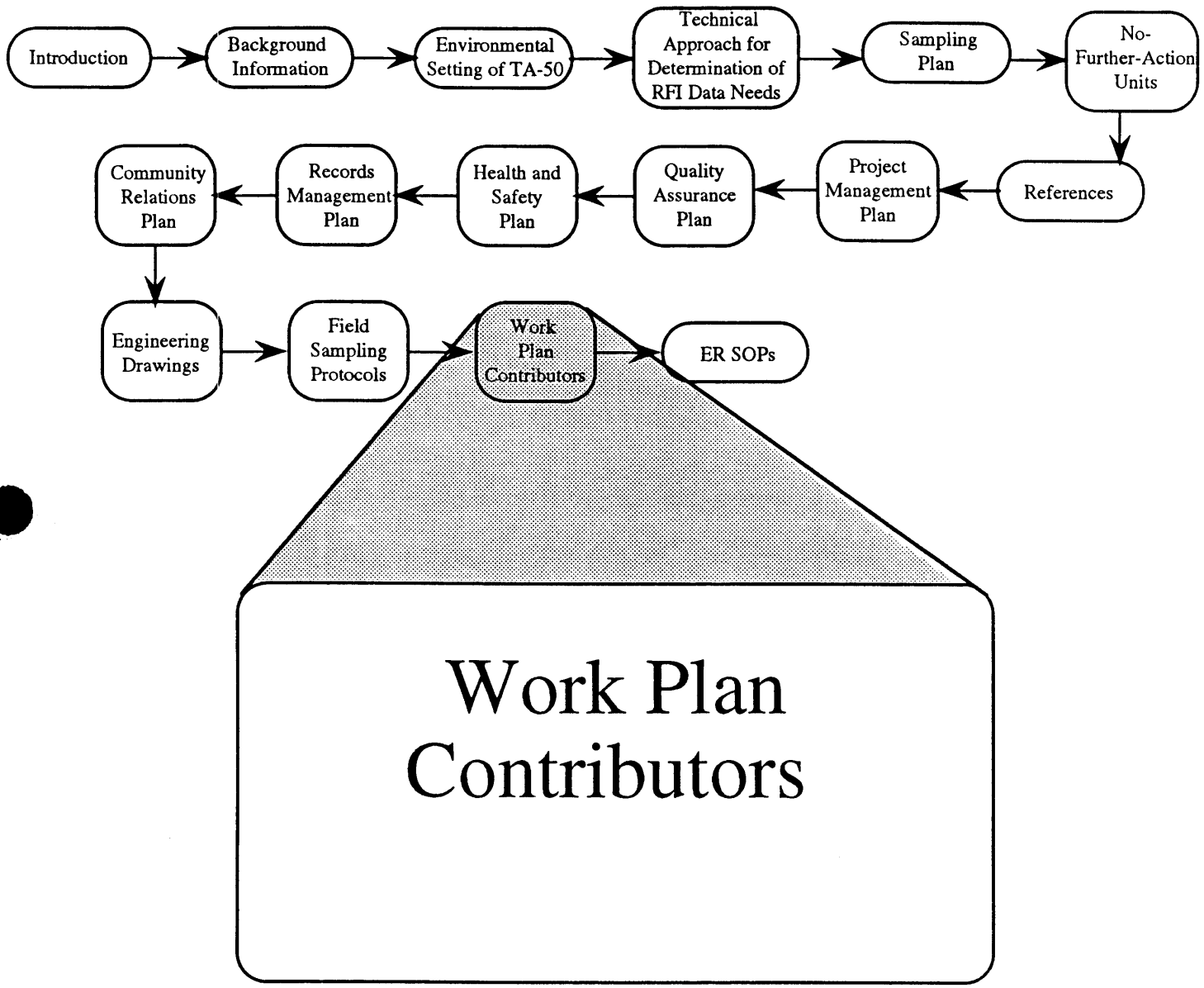
5.2 Action Levels

The action level concept is based on the EPA's proposed 40 CFR 264, Subpart S. (Proposed action levels are listed in Appendix F of the IWP.) Action levels will be used at TA-50 as described in Sec. 3.5.2.2 of the IWP (LANL 1991, 0553) in conjunction with background levels, to assess the presence, magnitude, and importance of environmental contamination from individual SWMUs. Sample analysis results will be compared with action levels as part of the process of deciding whether further characterization is needed or remediation should be initiated.

5.3 Decision Analysis

The decision analysis methodology for the Los Alamos ER Program is currently being developed. Pending completion of that methodlogy, the DQO process described in Chapter 4 (and in Appendix I of the IWP) will ensure that all decisions regarding sampling and site characterization are systematic and documented by formal reports of data assessment. (These reports will become technical addenda to the TA-50 RFI work plan.)

APPENDIX C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Work Plan Contributors

I. Administrative Management

Name and Affiliation	Education/Expertise	ER Program Assignment
Bob Vocke, EM-13	Ph.D. Water Resources 15 years experience in hazardous waste site assessment, including waste management, regulatory compliance, and program management.	Program Manager, Group Leader
Ted Norris, EM-13	Ph.D. Chemistry 12 years experience in radionuclide migration; 3 years experience in atmospheric pollutant transport; and 3 years experience as health and safety officer.	Programmatic Project Leader
Tom Hakonson, EES-15	Ph.D. Radioecology 27 years experience in radionuclide distribution and transport; 6 years in managing environmental resource programs; 12 years on hydrologic processes and their role in contaminant transport and land-fill remediation technology.	Operable Unit Project Leader
Ken Bostick, EES-15	B.A. Business Administration 27 years experience in environmental radioactivity monitoring and research; 20 years experience in logistics, budgeting and scheduling of field studies on contaminants in the environment.	Project Administration/ Financial Leader

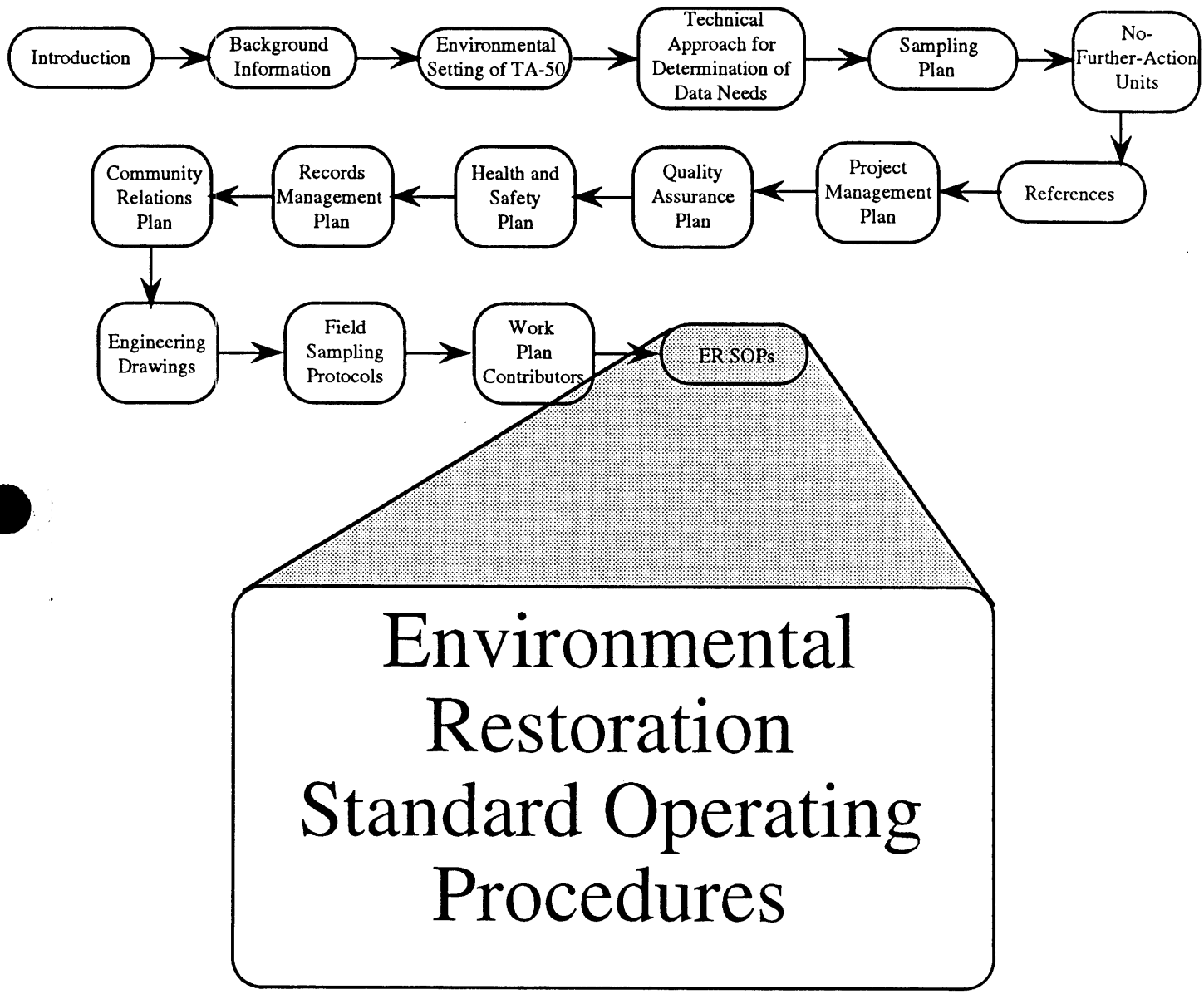
II Technical Contributors

Name and Affiliation	Education/Expertise	Document Sections
Laboratory personnel		
Grant Heiken, EES-1	Ph.D. Geology 23 years experience in volcanology, plantetology, and geothermal exploration.	Chapters 3, 5
Sue Goff, EES-4	M.S. Geology 14 years experience in managing and designing drilling projects in hostile environments. Also designed and operated Curation Facility for the US DOE Continental Scientific Drilling Program.	Chapter 5
John Conaway, EES-1	Ph.D. Geophysics 20 years experience in borehole surface, and airborne geophysics techniques. Worked in the theory and application of various geophysics techniques for geotechnical applications, mineral exploration, and petroleum exploration in university, Federal Government, industry, and National Laboratory settings. Published 40 papers on geophysics topics.	Chapter 5
E. Dow Davidson, Jr.	B.A. Anthropology	Chapter 5

	13 years experience in the design of sample curatorial facilities and sample controls. Majority of experience gained in the development of sample curatorial systems for the US DOE high-level nuclear waste projects.	
George Trujillo, EES-15	A.A. Environmental Health 17 years experience in field sampling and analyzing contaminant data, including the use of automated data acquisition systems, computer data base management systems, statistical packages for data analysis, computer graphics, and GIS systems.	Graphics, entire work plan
Will Polzer, EES-15	Ph.D. Chemistry 27 years experience in environmental research into geochemical processes in transporting waste contaminants. Strong background in environmental transuranic research.	Chapter 5
Vivienne Hriscu, IS-11	M.A. Prehistoric Archaeology 17 years experience in technical writing and editing.	Entire document
Lia Mitchell	A.A. Clerical Office 15 years experience as secretary/word processor in scientific fields.	Document production
Kristen Manies	BA Environmental Studies/ Sociology 1 year experience in technology research and development and environmental science.	Graphics and Production Support

Andrea Kron, contractor	B.A. Geology 15 years experience in cartography, geology, and technical illustration.	Illustrations, flow charts
Patricia Leyba, IS-5	B.B.A. (Business Administration) 9 years experience in office/ information management systems.	Document layout and production
William Francis, Retired Engineer	41 years experience in construction, engineering, and maintenance. 20 years in administration and personnel.	Engineering details

APPENDIX D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ER SOPs
Environmental Restoration Standard Operating Procedures

The following is a list of the SOPs provided in Environmental Restoration Standard Operating Procedures, Volumes 1 and 2 (LANL 1992, 0688). Some SOPs, notably those pertaining to Health and Safety, are still in process and are not included in this list. They will be added as they are completed.

Procedure Numbers	Title
1.0	**GENERAL INSTRUCTIONS**
LANL-ER-SOP-01.01,R0	General Instructions for Field Investigations
LANL-ER-SOP-01.02,R0	Sample Containers and Preservation
LANL-ER-SOP-01.03,R0	Handling, Packaging, and Shipping of Samples
LANL-ER-SOP-01.04,R0	Sample Control and Field Documentation
LANL-ER-SOP-01.05,R0	Field Quality Control Samples
LANL-ER-SOP-01.06,R0	Management of RFI-Generated Waste
3.0	**RECONNAISSANCE/FIELD SURVEYS**
LANL-ER-SOP-03.04,R0	Petrography
LANL-ER-SOP-03.05,R0	Determination of Volume Constituents in Thin Sections of Rocks
LANL-ER-SOP-03.06,R0	Fracture Characterization
LANL-ER-SOP-03.07,R0	Characterization of Lithologic Variation Within the Rock Outcrop of a Volcanic Field
LANL-ER-SOP-03.09,R0	Geologic Mapping of Bedrock Units
4.0	**DRILLING, EXCAVATING, SAMPLING AND LOGGING**
LANL-ER-SOP-04.01,R0	Drilling Methods and Drill Site Management
6.0	**SAMPLING TECHNIQUES**
LANL-ER-SOP-06.01,R0	Purging of Wells for Representative Sampling of Groundwater
LANL-ER-SOP-06.02,R0	Field Analytical Measurements of Groundwater Samples
LANL-ER-SOP-06.03,R0	Sampling for Volatile Organics
LANL-ER-SOP-06.04,R0	Sampling Commercial/Municipal/Domestic Wells
LANL-ER-SOP-06.05,R0	Soil Water Samples
LANL-ER-SOP-06.06.R0	Tensiometer (Soil Suction Monitor) Installation and Measurement
LANL-ER-SOP-06.09,R0	Spade and Scoop Method for Collection of Soil Samples
LANL-ER-SOP-06.10,R0	Hand Auger and Thin-Wall Tube Sampler
LANL-ER-SOP-06.11,R0	Stainless Steel Surface Soil Sampler
LANL-ER-SOP-06.13,R0	Surface Water Sampling
LANL-ER-SOP-06.14,R0	Sediment Material Collection
LANL-ER-SOP-06.15,R0	Coliwasa Samples for Liquids and Slurries
LANL-ER-SOP-06.16,R0	Thief Sampler for Dry Powders or Granules
LANL-ER-SOP-06.17,R0	Trier Samples for Sludges and Moist Powders or Granules
LANL-ER-SOP-06.18,R0	Collection of Sand, Packed Powder, or Granule Samples Using the Hand Auger
LANL-ER-SOP-06.19,R0	Weighted Bottle Sampler for Liquids and Slurries in Tanks
LANL-ER-SOP-06.21,R0	Volatile Organic Sampling Train
LANL-ER-SOP-06.22,R0	Canister Sampling for Organics EPA Method T0-14

Procedure Numbers	Title
7.0	**SUBSURFACE HYDROGEOLOGICAL SITE CHARACTERIZATION**
LANL-ER-SOP-07.01,R0	Pressure Transducers
LANL-ER-SOP-07.02,R0	Fluid Level Measurements
LANL-ER-SOP-07.03,R0	Well Slug Tests
LANL-ER-SOP-07.04,R0	Aquifer Pumping Tests
9.0	**GEOCHEMISTRY**
LANL-ER-SOP-09.01,R0	Thin Section Preparation
LANL-ER-SOP-09.02,R0	Operating the Microprobe
LANL-ER-SOP-09.03,R0	Operation of the Siemens X-Ray Diffractometer
LANL-ER-SOP-09.04,R0	Calibration and Alignment of the Siemens Diffractometers
LANL-ER-SOP-09.05,R0	Clay Mineral Separation for X-Ray Diffraction Analysis
LANL-ER-SOP-09.06,R0	Zeolite Purification and Separation
LANL-ER-SOP-09.07,R0	Operating Instructions for ISI ModelDS-130 Scanning Electron Microscope and Tracor Northern Series II X-Ray Analyzer
LANL-ER-SOP-09.09.R0	Certification of Standards for Electron Microanalysis
10.0	**FIELD SCREENING TECHNIQUES**
LANL-ER-SOP-10.01.R0	Screening of PCB'S in Soil
11.0	**GEOTECHNICAL ANALYSIS**
LANL-ER-SOP-11.01,R0	Measurement of Bulk Density, Dry Density, Water Content and Porosity in Soil
LANL-ER-SOP-11.02,R0	Particle Size Distribution of Soil/Rock Samples
LANL-ER-SOP-11.03,R0	Permeability of Granular Soils
LANL-ER-SOP-11.04,R0	Soil and Core pH
LANL-ER-SOP-11.05,R0	Total Organic Carbon
LANL-ER-SOP-11.06,R0	Cation-Exchange Capacity

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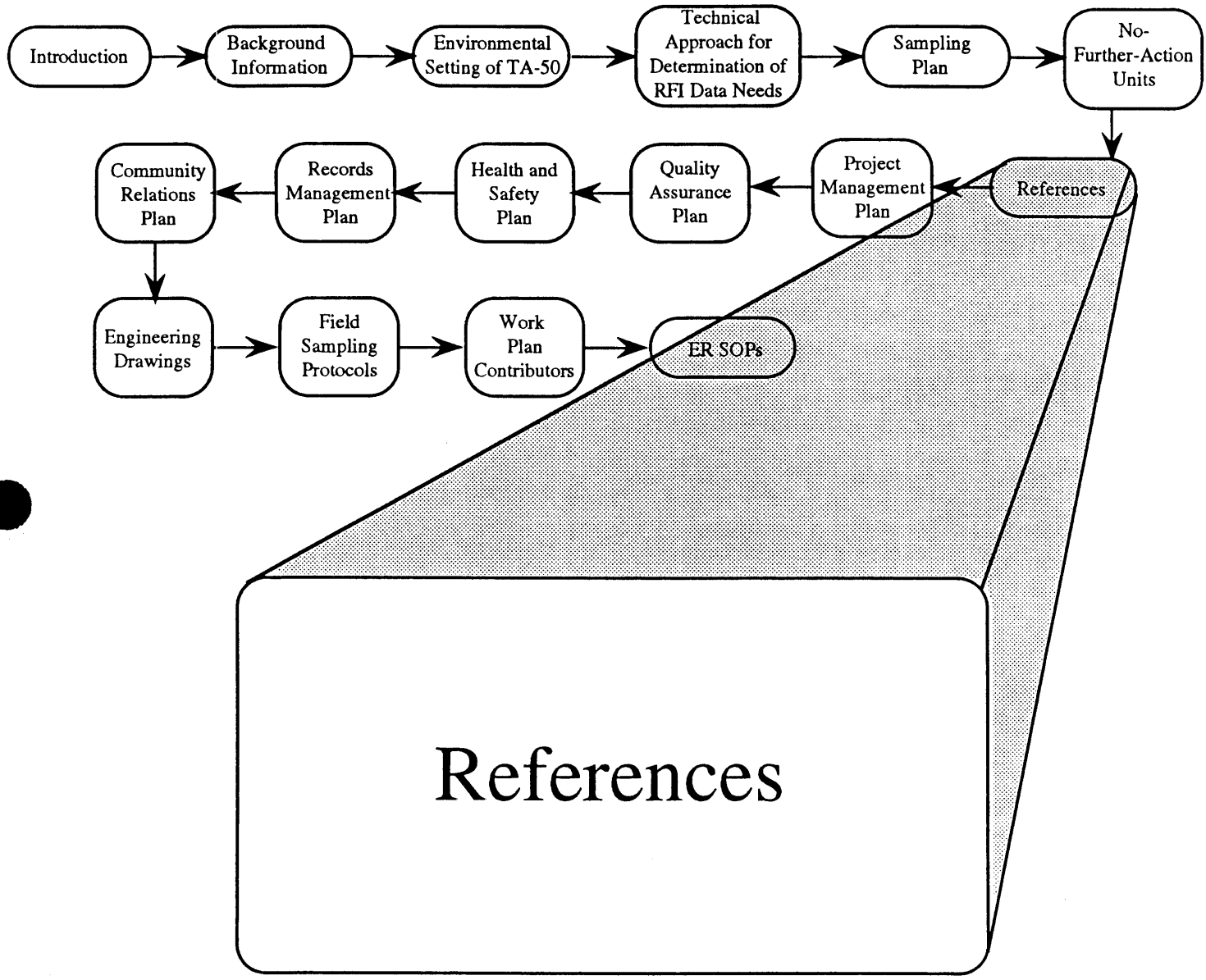
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