RFI Work Plan for Operable Unit 1132

Environmental Restoration Program

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A Department of Energy
Environmental Cleanup Program

Los Alamos
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Executive Summary

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EXECUTIVE SUMMARY

Purpose

The primary purpose of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan is to propose a methodology for determining (1) the nature and extent of releases of hazardous waste or hazardous constituents from solid waste management units (SWMUs) in Operable Unit (OU) 1132 and (2) the need for corrective measures studies (CMSs). The second purpose of this document is to satisfy those regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA that pertain to OU 1132. OU 1132 includes one active Technical Area (TA), TA-39. This TA is located in the southern part of the Los Alamos National Laboratory, in Los Alamos county, north-central New Mexico. It contains twenty-five potential release sites (PRSs), all of which are located on land owned by the Department of Energy (DOE).

Module VIII of the permit, known as the HSWA Module [the portion of the permit that responds to the requirements of the Hazardous and Solid Waste Amendments (HSWA)], was issued by the Environmental Protection Agency (EPA) to address potential corrective action requirements for SWMUs at the Laboratory. These permit requirements are addressed by the DOE's Environmental Restoration (ER) Program at the Laboratory. This work plan describes the sampling plans that will be followed to implement the RFI at OU 1132, and, together with eighteen other work plans (nine submitted to the EPA in May of 1993 and nine submitted earlier), meets the requirement set forth in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by May 23, 1993.

Installation Work Plan

The HSWA Module required the Laboratory to prepare an installation work plan (IWP) to describe the Laboratory-wide system for carrying out the RFI, doing CMSs, and implementing corrective measures—requirements satisfied by the Installation Work Plan for Environmental Restoration submitted to the EPA in November 1990. That document is updated annually, and the most recent revision was issued in November 1992. The IWP identifies the Laboratory's PRSs, describes their aggregation into 24 OUs, and presents the Laboratory's overall management plan and technical approach for meeting the requirements of the HSWA Module. Information relevant to this work plan that already appears in the IWP will be referenced (using the 1992 version of that document) rather than repeated here.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. Sites that potentially contain only non-RCRA materials are called areas of concern (AOCs). The term PRS is the generic name for both SWMUs and AOCs. It is understood that the language in this work plan pertaining to subjects outside the scope of RCRA is not enforceable under the Laboratory's operating permit.

Background

OU 1132 is essentially the same as Technical Area (TA) 39, located in the southeast portion of Los Alamos National Laboratory. TA-39 was established in 1953 as a remote, high-explosives (HE) firing site for experiments related to equation-of-state research, shock wave phenomena, development of implosion systems, development and application of explosively produced pulses of electrical power, and production of high magnetic fields. There are five outdoor firing sites at TA-39, of which four are still active; in addition, there are two gas guns, a single-stage and a two-stage.

The firing site experiments have generated most of the waste at this site. A significant portion of this waste has been disposed of in landfills on site. Materials of concern include beryllium, mercury, barium, chromium VI, lead, thallium, cadmium, natural and depleted uranium, HE, and solvents. (Mercury and depleted uranium are no longer used at this site.)

All of the facilities at TA-39 are in the bottom of a canyon, the northern branch of Ancho Canyon; as such, all are located on a flood plain. For this reason, the potential for transport of contaminants off site via the stream channel is a major focus of the RFI. Moreover, the very nature of the experiments makes inevitable the uncontrolled scattering of contaminants to the surrounding hill slopes and to the stream channel.

The PRSs at OU 1132 that will undergo RFI have been grouped into four aggregates: (1) landfills, (2) storage areas, (3) firing sites, and (4) septic systems and seepage pits. The RFI sampling plan is designed to ascertain the presence (and, to a limited extent, the distribution) of contamination of TA-39. PRSs recommended for no further action (NFA) include an incinerator that has been removed; an outfall that releases potable water only; and several storage areas where spread of contamination beyond the storage area boundaries has been ruled out.

At least five landfill pits have been used for disposal of firing site debris. The RFI will include geophysical surveys to locate these pits, as well as surface and subsurface sampling to ascertain the kinds and extent of contamination.

For the storage areas, we propose limited sampling to determine whether there is any evidence that contaminants have moved beyond the boundaries of an area.

We have elected to sample around the one inactive and the four active firing sites, to investigate the uncontrolled movement of contaminants from the surrounding hill slopes into the stream channel. Of special concern are the mercury and depleted uranium that were used in the past. To estimate the extent and distribution of contamination, samples will be collected every 150 ft along three 600-ft radial transects extending from each firing pad. Limited sampling will also be done on a large dump of soil that was excavated for construction of the most recent firing site, on mounds of accumulated debris at older firing sites, and on the gas-gun site. Remediation of the active firing sites will be deferred until decommissioning unless an immediate threat to human health or safety is revealed.

Two active septic systems, one inactive septic system, and two seepage pits make up the fourth aggregate. All but 39-006(b), the active system that has received only sanitary waste, will be sampled during the RFI.

Technical Approach

For the purposes of designing and/or implementing the sampling and analysis plans described in this work plan, most PRSs are grouped into aggregates (even though selected PRSs are investigated individually as necessary). This work plan presents the description and operating history of each PRS or aggregate, together with an evaluation of the existing data, if any. For some sites, NFA can be proposed on the basis of this review; these sites are discussed in Chapter 6. For other sites, this review is sufficient to determine that Phase I field investigations should be undertaken. These sites are discussed in Chapter 5.

The technical approach to the field investigations is designed to refine the conceptual exposure models for the PRSs or aggregates to a level of detail sufficient for baseline risk assessment and the evaluation of remediation alternatives, including voluntary corrective actions (VCAs). A phased approach to the RFI is used to ensure that any environmental impacts associated with past and present activities are investigated in a manner that is both cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation, with opportunities for additional sampling if required.

For some of the PRSs requiring RFI, there are existing data and/or strong historical evidence that suggest that a release has occurred. For these sites, the information has been evaluated and has been judged insufficient to support a baseline risk assessment and/or the evaluation of remediation alternatives. For other PRSs requiring RFI, there are no existing data and little or no historical evidence that a release has occurred. Phase I sampling will be done for the sites in both categories, to determine the presence or absence of hazardous and/or radioactive contaminants. If contaminants are detected at concentrations above conservative screening action levels, either a baseline risk assessment will be done to ascertain the need for remediation, or a VCA may be proposed. If a baseline risk assessment is judged necessary but the data collected during Phase I are insufficient for the assessment, a second phase of sampling will be done to characterize in more detail the nature and extent of the release.

A major concern at OU 1132 is the potential for movement of contaminants off site during flooding. If Phase I studies give evidence of such movement, a Phase II sampling plan will be designed in coordination with the OU 1049 (Canyons) RFI.

To ensure that the right type, amount, and quality of data are collected, data quality objectives will be developed for the RFI Phase I sampling and analysis plans described in this work plan. Field work for many sites includes field surveys and field screening of samples; samples for laboratory analysis will be selected on the basis of the results of this field work. All samples will be screened and/or analyzed for radioactive contamination, whether or not radioactive constituents are suspected in a given sample.

The six main chapters of this work plan are followed by five annexes; these describe the project plans, which correspond to the program plans in the IWP: project management, quality assurance, health and safety, records management, and community relations.

Schedule, Costs, and Reports

The RFI field work described in this document requires 1.6 years to complete. This assumes a single phase of field work, which is expected to be sufficient for most PRSs; however, a second phase will be scheduled if the results of Phase I show a need for it; in that case, the field work will take longer.

Cost estimates for baseline activities to complete the RFI for OU 1132 are provided in Table ES-1. The estimates for costs and schedule are the latest available, from the fiscal year 93 baseline request. These will be updated as appropriate.

TABLE ES-1
ESTIMATED COSTS OF COMPLETING OU 1132 RFI

Estimate to Complete	$13 785 000
Escalation	1 946 000
Prior Years	437 000
Total at Completion	$16 168 000

The HSWA Module stipulates the submittal of monthly reports and quarterly technical progress reports. In addition, an RFI phase report will be submitted at the completion of each of the sampling plans. The phase report will serve as

- a partial summary of the results of initial site characterization activities,
- a vehicle for proposing modifications to the sampling plans suggested by the initial findings,
- a work plan that describes the next phase of sampling (if such sampling is required),
- a vehicle for recommending VCA or NFA as mechanisms for delisting PRSs shown by the RFI to have acceptable health-based risk levels, and
- a summary of the sampling plan for that phase.

At the conclusion of the RFI, a final RFI report will be submitted to the EPA.

Public Involvement

Regulations issued pursuant to HSWA mandate public involvement in the corrective action process. In addition, the Laboratory is providing a variety of opportunities for public involvement, including meetings held as needed to disseminate information, to discuss significant milestones, and to solicit informal public review of this and the other draft work plans. It also distributes meeting notices and updates the ER Program mailing list; prepares fact sheets summarizing completed and future activities; and provides public access to plans, reports, and other ER Program documents. These materials are available for public review between 9:00 a.m. and 4:00 p.m. on Laboratory business days at the ER Program's public reading room (1450 Central Avenue in Los Alamos) and at the main branches of the public libraries in Española, Los Alamos, and Santa Fe.

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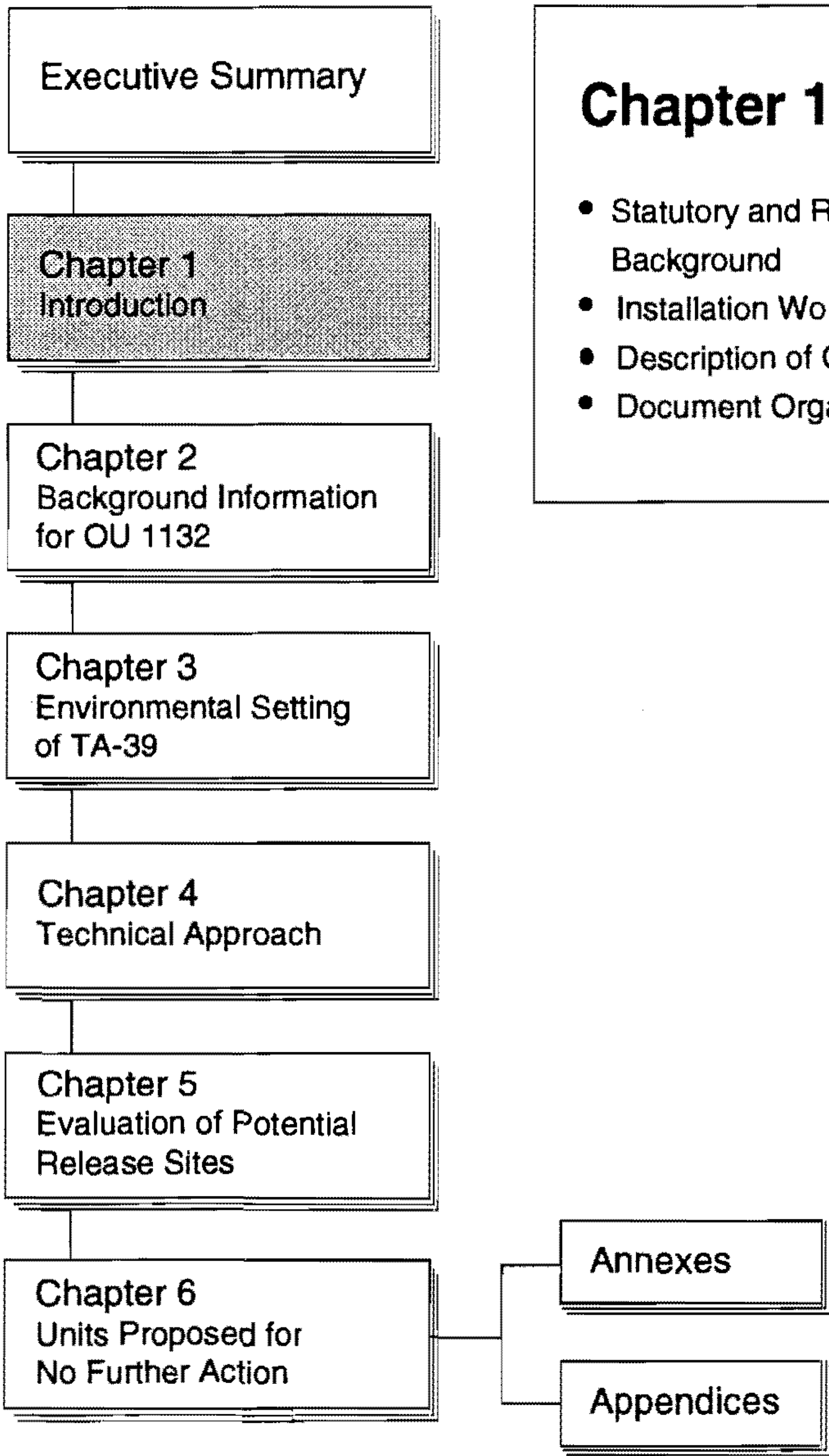
ABBREVIATIONS AND ACRONYMS USED
IN THE OU-1132 RFI WORK PLAN

ACGIH	American Conference of Governmental Industrial Hygienists
ADS	Activity data sheet
ALARA	As low as reasonably achievable
AOC	Area of concern
ANSI	American National Standards Institute
API	American Petroleum Institute
AR	Administrative requirement
ASTM	American Society for Testing and Materials
BRET	Biological resource evaluation team
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGI	Combustible gas indicator
CMI	Corrective measures implementation
CMS	Corrective measures study
DOE	US Department of Energy
DOE/AL	US Department of Energy/Albuquerque Operations Office
DQO	Data quality objective
EM	Environmental Management (Division)
EM-7	Waste Management Group
EM-8	Environmental Protection Group
EM-9	Health and Environmental Chemistry Group
EM-13	Environmental Restoration Group
EPA	US Environmental Protection Agency
ER	Environmental restoration
ESG	Environmental Surveillance Group
ES&H	Environment, safety, and health
FIDLER	Field instrument for detection of low-energy radiation
FIMAD	Facility for Information Management, Analysis, and Display
FY	Fiscal year
GPR	Ground-penetrating radar
HAZWOPER	Hazardous Waste Operations & Emergency Response
HE	High explosive
HMX	"Her Majesty's Explosive" (cyclotetramethylenetetranitramine)
HS	Health and Safety (Division)
HS-1	Radiation Protection Group
HS-2	Occupational Medicine Group
HS-3	Safety and Risk Assessment Group
HS-5	Industrial Hygiene Group
HSPL	Health and safety project leader
HSWA	Hazardous and Solid Waste Amendments
ICP	Inductively coupled plasma
IDLH	Immediately dangerous to life and health
IP	Induced polarization
IWP	Installation work plan
IWPHSPP	Installation work plan health & safety program plan

LAAO	Los Alamos Area Office (a branch of the Department of Energy)
LANL	Los Alamos National Laboratory; the Laboratory
LASL	Los Alamos Scientific Laboratory (LANL before 1979)
LP	Laboratory procedure
MDA	Material disposal area
MIS	Management information system
MWSDF	Mixed-Waste Storage and Disposal Facility
NEPA	National Environmental Policy Act
NFA	No further action
NIOSH	National Institute of Occupational Health and Safety
NMED	New Mexico Environment Department (New Mexico Environmental Improvement Division before 1991)
NPDES	National pollutant discharge elimination system
OEL	Occupational exposure limit
OSHA	Occupational Safety and Health Administration
OTD	Office of Technology Development
OU	Operable unit
OUHSP	Operable unit health and safety plan
OUPL	Operable unit project leader
PC	Protective clothing
PCB	Polychlorinated biphenyl
PEL	Permissible exposure limit
PETN	Pentaerythritol tetranitrate
PL	Project leader
PM	Program Manager (ER)
PMP	Program Management Plan
PPE	Personal protective equipment
PPL	Progammatic Project Leader
PRS	Potential release site
PVC	Polyvinyl chloride
QA	Quality assurance
QAPjP	Quality assurance project plan
QPP	Quality Program Plan
RCRA	Re[illegible]urce Conservation and Recovery Act
RDX	"R[illegible]al Dutch Explosive" (cyclonitrite, cyclotrimethylenetrinitramine)
RFI	RCRA facility investigation
RPF	Records Processing Facility
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard operating procedure
SSHSP	Site-specific health & safety plan
SSO	Site safety officer
SWMU	Solid waste management unit
SWP	Special work permit
TA	Technical area
TAL	Target analyte list
TATB	Triaminotrinitrobenzene
TCLP	Toxicity characteristic leaching procedure
TLD	Thermoluminescent dosimeter
TLV	Threshold limit values
TSD	Treatment, storage, disposal
TTL	Technical team leader (ER Program)

USATHAMA	US Army Toxic & Hazardous Materials Agency
UST	Underground storage tank
USGS	US Geological Survey
VCA	Voluntary corrective action
VCP	Vitrified clay pipe
WBS	Work breakdown structure



Chapter 1

- Statutory and Regulatory Background
- Installation Work Plan
- Description of OU 1132
- Document Organization

1.0 INTRODUCTION

1.1 Statutory and Regulatory Background

In 1976, Congress enacted the Resource Conservation and Recovery Act (RCRA), which governs the day-to-day operations of hazardous waste treatment, storage, and disposal (TSD) facilities. Sections 3004(u) and (v) of RCRA established a permitting system, which is implemented by the Environmental Protection Agency (EPA), or by a state authorized to implement the program, and set standards for all hazardous-waste-producing operations at a TSD facility. Under this law, Los Alamos National Laboratory (the Laboratory) qualifies as a treatment and storage facility and must have a permit to operate. The State of New Mexico, which is authorized by EPA to implement portions of the RCRA permitting program, issued the Laboratory's RCRA permit.

In 1984, Congress amended RCRA by passing the Hazardous and Solid Waste Amendments (HSWA), which modified the permitting requirements of RCRA by, among other things, requiring corrective action for releases of hazardous wastes or constituents from solid waste management units (SWMUs). EPA administers the HSWA requirements in New Mexico at this time. In accordance with these requirements, the Laboratory's permit to operate (EPA 1990, 0306) includes a section, referred to as the HSWA Module, that prescribes a specific corrective action program for the Laboratory. The HSWA Module includes provisions for mitigating releases from facilities currently in operation and for cleaning up inactive sites. The primary purpose of this RCRA field investigation (RFI) work plan is to determine the nature and extent of releases of hazardous waste and hazardous constituents from potential release sites (PRSs). The plan meets the requirements of the HSWA Module and is consistent with the scope of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The HSWA Module lists SWMUs, which are defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." These wastes may be either hazardous or nonhazardous (for example, construction debris). Table A of the HSWA Module identifies 603 SWMUs at the Laboratory, and Table B lists those SWMUs that must be investigated first. In addition, the Laboratory has identified areas of concern (AOCs), which do not meet the HSWA Module's definition of a SWMU. AOCs may contain radioactive materials as well as hazardous substances not listed under RCRA. SWMUs and AOCs are collectively referred to as PRSs. The ER Program uses the mechanism of recommending no further action (NFA) for AOCs as well as SWMUs. However, using this approach for AOCs does not imply that AOCs fall under the jurisdiction of the HSWA module.

For the purposes of implementing the cleanup process, the Laboratory has aggregated PRSs that are geographically related into groupings called operable units (OUs). The Laboratory has established 24 OUs, and an RFI work plan is prepared for each. This work plan for OU 1132 addresses PRSs located in one of the Laboratory's technical areas (TAs): TA-39. This plan, together with nine other work plans submitted to EPA in May of 1993 and nine plans submitted in 1990 and 1991, meets the schedule requirements of the HSWA Module, which is to address a cumulative total of 55% of the SWMUs in Table A and a cumulative total of 100% of the 182 priority SWMUs listed in Table B of the HSWA Module.

As more information is obtained, the Laboratory proposes modifications in the HSWA Module for EPA approval. When applications to modify the permit are pending, the ER Program submits work plans consistent with current permit conditions. Program documents, including RFI reports and the installation work plan (IWP; see 1.2 below), are updated and phase reports are prepared to reflect changing permit conditions.

The HSWA Module outlines five tasks to be addressed in an RFI work plan. Table 1-1 lists these tasks and indicates the ER Program equivalents. Table 1-2 indicates the location of HSWA Module requirements in ER Program documents.

1.2 Installation Work Plan

The HSWA Module required that the Laboratory prepare a master plan, called the installation work plan (IWP), to describe the Laboratory-wide system for accomplishing all RFIs and corrective measures studies (CMSs). The IWP has been prepared in accordance with the HSWA Module and is consistent with EPA's interim final RFI guidance (EPA 1989, 0088) and proposed Subpart S of 40 CFR 264 (EPA 1990, 0432), which proposes the cleanup program mandated in Section 3004(u) of RCRA. The IWP was first prepared in 1990 and is updated annually. This work plan follows the requirements specified in Revision 2 of the IWP (LANL 1992, 0768).

The IWP describes the aggregation of the Laboratory's PRSs into 24 OUs (Subsection 3.4.1). It presents a facilities description in Chapter 2 and a description of the structure of the Laboratory's Environmental Restoration (ER) Program in Chapter 3. Chapter 4 describes the technical approach to corrective action at the Laboratory. Annexes I-V contain the Program Management Plan, Quality Program Plan, Health and Safety Program Plan, Records Management Program Plan, and the Public Involvement Program Plan, respectively. The document also contains a proposal to integrate RCRA closure and corrective action and a strategy for identifying and implementing interim remedial measures. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the 1992 revision of the IWP.

1.3 Description of OU 1132

OU 1132 is located in Los Alamos county in north-central New Mexico (Figure 1-1). It contains a single active technical area, TA-39 (Figure 1-2). Twenty-seven PRSs have been identified at TA-39 (see Figures 1-3 to 1-6). Twenty-five of these are SWMUs and two have been proposed for SWMU status; all are on property owned by the US Department of Energy. RFI is recommended for 20 of these sites (including the two proposed for SWMU status). These 20 sites have been grouped into four aggregates: landfills, storage areas, firing sites (including a single-stage gas-gun site), and septic systems and seepage pits.

TA-39 was established as a remote, high-explosives test site. Experiments are conducted at the site to support research on equations-of-state, shock wave phenomena, development of implosion systems, development and application of

TABLE 1-1

RFI GUIDANCE FROM THE HSWA MODULE

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	I. LANL Installation RI/FS Work Plan	I. Quality Assurance Project Plan
A. Facility Background B. Nature and Extent of Contamination	A. Installation Background B. Tabular Summary of Contamination by Site	A. Task/Site Background B. Nature and Extent of Contamination
Task II: RFI Work Plan	II. LANL Installation RI/FS Work Plan	II. LANL Task/Site RI/FS Documents
A. Data Collection Quality Assurance Plan B. Data Management Plan C. Health and Safety Plan D. Community Relations 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	A. Quality Assurance Project Plan and Field Sampling Plan B. Records Management Project Plan C. Health and Safety Project Plan D. Community Relations Project Plan
Task III: Facility Investigation	III.	III. Task/Site Investigation
A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification		A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification
Task IV: Investigative Analysis	IV.	IV. LANL Task/Site Investigative Analysis
A. Data Analysis B. Protection Standards		A. Data Analysis B. Protection Standards
Task V: Reports	V. Reports	V. LANL Task/Site Reports
A. Preliminary and Work Plan B. Progress C. Draft and Final	A. LANL Installation RI/FS Work Plan B. Annual Update of LANL Installation RI/FS Work Plan C. Draft and Final	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

*RI/FS - remedial investigation/feasibility study.

TABLE 1-2

LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA Module Requirements or RFI Work Plans	Installation Work Plan and Other Program Documents	Documents for OU 1132
Task I: Description of Current Conditions		
A. Facility Background	IWP Section 2.1	
B. Nature and Extent of Contamination	IWP Section 2.4 and Appendix F	
Task II: RFI Work Plan		
A. Data Collection Quality Assurance Plan	IWP Annex II (Quality Program Plan)*	RFI Work Plan Annex II
B. Data Management Plan	IWP Annex IV (Records Management Program Plan)	RFI Work Plan Annex IV
C. Health and Safety Plan	IWP Annex III (Health and Safety Program Plan)	RFI Work Plan Annex III
D. Community Relations Plan	IWP Annex V (Community Relations Program Plan)	RFI Work Plan Annex V
E. Project Management Plan	IWP Annex I (Program Management Plan)	RFI Work Plan Annex I
Task III: Facility Investigation		
A. Environmental Setting	IWP Chapter 2	RFI Work Plan Chapter 3
B. Source Characterization	IWP Appendix F	RFI Work Plan Chapter 5
C. Contamination Characterization	IWP Appendix F	RFI Work Plan Chapters 4 and 5
D. Potential Receptor Identification	IWP Section 4.2	RFI Work Plan Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data Analysis	IWP Section 4.2	Phase Report and RFI Report
B. Protection Standards	IWP Section 4.2	RFI Report
Task V: Reports		
A. Preliminary and Work Plan	IWP, Rev. 0	Work Plan
B. Progress	Monthly Reports, Quarterly Reports, and Annual Revisions of IWP	Phase Reports
C. Draft and Final		Draft and Final RFI Report

* Annex II of the IWP addresses these requirements by reference to controlled documents: the Generic Quality Assurance Project Plan (LANL 1991, 0412) and the ER Program's standard operating procedures (LANL 1991, 0411).

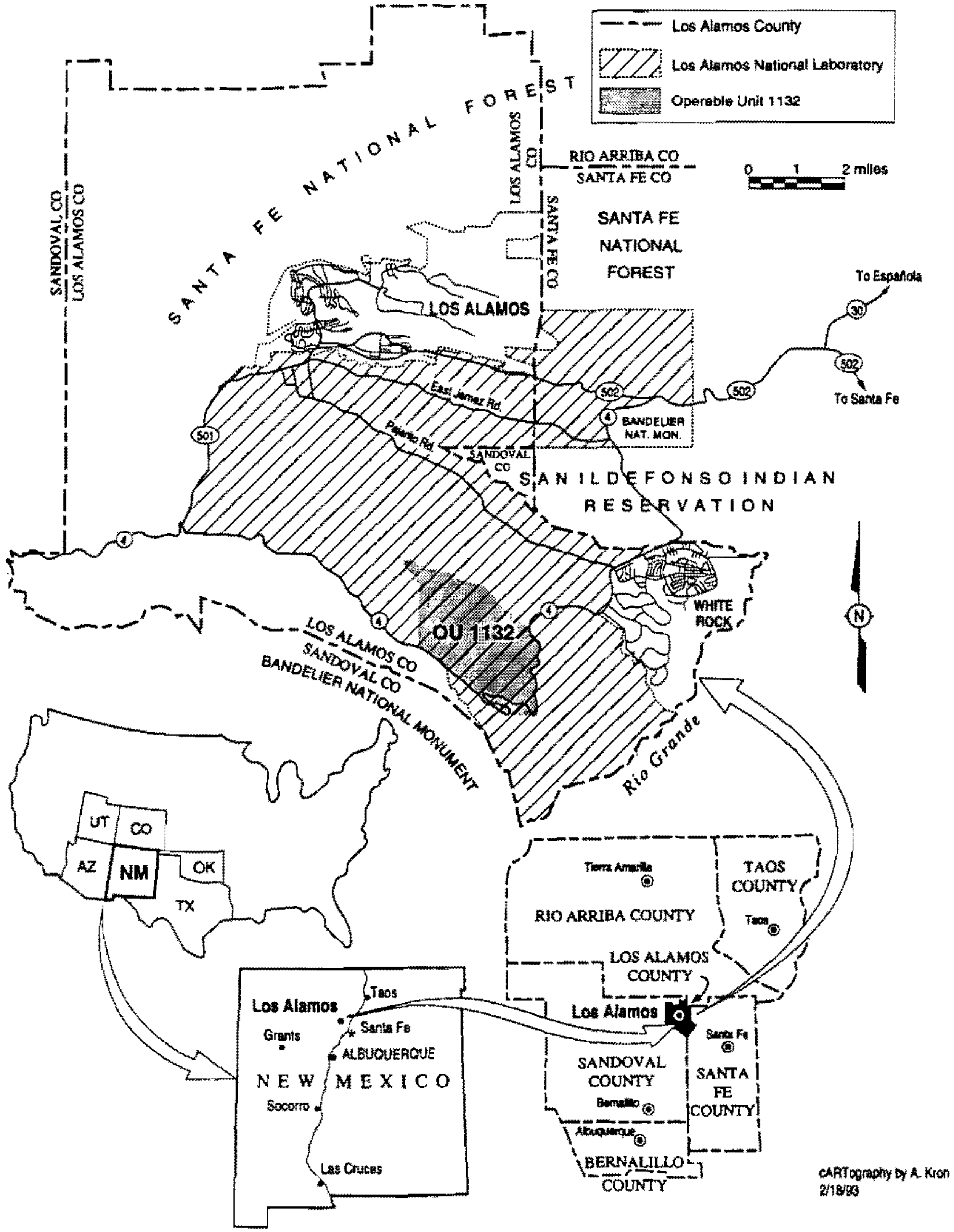


Figure 1-1. Location of Operable Unit 1132.

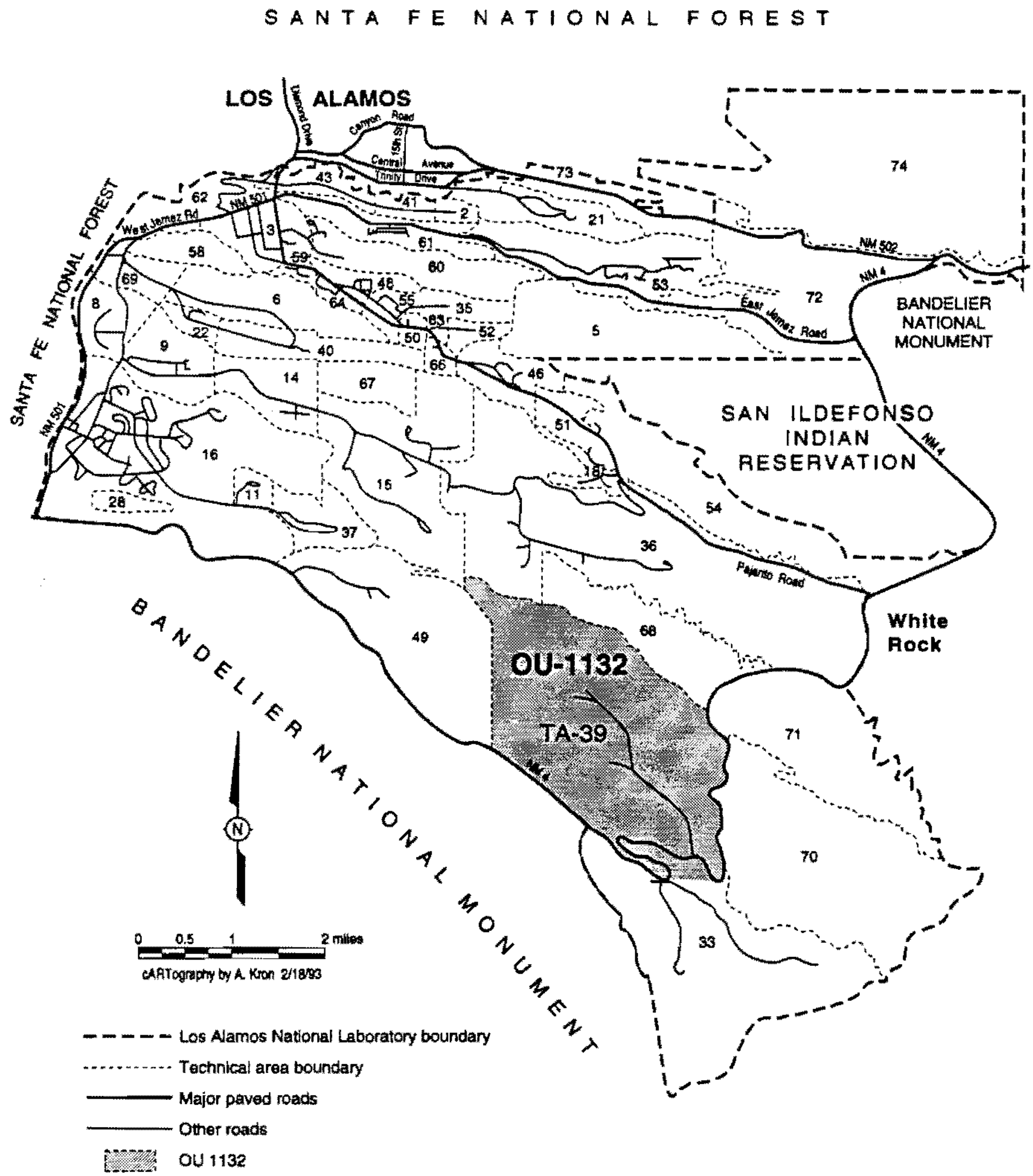


Figure 1-2. Location of Operable Unit 1132 with respect to Laboratory technical areas and surrounding landholdings.

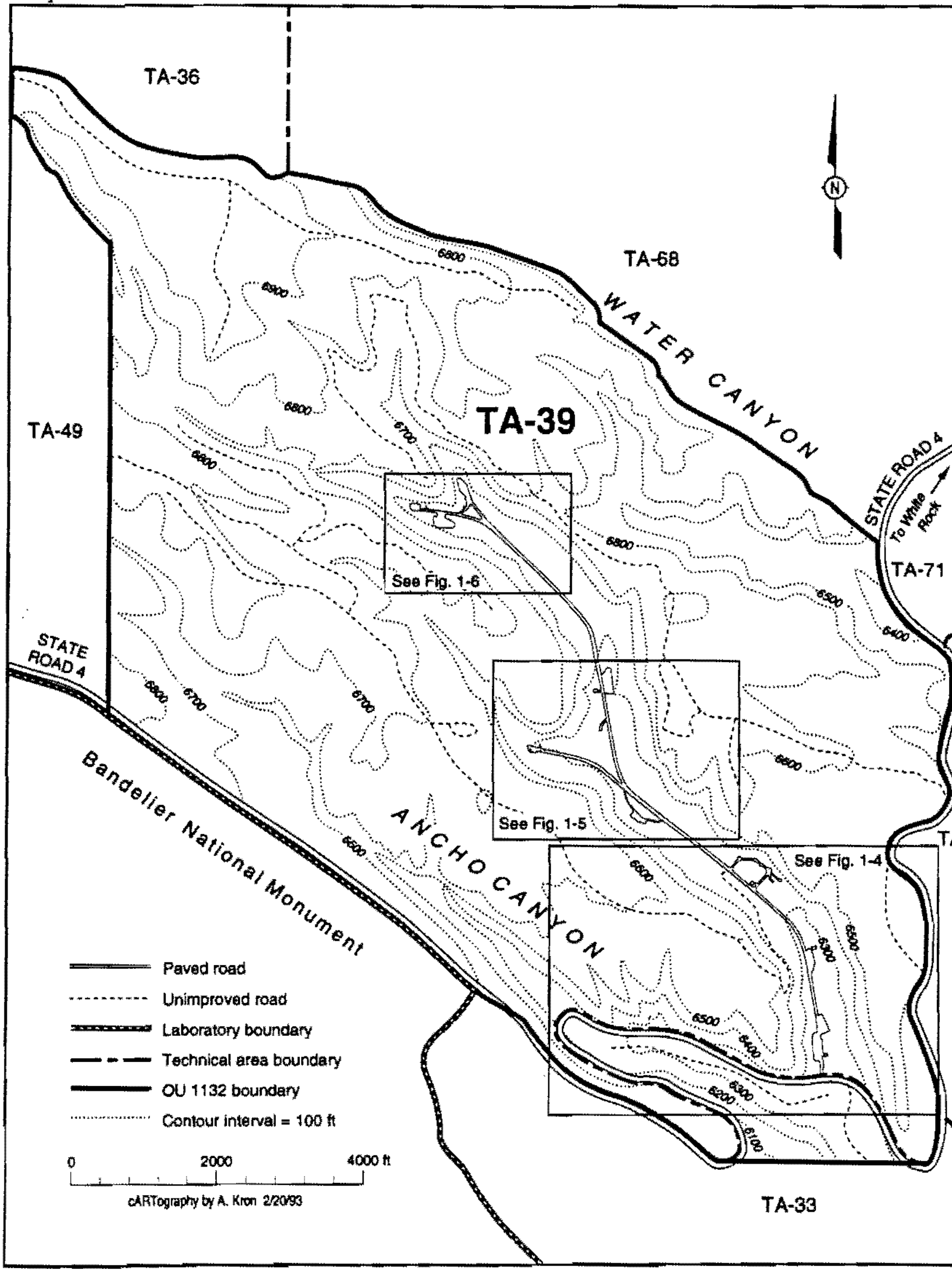


Figure 1-3. Operable Unit 1132.

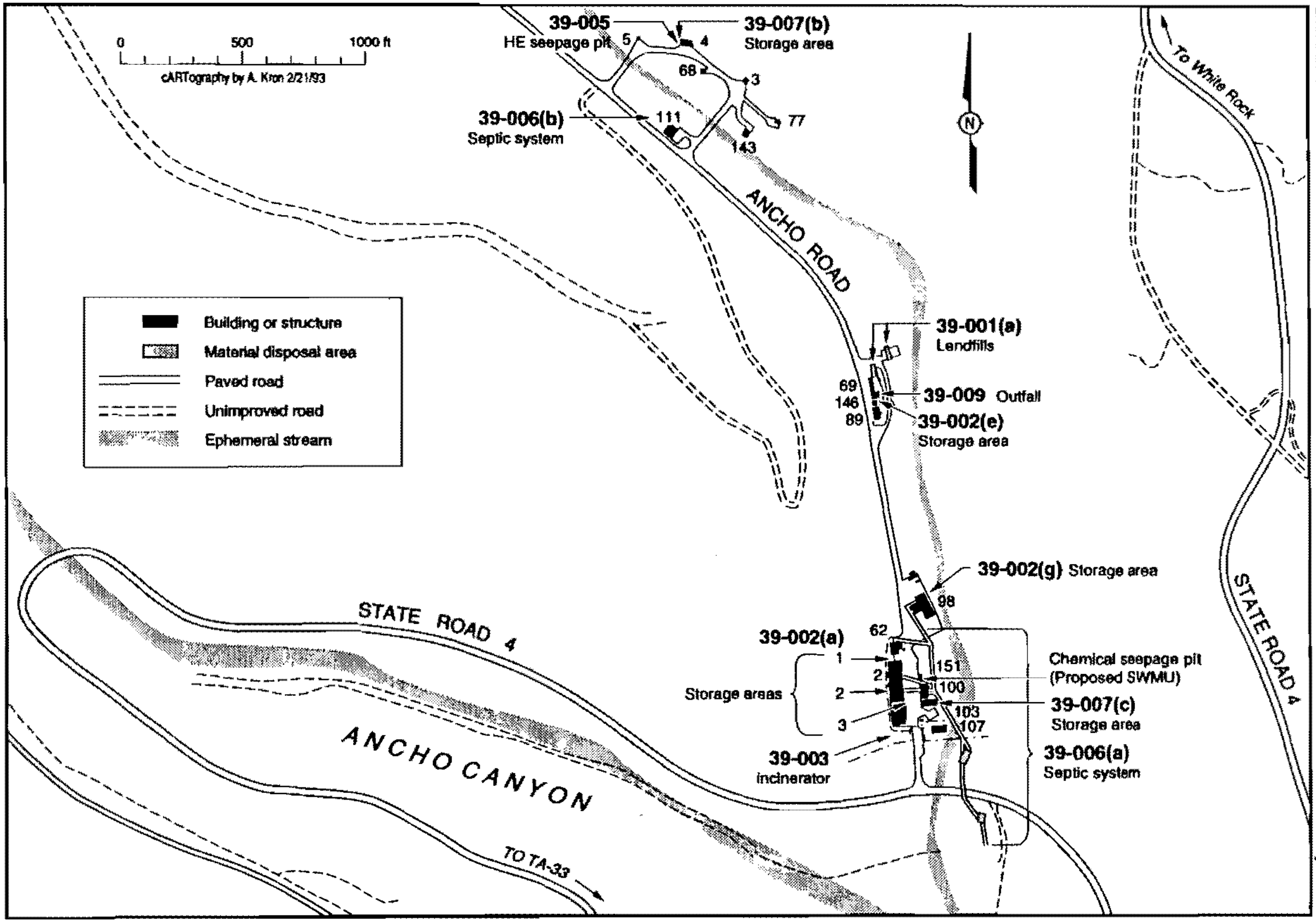


Figure 1-4. Location of PRSs in the southern portion of OU 1132.

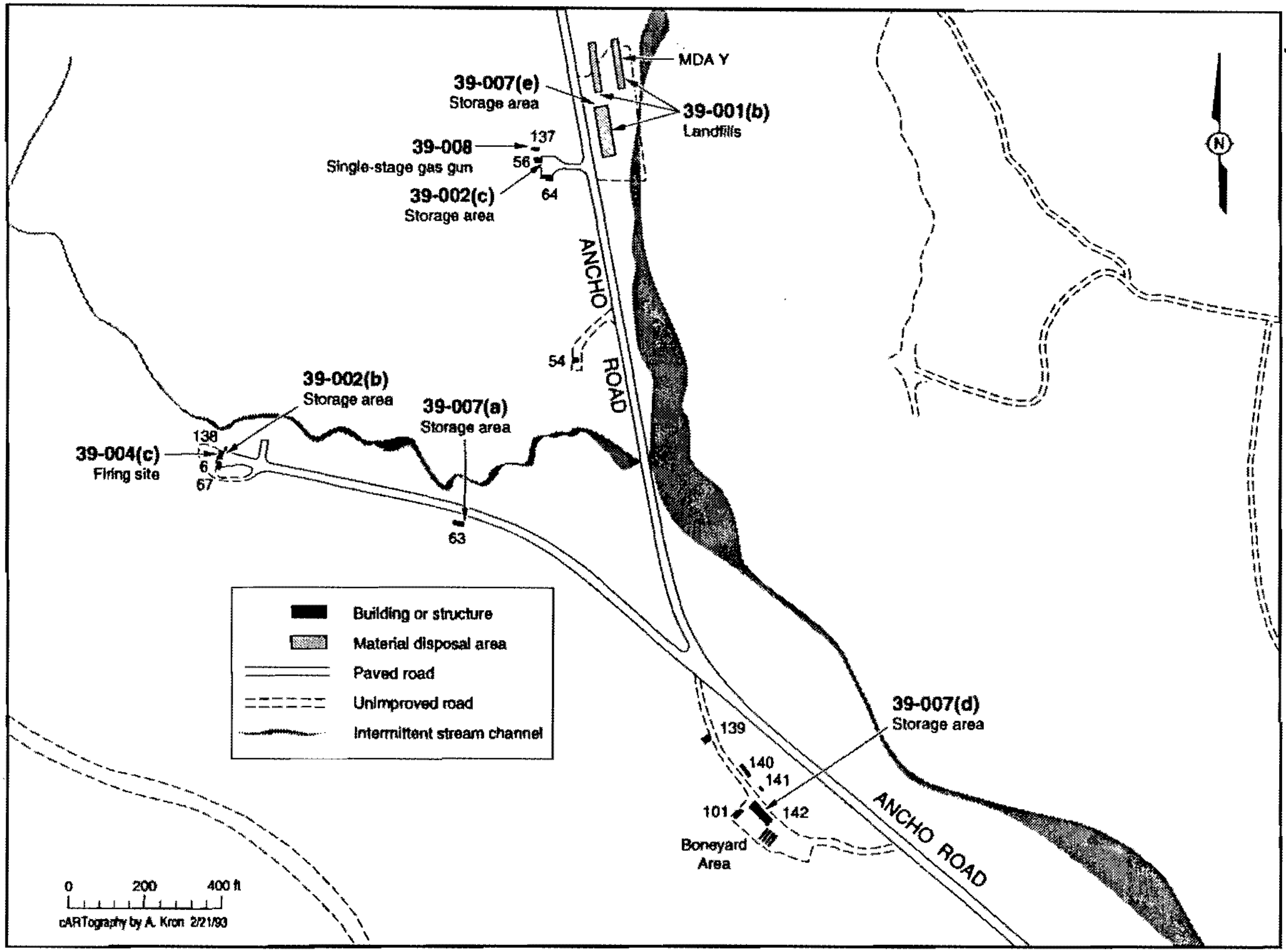


Figure 1-5. Location of PRSs in the central portion of OU 1132.

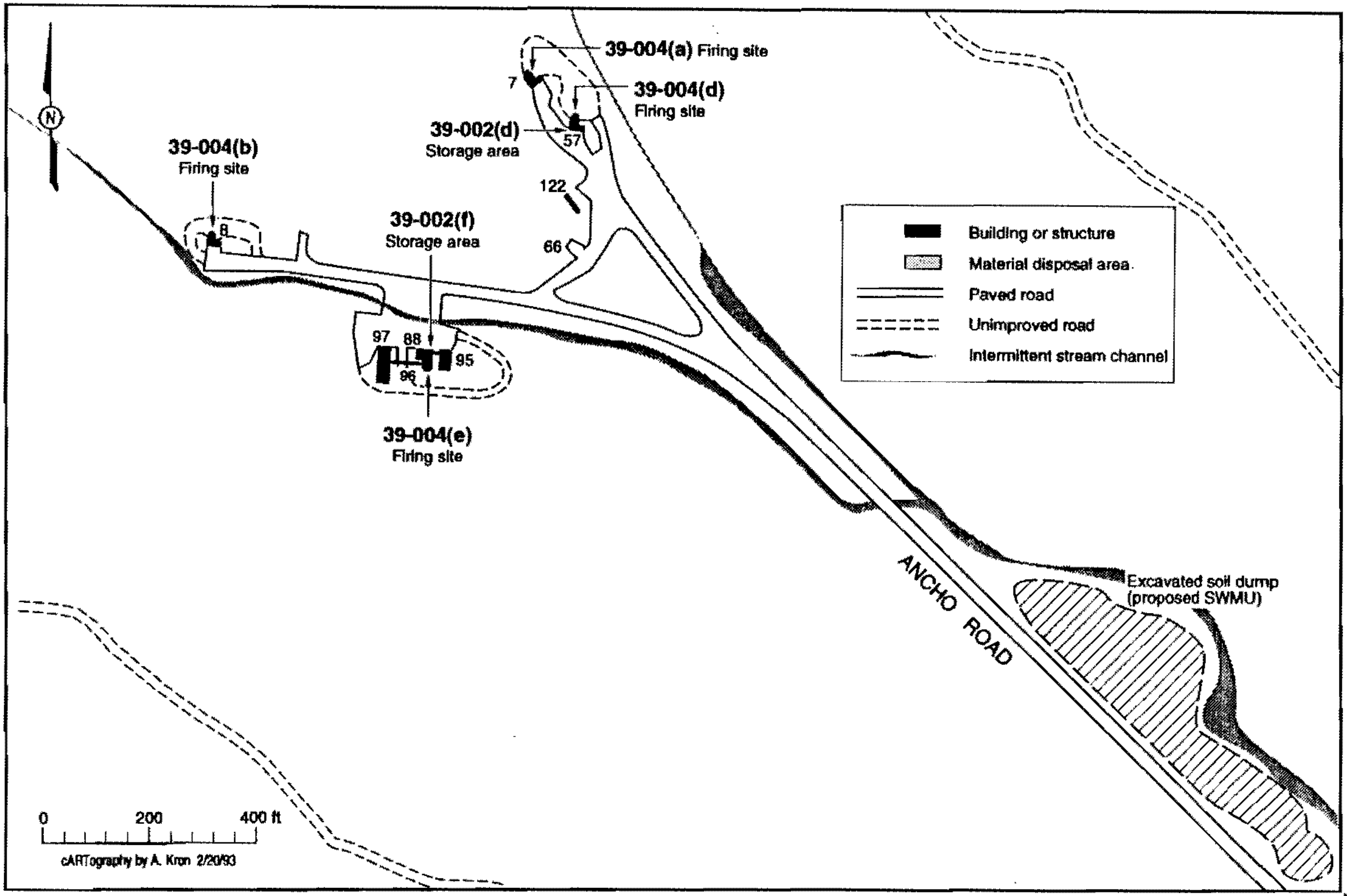


Figure 1-6. Location of PRSs in the northern portion of OU 1132.

explosively produced pulses of electrical power, and production of high magnetic fields. Most of the hazardous waste at TA-39 was generated by these activities. Contamination by heavy metals (e.g., depleted uranium, beryllium, mercury, cadmium, lead, silver) is of most concern at this site.

A feature of TA-39 that has important implications for contaminant transport is that all of the PRSs in this technical area are located in the bottom of a canyon that is a branch of Ancho Canyon; thus, all are within a few hundred feet of (and some are adjacent to) an ephemeral stream, which could rapidly carry contaminants off site. (Waters from this stream eventually discharge into the Rio Grande.)

Section 3.5 of the IWP states that each OU work plan may contain an application for a Class III permit to modify Table A of the HSWA Module when it is determined that a SWMU needs no further investigation or when it is necessary to add a SWMU to the current listing. Table 1-3 lists the SWMUs to be addressed in this work plan and shows which we propose for RFI and which for no further action (NFA) (see Chapter 4, Section 4.5.1, for a discussion of the criteria used to recommend NFA for a site). EPA's approval of this work plan has the effect of delisting NFA SWMUs unless otherwise specified by that agency. Official delisting is by permit modification, if appropriate.

1.4 Organization of This Work Plan and Other Useful Information

This work plan follows the generic outline provided in Table 3-2 of the IWP (LANL 1992, 0768). Following this introductory chapter, Chapter 2 provides background information on OU 1132, which includes a description and history of the OU, a description of past waste management practices, and current conditions at technical areas in the OU.

Chapter 3 describes the environmental setting, and Chapter 4 presents the technical approach to the field investigation. Chapter 5 contains an evaluation of all the PRSs in OU 1132, which includes a description and history of each PRS, a conceptual exposure model, remediation alternatives, sampling plan objectives, and a sampling plan. Chapter 6 provides a brief description of each PRS proposed for NFA and the basis for that recommendation.

The body of the text is followed by five annexes, which consist of project plans corresponding to the program plans in the IWP: project management, quality assurance, health and safety, records management, and public involvement. Appendix A lists the engineering drawings and the Environmental Restoration Standard Operating Procedures (SOPs) used, Appendix B gives details of field sampling procedures, and Appendix C contains a list of contributors to this work plan.

The units of measurement used in this document are expressed in both English and metric units, depending on which unit is commonly used in the field being discussed. For example, English units are used in text pertaining to engineering, and metric units are often used in discussions of geology and hydrology. When information is derived from some other published report, the units are consistent with those used in that report. A conversion table is provided at the end of this work plan.

A list of abbreviations and acronyms precedes Chapter 1. A list of references appears at the end of each chapter. A glossary of unfamiliar terms is provided in the IWP (LANL 1992, 0768).

TABLE 1-3

PRSs IN OU 1132

OU 1132 PRSs	Appears in HSWA Table A	Appears in HSWA Table B	Proposed for RFI	Proposed for NFA
39-001(a)	X*	X*	X	
39-001(b)	X*	X*	X	
39-002(a)	X		X	
39-002(b)	X		X	
39-002(c)			X	
39-002(d)			X	
39-002(e)			X	
39-002(f)			X	
39-002(g)				X
39-003	X			X
39-004(a)			X	
39-004(b)			X	
39-004(c)	X		X	
39-004(d)	X		X	
39-004(e)	X		X	
39-005			X	
39-006(a)	X		X	
39-006(b)	X			X
39-007(a)			X	
39-007(b)				X
39-007(c)				X
39-007(d)			X	
39-007(e)				X
39-008			X	
39-009				X
Chemical seepage pit (proposed SWMU)			X	
Excavated soil dump (proposed SWMU)			X	

*Because individual pits were numbered instead of the two landfill locations, 39-001(a) was listed as 39-001(a) and (b), and 39-001(b) as 39-001(c), (d), and (e).

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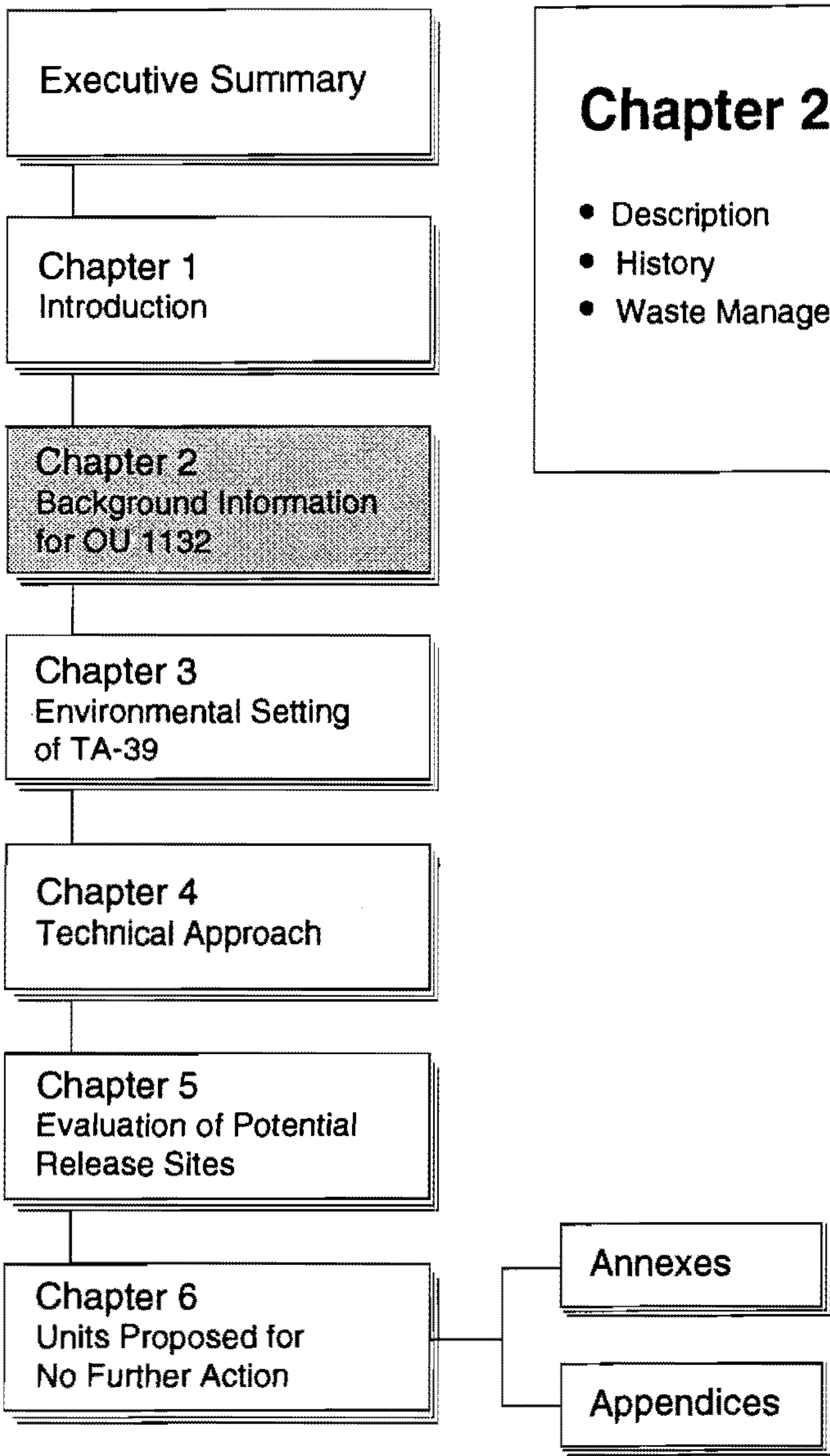

Chapter 2

- Description
- History
- Waste Management Practices

2.0 BACKGROUND INFORMATION FOR OU 1132

2.1 Description

OU 1132 consists primarily of canyons and mesas; it lies at elevations between 6,300 and 6,960 ft and is located in the southern part of the Laboratory (see Chapter 1, Figures 1-1 to 1-3). The OU includes much of the mesa between Water Canyon on the north and Ancho Canyon on the south, which is dissected by the northern fork of Ancho Canyon and by Indio Canyon. TA-39 is the only active Technical Area in this OU (although a small unoccupied portion of TA-33 is physically part of the OU).

The structures and firing sites of TA-39 are located in the north fork of Ancho Canyon, in a 2-mile-long area bounded by canyon walls (see Figures 1-3 to 1-6 in Chapter 1). The open-air detonation areas (TA-39-6, -7, -8 -57, and -88), the main laboratory (TA-39-2), the main magazine (TA-39-3), the trim (high-explosives-assembly) building (TA-39-4), and the ready magazine (TA-39-5) are made of concrete. The two gas-gun buildings (TA-39-137 and -69), the support building for TA-39-69 (TA-39-89), the main shop (TA-39-98), and several storage buildings are metal. The most recent office buildings (TA-39-100, -103, and -107) are transportable units.

The firing sites are built into embankments that enclose three sides of the structure, the fourth (the entrance) being at ground level. A variety of experiments using high explosives are conducted on top of the embankment level; these experiments aid researchers in equation-of-state studies, shock-wave-phenomena studies, development of implosion systems, development and application of explosively produced pulses of electrical power, and production of high magnetic fields (DOE 1987, 0264). Of the five firing sites originally built for open-air testing of explosives, four are still active and will remain so into the foreseeable future.

The SWMU Report (LANL 1990, 0145) lists twenty-five SWMUs in OU 1132: two inactive landfill areas (39-001), seven active waste storage areas (39-002), one incinerator (39-003), five firing sites (39-004), a seepage pit (39-005, referred to in some site documents as a "sump and drain field"), two septic systems (39-006), five inactive waste storage areas (39-007), possible soil contamination at the single-stage gas-gun site (39-008), and a drainline and outfall (39-009). It should be noted that use of the storage areas has varied over time, and some of the areas originally identified as inactive are currently in use, whereas some of those called active are not in current use.

TA-39 is still used for open-air detonation tests, occasional firings of projectiles into the canyon cliffs, and gas-gun experiments wherein both target and projectile are contained within a special chamber.

2.2 History

TA-39 was established in 1953, primarily as an area for the open-air testing of high explosives for the shock wave physics group, and has been continuously occupied since that time. The site was selected because of its remote location. It originally consisted of three firing sites (TA-39-6, -7, and -8), a main building containing offices, a laboratory, and a shop (TA-39-2), a high-explosives-assembly building (TA-39-4), two magazines (TA-39-3 and -5), and a single-stage gas gun. By the 1980s, two additional firing sites (TA-39-57 and -88), a capacitor bank enclosure (TA-39-67), a two-stage gas-gun facility (TA-39-69), a third magazine (TA-39-77), a metal shed enclosure for the single-stage gas gun, and two gas-gun support buildings (TA-39-56 and -89) had been added (DOE 1987, 0264). Between 1984 and 1986, three transportable office buildings (TA-39-100, -103, and -107) were set up across the road from TA-39-2; in 1987 the shop was relocated from TA-39-2 to a separate metal building (TA-39-98); and in 1989 the pulsed-power assembly building (TA-39-111) and its septic system (PRS 39-006[b]) were constructed.

2.3 Waste Management Practices

Because of the relative isolation of TA-39, most of the waste generated there has been disposed of on site. Before the creation of the first on-site landfills in 1959, waste from the firing sites was generally hauled to the Laboratory landfill just north of the Los Alamos airport. On a few occasions, however, such debris was dumped into the dry stream bed in the canyon, whence most of it has been carried off site during flooding. The debris included electrical cables (typically about 40 ft in length), plywood, garbage cans destroyed in the experiments, and empty acetone bottles. No radioactive materials were being used at that time. Paper waste from the office building was burned in an incinerator (39-003) located near TA-39-2; and because no regulations on proper disposal of solvent waste were in place, this waste was either dumped onto the ground or left in a pan to evaporate (Wheat 1992, 18-0017).

Beginning in 1959, landfills were established in Ancho Canyon. At least five large pits were dug, in two locations (39-001[a] and [b]), over the years. Each pit was covered over when full, the last one in 1989. Materials disposed of in these pits range from ordinary office waste to refuse from the firing sites. The latter include beryllium, mercury, silver, copper, brass, iron, lead, steel, thallium, cadmium, thorium-232, natural and depleted uranium, solvents, and PCB-containing oil (LANL 1990, 0145). In addition, plutonium was used in some of the contained gun experiments (DOE 1987, 0264); its use in these was closely monitored.

In addition to being disposed of in landfills, waste from the firing sites (including, often, debris from impact or acoustical erosion of nearby cliffs) either accumulated or was scraped up into mounds. Such debris mounds have been identified so far at three firing sites (39-004[a],[b], and [d]) and at the single-stage gas-gun site (39-008). At the latter, the area between the building and the cliff was leveled and the removed materials were pushed to the south side of the site, creating a sizable mound.

Large amounts of earth were removed in preparation for the construction of the most recent firing site, TA-39-88 (39-004[e]). The excavated materials were dumped some 1500 ft southeast of the site, between the road and the stream channel. Although much of this material apparently was excavated out of the natural hillside, the dump would also include materials from the surface areas, which, by proximity to older firing sites (39-004[a],[b],[d]), are very likely to have been contaminated by the experiments at those sites.

From 1953 to 1987, high-explosive (HE) particles, liquid waste (and, possibly, solvents) were disposed of in a seepage pit (39-005). The pit and contaminated soils from the drain field were removed, and no evidence of HE residuals has been found (LANL 1990, 0145; McCormick 1993, 18-0015).

Two septic systems are currently in use at TA-39. The first (39-006[a]) was installed in 1952 and consisted of a septic tank and a subsurface sand filter. In 1973, water began coming to the surface of the sand filter and discharging into Ancho Canyon. The problem was traced to years of routine dumping of photographic processing chemicals into the system. To correct this, a separate seepage pit for these chemicals was put in place (Francis 1992, 18-0010). In addition, the septic tank was enlarged and a new subsurface sand filter was put in place on the south side of State Road 4. By 1978, the new sand filter had become clogged. It was redesigned and replaced for the second time in 1985, when a new 2500-gal. septic tank was installed.

The second septic system (39-006[b]) was installed for the pulsed-power assembly building (TA-39-111). This system has a capacity of 1000 gallons and discharges into a leach field (LANL 1990, 0145).

A number of storage areas, some active and some inactive (see Section 2.1), are scattered throughout TA-39. These areas have been used at various times to store both unused and waste materials (sometimes concurrently), but they are principally used to store waste. Wastes stored include oil that contains lead and solvents; scrap HE; organic solvents; photographic processing chemicals; and radioactive materials (see Table 5-3 in Chapter 5). Those storage areas whose potential for release of contaminants to the environment is essentially nil (e.g., those located inside buildings) will not be sampled; all others will be investigated during the RFI.

Waste cooling water is discharged into Ancho Canyon from one location (39-009). This outfall, which operates under a National Pollutant Discharge Elimination System (NPDES) permit (LANL 1990, 0145), releases only potable water and has never been used for discharges of contaminated water.

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Executive Summary

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3.0 ENVIRONMENTAL SETTING OF TA-39

An understanding of the environmental setting—climate, topography, soils, geology, and hydrology—of a site is essential for assessing contaminant migration pathways. In this chapter, we provide that specific information for OU 1132, as a supplement to Chapter 2 of the IWP (LANL 1992, 0768), where the general environmental setting of Los Alamos National Laboratory is described.

3.1 Physical Description

The physical setting of the Pajarito Plateau, land ownership, and land-use patterns are discussed in Sections 2.1, 2.5.2, and 2.5.4 of the IWP.

OU 1132 contains only one Technical Area, TA-39, located in the southeastern portion of the Laboratory and bordered on the south by Bandelier National Monument (see Figure 1-1 in Chapter 1). TA-39 covers about 3.8 mi^2 and ranges in elevation from 6300 to 6960 ft. A number of canyons dissect the area, including Water Canyon, Ancho Canyon, and Indio Canyon. All of the TA-39 facilities are located in the north fork of Ancho Canyon (Figure 3-1); most if not all of the disturbance associated with TA-39 activities (site development, open-air explosions, waste generation and disposal) has been in this canyon. Public access to TA-39 is restricted.

3.2 Climate

General climatic information for the Los Alamos-White Rock area is given in Section 2.5.3 of the IWP. Very little or no climatic data specifc to TA-39 have been collected. Of the several Laboratory weather stations, the White Rock station would represent the climatic conditions closest to those at TA-39. Average annual precipitation at White Rock is about 14 in. About 40 percent of this precipitation comes in July and August in the form of brief, intense thunderstorms that can produce significant surface runoff and, occasionally, flash flooding. Snowmelt produces small amounts of runoff as well (Bowen 1990, 0033). The annual distribution of precipitation is illustrated in Figure 3-2. The erosion that results from these events is an important mechanism of contaminant transport at TA-39.

Average monthly temperatures for the southern section of the Laboratory, where TA-39 is located, are also shown in Figure 3-2. The only detectable shift in climatic patterns during the period of record (1911 - 1988) is slightly cooler temperatures and higher precipitation from 1961 to 1988.

Wind speed and direction are measured at five locations around the Laboratory (ESG 1989, 0308). The closest wind-measuring station to TA-39 is at TA-54, about 2 miles to the north. Strong winds occur mainly in the spring. Although wind directions in Los Alamos are quite variable because of the complex terrain, the predominant wind direction, especially for strong winds, is from the south-southwest. Wind-borne contaminants are therefore most likely to have been transported to the north-northeast of TA-39.

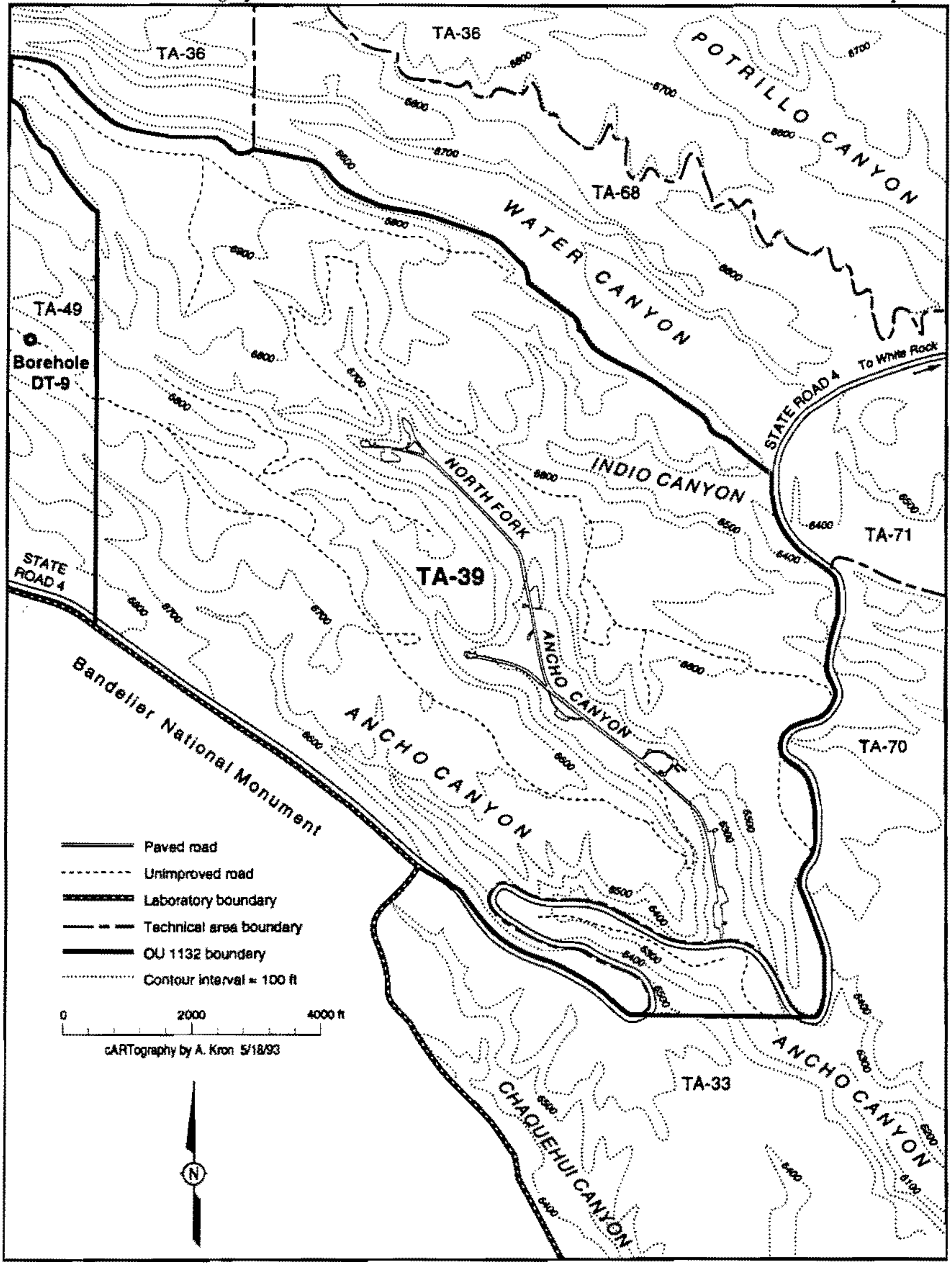


Figure 3-1. Topographic map of OU 1132 and surrounding area.

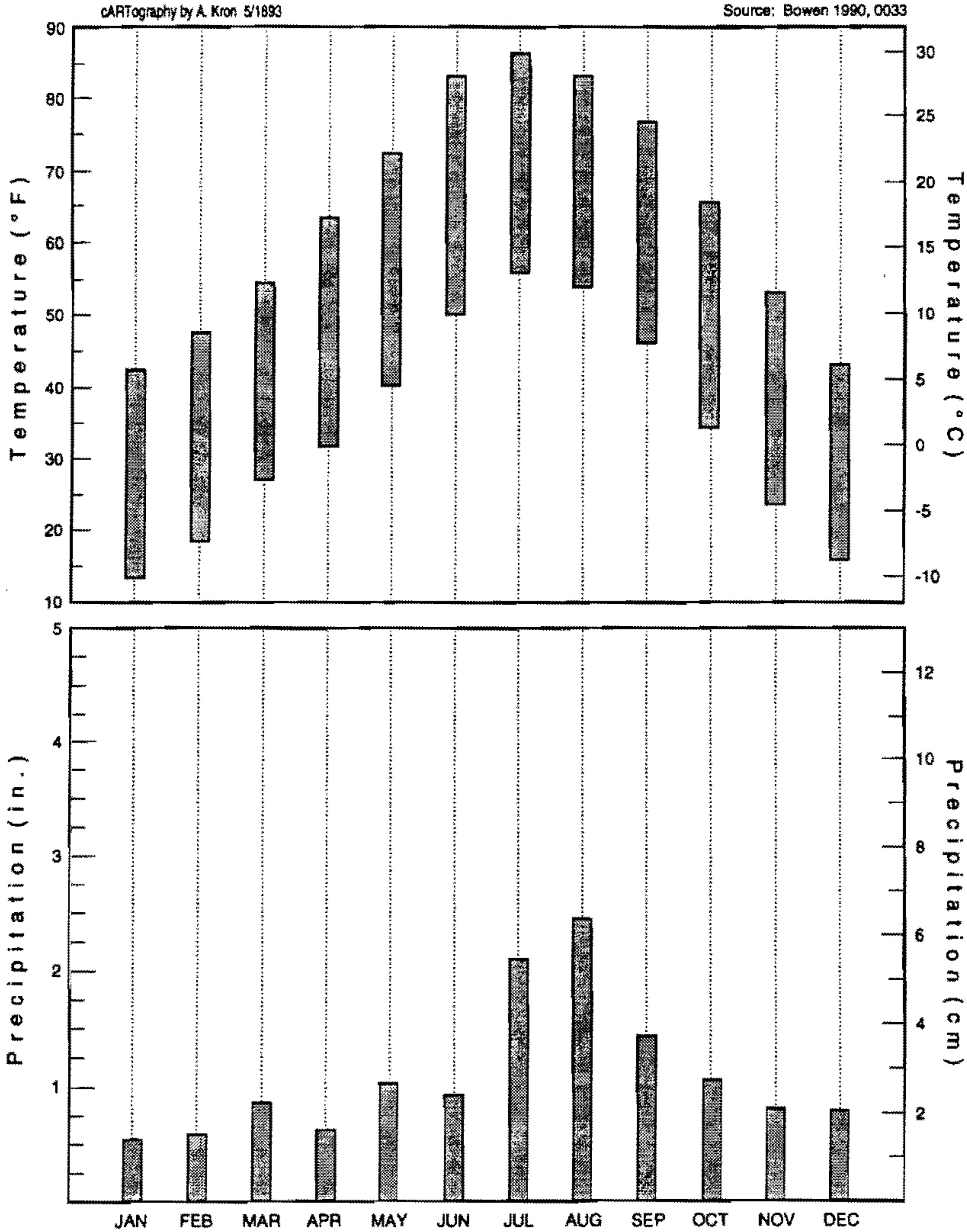


Figure 3-2. Monthly mean temperature and precipitation values for White Rock.

3.3 Biological Resources

3.3.1 Background

During 1992, the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (EM-8) carried out field surveys at OU 1132. The full report, *Biological and Flood Plains/Wetlands Assessment for the Environmental Restoration Program, OU 1132, Ancho Canyon* (Dunham, in preparation) will contain specific information on the survey methods and results, with particular attention to any restrictions that may be imposed on RFI activities to protect the environment and the biota. It will also include information that may aid in defining ecological pathways and restoring vegetation.

3.3.2 Relevant Statutes, Orders, and Regulations

The field surveys were conducted in compliance with the Federal Endangered Species Act of 1973, the New Mexico Conservation Act, the New Mexico Endangered Plant Species Act, Executive Order 11990 ("Protection of Wetlands"), Executive Order 11988 ("Floodplain Management"), 10 CFR 1022, and DOE Order 5400.1.

3.3.3 Methodology

The surveys had four objectives:

1. to determine the presence or absence of any critical habitat for any State or Federal sensitive, threatened, or endangered plant or animal species within the OU's boundaries,

2. To ascertain whether, and to what extent, RFI activities might affect these species.

3. to identify the presence or absence of any sensitive areas (such as floodplains and wetlands) within the region to be sampled and, if present, the extent and general characteristics of those areas, and

4. to obtain additional plant and wildlife data concerning the habitat types within the OU.

The survey data provide basic information about the biological components of the site and the site's status as a habitat before any sampling and site characterization activities begin. This information also becomes a component of the National Environmental Policy Act (NEPA) documentation for the site, on the basis of which a Categorical Exclusion may be granted. (Refer to 10 CFR 1021, Subpart D, Appendix B, for an explanation of the Categorical Exclusion [DOE 1992, 0868].)

EM-8 maintains a database of the habitat requirements for all State and Federal threatened or endangered plant and animal species known to occur within the boundaries of Los Alamos National Laboratory and surrounding areas. On the basis of the information therein, a Level 2 habitat evaluation survey was conducted. (Level 2 is for areas that are not highly disturbed and could potentially support threatened or endangered species.) The plant portion of the survey was designed to gather data on the percent cover, density, and frequency of both the understory and overstory components of the plant community.

The habitat information gathered through the field surveys was then compared with the requirements for species of concern identified in the database search. If habitat requirements were not met, no further surveys were conducted and the site was considered cleared with respect to impact on state and federally listed species. If habitat requirements were met, species surveys were done in accordance with pre-established protocols, which in some cases specify particular meteorological or seasonal conditions.

All wetlands and flood plains within the survey area were noted using National Wetlands Inventory maps, flood plain maps, and field checks. Characteristics of wetlands and riparian areas were noted using criteria outlined in the *Corps of Engineers Wetlands Delineation Manual* (Army Corps of Engineers 1987, 0871). Flood-plain boundaries were delineated by McLin (1992, 0825) using models developed by the Army Corps of Engineers.

3.3.4 Survey Results

The dominant trees within the overstory vegetation of OU 1132 are one-seed juniper *(Juniperus monosperma)*, pinon pine *(Pinus edulis)*, and ponderosa pine *(Pinus ponderosa)*. The shrub layer is primarily composed of wavyleaf oak *(Quercus undulata)*, Gambel oak *(Quercus gambelli)*, mountain mahogany *(Cercocarpus montanus)*, skunkbush *(Rhus trilobata)*, Apache plume *(Fallugia paradoxa)*, and rubber rabbit brush *(Chrysothamnus nauseosus)*. Dominant forbs and grasses include blue grama *(Bouteloua gracilis)*, Mountain muhly *(Muhlenbergia montana)*, snakeweed *(Guterrezia sarothrae)*, and bitterweed *(Hymenoxys richardsonii)*. In canyon bottom areas that have been disturbed by activity, the dominant vegetation includes a number of species characteristic of such environments, such as cheat grass *(Bromus tectorum)* and false tarragon sagebrush *(Artemisia dracunculus)*.

In the western-most portions of the OU, near the boundary with TA-49, the north-facing slopes of Frijoles Mesa display the occasional Douglas fir *(Pseudotsuga menziesii)* and white fir *(Abies concolor)*. At these higher elevations, ponderosa pine becomes the dominant overstory species in areas not burned by the 1977 La Mesa fire.

The following habitats were identified:

Ancho Canyon System

- Mesa top
  - Pinon-Wavyleaf oak
  - Pinon-Mountain mahogany
- North-facing slopes/canyon bottoms
  - Ponderosa pine-Gambel oak
  - Pinon-rabbit brush-Apache plume
- South-facing slopes
  - Pinon-Juniper

Frijoles Mesa
- Mesa top
  - Pinon-Wavyleaf oak
  - Pinon-Gambel oak

Within the OU there are an estimated 175 species of plants, 71 species of nesting birds, 22 species of mammals, and 8 species of reptiles and amphibians. Studies done by Travis (1992, 0869) indicate that the pinon-juniper woodland has the fewest bird species; the ponderosa pine and douglas fir forest, with its more varied understory and shrub canopy, supports the greatest number.

No threatened or endangered plant species were found during the field season of 1992. (However, the survey did not coincide with blooming of all such plants. Additional surveying may be required if sampling is proposed within any sensitive habitat. BRET will be notified of specific sampling locations.)

Only one threatened or endangered animal species has potential for occurrence within or near OU 1132: the spotted bat (*Euderma macalatum*), which is listed by the state as endangered and listed federally as endangered candidate. This bat is found in pinon-juniper, ponderosa pine, mixed conifer, and riparian habitats. Its two critical requirements are a source of water and roost sites (caves in cliffs or rock crevices). Water Canyon and Ancho Canyon should have sufficient roost sites, but water sources appear to be limited. (Suitable water is defined as small ponds or pools of slowly moving water.) To date, no spotted bats have been mist-netted on Laboratory property. The proposed OU-1132 site characterization is not expected to affect the spotted bat if small caves are not disturbed and water sources in the canyon bottoms are not altered.

3.3.5 Wetlands and Flood Plains

The stream channel in Ancho Canyon is classified by the National Wetlands Inventory as an intermittent riverine system. Field checks of the area indicate that the soil does not remain saturated long enough for the channel to qualify as a jurisdictional wetland. Flood-plain maps developed by McLin (1992, 0825) indicate that a flood plain does exist within Ancho Canyon. In compliance with 10 CFR 1022, a Flood-Plain/Wetland Involvement Notification will be submitted to the Federal Register for public comment. RFI activities are not anticipated to adversely affect the Ancho Canyon flood plain or the intermittent riverine system as long as the work practices outlined in Chapter 4, Section 4.9.3, are adhered to.

3.4 Cultural Resources

During the summer of 1992, a cultural resource survey was conducted at OU 1132, as required by the National Historic Preservation Act of 1966 (as amended). The methods and techniques used for this survey conform to those specified in *Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines* Notice. (National Park Service 1983, 0632)

Twenty-nine archeological sites are located within the survey area (Table 3-1). Because of their research potential, twenty-seven of these are eligible for

TABLE 3-1

ARCHAEOLOGICAL SITES LOCATED WITHIN OU 1132

Site No.	Site Type[1]	Cultural Affiliation	Time Period[2]	Eligible
LA 12689A	CP	Anasazi	Coalition	Yes
LA 12689B	WC	Anasazi	Coalition	Yes
LA 12689C	CP	Anasazi	Coalition	Yes
LA 12702	CP	Anasazi	Coalition	PE[3]
K-34A-C	CP	Anasazi	Coalition-Classic	Yes
K-53	CP	Anasazi	Coalition-Classic	PE
K-54	CP	Anasazi	Coalition-Classic	Yes
K-55	CP	Anasazi	Coalition	Yes
K-56	CP	Anasazi	Coalition	Yes
K-57	CP	Anasazi	Coalition	Yes
K-58	SH	Anasazi	Coalition	PE
K-60	CP	Anasazi	Coalition	Yes
K-61	CP	Anasazi	Coalition-Classic	Yes
K-62	SH	Anasazi	Coalition	Yes
K-63	CP	Anasazi	Coalition	Yes
K-64	CP	Anasazi	Coalition	Yes
K-65	AS	Anasazi	Coalition	PE
K-66	CP	Anasazi	Coalition-Classic	PE
K-67	AS	Anasazi	Coalition	PE
K-68	CP	Anasazi	Classic	Yes
K-69A	SH/OH	Anasazi/ Hispanic/ EuroAmerican	Unknown/ General Historic	Yes
K-69B	SH	Anasazi	Coalition	Yes
K-69C	AS	Anasazi	Coalition	Yes
K-70A-C	CP	Anasazi	Coalition-Classic	Yes
K-71	SH	Anasazi	Unknown	No
K-72	CP	Anasazi	Coalition-Classic	Yes
K-73A-B	TS	Anasazi	Coalition	No
K-75	SH	Anasazi	Unknown	Yes
K-76	CP	Anasazi	Coalition-Classic	PE
K-77	GP	Anasazi	Unknown	Yes
K-78	CP	Anasazi	Coalition-Classic	Yes
K-80	TS	Anasazi	Coalition-Classic	PE
K-81	SH	Anasazi	Unknown	PE

[1] Site Types: AS = Artifact Scatter, CP = Cavate(s) or Cavate Pueblo, OH = Other Historic Site Type, SH = Rock Shelter, TS = Trail or Steps, WC = Water or Soil Control Device.

[2] Time Period: Coalition Period = A.D. 1100 to A.D. 1325; Classic Period = A.D. 1325 to A.D. 1600; General Historic Period (includes the Spanish Colonial, Territorial, and Homesteading periods) = A.D. 1600 to A.D. 1943.

[3] PE = Potentially Eligible.

inclusion on the National Register of Historic Places under Criterion D. That potential will not be affected by the RFI activities proposed at OU 1132.

A report documenting the survey area, methods, results, and monitoring recommendations, if any, will be transmitted to the New Mexico State Historic Preservation Officer for his concurrence in a "Determination of No Effect" for the OU-1132 RFI. As specified in 36 CFR 800.5(b), and following the intent of the American Indian Religious Freedom Act, copies of this report will be sent to the governor of San Ildefonso Pueblo and to any other interested tribal group for comment on any possible impacts to sacred and traditional places.

All personnel involved in ER RFI activities must follow the monitoring and avoidance recommendations contained in *Environmental Restoration Program, Operable Unit 1132, Cultural Resource Survey Report* (Manz et al., in preparation).

3.5 Geology

3.5.1 *Alluvium and Colluvium Within the Canyons of TA-39*

TA-39 is drained by a number of intermittent streams, tributaries of the main stream channel that runs through Ancho Canyon and joins the Río Grande in White Rock Canyon. All of the canyons through which these tributaries flow contain alluvium of unknown thickness (most likely deposits of fluvial sands and gravels, like those observed in other canyons of the Pajarito Plateau). Although specific data are lacking for the TA-39 canyons, information from other Pajarito Plateau canyons having a similar geologic situation (Mortandad, Cañada del Buey, and Pajarito) shows that alluvial deposits vary greatly, from <3 ft to >100 ft (Devaurs and Purtymun, 1985). The provenance for these deposits is the Bandelier Tuff and the Tschicoma Formation. Within Pajarito Canyon, the alluvium consists of tuff boulders, cobbles, and pebbles mixed with sand, silt, and clay (Baltz et al. 1963, 0024). Thicknesses near the valley center line are 50-70 ft. Alluvial deposits within Cañada del Buey range from 9-12 ft thick and are derived from weathered Bandelier Tuff (IT Corp. 1987, 0327).

The alluvium in these canyons is very permeable relative to the underlying tuff; intermittent runoff infiltrates the alluvium until it is impeded by the tuff, causing a perched reservoir to form. As the shallow alluvial groundwater moves downgrade, it is depleted by evapotranspiration, infiltration into the tuff, or suspension in soil. Although some investigators concluded that these perched reservoirs are not connected to the main aquifer that underlies the volcanic rocks of the plateau (Purtymun 1984, 0196), others believe that such a hydrologic connection is a good possibility (Kearl et al. 1991, 0652).

Very little is known about the colluvium that forms slopes between the cliffs and the canyon floors. Nearly all of it is composed of large blocks of Bandelier Tuff that have broken away from the cliffs along cooling joints. Some of these deposits consist of thick, shattered slump blocks, whereas others form only a thin veneer across the underlying tuff.

3.5.2 Stratigraphy of the Bandelier Tuff at TA-39

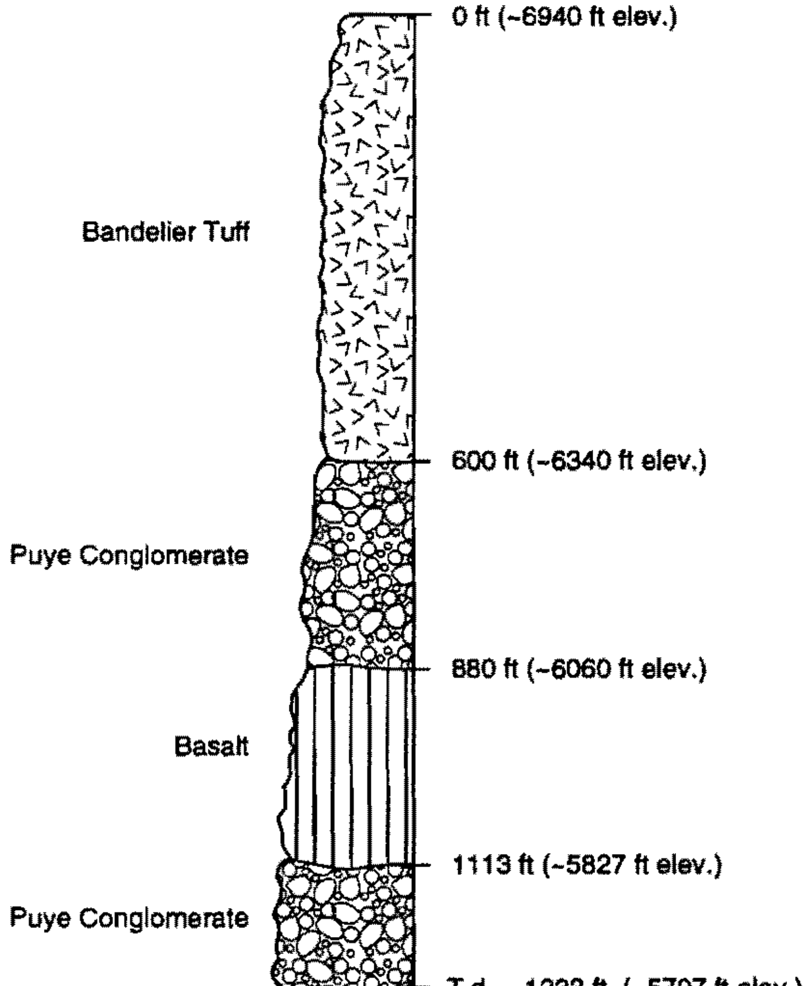
The Los Alamos National Laboratory is perched on a plateau consisting mostly of the Tshirege (upper) and Otowi (lower) members of the Bandelier Tuff. The Bandelier Tuff was deposited during two caldera-forming episodes, 1.5 and 1.1 million years ago, and covers the flanks of the Jemez Mountains volcanic field. For a general description of the Bandelier Tuff, see the Geology section of the IWP (Section 2.6.2).

At TA-39 the Bandelier Tuff ranges in thickness from several feet (along the northeastern margin of the site) to 600 ft (in Borehole DT9, located just west of TA-39—see Figures 3-1 and 3-3) (Purtymun 1984, 0196). These significant variations in lateral thickness are related to pre-Bandelier-Tuff paleotopography. Before the eruptions that laid down the Bandelier Tuff, the area of TA-39 was in a valley between the southwestern flank of a basaltic shield volcano (now underlying the village of White Rock) and a scoria cone (now exposed within TA-33, to the south of TA-39).

Most of the facilities at TA-39 are located within canyons, which are underlain and flanked by Bandelier Tuff. Although at first glance the tuffs appear to be fairly uniform and homogeneous, they are in fact remarkably heterogeneous; physical variations can be observed that relate to mode of emplacement, composition, paleotopography, tuff thickness, and the secondary processes of welding and vapor-phase crystallization. Many of the changes in texture, color, and physical properties now visible in exposures of the Bandelier Tuff were caused by such secondary processes. After compaction, induration, and welding, thermal contraction during cooling can cause columnar jointing, primarily in welded or partly-welded tuffs. The extent, shape, and size of these joints are not known for most of the Pajarito Plateau.

In the Bandelier Tuff of the canyon walls around TA-39 are some nearly horizontal zones, ranging from a couple of inches to almost 1 ft, that are more resistant to erosion and have the appearance of layers. They are not layers, but thin horizons cemented by zeolite (clinoptilolite). They may be the upper boundaries of fossil water tables. It has been proposed that exhumation of the paleocanyons and paleovalleys of the Pajarito Plateau by erosion over the last million years lowered the perched water table within the nonwelded portions of the Tshirege Member of the Bandelier Tuff, leaving behind the zeolite-cemented horizons (Bailey and Smith 1978, 0865). If this hypothesis is true, these horizons leave us a record of the level of the former water table. Further, they suggest that perched groundwater bodies are not restricted to alluvium, but can extend into the Bandelier Tuff.

The Bandelier Tuff varies greatly in thickness, stratigraphy, and physical properties across the Pajarito Plateau. A general stratigraphy, developed by Smith and Bailey (1966, 0377), Baltz et al. (1963, 0024), and Purtymun (1984, 0196) is described in the IWP; its general characteristics are briefly summarized in the following two sections.



Source: Purtymun 1984, 0196.
cARTography by A. Kron 5/18/93

Figure 3-3. Simplified stratigraphic log of Borehole DT-9, ~250 yd west of the western boundary of TA-39.

3.5.2.1 Tshirege (Upper) Member of the Bandelier Tuff

The Tshirege Member of the Bandelier Tuff is dated at about 1.1 Ma (Doell et al., 1968, 0599). The eruption sequence consists of a basal pumice-fall deposit overlain by thin surge beds and by pyroclastic flow units that make up the ignimbrite cooling units (Fisher 1979, 0864; Self et al. 1986, 0375).

The basal pumice-fall deposit (Tsankawi Pumice Bed) is a few cm thick in the TA-39 area and drapes over erosional remnants of the underlying Otowi Member. The Tshirege member ignimbrite consists of nonwelded to densely welded, crystal-vitric to vitric-crystal tuff (~32% phenocrysts of mostly sanidine and quartz, with traces of hornblende and magnetite).

The upper portions of the Tshirege Member are broken by cooling joints. These joints, which formed according to the degree of welding, vapor-phase alteration, and decrease in volume of the deposit as it cooled, may influence the permeability of the plateau tuffs. The jointed portions, the cliff formers within TA-39, may allow infiltration of surface water. For example, surface water in Mortandad Canyon (TA-35) was observed to infiltrate the tuff in less than 100 feet of surface flow. Soil moisture measurements, however, indicate that the thin soil cover on the tuff may inhibit infiltration of precipitation (Baltz et al. 1963, 0024).

3.5.2.2 Otowi (Lower) Member of the Bandelier Tuff

The Otowi Member of the Bandelier Tuff consists of a pumice-fall deposit (Guaje Pumice Bed) overlain by thin surge beds and by massive pyroclastic flow units. The age of this eruption is ~1.5 Ma (Doell et al., 1968, 0599). The pumice-fall deposit is absent or only a few inches thick in the area of TA-39. The orange-tan, nonwelded ignimbrite contains abundant lithic clasts, pumice clasts, and phenocrysts of mostly sanidine and quartz in a vitric-crystal or crystal-vitric ash matrix. Lithic clasts make up from a trace to 30% of the tuffs, and phenocrysts 30-35%. The Otowi Member tuff can be seen along State Road 4, about 100 yd west of the entrance to TA-39, where an erosional remnant of the massive ignimbrite is exposed.

3.5.3 Basalt Flows of the Cerros del Río and Older Sedimentary Deposits

Basaltic deposits of the Cerros del Río volcanic field, a field of late Tertiary basaltic volcanoes that extends from near the Santa Fe Airport to the Pajarito Plateau, underlie the Bandelier Tuff at TA-39. These include the well-jointed basaltic lava flows visible at the surface in Water Canyon, along the northeast margin of TA-39, and cropping out within a few hundred yards of the southeast margin of the site in lower Ancho Canyon; 350 ft of basaltic lava and interbedded hydrovolcanic tuff and stream gravels exposed at the intersection of Ancho and White Rock Canyons (Dethier, in press); and a scoria cone over 300 ft thick exposed in Chaqehui Canyon, the next canyon south of TA-39 (the northern flank of this cone should underlie Ancho Canyon within TA-39).

Outcrops visible down to an elevation of 5500 ft within White Rock Canyon show interbedded Puye Conglomerate, Santa Fe Group sandstones and conglomerates, and more basalt or basaltic andesite flows (Dethier, in press).

We know very little about the Santa Fe Group at TA-39; only a few outcrops are visible in White Rock Canyon at its intersection with Ancho Canyon (Figure 3-4). Within Well DT-9, located just beyond the western margin of TA-39 (see Fig. 3-3), the Bandelier Tuff is underlain by about 280 ft of Puye Conglomerate, 230 ft of basaltic lava flows, and 120+ ft of yet more Puye Conglomerate (Purtymun, 1984, 0196). At present, these simple well data are the only data available for these depths in the TA-39 area. A detailed description of the conglomerates, sandstones, and siltstones of the Santa Fe Group in the Espanola Basin and northern part of Los Alamos County is given in the IWP (Section 2.6.1.2.1).

3.6 Soils

The general characteristics of the soils of the Pajarito Plateau are discussed in Section 2.6.1.3 of the IWP. Existing information on these soils is extremely limited and will need to be expanded, especially in regard to soil characteristics that influence contaminant transport. Los Alamos County soils have been described by Nyhan et al. (1978, 0161). (Names given to soil series—Hackroy, Nyjack, etc.—have local significance only.)

Soils at TA-39 can be divided into three major categories according to topographic position: Mesa Top, Canyon Wall, and Canyon Bottom. At OU 1132, the last of these are the most important because all the PRSs are located in the canyon bottom.

3.6.1 Mesa Top

The Hackroy series is typical of mesa-top soils. As described by Nyhan et al. (1978, 0161), "The surface layer of the Hackroy soils is a brown sandy 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 (2-4 ft) and frequently exhibit pumice fragments in the lower levels. Soil texture, depth, and degree of development will vary according to distance from canyon walls. (Because natural erosion rates increase with proximity to canyon walls, the best-developed soils are found toward the middle of the mesa.)

3.6.2 Canyon Walls

The walls of the canyons at TA-39 are mostly steep rock outcrops, consisting of about 90% bedrock studded with patches of shallow, undeveloped soils. South-facing canyon walls are less steep and often have areas of very shallow, dark-colored soils (Nyhan et al. 1978, 0161).

3.6.3 Canyon Bottom

The canyon bottom soils, typically young (and thus poorly developed), are classified as Entisols. The Totavi series soils are typical of such soils in the Pajarito Plateau area. Described by Nyhan at al. (1978, 0161), these are deep, well-drained soils having a gravelly-loamy-sand or sandy-loam texture.

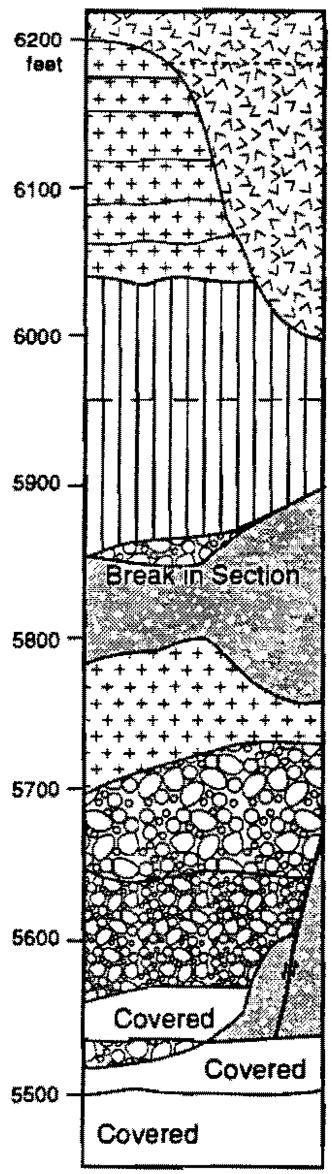


Figure 3-4. Stratigraphic section at the intersection of Ancho and White Rock canyons, ~1.5 miles southeast of the entrance to TA-39.

3.7 Hydrology

Because most contaminants are transported by water, an understanding of water movement at TA-39 is essential for understanding contaminant transport in this area. Although no hydrologic investigations have been done specific to TA-39, inferences about water movement at TA-39 can be made from such investigations conducted on other parts of the Pajarito Plateau. A detailed discussion of hydrologic processes on the Pajarito Plateau can be found in the IWP, Sections 2.6.3-2.6.8. The conceptual hydrogeologic model for OU 1132 is presented in Figure 3-5.

3.7.1 Surface-Water Hydrology

Only a few studies have quantitatively examined surface runoff from the Pajarito Plateau; most characterizations of surface runoff have been based on anecdotal observations. Because the data are so limited, reliable contaminant transport modeling is difficult. Another factor, which adds to the difficulty of predicting runoff levels, is the permeability of the stream bed: significant quantities of water are lost by infiltration into these sediments (a phenomenon known as channel transmission loss).

At TA-39, all the stream channels carry intermittent flow. Runoff, when it does occur in these alluvial channels, is produced by intense summer thunderstorms or snowmelt. Flash flooding does occur, and can be severe—as was demonstrated in the summer of 1991, when roads and buildings at TA-39 were damaged. This kind of flooding has tremendous potential for moving contaminants off site—for example, by cutting into and carrying away portions of the landfills adjacent to the stream channel.

3.7.2 Hydrogeology

3.7.2.1 *Vadose Zone*

The unsaturated area above a groundwater body (or saturated zone) is known as the vadose zone. A distinction is made between unsaturated (vadose) and saturated sediments because water and contaminant movement varies greatly with degree of saturation. Generally, the drier the medium, the more slowly water (and contaminants) move.

The vadose zone of the Pajarito Plateau is very thick and consists mostly of Bandelier Tuff. There has been considerable debate about water movement through the vadose zone into the main aquifer. The issue remains unresolved and needs to be examined further.

At TA-39, the vadose zone of most interest is the unsaturated alluvium of the canyon bottoms, because most of the contamination will be in this area. Of secondary interest is the vadose zone underlying the surrounding mesa tops (even though there are no PRSs on the mesa tops, some contamination will have reached these areas from the firing experiments).

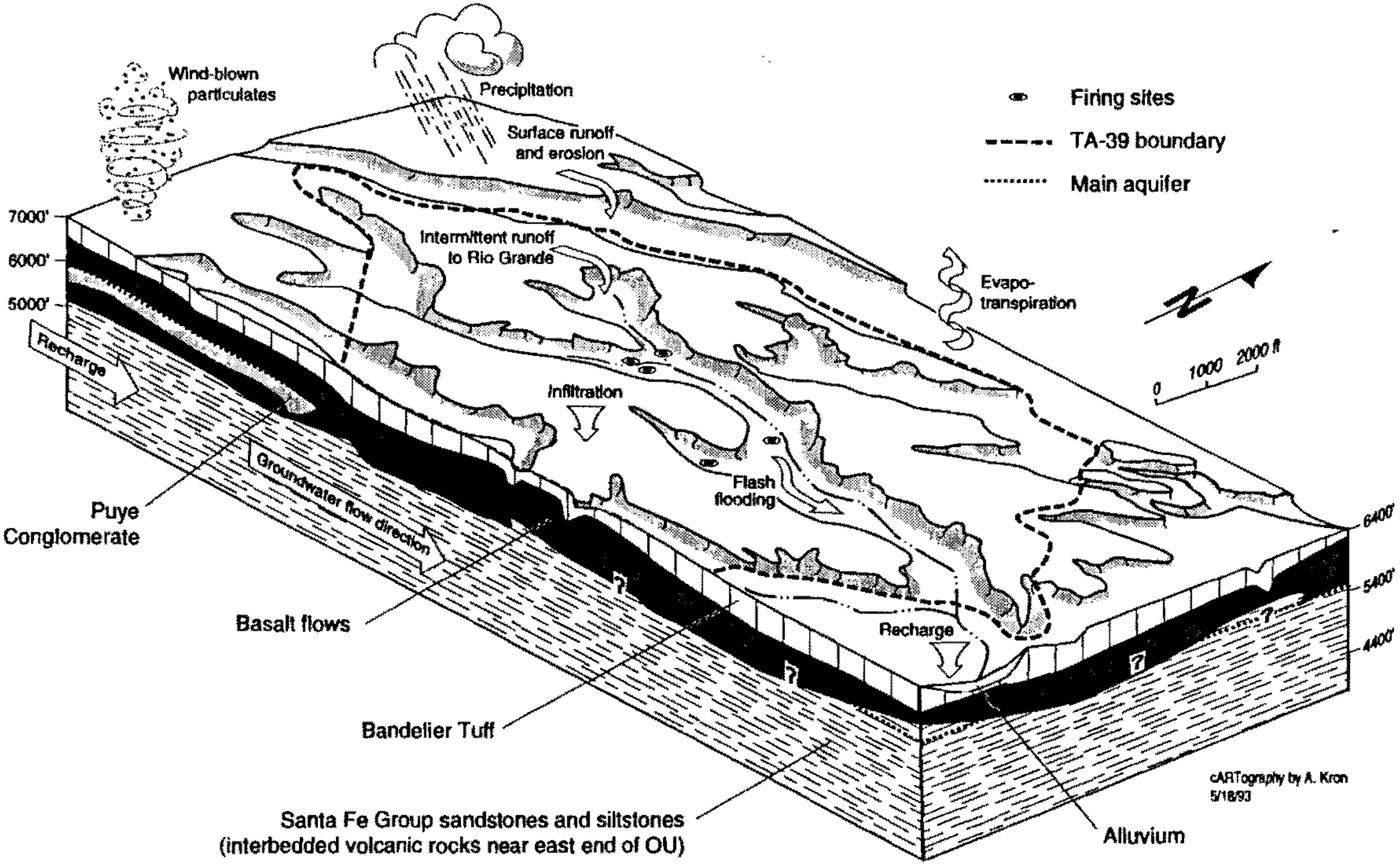


Figure 3-5. Conceptual hydrogeologic model for OU 1132.

3.7.2.2 Perched Groundwater

A perched reservoir is an unconfined groundwater body separated from the main aquifer by unsaturated material. Two types of perched reservoirs exist on the Pajarito Plateau: one in alluvial sediments of various canyons, and the other in deeper deposits (120-200 ft below the surface), in conglomerates and basalts underlying alluvium in Los Alamos Canyon and Pueblo Canyon.

3.7.2.2.1 Perched Alluvial Reservoirs

The floors of canyons in the Pajarito Plateau, especially the eastern portion of the plateau, are typically covered with alluvium that ranges in thickness from about 3 ft to 100 ft. When runoff occurs, most of it infiltrates into the alluvium (it is rare that any reaches the Rio Grande). Some of this water may then be lost via transpiration, some may seep into the underlying tuff, and some may be stored in the alluvium, creating a perched alluvial reservoir. If there is a hydrologic connection between perched alluvial reservoirs in these canyons and the main aquifer, the reservoirs could be an important source of recharge for the main aquifer.

It is not known whether a perched alluvial reservoir is present under the northern fork of Ancho Canyon, where the TA-39 facilities are located. To date, perched alluvial reservoirs have been found on the Pajarito Plateau only in canyons that originate in the Sierra de los Valles or that are sinks for industrial effluent, neither of which is true of Ancho Canyon. The presence or absence of a perched alluvial reservoir at TA-39 has important implications for contaminant transport, and will be investigated as part of the sampling plan.

3.7.2.2.2 Deeper Perched Reservoirs

The deeper perched reservoirs of the basalts and conglomerates in Los Alamos Canyon and Pueblo Canyon are hydrologically connected to the stream flow in the canyons, as evidenced by fluctuations in the height of the water table that correspond to surface water runoff. No wells have been dug at TA-39, but Purtymun and Alquist (1986, 18-0016) found no evidence of a perched reservoir at TA-49, just northwest of TA-39. On the other hand, the zeolite-cemented horizons referred to earlier (Section 3.5.2) could indicate that there once was a perched reservoir in the Otowi Member at TA-39.

3.7.2.3 Main Aquifer

Many of the hydrologic studies on the Pajarito Plateau have focused on the main aquifer because it serves as the water supply for the county. Three well fields have been developed, with a total of 18 supply wells, 10 test wells, and 2 stock wells. Characterization of the aquifer is based on information from these wells and from springs discharging into the Rio Grande at White Rock Canyon. The main aquifer is found in the Tesuque Formation and the overlying Puye Conglomerate, at depths below the surface ranging from less than 300 ft in the canyon bottoms (towards the eastern end of the plateau) to over 1000 ft on the mesa tops.

No groundwater measurements have been made at TA-39, but Purtymun (1984, 0196) estimates that the groundwater table is about 600 ft below the surface of Ancho Canyon and about 1000 ft below the surrounding mesa tops.

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Executive Summary

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4.0 TECHNICAL APPROACH

This chapter presents the basic technical approach that will be used to conduct field investigations at OU 1132 under the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA). A full discussion of the overall technical approach at Los Alamos appears in Chapter 4 of the Installation Work Plan (IWP) (LANL 1992, 0768).

Explanations of terms used frequently in this chapter that have specific meanings with regard to the field of risk assessment and/or the ER Program may be found in the IWP (*Glossary*, Vol. II).

4.1 Aggregation of Potential Release Sites

Of the 25 SWMUs identified at OU 1132 (LANL 1990, 0145), 7 will be recommended for no further action (NFA)—see Chapter 6; the remaining 18 SWMUs, plus 2 proposed SWMUs, have been grouped into four "aggregates" on the basis of similarity of contaminants, transport processes, and sampling strategies that would be applied to the site. These aggregates are landfills, storage areas, firing sites (including the single-stage gas gun), and septic systems and seepage pits. The PRSs in a particular aggregate are not necessarily in close proximity. However, because of the relatively small size of TA-39, all PRSs in this OU share general site characteristics.

4.2 Site Characterization

The goal of this RFI is to ensure that health and environmental impacts associated with past activities at OU 1132 are investigated in compliance with the Laboratory's RCRA Part B (HSWA Module) permit. The technical approach set forth here is designed to meet the required site characterization objectives in a cost-effective manner and conforms with that described in Chapter 4 of the IWP. This approach uses a decision-making process based on risk to human health (Phase I investigations) and proposed Subpart S of 40 CFR 264 (EPA 1990, 0432) for recommending PRSs for NFA or for further investigation. Risk to ecological components will also be considered, as part of Phase II investigations (see Section 4.6).

The site of each OU 1132 PRS will be characterized through (1) interpretation of archival data, (2) phased sampling to ascertain the nature and extent of contamination and to identify contaminant migration pathways, and (3) risk assessment.

4.2.1 Interpretation of Archival Data

Archival data include reports, memoranda, letters, photographs, drawings, etc. that pertain to the PRS. These are studied to gain a basic understanding of the processes and events that produced the PRS and the contaminants that may be present.

4.2.2 Phased Sampling

In general, Phase I sampling is intended to ascertain the presence or absence of contaminants. (All samples will be screened and/or analyzed for radioactive contamination, whether or not radioactive constituents are suspected in a given sample.) In some cases, Phase I may also include data collection to further define the extent of contamination or the site conditions that could lead to migration if an environmental release of contaminants is suspected. At OU 1132, the PRS aggregates of most concern are the landfills and the firing sites, which have the greatest potential for uncontrolled spread and release of contaminants. For this reason, sampling during Phase I will be more detailed for these sites than for the other PRSs.

Phase II sampling (where needed) will further document the extent and distribution of contaminants identified during Phase I. Phase II studies are needed in many cases to support baseline risk assessments.

4.2.3 Risk Assessment

If Phase I and/or Phase II sampling reveals the presence of contaminants at a PRS, the potential for human exposure to those contaminants may be quantified by means of a baseline risk assessment, which employs a model based on the most realistic assumptions of current and future land use. For OU 1132, the most likely land-use scenarios are (1) Continued Laboratory Operations and (2) Recreational Use. (For background information on the methodology for these assessments, refer to the IWP, Section 4.3 and Appendix K [LANL 1992, 0768]).

4.2.3.1 Continued-Laboratory-Operations Scenario

For the foreseeable future, land use within OU 1132 is likely to be very similar to what it is at present. Most areas of the OU are and probably will continue to be active sites for Laboratory operations. On-site workers (office workers, maintenance personnel, and construction workers) are the assumed human receptors for this scenario. Part of the output of the baseline risk assessment will be a determination of which of these groups is likely to be the most affected. That group would serve as the reference point for the conclusions of the assessment.

Office and maintenance workers could be exposed to contaminants through inhalation of dust and volatile compounds, incidental ingestion of soil and dust, and/or direct exposure to radiation sources. Construction workers, in addition to these means of exposure, could be exposed through dermal contact with contaminated soils and/or explosives materials.

4.2.3.2 Recreational-Use Scenario

If OU 1132 is decommissioned in the future, it is conceivable that the area could be released for recreational use—particularly given its proximity to Bandelier National Monument. Campers and hikers are estimated to be the most likely human receptors under this scenario, which would consider short-term camping, daily hiking, hunting, and possibly limited construction.

Recreational users of the area could come into contact with contaminants through inhalation, ingestion (including ingestion of game), or skin contact. Game are subject to contamination through ingestion of contaminants in surface water, plants, and soils. The model assumes that campers would carry in potable water and does not consider consumption of contaminated drinking water.

4.2.4 Decision Analysis

A detailed discussion of the decision analysis process appears in Chapter 4 of the IWP, Section 4.1. The basic strategy is represented graphically in Figure 4-1 and may be summarized as follows:

If a review of archival data leads to the conclusion that a given PRS presents no current or future risk to human health, the PRS may be recommended for NFA. Those OU 1132 PRSs that we propose for NFA are discussed in Chapter 6.

For most of the PRSs at OU 1132, the archival data are not sufficient for proposing NFA. We plan to carry out a Phase I RFI for each of these PRSs to (1) identify those that pose no hazard to human health and may be added to the NFA group, and (2) for those that may pose a risk, ascertain whether there is contamination and the nature of any contamination (as well as, to some degree, the extent).

Whether or not a PRS presents a danger to human health is judged via (1) the screening assessment, in which potential contaminant levels are compared with established screening action levels (see 4.2.5, below); and (2) baseline risk assessment, which uses site-specific risk criteria to arrive at the most realistic evaluation of potential risks to human health (see Section 4.2.3, above).

In the event that contaminants are found at any PRS, the decision process considers whether a need for corrective action can be established on the basis of the available data and whether there is an obvious, feasible, and effective remedy. If the answer to both is yes, voluntary corrective action (VCA) will be proposed (see Section 4.5.2). If the available data are not sufficient for establishing the need for corrective action, further data (Phase II) will be gathered; these may be used to support a baseline risk assessment, or they may lead to the conclusion that doing a VCA directly will be more time- and cost-effective than doing baseline risk assessment. A baseline risk assessment may in turn lead to VCA; alternatively, it may lead to NFA or to a corrective measures study to determine the optimum remediation strategy for the PRS.

A major part of the decision analysis process is the definition of data quality objectives (DQOs), which are discussed in detail in the IWP (Appendix H). Establishment of DQOs considers the objective of data collection, the type and amount of data required to achieve the stated objective, and how good the data must be. The Quality Assurance Project Leader will review all RFI data, as specified in the QAPjP. In addition, all data that results from laboratory analysis of collected samples will be validated by the Laboratory's Health and Environmental Chemistry Group (EM-9) against quality control samples, field replicates, and duplicate samples, using specified control requirements (an SOP for data validation is in process).

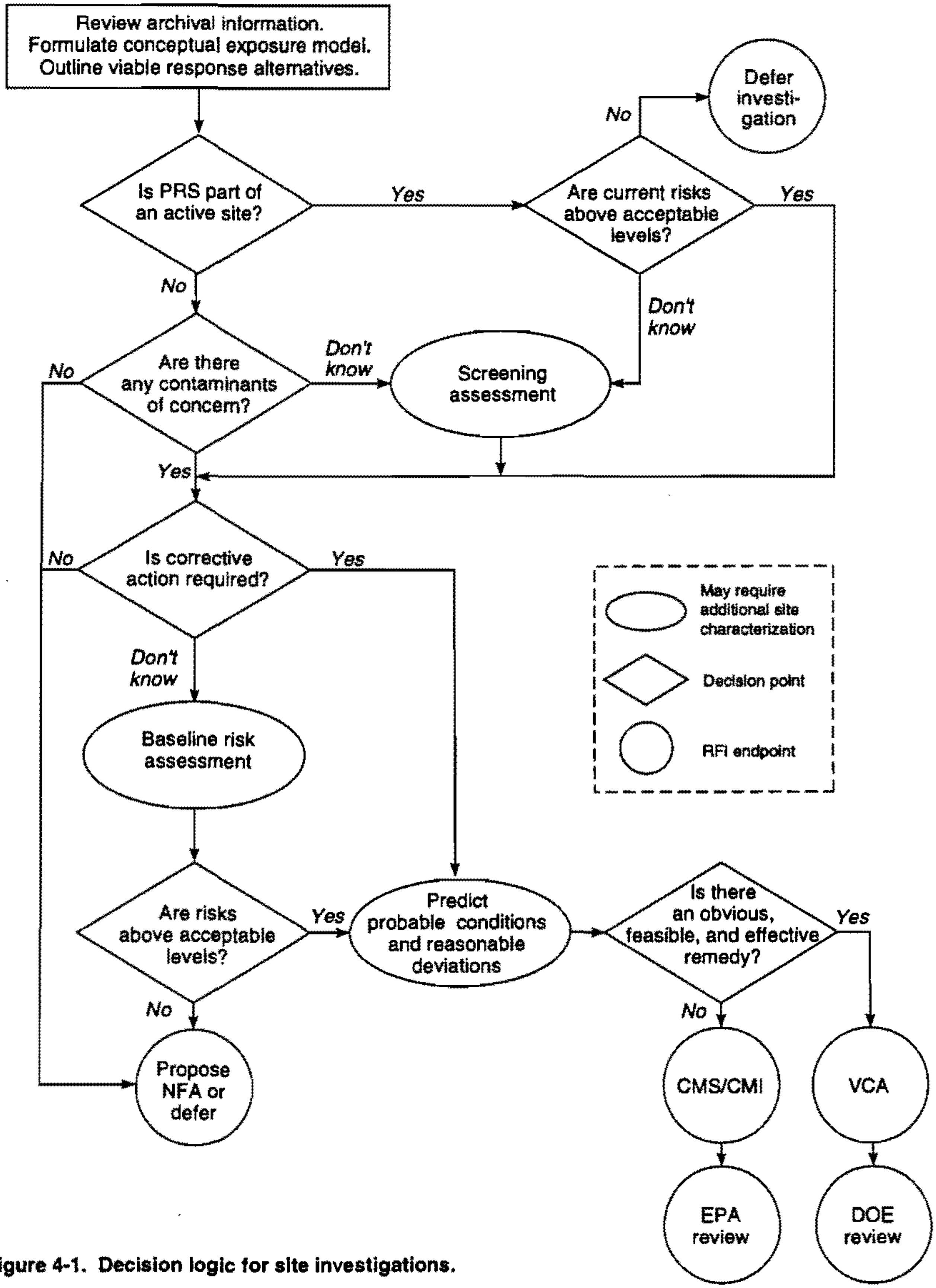

Figure 4-1. Decision logic for site investigations.

4.2.5 Screening Action Levels

A detailed discussion of screening action levels—how they are derived and the rationale for their use—is found in the IWP (Sections 4.2.2 and 4.2.3; Appendix J). Screening action levels are tools for efficiently discriminating between problem and nonproblem sites so that resources can be used effectively; they are generally used only to identify the presence of contamination—i.e., levels that may pose a hazard to human health and safety—and to guide further sampling.

Screening action levels are not cleanup criteria. They are based on a residential exposure scenario, that is, one that assumes that the site is the residence of one or more individuals and that exposure is the result of direct radiation from soil surfaces, ingestion/inhalation of soil particles, and/or ingestion of contaminated groundwater. (At OU 1132, the potential for the last depends on the presence or absence of a perched alluvial reservoir.) Cleanup levels, on the other hand, are based on site-specific (baseline) risk evaluations and ALARA (as low as reasonably achievable) criteria. In most cases, they will be higher than screening action levels (for example, if the site will never be a residential one but may realistically be used for recreation or other part-time activities, the level of soil contamination considered acceptable could be higher than the residential scenario would allow).

Because we have as yet no evidence for the presence of an alluvial reservoir, the Phase 1 RFI will use screening action levels for soil. Those levels, for the major contaminants expected at OU 1132, are listed in Table 4-1.

4.3 Conceptual Exposure Model

A conceptual exposure model is useful for illustrating how contaminants can move from PRSs to human or environmental receptors, and thereby for identifying appropriate media and locations for sampling. A conceptual exposure model for OU 1132 appears in Figure 4-2. The *contaminant sources* are the PRSs themselves, that is, the landfills, the firing sites, the septic systems and seepage pits, and the storage areas. *Primary release mechanism* refers to the way in which the contaminants probably were made available to the environment. The *transport mechanisms* are the ways in which contaminants may migrate at OU 1132 (see Section 4.3.1). The *contaminated media* are soil, sediment, air, biota, and (potentially) groundwater. (The presence of a perched alluvial reservoir at OU 1132 has not been established but is a possibility given that much of the OU is on a broad alluvial canyon bottom.) *Exposure routes* are the ways in which human or animal receptors may become exposed; these include ingestion, dermal contact, inhalation, and external radiation (Section 4.3.2).

4.3.1 Potential Transport Mechanisms

Before sampling, it is important to consider the mechanisms by which contaminants could be transported within and beyond the boundaries of OU 1132, because those mechanisms determine where contaminants probably reside and therefore where sampling will be most effective. Because very little work has been done in this area at OU 1132, the sampling plans are designed at least partially to identify the mechanisms/pathways of contaminant spread and to ascertain whether any uncontrolled contamination is moving via one or more of them.

TABLE 4-1
SCREENING ACTION LEVELS
FOR POSSIBLE CONTAMINANTS AT OU 1132

Constituent	Screening Action Level for Soil (mg/kg)
INORGANICS	
Barium	5 600
Beryllium	0.16*
Cadmium	80
Chromium (VI)	400
Cobalt	**
Copper	3 000
Cyanide	1 600
Lead	500
Mercury	24
Nickel	1 600
Silver	400
Thallium	6.4
Uranium	240
Zinc	24 000
VOLATILES	
Acetone	8 000
Benzene	0.67
Carbon tetrachloride	0.21
Chlorobenzene	67
Chloroform	0.21
1,1-Dichloroethane	410
1,1-Dichloroethene	0.59
1,2-Dichloroethane	0.2
Methylene chloride	5.6
1,1,2,2-Tetrachloroethane	3.9
Tetrachloroethene	5.9
Toluene	890
1,1,1-Trichloroethane	1 000
Trichlorethene	3.2
Xylenes (Total)	160 000
SEMIVOLATILES	
Acenaphthene	4 800
Acenaphthylene	**
Anthracene	24 000
Benzo(a)anthracene	**
Benzo(k)fluoranthene	**
Benzo(ghi)perylene	**
Bis-(2-chloroethyl)ether	0.13
Bis-(2-ethylhexyl)phthalate	50
Butyl benzyl phthalate	16 000
2-Chlorophenol	400

TABLE 4-1 (continued)
SCREENING ACTION LEVELS FOR POSSIBLE CONTAMINANTS AT OU 1132

Constituent	Screening Action Level for Soil (mg/kg)
SEMIVOLATILES (cont'd)	
Chrysene	**
Dibenz(a,h)anthracene	**
Di-n-butylphthalate	8 000
2,4-dichlorophenol	240
Diethylphthalate	64 000
2,4-Demethylphenol	1 600
Dimethyl phthalate	80 000
2,4-Dinitrotoluene	1
Fluoranthene	3 200
Fluorene	3 200
Indeno[1,2,3-cd]pyrene	**
Naphthalene	3 200
4-Nirophenol	**
N-Nitrosodiphenylamine	140
Pentachlorophenol	5.8
Phenanthrene	**
Phenol	48 000
Pyrene	2 400
2,4,6-Trichlorophenol	64
EXPLOSIVES	
Barium nitrate (as barium)	5 600
TNT (2,4,6-trinitrotoluene)	40/233
2,4-DNT (2,4-dinitrotoluene)	160/1
2,6-DNT (2,6-dinitrotoluene)	4/1
1,3-DNB (1,3-dinitrobenzene)	8
RDX (cyclotrimethylenetrinitramine)	240/64
PETN (pentraerythritoltetranitrate)	1 600
HMX (cyclotetramethylenetetranitramine)	4 000
TATB (triaminotrinitrobenzene)	**
Composition B (RDX-60%, TNT-39%, Wax-1%)	**
Cyclotol (RDX-75%, TNT-25%)	**
Baratol (Barium nitrate-76%, TNT-24%)	**
RADIONUCLIDES	
Cs-137	3.2
Pu-239	20.15
Th-232	0.72
U-233	69.9
U-235	14.75
U-238	47.81

*Because the background level for beryllium is higher than the screening action level, we will use a background level established on the basis of soil samples from the OU 1132 area as the screening action level.

**Screening action level not available or not found.

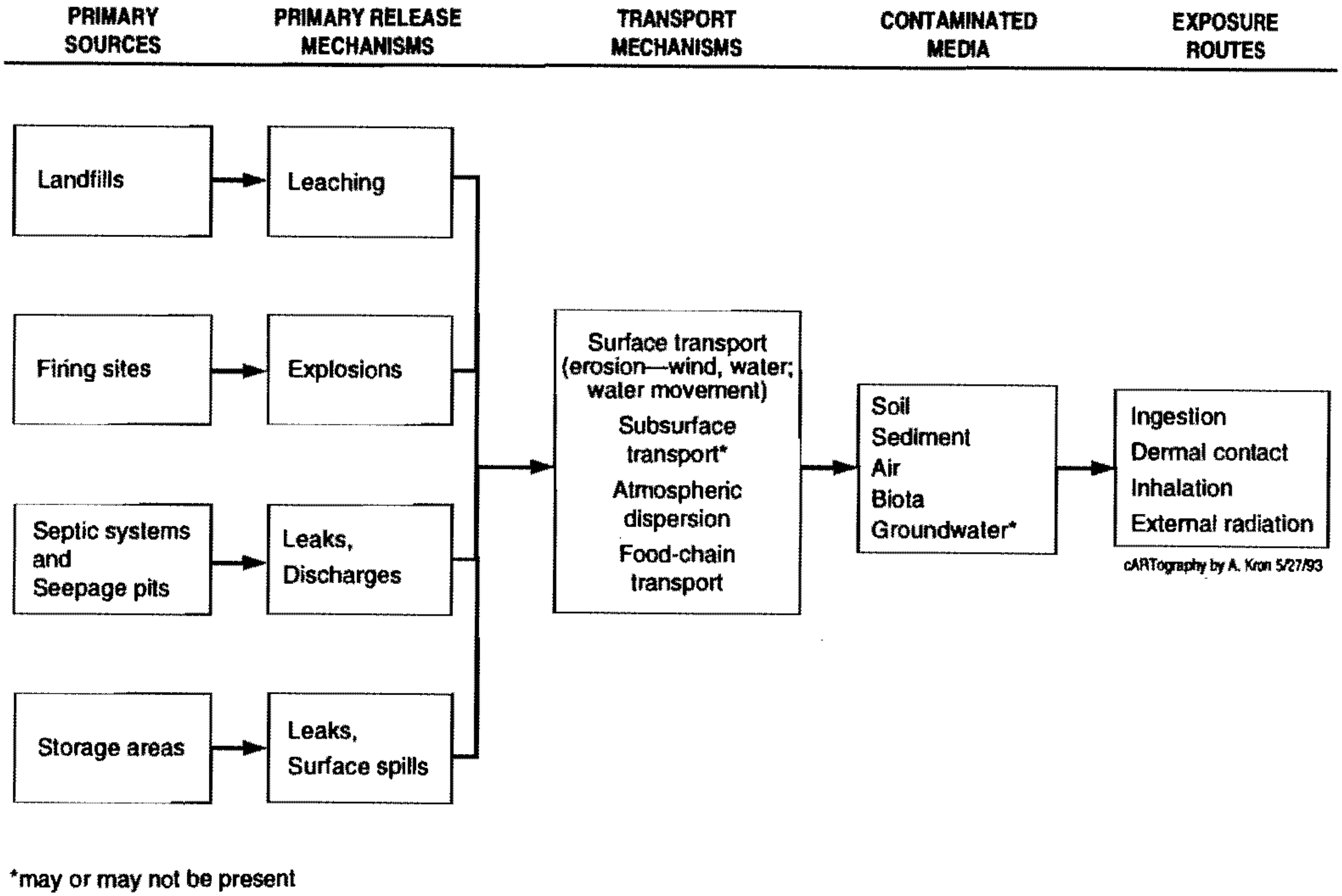

Figure 4-2. Conceptual exposure model for OU 1132.

4.3.1.1 Surface Transport

All of the waste-generating activities at OU 1132 have taken place—and still do—in the canyon bottom. This has tremendous significance for the ultimate fate of any contaminants in the waste, because an alluvial stream channel runs the entire course of the canyon and its branches. Contaminants do not have to travel very far to get to the channel, which is a rapid conduit to the Rio Grande (about 3 miles downslope)—especially under flash flood conditions. Alluvial channels like this one can concentrate contaminants in downstream deposition areas (Muller et al. 1978, 0866). Most radionuclides and heavy metals bind tightly with soil particles, particularly fine-grained silts and clays. Contaminants move to the channel by overland runoff or by being directly deposited during a firing site experiment. Transport of contaminants by surface runoff is most likely where contaminants are exposed on the surface, such as at the firing sites (and, possibly, the storage areas).

4.3.1.2 Subsurface Transport

Subsurface transport of contaminants can take place via vapor flow, unsaturated flow, or saturated flow. At OU 1132, the importance of subsurface transport of contaminants will depend to a great extent on whether or not a perched alluvial reservoir is present in Ancho Canyon—as yet unknown. If one should exist, it would mean that subsurface flow is mainly saturated, which can carry contaminants much faster than unsaturated flow. One of the aims of the RFI, therefore, is to find out whether a perched alluvial reservoir exists below TA-39. So far, in the Pajarito Plateau area, such reservoirs have been found in canyons that either originate in the Jemez or have a major industrial effluent source upstream that creates a man-made perched reservoir. The segment of Ancho Canyon that runs through OU 1132 has neither of these characteristics.

Vapor-phase movement is an important transport mechanism for volatile contaminants, such as organic solvents. Such movement is influenced by concentration gradients, temperature gradients, density gradients, and/or air-pressure gradients.

At OU 1132, subsurface transport of contaminants is of most concern for the PRSs in which contaminants are already underground, such as the septic systems, seepage pits, and, especially, the landfills (where probably the greatest amounts of contaminants are to be found). Contaminants from the firing site activities could also move into the subsurface, once soils have become contaminated.

4.3.1.3 Atmospheric Dispersion

Atmospheric dispersion can follow from wind erosion (entrainment of contaminated soil), from direct expulsion of contaminants into the air (for example, pulverized material from a firing site experiment), or from evaporation, as of a volatile organic compound. The extent to which contaminated soil particles can be dispersed atmospherically depends on such factors as soil properties (e.g., particle size), roughness of the terrain, vegetative cover, and atmospheric conditions. Wind erosion around the firing sites is of particular concern because the surface soils, which are almost certainly contaminated, are vulnerable to erosion. We have no specific information as to how far contaminants generated at OU 1132 may travel as a result of atmospheric dispersion, but certainly off-site transport is possible. Typically, however, the hazard decreases with distance downwind.

4.3.1.4 Food-chain Transport

The importance of biological uptake of contaminants by plants relative to other transport pathways is largely unknown. Studies at Los Alamos show that most radionuclides in vegetation come from deposition of contaminated soil onto vegetation surfaces, and uptake of waste-site radionuclides by plants is known to occur (Hakonson and Nyhan 1980, 0177). However, there is no history of gardening or hunting at TA-39 and therefore no suspected exposure of humans via the food chain at this site.

4.3.2 Factors Affecting the Fate and Transport of Potential Contaminants

The fate and transport potential—or potential for mobility in the environment—of each of the various possible OU 1132 contaminants is affected, first, by the medium in which it exists and, secondarily, by interactions between the constituent and the medium. In water, the constituent's mobility is determined by its degree of solubility, its potential for degradation (in the case of organics), and whether it is positively charged, negatively charged, or neutral (negatively charged and neutral species are more mobile). For constituents existing in or on surface soils or sediments, mobility is determined chiefly by particle size.

The three major categories of possible contaminants at OU 1132 are metals, organics, and high explosives.

4.3.2.1 Metals

This category includes barium, beryllium, silver, mercury, lead, cadmium, chromium (VI), and uranium (the last is the only radionuclide of potential concern at OU 1132; its fate in the environment is best described by considering it as a metal). The solubility of these metals is controlled by (1) the physical and chemical properties of the solid phase and (2) the other constituents already in solution in the water. The information in the following paragraphs is based mainly on Garrels and Christ (1965, 0961) and Lindsay (1979, 0883).

Barium— Barium metal is expected to oxidize upon detonation and, as such, should be highly soluble. However, soluble barium combines readily with carbonates (at high pH) or with sulfates in soil water to form precipitates, leaving very little barium in solution. Because soluble barium is generally positively charged, it will be less mobile and will tend to be sorbed on soils and sediments. The most likely means of transport, then, for soluble barium as well as barium precipitates, are surface (erosion) and atmospheric dispersion (wind).

Beryllium— Beryllium metal deposited in the environment is expected to oxidize to a hydrated oxide at a relatively slow rate. The less crystalline the oxide, the more soluble it will be. The mobility of soluble beryllium depends largely on its electrical charge, which in turn depends on pH: at > about 8, the charge is likely to be negative, and at < 8 it is likely to be positive. The negatively charged species will be highly mobile and can be transported by surface and subsurface water movement. The positively charged one will be sorbed by soil and sediments and, like nonsoluble beryllium oxide, will be transported mainly via wind and soil/sediment erosion.

Silver— Silver metal is unstable in most soil/sediment environments. The phases most likely to be stable are the halides. Soluble species are positively charged at low halide concentrations and as such will tend to be sorbed by the soil. They are neutral at high halide concentrations and, thus, are mobile and likely to be transported by surface and subsurface water movement.

Mercury— Mercury can exist in soils and sediments as either a solid or a liquid; this depends on numerous conditions (pH, Eh, halide concentration, organic matter content, etc.). A certain amount of solid mercury will be soluble and electrically neutral; this mercury is readily transportable by surface and subsurface water movement. Insoluble mercury will be transported by erosion of the soils and sediments in which it is located. In the liquid phase, significant--if small--amounts of mercury can be vaporized to the atmosphere and dispersed by wind.

Lead— Lead is generally found in metal or oxide form. These are unstable in soils and soil water and will dissolve until they combine with other ions in solution to form precipitates. At high pH (>7.5), some of the lead may combine with carbonate ions, and at low pH (<6), some may combine with sulfate ions. At neutral or near-neutral pHs (6-7.5), lead may react with any number of ions, such as phosphates. The portion of the lead remaining in solution that is positively charged will tend to be sorbed on soil and sediment particles, whereas lead that is neutral or negatively charged (for example, because of high chloride or halide concentrations in the water) will be more mobile and could be transported by surface and subsurface water movement.

In the case of OU 1132, we postulate that most of the lead will be precipitates and positively charged soluble species; the major transport mechanism for these would be wind and water erosion of soils and sediments.

Cadmium— Concentrations of soluble cadmium generally do not exceed 10^{-7} moles/L (~0.1 mg/L), because most of the cadmium will combine with phosphates to form a cadmium phosphate precipitate. At high pH (>7.5), the concentrations may be even smaller because some cadmium will combine with carbonate to form a more stable precipitate, such as octavite. The remaining cadmium, because it is positively charged, will have greater sorption potential and, like the precipitated cadmium, will be transported mainly by erosion of soils and sediments by wind and/or water.

Chromium-- Chromium metal can oxidize to chromium (VI) and, as such, most of it can dissolve (at an unknown rate, possibly very slow) and remain in solution. The soluble chromium is generally negatively charged and thus highly mobile; the primary transport mechanism would be surface and subsurface water. If the rate of dissolution is extremely slow, much of the chromium could continue to exist as a metal for long periods. This chromium would be transported primarily by wind and/or water erosion of the soils and sediments in which it exists.

Uranium-- Uranium metals typically corrode to form hydrated uranium (VI) oxides, such as schoepite. These oxides tend to dissolve, perhaps slowly, to form soluble oxidized species. Solubility is controlled by pH, total carbonate content, and concentrations of other constituents with which it may combine (such as phosphate, soluble organic carbon). Positively charged species will tend to be adsorbed to soil particulates and, like the finer uranium metal and corrosion products, can be transported by wind and soil/sediment erosion. Negatively charged and neutral species, which remain mobile in water, will be transported primarily by surface and subsurface water movement.

4.3.2.2 Organics

For this group of constituents, volatilization from solution, soils, and/or sediments is a significant transport mechanism. In general, constituents having high solubility in water and/or a lower Henry's law constant (such as PCBs) will volatilize less than those having low solubility and/or a higher Henry's law constant (such as volatiles and semivolatile organics).

The conditions of the media will also affect whether potential contaminants volatilize or remain in solution, soil, or sediments. Dry soils contribute to volatilization whereas moist soils retard it; more porous soils allow more volatilization; greater flow rates, turbulence, and higher temperatures will all increase volatility from solution; and the greater the depth at which a constituent is located, the longer it will take to volatilize to the atmosphere.

Another significant transport mechanism for organic constituents having high water solubility, especially those with a low K_{OC}, is leaching (the higher the K_{OC} of the constituent, the greater its ability to bind with organic matter and thus remain in soils or sediments).

4.3.2.2.1 Polychlorinated Biphenyl

In the past, polychlorinated biphenyl (PCB) compounds were added to oils to inhibit microbial degradation. PCB-containing oils were used at TA-39, some in conjunction with firing site experiments, and both stock and waste oils were kept in several storage areas. The tendency of PCBs to persist and to accumulate in biota magnifies their potential hazard. Once these compounds have entered the soil, through oil spills, container leaks, or use in experiments, they can volatilize and enter the atmosphere. Chemicals that have low vapor pressure, are hydrophobic, and are resistant to degradation, such as PCBs, typically volatilize in significant amounts. Limiting factors would be adsorption by soil particles, which increases with increased clay and/or organic matter content; temperature; wind velocity; soil moisture; and photodegradation. Little is known at present about the precise effects of these factors on volatilization, but PCBs must be part of a labile, mobile pool (including dissolved and adsorbed materials) in order to migrate. If they are adsorbed or bound to an immobile phase, movement or volatilization is slow.

4.3.2.2.2 Volatile and Semivolatile Organic Compounds

In general, volatile and semivolatile organics, such as trichloroethane and phenol, are soluble in water and have a lower K_{OC}. This means that they tend to volatilize or to leach to lower soil horizons and/or groundwater.

4.3.2.3 Explosives

The migration and decomposition of explosives in soils has been studied at Los Alamos (DuBois and Baytos 1991, 0718) and in Nevada (Harris et al. 1989, 0876). In the Los Alamos studies, it was observed that explosives having water-soluble components (Baratol, Boracitol, Composition B-3, Cyclotol, and Octol) decreased with time, whereas those having non-water-soluble components (RDX, HMX, PETN) changed very little. In the Nevada studies, it was found that only explosives on or near the soil surface had been biotransformed, hydrolyzed, and/or phototransformed to a noticeable extent, and only compounds carried by water (ionic compounds in solution as well as nonsoluble compounds) migrated a significant distance from the original disposal site. TNT apparently degraded in place rather than migrating.

The studies showed that explosives broke down at a faster rate in moist soils. The primary transport mechanism is probably water erosion of soil and sediment; subsurface water movement may also play a role.

4.3.3 Exposure Routes

Workers at OU 1132 and surrounding sites could be exposed to chemical or radioactive contamination through ingestion, inhalation, and/or dermal contact with contaminants. Disturbance of the surface of a landfill or a firing site could resuspend contaminants, allowing them to be inhaled or ingested. Because radionuclides (with the exception of tritium) are not readily absorbed by the skin, dermal contact is a less common means of exposure to these elements than ingestion or inhalation. (This is probably true of nonradioactive constituents as well.)

In addition, plants and animals living in contaminated areas can be continuously exposed to external radiation from surface and subsurface sources. Studies using small mammals implanted with dosimeters (Miera et al. 1977, 0148) show that doses to animals living in a contaminated area can be several orders of magnitude above background.

4.3.4 Potential Impacts

As mentioned earlier, the residential exposure scenario may not represent the most realistic future use of the OU 1132 area. However, because this scenario is used in calculating screening action levels, it will be applied to all PRSs in OU 1132 for the Phase I investigations. (Even if measured concentrations of potential contaminants do not exceed screening action levels, if several come close, further investigations may be carried out.) The principal contaminant source for this exposure scenario is contaminated soil. A secondary source would be a perched alluvial reservoir—if present and if capable of development as a water supply. (More information from other areas where alluvial reservoirs are present is needed to determine whether there is a hydrologic communication between those reservoirs and the main aquifer.). Should Phase I investigations suggest that a perched alluvial reservoir is present at OU 1132, and that there could be a hydrologic connection to the main aquifer, Phase II studies would be developed to investigate in more detail (and, in particular, to ascertain whether the reservoir is contaminated).

4.4 Evaluation Criteria

Most of the data gathered during Phase I of the RFI will be applicable to the first of the evaluation criteria, human health and safety risks (refer to the IWP, Section 4.2.1, for a full discussion of the evaluation criteria).

4.5 Potential Response Actions

A detailed discussion of potential response actions can be found in the IWP (Section 4.5). Specific potential response actions for OU 1132 are discussed below and summarized in Table 4-2.

TABLE 4-2
POTENTIAL RESPONSE ACTIONS FOR PRS AGGREGATES

PRS Aggregates	Potential Response Actions
Landfills	Stabilization in Place Removal of Contaminated Material
Storage Areas	NFA Removal of Contaminated Material
Firing Sites	NFA Deferral until Decommissioning Stabilization in Place Removal of Contaminated Material
Septic Systems and Seepage Pits	NFA Removal of Contaminated Material

4.5.1 No Further Action

The criteria for NFA are discussed in Section 4.5.1 and Appendix I of the IWP. The PRSs currently proposed for NFA at OU 1132 are listed in Chapter 1, Table 1-4, and then discussed in detail in Chapter 6, of this work plan. NFA has been proposed for these sites on the basis of archival research; in addition to these, other PRSs may be recommended for NFA if Phase I or Phase II investigations indicate that they pose no significant risk. NFA may be recommended for a PRS if one or more of the following criteria are met.

Criterion 1. There is documented evidence that the identified PRS does not contain and never did contain hazardous or radioactive material.

Criterion 2. The PRS has been remediated or characterized, and residual contamination has been shown not to exceed screening action levels.

Criterion 3. A baseline risk assessment has been done for the PRS and has demonstrated that the level of risk posed by the type and extent of contamination and by the associated transport pathways is acceptable.

4.5.2 Voluntary Corrective Action

Voluntary corrective action (VCA) is an obvious, feasible, and effective remedy implemented for a site where contamination has been identified and direct remediation is more cost-effective than the characterization studies needed for a baseline risk assessment. A VCA may be proposed during any phase of the RFI. (VCAs that will produce mixed waste will be deferred until a mixed waste disposal facility is available.) Any VCAs undertaken at OU 1132 will be described in quarterly technical reports to DOE, and will be reported on quarterly in public meetings.

4.5.3 Removal of Contaminated Soil

The digging up and removal of contaminated soil is a potential remediation strategy for any of the PRSs. It is an attractive option for sites for which Phase I results show contamination that is limited in extent (which, for our purposes, we define as not exceeding 10 m^2 in total area). Examples of sites where it could be used as a VCA are the chemical seepage pits, the inactive septic system, and inactive storage areas. It may also be a viable option for the gas-gun firing site, where outdoor experiments are no longer conducted, and for the abandoned firing site (39-004[b]) if the latter is not being contaminated by current activities at the other firing sites.

This option will also be considered for the landfills. However, it could be a very expensive one if there is a large volume of contaminated material.

If sampling shows that soils are contaminated by both hazardous and radioactive waste, the soils will be removed as soon as a mixed waste disposal facility is available to receive them.

4.5.4 Stabilization in Place

This type of remediation technology may be appropriate at the inactive firing sites and the landfills. For example, if it is found that contamination at the inactive firing site is limited to the firing pad and immediately surrounding area and that the major mechanism of contaminant transport is surface wind and water action, then covering the area with a layer of gravel would be effective. In contrast, such a treatment would not be effective if subsurface mechanisms were at work and contaminants were rapidly moving through the vadose zone.

For landfills, this type of technology is used to isolate contaminants in place, preventing their transfer beyond the boundaries of the PRS. Enhanced capping technologies have been extensively researched at Los Alamos National Laboratory (Hakonson et al. 1986, 0126; Nyhan et al. 1990, 0173; Nyhan et al. 1984, 0167). They are designed to control erosion at the surface and to provide primary and secondary barriers to downward movement of water. The primary barrier consists of an optimum combination of soil, vegetation, surface slope, and gravel. 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.

Such containment technologies would be appropriate for the landfills only if it is determined that the flood plain of Ancho Canyon is suitable for long-term storage of contaminants.

4.6 Ecological Risk Assessment

A methodology for assessing risk to the ecology of an area, from residual contamination and from proposed remedial actions, is currently being developed by the ER Program's Ecological Risk Assessment Technical Team.

As mentioned earlier, a recommendation of NFA for an individual PRS will be based on a comparison of potential contaminant levels with screening action levels (which are determined by generic human-health risk factors) and/or on a baseline risk assessment (which uses site-specific human-health risk factors). The assessment of ecological risk, on the other hand, will be based on different kinds of measurements (or "end points"), which have yet to be defined, and on different spatial boundaries, which may not coincide with those of the PRS, PRS aggregate, or OU. The task is complex because of the many possible ecological variables. For example, given the impossibility of considering each individual plant and animal species that could be affected—each having its own range, frequency of occurrence, feeding habits, etc.—the risk assessment model will need to use certain indicator species to focus investigations. (Guidance on the end points and spatial boundaries that will be used for the model will appear in the 1993 IWP.)

If the ecological risk assessment identifies unacceptable impacts, the contribution of each PRS to those impacts will be assessed (including a review of those already recommended for NFA). An ecological mitigation strategy can then be developed.

4.7 Proposed Strategies for Inactive Sites

Voluntary corrective action will be proposed for inactive sites where contamination is above screening action levels but is limited in extent. The action will be designed to remove all contaminated material or, where this is not possible, to reduce contamination to levels deemed acceptable by the baseline risk assessment. At OU 1132, the inactive septic system and inactive storage areas are potential candidates for VCA.

In the case of the septic system, VCA would include removal of any contaminants in the system and any associated contaminated soil. If removal of any parts of the inactive septic system would cause major site disruption or require extensive reconstruction of facilities, removal may be deferred until the site is decommissioned. In this case, Phase II sampling would be done to ensure that the septic system was not a source of continuing release.

In the case of the inactive storage areas, VCA would consist of removal of contaminated soil.

NFA will be recommended for inactive sites where contamination is shown not to exceed screening action levels.

4.8 Proposed Strategies for Active Sites

4.8.1 Storage Areas

Contaminated waste is considered *contained* if it is stored in an area from which the potential for release to the environment is essentially nil (e.g., an area located inside a building). Contained contamination is managed by the Laboratory in accordance with applicable regulations. If *uncontained* contamination is found in excess of screening action levels at any of the active storage areas, VCA (consisting of removal of contaminated soil) will be proposed. NFA is recommended for those at which contamination is both below screening action levels and contained.

4.8.2 Septic System and Seepage Pit

If Phase I sampling shows that contaminants in the active septic system and seepage pit exceed screening action levels, more detailed Phase II sampling will be done to enable a baseline risk assessment. If the assessment indicates that risks are acceptable, deferred action (until decommissioning) will be recommended.

4.8.3 Firing Sites

Since 1953, experiments at the OU 1132 firing sites have released significant quantities of toxic materials, including PCBs, mercury, depleted uranium, beryllium, lead, and other heavy metals, into the environment. Moreover, all of the firing sites are situated on the flood plain of Ancho Canyon, adjacent to an ephemeral stream channel that drains into the Rio Grande 3 miles from TA-39. The Phase I (and, if needed, Phase II) investigations will attempt to determine the fate of, and associated risk from, these contaminants. If these investigations show (as we expect they will) that there is no immediate danger to life and health from these sites that demands swift remedial action, we propose to defer remediation until the sites are decommissioned.

The gas-gun site is also still active, but experiments are now restricted to inside Building TA-39-137. Because past testing activity at this site was outside the building, Phase I investigations will focus on the grounds outside.

Proposed strategies for the active PRSs are summarized in Table 4-3.

TABLE 4-3
PROPOSED STRATEGIES FOR ACTIVE PRSs AT OU 1132

PRS #	Description	Proposed Action
39-002(a)		
Area 1	Storage Area	NFA or VCA
Area 2	Storage Area	NFA
Area 3	Storage Area	NFA or VCA
39-002(b)	Storage Area	NFA or VCA
39-002(c)	Storage Area	NFA or VCA
39-002(d)	Storage Area	NFA or VCA
39-002(e)	Storage Area	NFA or VCA
39-002(f)	Storage Area	NFA or VCA
39-002(g)	Storage Area	NFA or VCA
39-004(a)	Firing Site	Deferred Action or VCA
39-004(c)	Firing Site	Deferred Action or VCA
39-004(d)	Firing Site	Deferred Action or VCA
39-004(e)	Firing Site	Deferred Action or VCA
39-006(a)	Septic System	Deferred Action
39-007(d)	Storage Area	NFA or VCA
39-008	Gas-Gun Site	NFA or VCA
39-009	Outfall	NFA
Proposed SWMU	Chemical Seepage Pit	NFA or VCA

4.9 Sampling Strategies and Methods

4.9.1 Standard Operating Procedures

The sampling strategies for the individual PRS aggregates are presented in detail in Chapter 5. The Laboratory's Environmental Restoration standard operating procedures (LANL-ER-SOP) (or equivalent procedures) that will be used during field investigations at OU 1132 are listed in Appendix A. Some of these SOPs have been formally issued by the ER Program, some have been previously issued and withdrawn, and some have yet to be written. An appropriate, approved procedure will be in place before any sampling or analysis activity is carried out.

4.9.2 Records Management

Annex IV, the Records Management Plan in this work plan, refers to the master document in the IWP (Annex IV), which gives general guidelines for data management and protection, including technical data. As stated there (Section 2.3.1), records requirements for technical work (documentation of samples, measurements, survey locations, etc., and activity logs) are detailed in SOPs and in applicable quality procedures and administrative procedures (LANL 1993, 0951).

4.9.3 Work Practices for Environmental Protection

During the RFI, work practices will be designed to minimize ecological impact on the OU. The following will be avoided:

- unnecessary disturbance (e.g., off-road travel) to surrounding vegetation during the actual sampling and when traveling into sampling sites,
- removal or disturbance of vegetation along water sources, drainage systems, canyon slopes, and stream channels, and
- tree removal. (If tree removal is absolutely necessary, BRET will be contacted for evaluation.)

The *Biological and Flood-Plains/Wetlands Assessment for the Environmental Restoration Program, OU 1132, Ancho Canyon* (see Chapter 3, Section 3.3.1) will be evaluated by the U.S. Fish and Wildlife Service for compliance with the Endangered Species Act. This federal agency may require restrictions in addition to those outlined here.

References for Chapter 4

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Chapter 5

- Aggregate 1: Landfills
- Aggregate 2: Storage Areas
- Aggregate 3: Firing Sites, Gas-Gun Site, and Excavated Soil Dump
- Aggregate 4: Septic Systems and Seepage Pits

5.0 EVALUATION OF POTENTIAL RELEASE SITES

This chapter describes, and proposes a sampling plan for, each of the four PRS aggregates in OU 1132: landfills, storage areas, firing sites, and septic systems and seepage pits. It draws on background information contained in Chapter 2 as well as on the technical approach to site characterization presented in Chapter 4. The primary purpose of the sampling plans is to ascertain the presence and determine the current concentrations and distribution of contaminants in soils, sediments, and rock at OU 1132. We will use these data to infer transport mechanisms, estimate risks, and formulate remediation strategies. The sampling plan is designed to provide information pertinent to specific goals of the RFI:

1. to determine whether concentrations of potential contaminants in soil, sediment, and tuff exceed screening action levels;
2. to investigate the vertical and lateral distribution of contaminants in selected areas of the site;
3. using the geophysical data, contaminant distribution data, and contaminant transport models, to determine potential contaminant transport pathways in surface, near-surface, and subsurface zones;
4. to characterize and measure selected physical, chemical, and biological properties of the site to allow better prediction of contaminant transport; and
5. to use the contaminant concentration data to calculate risk, incorporating transport pathways data into the calculations if necessary to improve risk estimates.

The sampling plan is designed around the DQO methodology discussed in the IWP and in Chapter 4 of this work plan and follows the ER Program's standard operating procedures (SOPs—see Appendixes A and B). We will use a phased approach for sampling (see Chapter 4). With respect to quality assurance, we will follow the guidance given in the generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412); see also Chapter 4, Section 4.2.4.

Whether or not a mobile field laboratory will be used for some analyses will be decided at a later stage. At present, it appears that using the mobile laboratory could be less time- and cost-effective than using an off-site laboratory for all analyses: the mobile laboratory can be difficult to schedule for the time needed, can require special provisions for site access and permitting, and can entail substantial costs for set-up, power connection, etc.

5.1 Aggregate 1: Landfills

5.1.1 Background

5.1.1.1 Description and History

Between 1959 and 1989, on-site landfills were used for disposal of waste at OU 1132. (Before 1959, most waste materials were hauled to the Laboratory landfills near the airport. Some, however, were dumped into the stream channel; most of that waste has since been washed off site, but scattered debris can be found in the channel.) The on-site landfills were established in two locations, one consisting of two disposal pits and the other probably of three (See Figure 5-1 and Section 5.1.1.1.2 below). Materials disposed of in these pits include debris from firing site experiments, empty chemical containers, and office waste. It is not impossible that waste generated at other sites also ended up in these landfills (detailed logs were not kept, so this is open to speculation). If this were the case, other contaminants could be present as well. After 1976, hazardous and radioactive materials were separated from other waste and were disposed of off site.

5.1.1.1.1 PRS 39-001(a)

The two disposal pits that make up this PRS are located east and north of Building TA-39-69. Their exact boundaries are unknown (no engineering drawings can be found), but it is believed that each measures approximately 80 ft x 20 ft x 10 ft deep. Parts of the pits may be covered by Building TA-39-69 and the volleyball court to the east of the building. Approximate locations, based on recollections of site personnel, are shown in Figure 5-2. A geophysical survey was conducted on this site in association with Environmental Problem 22 during the DOE Environmental Survey (DOE 1989, 0271). The survey methods included magnetic (to detect ferromagnetic materials), inductive electromagnetic, and induced polarization (IP)/resistivity (both the latter to detect differences between materials filling the pits and the undisturbed surrounding soil). The survey apparently was successful in locating some pit boundaries on the east side of the site (a water line running along the road obscured measurements on the west side); but actual survey data was not published in the final report.

5.1.1.1.2 PRS 39-001(b)

At least three (possibly four) pits were dug and filled with refuse at this location, east of Ancho Road and north and east of Building TA-39-56 (Figure 5-3). Only the original pit, known as MDA (Material Disposal Area) Y, appears on engineering drawings (LANL 1973, 18-0012; LANL 1974, 18-0011). This pit measures approximately 148 ft x 20 ft x 12 ft deep. According to the SWMU Report (LANL 1990, 0145), a second pit of about the same dimensions is located west of MDA Y, and a third pit directly to the south of these two. The SWMU Report gives "late 1960s" as the date when Pit 1 was dug, but the engineering drawings indicate that Pit 1 was surveyed and dug in 1973. According to the report, Pit 2 was in use from about 1976 to 1981 and Pit 3 from 1981 to 1989.

Although a fourth pit is mentioned in the SWMU Report, we do not believe this pit ever existed. Not only does it not appear in any photographs or drawings, but there is no room for a fourth pit between Pit 3 and the stream channel (Francis 1992, 18-0002; Figure 5-3). Francis further suggests that Pit 2 may have been enlarged to prolong its use until about 1986, and that the pit that appears in a 1986 photograph is in fact Pit 3, which he believes was "probably constructed in 1985 or 1986 and . . . backfilled in 1989 when it was only partially full." We plan to resolve the questions concerning the presence (and location) or the absence of a fourth pit, and the locations and dimensions of Pits 2 and 3, mainly by geophysical survey, during the RFI.

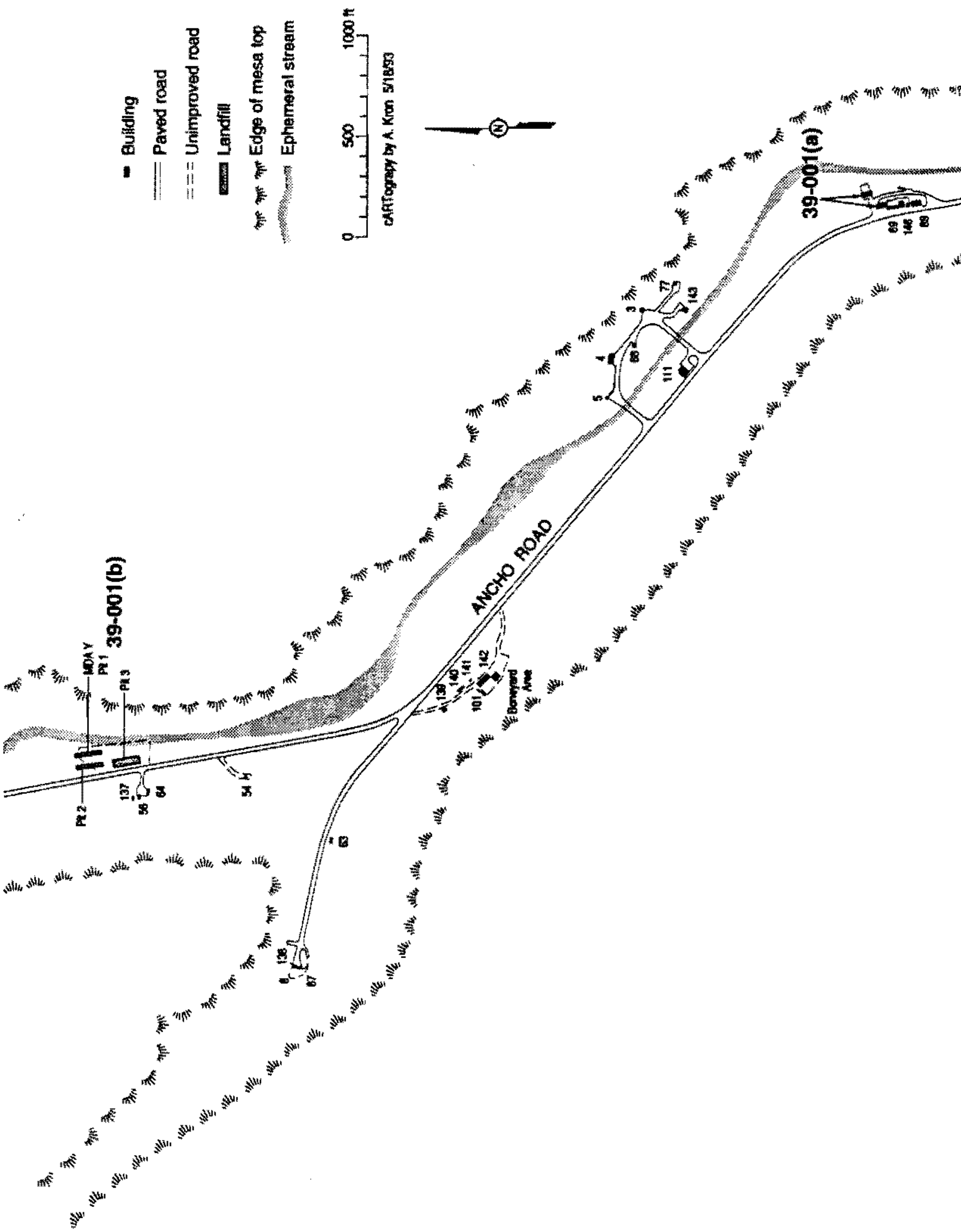

Figure 5-1. Location of PRS Aggregate 1, Landfills.

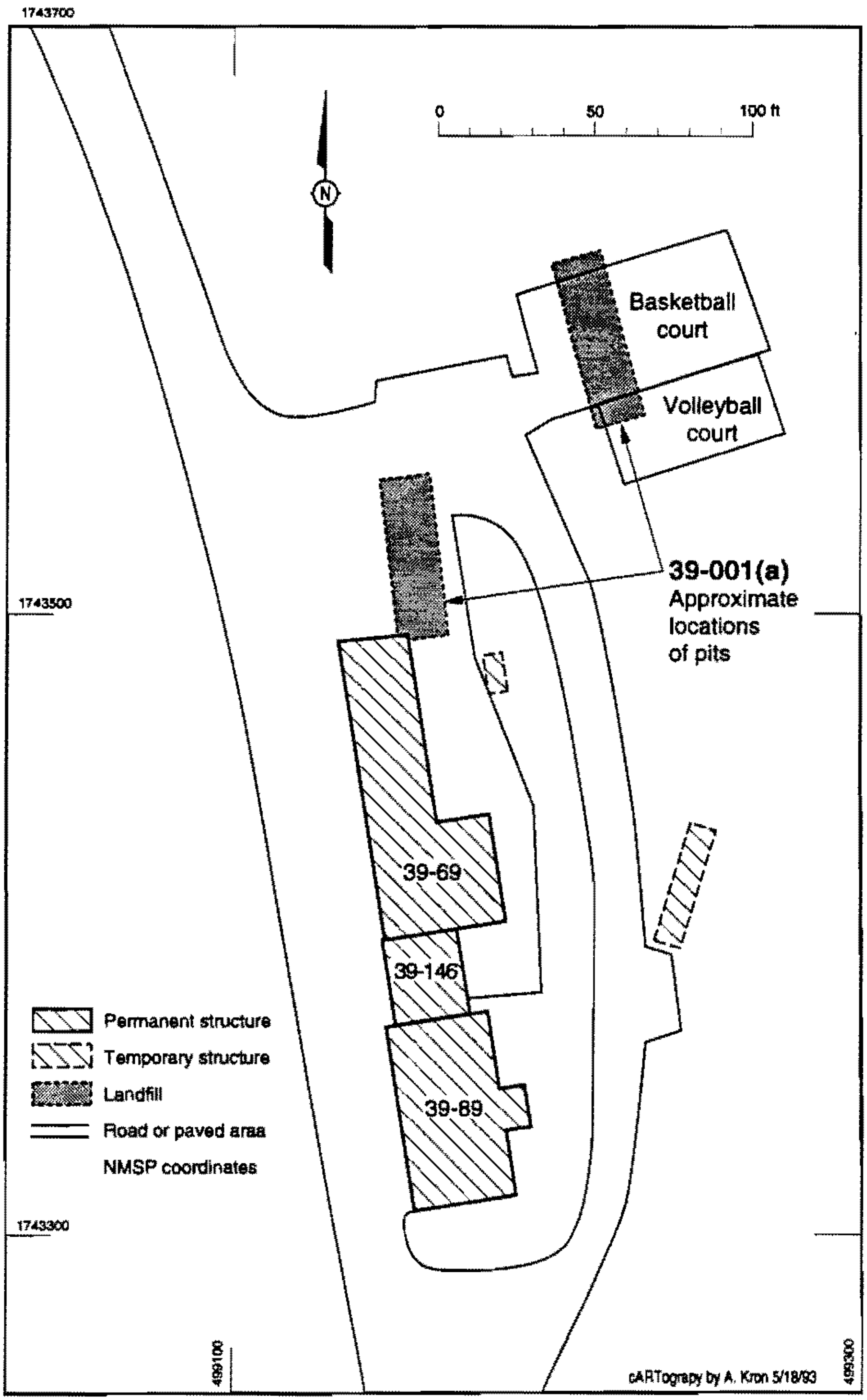

Figure 5-2. Location of PRS 39-001(a).

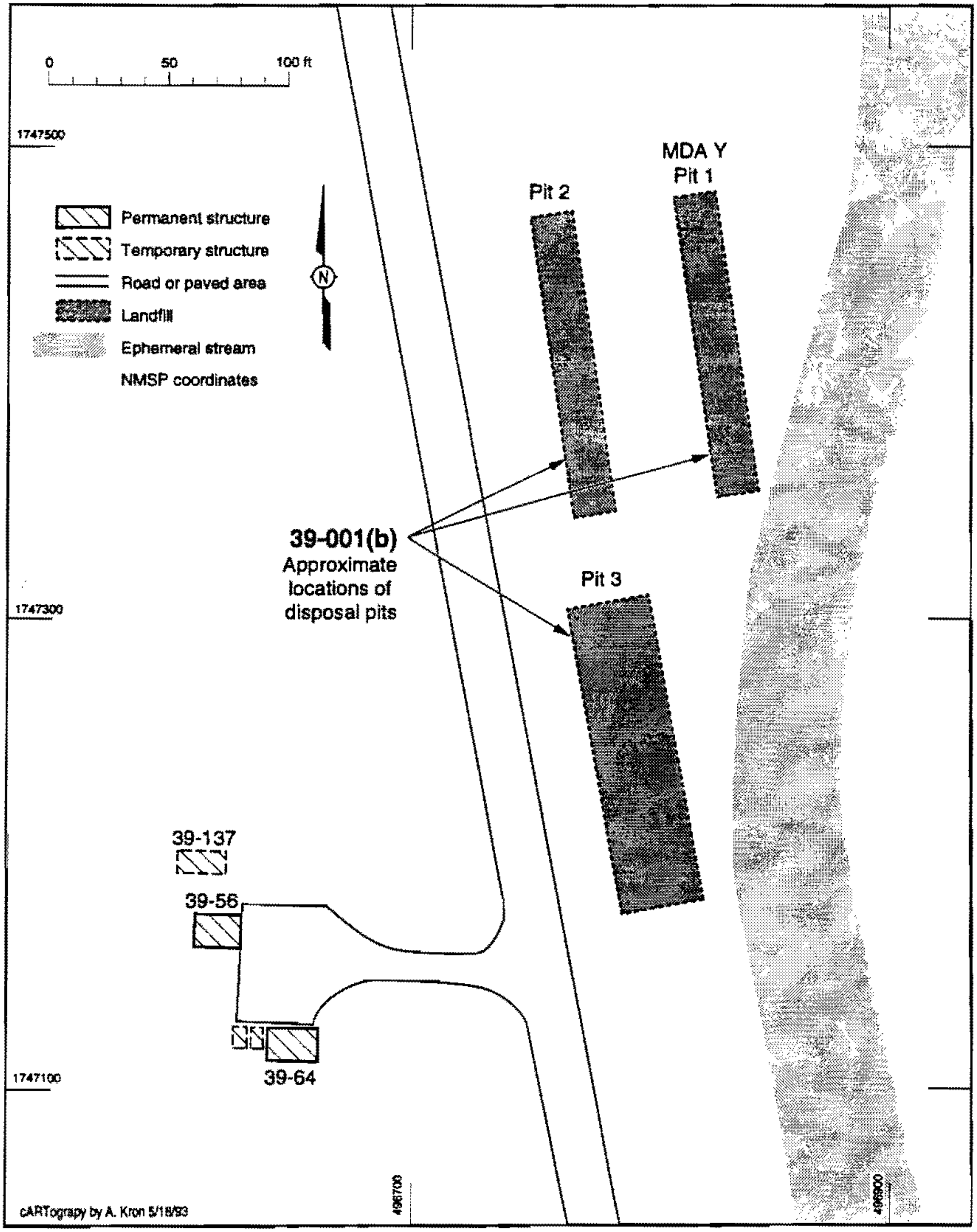

Figure 5-3. Location of PRS 39-001(b).

5.1.1.2 Existing Data on Nature and Extent of Contamination

All of the waste generated at TA-39 between 1959 and 1976 went into the disposal pits that existed at that time. Most of it was debris from the firing tests and office waste. Hazardous and radioactive materials disposed of in the pits (before 1976) probably include uranium, lead, mercury, beryllium, PCB-containing oils, HE, and solvents. The geophysical survey done at 39-001(a) as part of the DOE Environmental Survey indicated that many large ferromagnetic objects were buried in the pits there.

A limited amount of sampling was done in and around Pit 3 at 39-001(b) in association with Environmental Problem 14 (DOE 1989, 0271). Three surface samples were taken from the south end of Pit 3 while it was still open, and one borehole sample was collected at a depth of about 19 ft just outside the southeast corner (downslope, where contamination—if present—was judged most likely). These samples were analyzed for volatile organics, metals, HE, and total uranium. The results are shown in Table 5-1.

TABLE 5-1
ANALYSIS OF 39-001(b), PIT 3, SAMPLES (DOE ENVIRONMENTAL SURVEY)

Analyte	Concentration (mg/kg) Surface Sample	Concentration (mg/kg) Borehole Sample	Screening Action Level (mg/kg)
Barium	30-150	38	5 600
Chromium VI	4-10	none detected	400
Lead	4-130	6	500
Zinc	18-47	26	24 000
Copper	440-580	none detected	3 000
Acetone	none detected	0.054	8 000
HE	none detected	none detected	N/A
Total uranium	5-16	5	240

In addition, gamma scans detected small amounts of uranium-235 (136 pCi/kgW) in one surface sample. In all cases, the concentrations found were below screening action levels for the constituents. (Note that both Pits 2 and 3 would have been in use almost entirely after the regulations went into effect prohibiting on-site disposal of hazardous and radioactive wastes. It is not unlikely, then, that neither of these pits contains any RCRA-regulated wastes.

5.1.2 Conceptual Exposure Model

An overall conceptual exposure model for OU 1132 is given in Chapter 4.

The most likely mechanisms for migration of contaminants from the pits are subsurface flow of water and vapor-phase transport. The geologic substrate has not been characterized sufficiently to predict the potential for either type of contaminant spread, but the samples taken from Pit 3 and from the borehole some 10 ft southeast of the pit (see Table 5-1) suggest that potential contaminants have spread laterally toward the stream channel. The borehole, drilled to a total depth of 24 ft, gave no evidence of perched water; but if a perched alluvial reservoir is present in the canyon bottom, the potential for spread of a contaminant plume is greater. If contamination exists on the surface, wind and surface water are additional mechanisms.

5.1.3 Potential Remediation Alternatives

Remediation alternatives for landfills are discussed in Chapter 4. The two most likely strategies for the OU-1132 landfills are

- *Stabilization in Place.* This would include capping to prevent water movement through and out of the landfill and, possibly, engineering measures to strengthen the stability of the landfill. Capping by itself would be feasible only if it could be demonstrated that (1) no perched alluvial reservoir exists (water from such a reservoir could move laterally through the landfill, making the cap useless) and (2) there is little danger of flooding capable of eroding the cap. Capping plus engineering measures to prevent damage from flooding could be the best strategy if no alluvial groundwater is present.
- *Removal of all Contaminated Material.* This option has the advantages that (1) once material is removed, institutional control is no longer required; and (2) the threat of removal of landfill materials by flooding is eliminated. Implementation would be expensive, however, and would be possible only if an appropriate facility were available for disposal of any mixed waste.

5.1.4 Sampling Plan

5.1.4.1 Phase I Investigations

5.1.4.1.1 Data Needs and Objectives

During Phase I, data gathering for the landfills will have six specific objectives:

1. Examine the history of flooding in Ancho Canyon.
2. Characterize the environmental features of the landfills that would influence contaminant transport. (For example, what is the potential for damage to the landfills from flooding? Does a perched alluvial reservoir underlie the landfills?)
3. Determine the number of pits and, as precisely as possible, the boundaries of each pit.
4. Determine whether contaminants have migrated beyond the pit boundaries.
5. Using field data collection and contaminant transport modeling, characterize migration pathways.
6. If a CMS is necessary, define its scope.

5.1.4.1.2 Environmental Characterization

For a number of the PRSs in TA-39, and for the landfills in particular, a knowledge of the history of flooding in Ancho Canyon is essential for selecting an effective remediation. To study that history, we plan to dig a trench across the stream channel and a portion of the flood plain, at a location south of Pit 3 that will not disturb Laboratory activities. (The approximate location of this trench is shown in Fig. 5-4). The trench will measure approximately 10 ft deep (depending on what is found as the investigation proceeds) x 250 ft long. Soils and sediments will be sampled at various depths, stratigraphic units will be identified and described, and the nature of contacts between geologic and soil units will be noted. These data should tell us whether the canyon is being scoured by flooding or, to the contrary, is being filled in by sediment deposition. The answer to this question will be important for deciding on a remediation strategy. (Surface characteristics of the canyon bottom suggest it is being filled in; if this is true, *in-situ* stabilization could be an effective remediation. However, if the canyon is being actively deepened by flooding, this strategy would not be appropriate.)

Subsurface water flow, saturated and/or unsaturated, is a potentially important contaminant transport mechanism, especially in the stream channel/flood plain zone. For this reason, the geologic and hydrologic properties of the canyon substrate that affect subsurface transport will be investigated, via four coreholes at selected locations (Figure 5-4), to determine

- the presence and extent of a perched alluvial reservoir,
- vertical changes in the canyon bottom stratigraphy to a depth of 150 ft, and
- hydraulic characteristics of the alluvial material (porosity, bulk density, grain-size distribution with depth, saturated and unsaturated conductivity, etc.).

The coreholes will extend 20 ft below the alluvium or to a total depth of 100 ft, whichever is less.

The sampling procedures to be used are described in Section 5.1.4.1.3.3, below. Details of the techniques to be used for coring and for measuring hydraulic characteristics can be found in Appendix B of this work plan.

5.1.4.1.3 Characterization of Contamination

5.1.4.1.3.1 Surface Field Surveys

The areas delineated in Figures 5-5 and 5-6 will be surveyed for radioactivity and for the presence of metals as well as for geophysical features (see Table 5-2 for details). Surface radiation levels will be tested with hand-held instruments; the specific type of survey (gross beta-gamma or low-energy gamma) and instrument used will be decided by the site health physicist on the basis of the particular conditions at the site. Selected locations on the grid, or other layout, used for the radiological survey (e.g., locations showing elevated radiation) will be checked for metals by X-ray fluorescence (XRF) measurement. We estimate that in most cases, 20-30 percent of these locations will be tested for metals. (Note: The area north of Pit 3 that was formerly the site of PRS 39-007(e), a

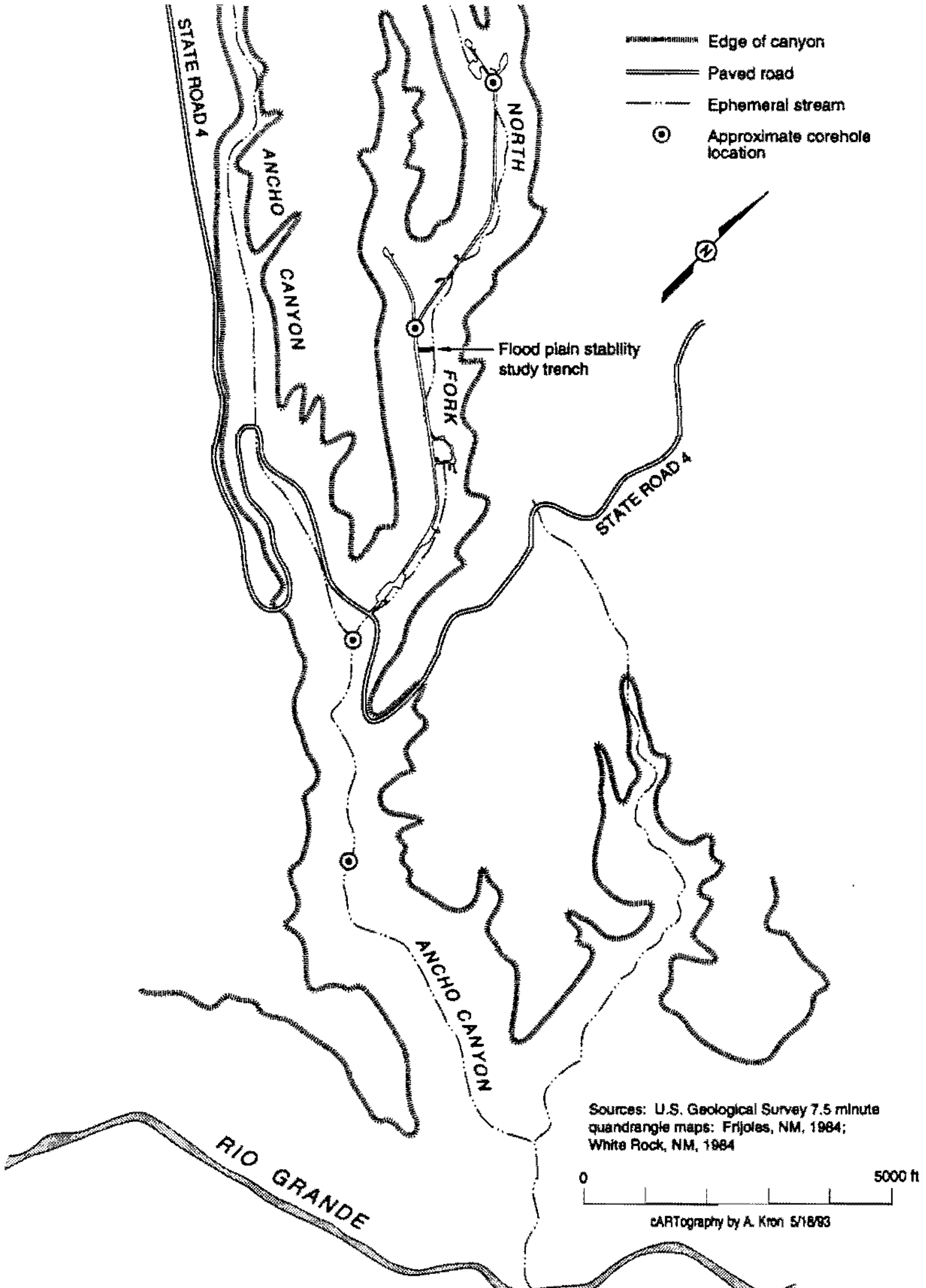

Figure 5-4. Approximate locations of coreholes for subsurface geologic/hydrologic characterizations and of trench for flood plain stability study.

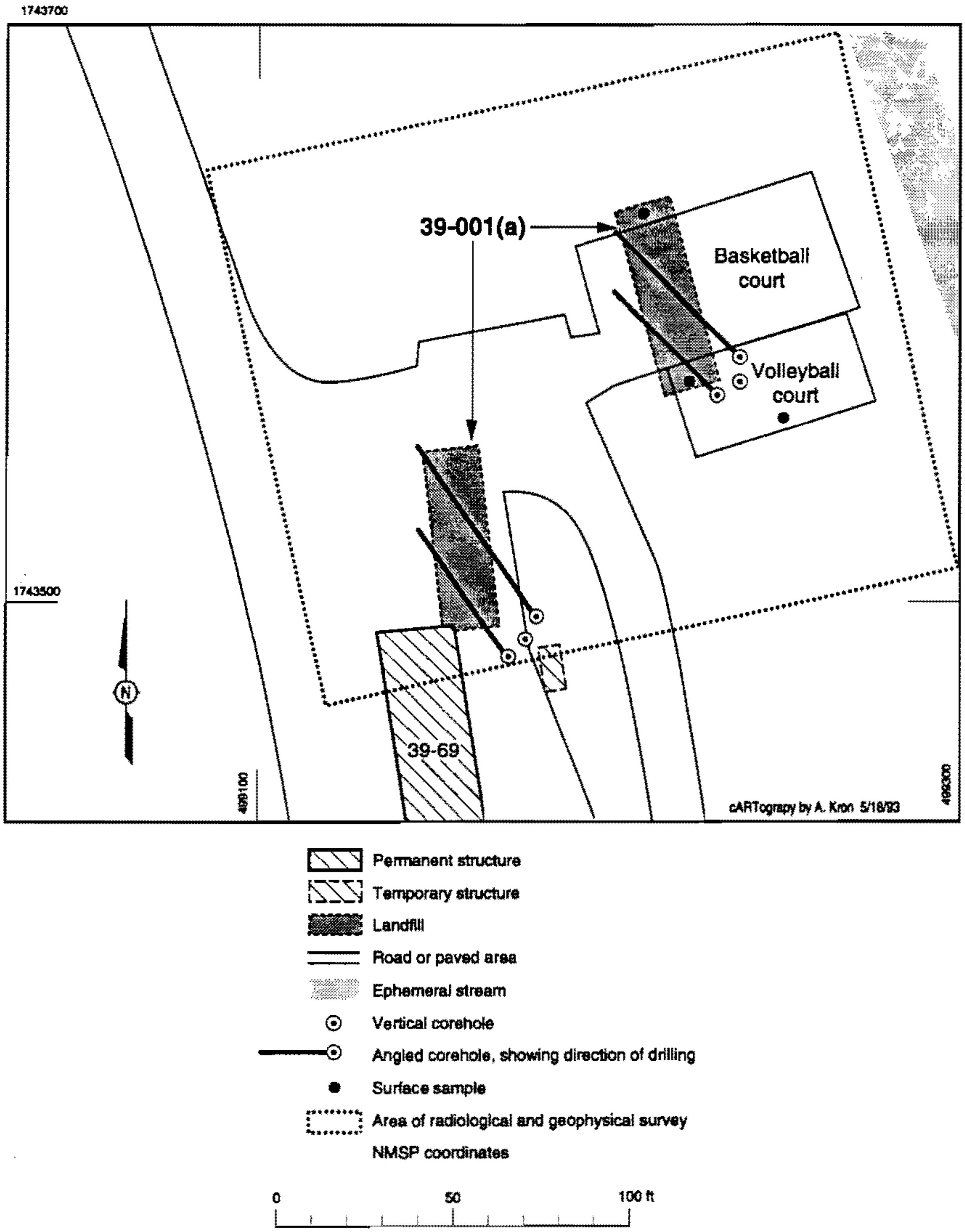

Figure 5-5. Survey area and approximate corehole and surface sampling locations for 39-001(a).

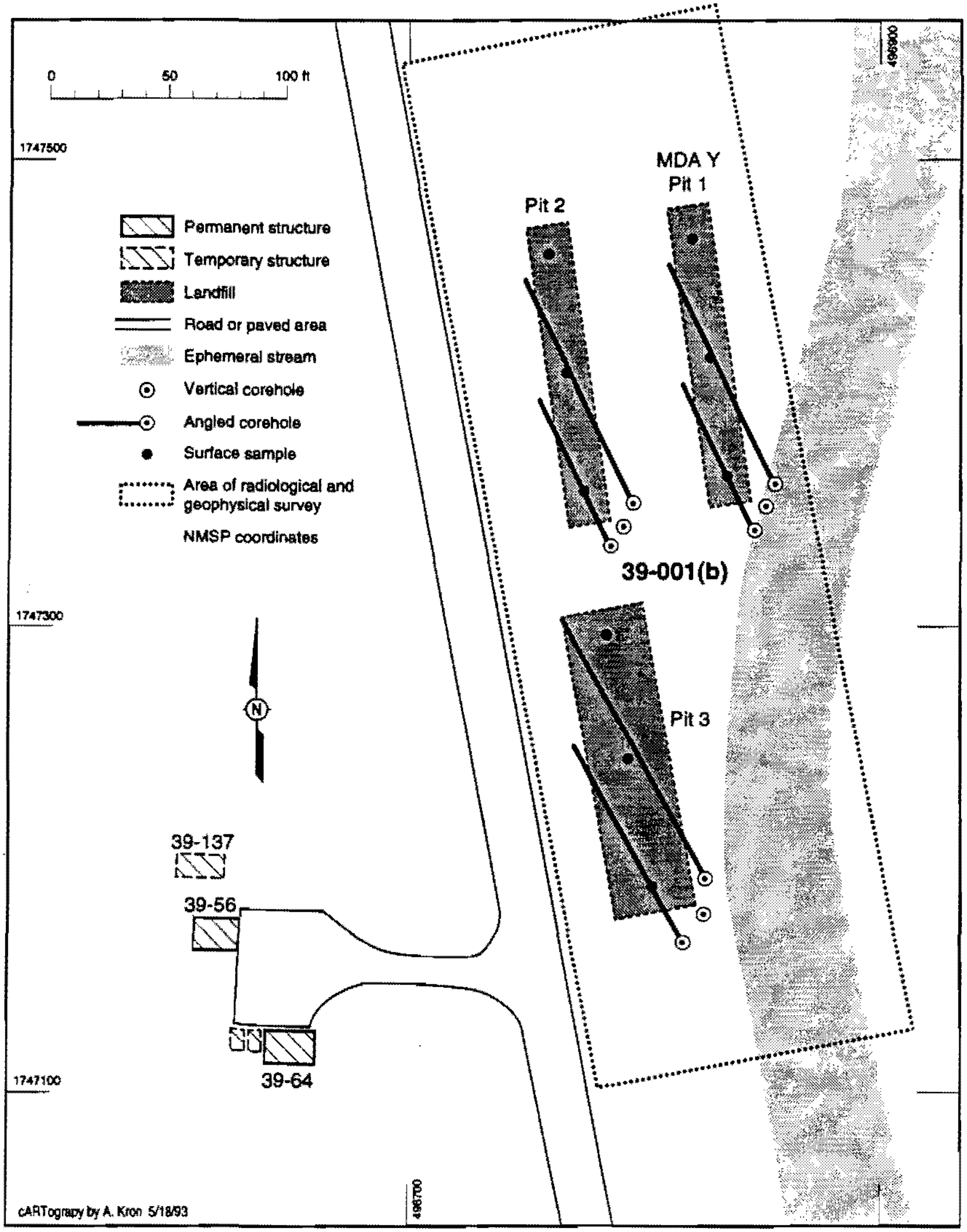

Figure 5-6. Survey area and approximate corehole and surface sampling locations for PRS 39-001(b).

TABLE 5-2

PHASE I SAMPLING PLAN FOR PRS AGGREGATE 1 (LANDFILLS)

								Field Survey				Field Screening				Laboratory							
PRS	No. of Core-holes	Sample Type	Sampling Method	No. of Sample Locations	Depth	Length (ft)	Interval (ft)	Radiological/XRF	Geophysical (surface)	Geophysical (borehole)	Land mapping	Radiological	Lithologic logging	Organic vapor/gases	HE (M-1 kit)	Radiological (γ spectrometry)	Uranium and thorium*	Volatile organics (SW 8240)	Semivolatiles (SW 8270)	Metals & cyanide (SW 6010)	HE (USATHAMA)	PCBs (SW 8080)	Petroleum hydrocarbons
39-001(a)								X	X		X												
		surface	hand auger	3	0–2 in.							X			X	X	X		X	X	X	X	X
	2	vertical core	dry-core drilling	32	80 ft		5			X		X	X	X	X	X	X	X	X	X	X	X	X
	4	angled core	dry-core drilling	44		55	5			X		X	X	X	X	X	X	X	X	X	X	X	X
39-001(b)								X	X		X												
		surface	hand auger	9	0–2 in.							X			X	X	X		X	X	X	X	X
	3	vertical core	dry-core drilling	48	80 ft		5			X		X	X	X	X	X	X	X	X	X	X	X	X
	6	angled core	dry-core drilling	66		55	5			X		X	X	X	X	X	X	X	X	X	X	X	X

*See Appendix B.

cARTography by A. Kron 5/18/93

removed hazardous waste storage shed, will be checked closely during the survey for any signs of residual contamination. If any are found, the location will be noted for soil sampling.) Finally, for the geophysical survey (to establish the location of each pit and, for PRS 39-001(b), whether or not a fourth pit exists), we will use a combination of electromagnetic and magnetic techniques. (See Appendix B for detailed information on the techniques and instruments that will be used for these field surveys.)

5.1.4.1.3.2 Surface Sampling

At least three surface samples will be collected at PRS 39-001(a), from the unpaved areas of the eastern-most pit and from the unpaved adjacent recreational area (Figure 5-5). The sampling locations will be "biased" if possible: within "hot spot" areas found during the radiological survey, areas showing elevated XRF readings, or areas with visible indicators (stained soil, stressed vegetation, etc.) If biased sampling locations are not found, three samples will be collected from random locations.

For PRS 39-001(b), surface contamination is not anticipated, but at least nine surface samples will be collected for analysis in the laboratory (see Figure 5-6). If possible, biased sampling locations will be selected, in the same way as for 39-001(a). If biased locations are not found, samples will be collected from three evenly spaced locations on each pit.

5.1.4.1.3.3 Subsurface Investigations

Subsurface investigations of OU 1132 landfills will be designed to characterize contaminant movement (if any) out of the pits, including the media in which the contaminants are carried. One vertical core will be taken downgradient from each pit—the locations selected to maximize the probability of detecting any migration plumes of contaminants; in addition, two angled coreholes will be drilled from southeast to northwest below each pit (see Figures 5-5 and 5-6). Details on the subsurface sampling techniques, including references to appropriate SOPs, are given in Appendix B.

A dry-core drilling technique will be used to minimize the chances of contaminant mobilization by drilling fluids and of disturbance of the moisture conditions in the alluvium and underlying bedrock. Any cores not sampled for analysis will be archived for the duration of the RFI.

A lithologic log will be kept for each corehole, to record such data as lithologic changes with depth, grain size, sorting, color, cementation, roundness, clay content, stratigraphic contacts, alteration features, welding characteristics, and lithic content. If tuff is encountered, the log will also include information on fractures. The core will be photographed in color, and then samples will be removed for analysis. In this way, a complete lithologic description of the core will be available for site characterization and for permanent TA-39 records.

The vertical coreholes will be drilled to a depth of 10 ft below the alluvium. Alluvial deposits in this area generally do not exceed 100 ft (IWP Section 2.6.2.2.1), but data collected in association with Environmental Problem 22 (DOE 1989, 0271) show that they attain a thickness of at least 24 ft.

The estimated number of sample locations for each corehole is based on a depth of 80 ft.

Discrete samples for laboratory analysis will be taken every 5 ft along the length of each core. Additional samples may be taken at interfaces between geological materials of different types and/or (if Bandelier tuff is encountered) from fractures. All core samples will be taken in amounts adequate for analysis, and will include approximately equal quantities of material from above and below the selected sampling depth.

The borehole itself will be used as a source of additional information. The air inside the hole will be analyzed for volatile organic compounds; and geophysical studies will provide data on characteristics such as moisture content and bulk density of the materials, which contribute to an understanding of contaminant transport. (In addition, using new techniques in borehole geophysics, we may be able to gather more specific data on the nature and extent of contamination in these materials.)

Finally, two of the boreholes at each landfill PRS will be cased, so that groundwater monitoring instrumentation—if needed for subsequent investigation of the presence or absence of perched groundwater—can easily be installed.

The field survey, screening, and analysis program for the landfills is summarized in Table 5-2.

5.1.4.2 Phase II Investigations

Phase II investigations will be developed and implemented if Phase I investigations suggest that contamination has spread beyond the boundaries of the landfill pits and that more information is needed to do a baseline risk assessment. (We anticipate that a CMS will probably be needed for the landfills). For example, if coring indicates that the contaminant plume extends beyond the pits, a Phase II investigation will focus on fully characterizing the nature and extent of the contaminant plume. Similarly, if Phase I investigations reveal the presence of contamination in a perched alluvial reservoir, Phase II investigations would include confirming or ruling out a hydrologic connection between the perched reservoir and the main aquifer.

5.2 Aggregate 2: Storage Areas

OU 1132 contains twelve active and inactive storage areas. (Note: At the time of the SWMU Report [LANL 1990, 0145], the then-active areas were numbered -002 and the then-inactive ones -007. In a few cases, either an area was incorrectly labelled as active or inactive or its status changed since the original designations.) Four of the storage areas are recommended for NFA (see Chapter 6). Field investigations will be done for the remaining eight; these are shown in Figure 5-7 and are described below.

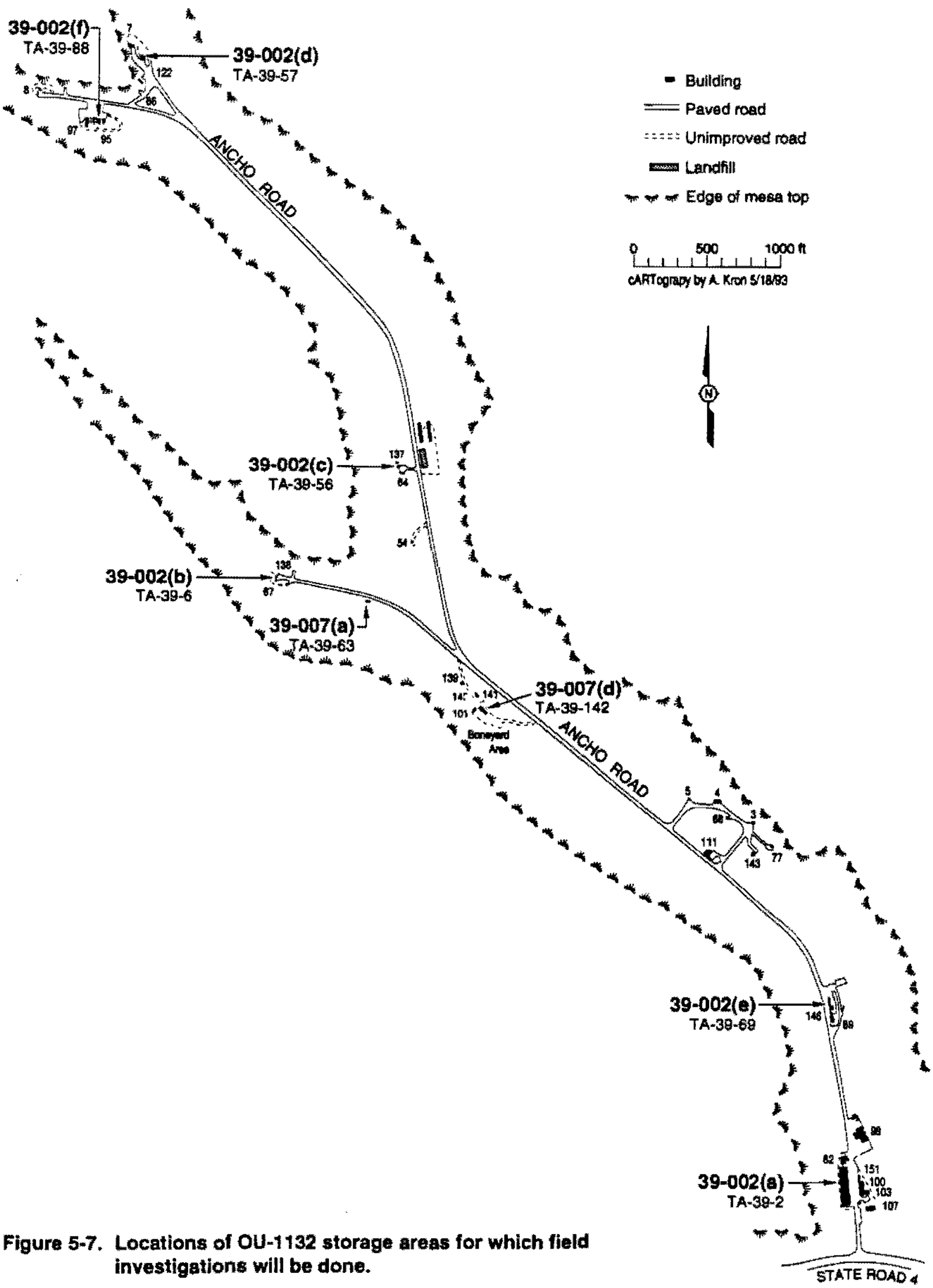

Figure 5-7. Locations of OU-1132 storage areas for which field investigations will be done.

5.2.1 Background

5.2.1.1 Description and History

5.2.1.1.1 PRS 39-002(a)

PRS 39-002(a) contains three separate storage areas.

Area 1 is an RCRA Satellite Hazardous Waste storage site located near an exit door at the outside northwest corner of Building TA-39-2 (Figure 5-8); the surface is earth/gravel (no berm), and it is not protected by a roof. This site has been in occasional use for approximately 10 years. It is currently occupied by a 30-gal. drum that holds small quantities of solvents and adhesives along with rags and paper wipes contaminated with solvents or adhesives. (Waste solvents are usually returned to their original containers, which are then placed in the drum; contaminated rags and paper are put into plastic bags before being placed in the drum.) Solvents stored at this site include acetone and ethanol. There is no evidence, visible or documented, of any spills or leaks at this site.

In the past year, an outside metal dumpster was temporarily located near Area 1 to receive low-level radioactive debris from the remodeling of a vault where radioactive materials had been stored for use in experiments. The dumpster has been removed from the area.

Area 2 is an indoor storage area (inside Room 18-A of Building TA-39-2). It has been in use for about the last 10 years, for storage of waste chemicals from photographic processing, and currently contains about 5 gal. of these chemicals. No releases are known or have ever been documented at Area 2, and because the site is inside a building, the potential for release is negligible if not zero. For this reason, we do not plan to do sampling at Area 2.

Area 3 is an outside storage area, on the asphalt driveway, at the north end of the loading dock on the southeast side of Building TA-39-2 (Figure 5-8). Various materials used in the firing site experiments are delivered here and picked up as needed. They include transformer oil in 55-gal. drums (one or two per month) and small quantities (1 gal. or less) of vacuum pump oil and solvents (ethanol, acetone, and trichloroethane). The use of trichloroethane is being phased out of current operations, but small quantities are still stored at this site. There is no evidence, visible or documented, of any spills or leaks at this site.

5.2.1.1.2 PRS 39-002(b)

This small concrete pad outside of Building TA-39-6 (Figure 5-8) measures about 5 ft x 5 ft. It has been used since 1953 to store small quantities of paper contaminated with waste solvents (ethanol, acetone, trichloroethane, copper sulfate); transformer oil; vacuum grease; and photographic wastes (Polaroid). Nothing is currently stored here, but the area remains active for use as needed. No evidence of spills or leaks is visible or has been documented.

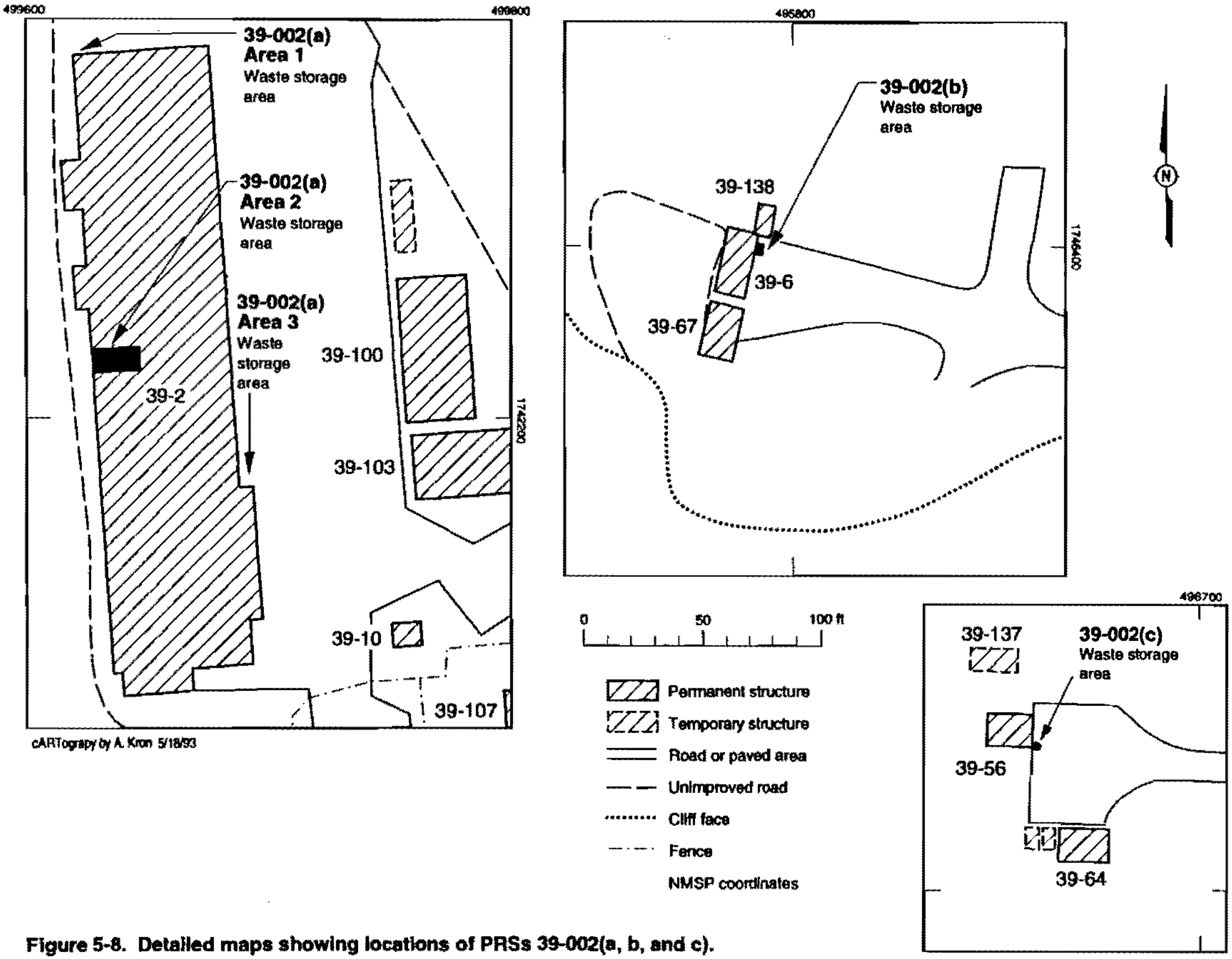

Figure 5-8. Detailed maps showing locations of PRSs 39-002(a, b, and c).

5.2.1.1.3 PRS 39-002(c)

This area, on the asphalt pavement outside the southeast corner of Building TA-39-56 (Figure 5-8), contains an empty 55-gal. barrel. It is used only as needed for activities in the vicinity, to store waste paper and rags contaminated with solvents (ethanol, acetone, trichloroethane) and vacuum grease. No evidence of spills or leaks is visible or has been documented.

5.2.1.1.4 PRS 39-002(d)

This area is a gravel pad on the outside southwest corner of Building TA-39-57 (Figure 5-9). It has been in use since the 1980s for storage of photographic (Polaroid) wastes and cloth and paper contaminated with various substances (acetone, ethanol, transformer oil, trichloroethane, vacuum grease, and copper sulfate). The area is currently empty but remains active for use as needed. There is no evidence, visible or documented, of spills or leaks.

5.2.1.1.5 PRS 39-002(e)

Located at the south end of Building TA-39-69 (Francis, 1992, 18-0003; Figure 5-9), this is a concrete pad under the breezeway that connects Building 69 to Building 89. (The SWMU Report [LANL 1990, 0145] erroneously listed this area as at the north end of Building 69.) Since the 1980s, when these buildings were built, it has served as a hazardous waste storage and pick-up area (containers of waste are placed here when full for pick-up). The materials stored are waste products from the two-stage gas gun experiments, which include Gunk, aluminum, lead, carbon dust, nylon, WD-40, Polaroid film, ethanol, brass, paraffin, stainless steel, quartz, and *Fantastik* cleaner. A total of about 60 gal. of waste are generated per year. No evidence of spills or leaks is visible or has been documented.

5.2.1.1.6 PRS 39-002(f)

This is a small storage area on the asphalt driveway outside the northeast corner of Building TA-39-88 (Figure 5-9). This area has been used since the 1980s to store small quantities of waste solvents (ethanol, acetone, trichloroethane, copper sulfate), transformer oil, vacuum grease, and, later, photographic (Polaroid) wastes. The area is currently empty but remains active for use as needed. No evidence of spills or leaks is visible or has been documented.

5.2.1.1.7 PRS 39-007(a)

This is a concrete-pad storage area under a covered porch outside the northeast corner of Building TA-39-63 (Figure 5-9). In the past, waste transformer oil was stored here. No evidence of spills or leaks is visible or has been documented. Nothing is currently stored here, and future use of this site for storage is not planned.

5.2.1.1.8 PRS 39-007(d)

Erroneously identified as an inactive storage area in the SWMU Report, this is an active storage area (Francis 1992, 18-0008) consisting of a bermed asphalt pad, about 30 ft × 90 ft, covered by a metal roof. Designated TA-39-142, it was built

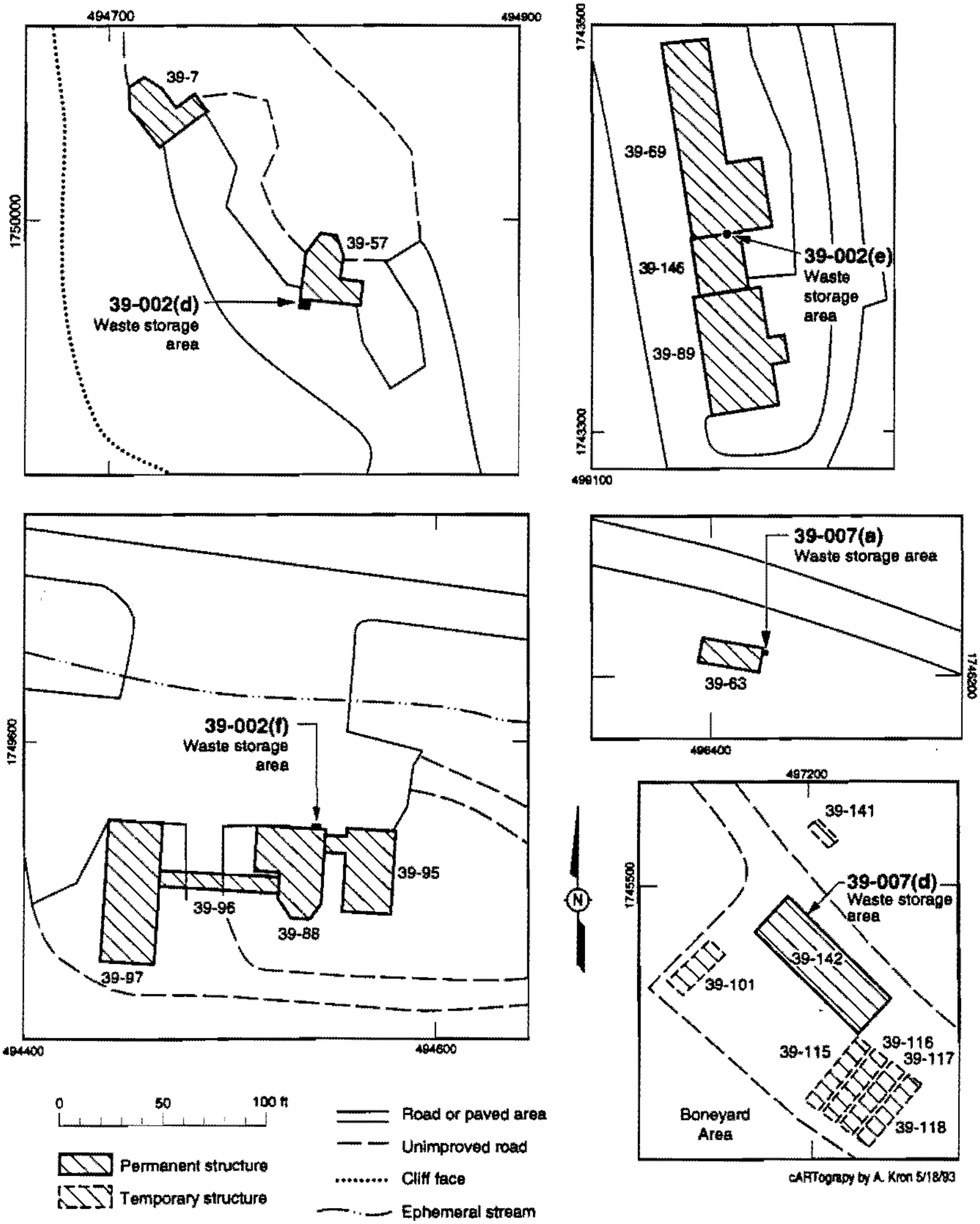

Figure 5-9. Detailed maps showing locations of PRSs 39-002(d), (e), (f); and 39-007(a), (d).

in 1989. Since the early 70s, before construction of the pad, this area—called the "Boneyard"—was used for storage of metals (for use in test stands and shielding) and, occasionally, a drum or two of transformer oil. Chemicals were first stored at the site around 1985-87. Currently, the pad contains barrels of dielectric (silicon transformer) oil, empty barrels, ethylene glycol, weathered lead sheets, and capacitors (labeled "No PCBs"). Barrels for dispensing acetone, oil, kerosene, and trichloroethane are aligned just inside the berm on the east side. An oil-like substance covers about half of the pad and has accumulated near the east end, where a valved drain pipe (about 3 ft long) extends through the berm. This pipe discharges water and other liquids from the bermed area, which then flow across the access road and east along the road edge to the Ancho Road drainage.

5.2.1.2 Existing Data on Nature and Extent of Contamination

Table 5-3 summarizes existing information on the nature of the wastes likely to be present in each of the storage areas.

5.2.2 Conceptual Exposure Model

An overall conceptual exposure model for OU 1132 is presented in Chapter 4.

Migration of contaminants from non-contained storage areas is possible if spillage or leakage has occurred. Receptors could become exposed through dermal contact, inhalation, or ingestion of hazardous material.

5.2.3 Potential Remediation Alternatives

Voluntary corrective action (VCA), consisting of removal of contaminated material, will be recommended for any storage areas where contamination is not contained (soils surrounding the area are found to be contaminated).

5.2.4 Sampling Plan

5.2.4.1 Phase I Investigations

5.2.4.1.1 Data Needs and Objectives

Phase I sampling for this aggregate will characterize contamination (if present) on storage area pads and in soils surrounding the area. Specifically, sampling will be designed to answer the following questions:

- are there uncontained potential contaminants associated with any of the storage areas?

- do the levels of potential contaminants exceed the screening action levels?

5.2.4.1.2 Characterization of Contamination

Each of the storage areas will be scanned for radiation and for the presence of metals (see Table 5-4). Surface radiation levels will be tested with hand-held instruments; the specific type of survey (gross beta-gamma or low-energy gamma) will be decided by the site health physicist on the basis of the particular

TABLE 5-3
OU 1132 STORAGE AREAS FOR PHASE I RFI

PRS Number	Location	Nature of Wastes Stored	Hazardous Release	Radioactive Release
39-002(a) Area 1	Outside Bldg TA-39-2	contaminated wipes, solvents, adhesives, radioactive materials	unknown	unknown
Area 3	Outside Bldg. TA-39-2	solvents, vacuum pump oil, transformer oil	unknown	none suspected
39-002(b)	Outside Bldg. TA-39-6	solvents, transformer oil, vacuum grease, photographic waste	unknown	none suspected
39-002(c)	Outside Bldg. TA-39-56	paper, cloth contaminated with solvents and vacuum grease, photographic waste	unknown	none suspected
39-002(d)	Outside Bldg. TA-39-57	photographic waste, cloth and paper contaminated with solvents, vacuum grease, and transformer oil	unknown	none suspected
39-002(e)	Outside Bldg. TA-39-69	Gunk, WD-40, spent propellant, aluminum, brass, lead, stainless steel, ethanol, polyethylene, nylon, paraffin, quartz, carbon dust, Polaroid film, polycarbonate, *Fantastik* cleaner	unknown	none suspected
39-002(f)	Outside Bldg. TA-39-88	solvents, contaminated transformer oil, vacuum grease, photographic waste	unknown	none suspected
39-007(a)	Outside Bldg. TA-39-63	waste transformer oil	unknown	none suspected
39-007(d)	Bldg. TA-39-142	oil, solvents, lead, dielectric oil, capacitors	unknown	none suspected

TABLE 5-4

PHASE I SAMPLING PLAN FOR PRS AGGREGATE 2 (STORAGE AREAS)

PRS	Samples		Sampling Method	Depth (in.)	Field Survey		Field Screening			Laboratory					
	Type	Number			Radiological/XRF	Land mapping	Radiological	Organic vapor/gases	HE (M-1 kit)	Radiological (γ spectrometry)	Semivolatiles (SW 8270)	Metals & cyanide (SW 6010)	HE (USATHAMA)	PCBs (SW 8080)	Petroleum hydrocarbons
39-002(a)															
Area 1	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
Area 3	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-002(b)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-002(c)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-002(d)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-002(e)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-002(f)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-007(a)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X
39-007(d)	surface	2	hand auger	0–6	X	X	X	X	X	X	X	X	X	X	X

cARTography by A. Kron 5/18/93

conditions at the site. Selected locations on the grid (or other layout) used for the radiological survey (e.g., locations showing elevated radiation) will be checked for metals by XRF measurement. (See Appendix B for detailed information on the techniques and instruments to be used for these field surveys.)

Each storage area will be inspected for stains, residues, and features that could contribute to contaminant leaks (such as a cracked or sloping concrete pad). On the basis of these inspections, the radiological and metals surveys, and other factors—such as where the drums are stored and where they are during addition or removal of wastes—we will select two sampling locations in the area(s) most likely to have received contamination. (Sampling in two locations increases the possibility of finding the area of highest contamination.) Samples will be field-screened for gross gamma, gross alpha, organic vapor, and HE. Laboratory analyses will include gamma spectrometry, gross alpha, semivolatiles, metals, HE, PCBs, and petroleum hydrocarbons (see Table 5-4).

5.2.4.2 Phase II Investigations

If the results of Phase I sampling show the presence of contamination, more detailed Phase II sampling will be done.

5.3 Aggregate 3: Firing Sites, Gas-Gun Site, and Excavated Soil Dump

This aggregate includes active and inactive firing sites, a single-stage gas-gun site, and a large soil dump contaminated by firing site activities (Figure 5-10). These PRSs have been grouped together because the types of potential contaminants in them will be similar. A rationale for evaluating contaminant migration from the active firing sites was presented in Chapter 4. Sampling at these sites will focus on determining whether there is uncontained contamination and whether it is moving off site.

5.3.1 Background

5.3.1.1 Description and History

5.3.1.1.1 PRS 39-004(a)-(e): Firing Sites

Of the five firing sites for open-air detonation at TA-39, four are active and one is inactive. These sites are located in two general areas within Ancho Canyon (see Figure 5-10 for site locations and Figure 5-11 for detail maps of each site.). The three sites TA-39-6, -7, and -8 (PRSs 39-004[c], [a], and [b], respectively) date from the time of TA-39's establishment as a remote test firing facility; the other two were constructed more recently. Testing at one of the original sites, TA-39-8 (PRS 39-004[b]), was discontinued around 1980 because of the constant hazard of falling debris from the nearby cliff. (It should be noted that the identification of TA-39-7 as inactive in the SWMU Report was in error [Francis 1992, 18-0005].)

The experiments conducted at the firing sites, the primary purpose of which is to test materials, are designed to expend all of the HE in the device. If a shot fails, so that not all the HE is spent, an effort is made to pick up and destroy the unexploded HE. A typical shot carries 10 to 100 lb. of HE, but on occasion up to

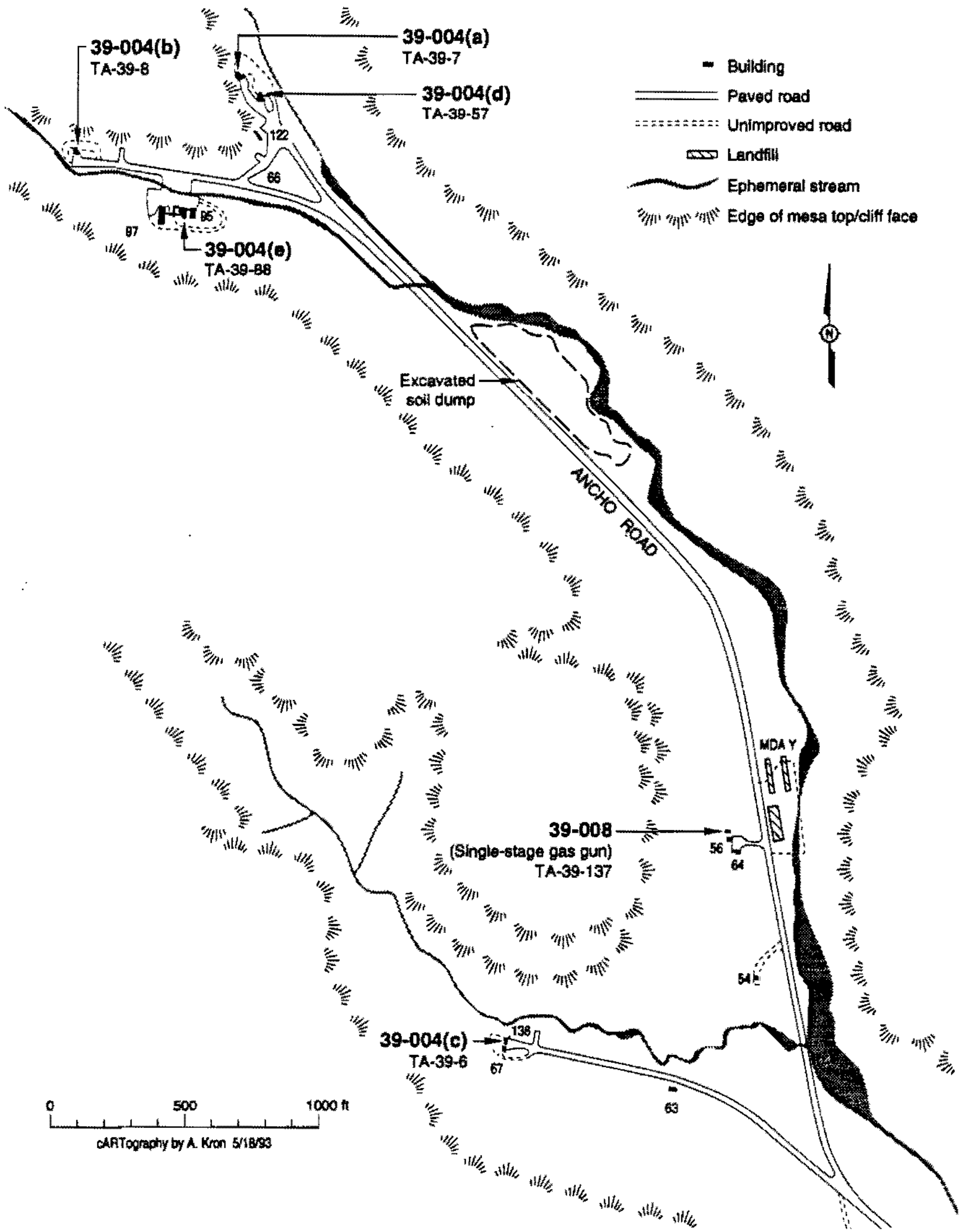

Figure 5-10. Locations of firing sites, single-stage gas-gun site, and excavated soil dump.

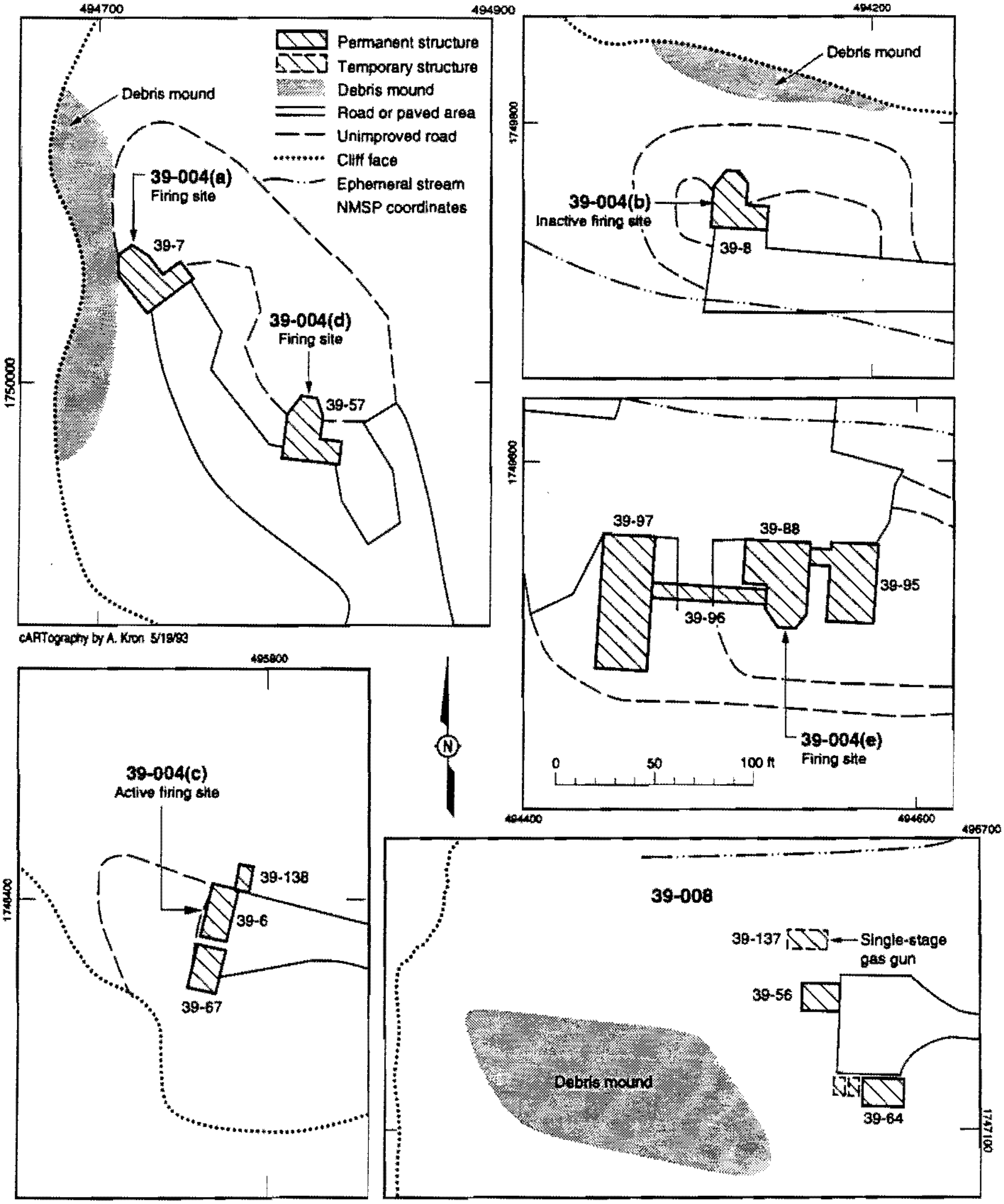

Figure 5-11. Detailed maps showing firing sites and single-stage gas gun site.

1000 lb. may be used. Althoug debris from the latter may travel a mile or more, signs of impact are generally noticeable only within a 200-ft radius around the firing pad.

Three of the four active sites ([a], [c], and [e]), are pulsed-power sites (pulsed-power experiments use electrical energy in addition to HE for detonation). The SWMU Report mistakenly identified PRS 39-004(d) as a pulsed-power site as well (Francis 1992, 18-0005).

Table 5-5 summarizes operational information on the firing sites.

TABLE 5-5
FIRING SITE PRSs

PRS Designation	Structure number	Operational Status	Dates of Operation	Size of Firing Pad (ft^2)
39-004(a)	TA-39-7	active	1953 - present	500
39-004(b)	TA-39-8	inactive	1953 -1980	1 500
39-004(c)	TA-39-6	active	1953 - present	1 600
39-004(d)	TA-39-57	active	1958 - present	1 590
39-004(e)	TA-39-88	active	1978 - present	7 700

5.3.1.1.2 PRS 39-008: Soil Contamination at the Gas-Gun Site

Building TA-39-137 contains a single-stage gas gun (Figure 5-11) that is used to fire projectiles at targets attached to the end of the gun. In the past, the area outside and to the west of Building TA-39-137 was used for outdoor gas-gun experiments, using a propellant gun with a 6-in.-diameter barrel. Most of the debris from these firings is scattered over the area just west of the building, but occasionally projectiles and target fragments would hit the cliff face, some 200 ft west of Building TA-39-56. Photographic evidence indicates that the area between the buildings and the cliff was later leveled, and the removed surface materials were pushed into a mound on the south side of the test area. Testing at this site began in 1960 and continued until 1975, was suspended for 13 years, and then resumed in 1988.

5.3.1.1.3 Excavated Soil Dump (Proposed SWMU)

In the course of construction of the most recent firing site, TA-39-88, large quantities of earth were removed and deposited in the canyon bottom to the east of the site (see Fig. 5-10). This soil dump, which covers about 76,200 sq ft, was not identified as a SWMU or an area of concern (AOC) by the SWMU Report; however, because it is potentially contaminated from the experiments at TA-39-8, we will include it in the RFI.

5.3.1.2 Existing Data on Nature and Extent of Contamination

Firing sites: Materials used in significant quantities at the firing sites over the years include beryllium, mercury, natural and depleted uranium, lead, aluminum, copper, brass, iron, stainless steel, and various types of HE (RDX, HMX, Baratol, PETN, TATB, TNT, Composition B, and cyclotol). The beryllium, mercury, and uranium are of particular concern. Firing site TA-39-57 has been very active in firing beryllium, and beryllium has also been found in soils at TA-39-7 and TA-39-8. Although mercury is no longer in use, we estimate that approximately 1600 lbs was used in the past to attenuate the explosive force of selected shots (Wheat 1992, 18-0017). Shot records indicate that as much as 5 tons of depleted uranium has been blown up at TA-39 (Wheat 1992, 18-0017). The DOE Onsite Discharge Information system indicates that as of December 1981, the uranium inventory at TA-39 was 0.126 Ci natural uranium and 2.605 Ci uranium-238.

In April 1987, in response to concerns raised by the DOE audit team, the four active firing sites and the gas-gun site were sampled for barium by coring at five locations on each firing pad. Materials from the cores, composited into a representative sample for each site, were analyzed by the Health and Environmental Chemistry Group (now EM-9). The results—for total barium content—ranged from <4 mg/kg to 24 mg/kg (Drypolcher 1987, 18-0020), all far below the screening action level of 5600 mg/kg.

Other materials used include thallium, cadmium, chromium, and thorium (the last, apparently, was naturally occurring thorium-232 [Wheat 1993, 18-0018]). In addition, firing assemblies were covered with dielectric oil (about 100 gal. per shot), much of which ended up in the soil of the firing pad. This oil may have contained PCBs.

Gas-gun site: Potential contaminants of concern at the gas-gun site include beryllium, depleted uranium, and lead. No information exists on the extent of possible contamination. Although debris on the ground is periodically collected and removed, no effort has been made to remove fragments from the cliff face (nor is evidence of such fragments visibly obvious). Some experiments using plutonium were conducted just northeast of TA-39-137; no plutonium was released during these experiments, which were specially designed to capture the Pu-containing projectiles in a sealed chamber attached to the end of the gun barrel. Monitoring of the area after the experiments confirmed that no plutonium was released. However, because no official documentation of the monitoring results exists, we will include plutonium in our analysis of selected samples.

Excavated soil dump: No data are available concerning the nature and extent of possible contamination of the soil dump. If contaminated, it will contain primarily the same materials as those used at the firing sites.

5.3.2 Conceptual Exposure Model

An overall conceptual exposure model for OU 1132 is presented in Chapter 4.

Surface contamination is the primary concern at the firing site PRSs. More uncontrolled contamination has probably resulted from activities at these sites than from any others at TA-39. Hazardous materials from the explosions are scattered across the firing sites and adjacent areas, and debris has been found as far away as 1 mile. In other words, all of TA-39 could be contaminated with material used during the firing experiments. Further, contaminated soil is subject to transport by surface or subsurface water movement and wind action; and some contaminants can be taken up by plants as well. Receptors may become exposed to these hazardous materials by dermal contact, ingestion, or inhalation.

5.3.3 Potential Remediation Alternatives

5.3.3.1 Firing Sites

A baseline risk assessment will be done for each of the five firing sites. Because of the possibility that contaminants from the firing sites have spread over the whole of TA-39, and could continue to spread as long as some sites remain active, the results of sampling from various areas will provide guidance for deciding when remediation should be undertaken and what kind. If the results show that contamination poses an immediate hazard at any site, appropriate remedial action will be taken (this could, for example, take the form of a VCA on part of a site that may not even require closure of the site). For active sites that show no current hazard, remediation will be deferred until decommissioning. Remediation of the inactive site will be decided upon in the same way.

In general, we expect remediation to include physical removal of large pieces of shrapnel and stabilization of contaminated soil in place and/or removal of contaminated soils on or adjacent to firing sites. Soils can be effectively and easily stabilized by covering them with a layer of gravel, which lessens surface erosion and encourages infiltration of water into the soil. While greater infiltration of water means increased plant growth, which further stabilizes the site, it can also mean increased downward movement of contaminants. However, we believe that most (if not all) of the water would be lost through evapotranspiration, so that very little would move beyond the root zone of the soil. (Wherever gravel coverings are used, the soil water of the site will be monitored to ensure that contaminants are not being carried to deeper levels.)

5.3.3.2 Gas-Gun Site

If potential contaminants are found to exceed screening action levels in the soil or cliff face, further studies will be done, leading either to a baseline risk assessment or VCA. The most likely remediation options are removal of areas of contamination and, in the case of soil areas, stabilization in place. (The latter may consist simply of covering the site with a gravel layer to reduce wind and water erosion.) The choice of remediation will depend on the extent of contamination.

5.3.3.3 Soil Dump

If contaminants are identified in the excavated soil dump and either remediation is indicated by risk assessment or VCA is elected, the possible actions include stabilization in place and removal of the material. Stabilization in place may not be feasible for this site, because the dump is in the flood plain and susceptible to erosion when runoff is heavy. The flood plain stability studies associated with the landfills will provide information for deciding whether to stabilize or remove contaminated material.

5.3.4 Sampling Plan

The domain of interest for this portion of the RFI is contaminated soils, sediments, and tuff associated with the firing sites, gas-gun site, and soil dump. Soil contamination from the firing site experiments is potentially widespread within TA-39 but is probably highest close to the firing pads. Field sampling to characterize contamination will include both the active and the inactive firing sites. (We will not postpone sampling of the active sites until decommissioning because (1) we need to evaluate whether contaminants are moving off site—a question that is particularly important because of the proximity of the Rio Grande and of Bandelier National Monument; and (2) sampling now will give us useful data on the distribution of major potential contaminants no longer in use at TA-39, notably mercury and depleted uranium.)

The extensiveness of the area that could have been affected by firing site activities over the years makes it necessary to design a sampling plan that will maximize coverage (including the stream channel, hillslopes, and mesa tops) without creating prohibitive conditions with respect to logistics and cost. On the assumption that contaminant distributions will be more or less consistent—i.e., concentrations will decrease with distance from the firing pads—we have designed a plan that uses, as one major component, radial transects extending outward from each firing pad and taking in adjacent stream-channel, hillslope, and mesa-top areas. The second major component is targeted sampling of the pads themselves, the debris mounds, and the stream channel both upstream and downstream of each firing site.

Contamination at the gas-gun site, if present, is probably localized. Any contamination at the soil dump is probably mostly localized, but the stream channel has encroached into some of the dump and moved material from it downstream.

5.3.4.1 Phase I Investigations

5.3.4.1.1 Data Needs and Objectives

Data gathering during Phase I will have three specific objectives:

1. to characterize the concentrations and distribution of potential contaminants associated with firing-site activities at PRSs, on adjacent hillslopes and mesa tops, and in the stream channel;
2. to assess whether there has been surface and/or subsurface migration of these potential contaminants; and
3. to determine whether potential contaminant distributions and concentrations present a health risk.

5.3.4.1.2 Effects of Environmental Setting

We anticipate that potential contaminants from the firing sites at TA-39 will be widespread and that their migration is active and ongoing. The environmental setting of TA-39 will have had a significant impact on this migration, with respect to both type of contaminant and extent of migration. Accordingly, an important part of the RFI will be to characterize the environmental conditions at TA-39 that influence contaminant migration from the firing sites. This characterization will precede any sampling so that it can be used to guide and to improve the efficiency of sampling.

5.3.4.1.2.1 Geomorphic Characterization

Geomorphic characterization at TA-39 will identify major landform features, stream channels, drainage patterns, and sites of active or potentially active surface erosion. Stream channel descriptions will include bed material as well as deposition and scour zones within the channels. The information from these studies will be synthesized and recorded on a 1:36,000-scale map of the site. A primary use of the data will be for identifying possible sources of contaminants, such as deposition zones in the stream channel and rapidly eroding areas of potentially contaminated hillslopes.

5.3.4.1.2.2 Soils Characterization

A reference data base of soil and sediment characteristics will be established on the basis of soil samples from locations likely to be the least affected by the firing sites, in each of the four major geomorphic regions: stream channel, canyon bottom, canyon slopes, and mesa tops. Shallow (<5 ft) pits will be hand dug and samples collected from each of the major soil horizons. (The precise sampling locations will be selected on the basis of representativeness, accessibility, and degree of disturbance.) A second set of samples will be collected from the firing sites. Both sets will be analyzed, to the series level, for the following characteristics:

- saturated hydraulic conductivity,
- porosity and bulk density,
- cation-exchange capacity,
- pH,
- particle-size distribution, and
- mineral content.

This information will allow us to develop realistic contaminant transport models (see Chapter 4, Section 4.3.2) for evaluating the fate of potential contaminants.

5.3.4.1.3 Characterization of Contamination

5.3.4.1.3.1 Firing Sites

Field radiation surveys will be conducted to detect areas of elevated radiation and to locate potentially contaminated debris or chunks of depleted uranium. The survey will initially cover a 100-ft radius from the center of each firing pad, which will include the debris mounds and the adjacent stream channel (see Figures 5-12 and 5-13). Readings will be taken over the survey area using a 10-ft x 10-ft grid as a basis. If an anomaly is detected visually or a "hot spot" is picked up through instrument response, the area immediately surrounding the nearest grid point will be surveyed closely to find the location with the highest reading. That location will be documented and added to the Phase I sampling plan.

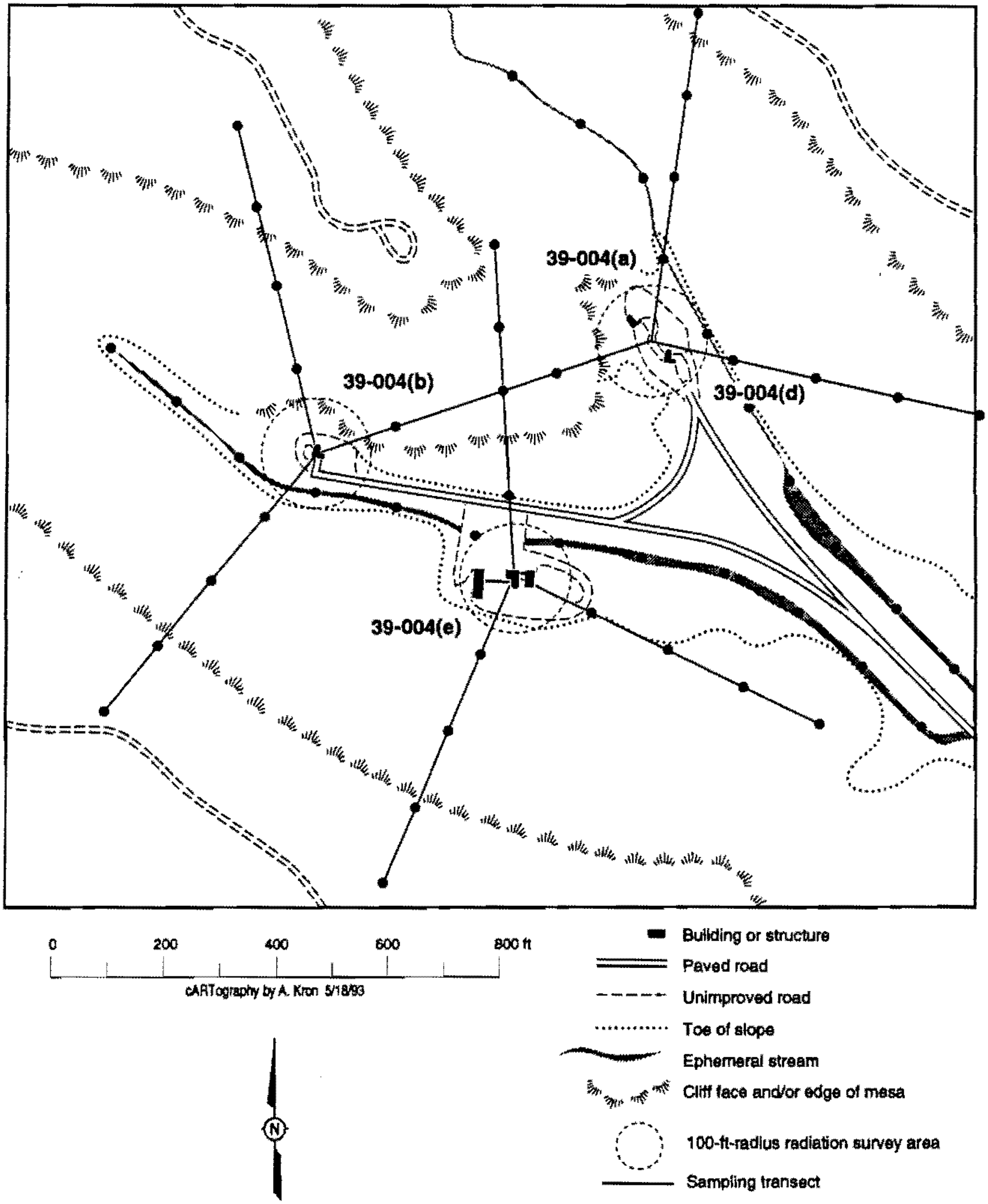

Figure 5-12. Radiological survey and sampling map for PRSs 39-004(a), (b), (d), and (e).

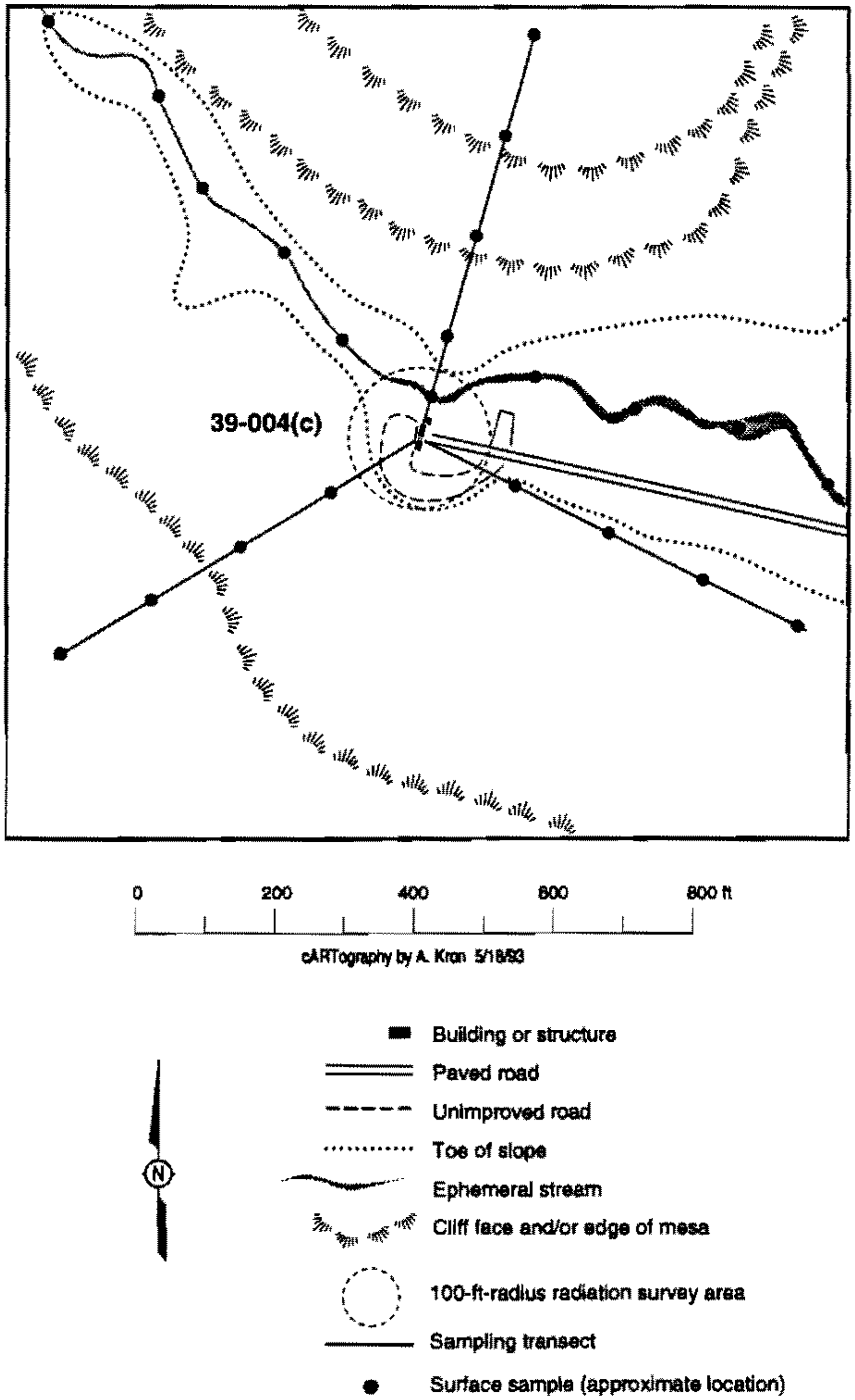

Figure 5-13. Radiological survey and sampling map for PRS 39-004(c).

The same protocol—but using the sampling transects described below as a basis—will be employed to radiologically survey the hillslopes and mesa tops adjacent to each firing site. As shown in Figures 5-12 and 5-13, these surveys will begin where the firing pad surveys ended and will extend to the farthest sampling point of each transect. (Because debris from firing experiments will have been scattered randomly over the area, the number and direction of the transects were determined on the basis of best coverage of the area at minimum cost.) Radiation will be measured every 10 ft (based on map coordinates) along these transects—insofar as such measurement is safe and feasible. If elevated radiation is detected at a survey point, a 5-ft radius around that point will be scanned and the location of the highest reading will be documented and added to the Phase 1 sampling plan.

Metals surveys, by means of XRF measurement, will be conducted over the same area as the radiological survey. These measurements will be made at selected locations (e.g., those showing elevated radiation). We estimate that 20-30 percent of the radiological survey locations will be tested for metals; the specific survey plan will be determined on site, to achieve the best balance between representative coverage and cost.

See Appendix B for detailed information on the techniques and instruments that will be used for the field radiation and metals surveys.

Field sampling will be done according to six distinct zones:

- **Firing Pads:** Four surface samples will be taken from each firing pad—two from the locations that showed the highest radiation levels during the field surveys and two from the center of the pad, about 10 ft apart. Firing sites 7 and 57 will be sampled as a unit because they are adjacent.

- **Debris Mounds:** Mounds of accumulated debris, a combination of debris from firing site activities and from acoustical erosion of the cliff face, have been identified north of firing site 8 and west of firing sites 7 and 57 (see Figure 5-11). Each will be sampled by means of two angled cores, drilled at about 45 degrees from the vertical to intersect the juncture of the canyon wall and the canyon floor and to include the interface between the debris mound and the original land surface. Each core will be screened over its full length for radiation (low-energy gamma or beta-gamma) and checked for HE. Three 2-in.-long segments will then be taken for analysis from each: one from the debris mound surface, one from the mound bottom/land surface interface, and one from the part of the core showing the highest radiation reading. (If no elevated radiation readings are found, the third sample will be from the middle of the core.) In addition, if HE was found during the field screening, a sample from that part of the core will also be sent for analysis.

  If other such debris mounds are found at other firing sites, they will be sampled in the same way.

- **Adjacent Stream Channel:** We plan to collect samples from the stream channel adjacent to (both upstream and downstream of) each firing site, at intervals of about 150 ft (see Figures 5-12 and 5-13), from the surface and 10 in. below the surface. If the geomorphic survey reveals zones of deposition in the channel, these will be preferentially sampled.

Similarly, additional samples will be taken from any locations in the channel that exhibited high radiation readings during the field survey.

- **Adjacent Hillslopes:** Selected hillslopes adjacent to firing sites will be sampled along transects as shown in Figures 5-12 and 5-13, by collection of soil samples (from the surface and from 10 in. below the surface) every 150 ft along each transect. If the rocky terrain prevents sampling at a specified location, the sample will be taken as close as possible to the location, and the exact sampling point will be documented. If elevated radiation readings were found during the field survey, additional samples will be taken from each of the two areas having the highest readings.

- **Adjacent Mesa Tops:** Samples will be collected from mesa-top locations along extensions of the hillslope transects. The same sampling protocol as for the hillslopes will be used (see above and Figures 5-12 and 5-13).

- **Downstream Canyon Bottom:** To ascertain whether contaminants are being transported and deposited on the flood plain downstream of the firing sites, the canyon bottom in that area will be sampled along three transects (see Figure 5-14). These will be located more or less perpendicular to the stream channel, in such a way as to avoid obstructions that would interfere with sampling while intercepting the major zones of potential contaminant deposition. Two of the transects will be located within TA-39 and the third between the eastern boundary of TA-39 and the Rio Grande. Soil or sediment samples will be collected, from the surface and from 10 in. below the surface, at four locations along each transect: at the center of the stream channel, at the edge of the channel (in the area showing the most sediment deposition), and in the valley fill 10 ft from the edge of the channel on both sides.

See Table 5-6 for a summary of the field surveys, field screenings, and laboratory analyses that will be done for the firing site PRSs.

5.3.4.1.3.2 Gas-Gun Site

The gas-gun site includes four zones, which will be individually surveyed and sampled: a leveled area between the gas-gun buildings and the cliff face, a cliff-face impact area, a debris mound, and a small wash that drains the area.

Field radiation surveys will be conducted over the area extending from Building 39-56 to the cliff face, about 100 ft to the north, and about 100 ft to the south of the building. This area will be surveyed using a 10-ft x 10-ft grid (based on map coordinates) as a basis. It will include the debris mound and probably portions of the wash catchment area as well. The rest of the wash will be surveyed up to the edge of the paved road, at 10-ft intervals. For the cliff face, the visible impact area will be scanned for radioactivity.

Field sampling will then be carried out as follows:

- **Leveled Area:** Surface samples from this area will be collected at six selected locations: two where the highest radiation readings were recorded during the field survey, and four evenly spaced between the cliff and Bldgs. 137 and 56. Analyses will include isotopic plutonium (see 5.3.1.2).

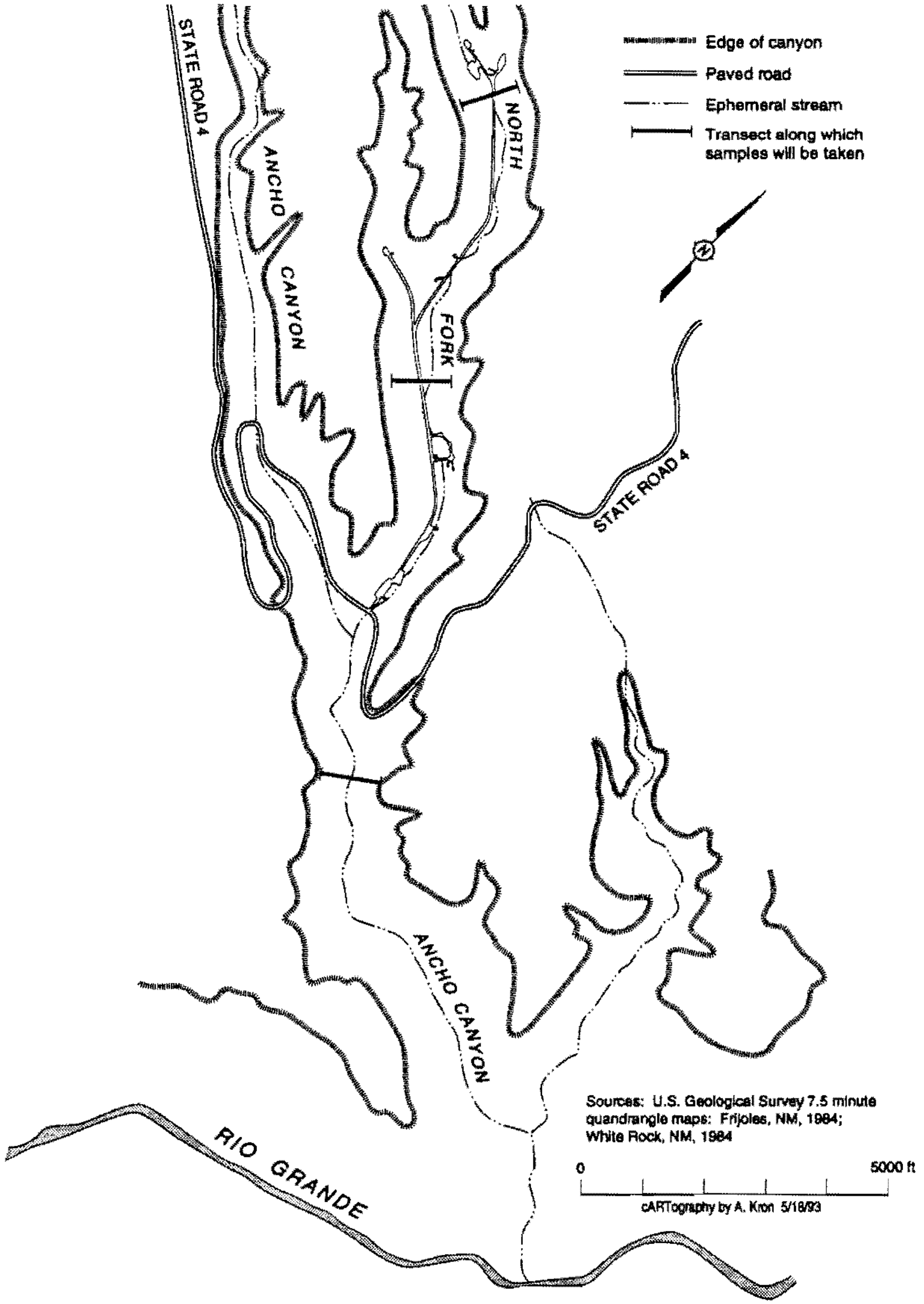

Figure 5-14. Sampling locations in the canyon bottom downstream of the firing sites.

TABLE 5-6

PHASE I SAMPLING PLAN FOR PRS AGGREGATE 3 (FIRING SITES)

					Field Survey			Field Screen		Analytical Laboratory							
Sampling Zones/PRS	**No. of Sample Locations**	**Sampling Method**	**Sampling Location**	**Sampling Depth**	Radiological/XRF	Geomorphic	Land mapping	Radiological	HE (M-1 kit)	Radiological (γ spectrometry)	Uranium and thorium*	Isotopic plutonium	Semivolatiles (SW 8270)	Metals & cyanide (SW 6010)	HE (USATHAMA)	PCBs (SW 8080)	Petroleum hydrocarbons
FIRING SITES																	
Firing pads					X		X										
39-004(a), (b), (c), (d), & (e)	4 each	scoop/ template	2 from area of highest radiation; 2 from pad center	*surface*				X	X	X	X		X	X	X	X	X
Debris mounds					X		X										
39-004(a) and (d)	6	45° angled cores (2 each mound)	mound surface (2); mound-bottom/land-surface interface (2); highest rad. or center (2)					X	X	X	X		X	X	X	X	X
39-004(b)								X	X	X	X		X	X	X	X	X
Adjacent stream channel					X	X	X										
	~32	scoop/ template	150-ft intervals	surface; 10 in.				X	X	X	X		X	X	X	X	X
Adjacent hillslopes and mesa tops					X	X	X										
	42	scoop/ template	within 10-ft radius of transect points	surface; 10 in.				X	X	X	X		X	X	X	X	X
Downstream canyon					X	X	X										
	12	scoop/ template	mid-channel; edge; sides	surface; 10 in.				X	X	X	X		X	X	X	X	X
GAS-GUN SITE					X		X										
Levelled area	6	scoop/ template	4 evenly spaced; 2 highest rad;	surface; 10 in.				X	X	X	X	X	X	X	X	X	X
Cliff face	2	rock hammer	elevated rad. or random	—				X	X	X	X		X	X	X	X	X
Debris mound	12	vertical cores (4)	surface; interface; center or highest radiation					X	X	X	X	X	X	X	X	X	X
Wash	1		mouth of wash	2 in.				X	X	X	X		X	X	X	X	X
SOIL DUMP/ STREAM CHANNEL					X		X										
	30	vertical cores (10)	surface; interface; center or highest radiation					X	X	X	X		X	X	X	X	X

cARTography by A. Kron 5/18/93

*See Appendix B.

- **Cliff Face Impact Area:** The cliff face will be radiologically surveyed and examined to identify impact points. All visible impacted materials (projectiles, target fragments) will be removed; two samples will be collected from any locations showing elevated radiation levels. In the absence of elevated radiation, samples will be taken from two randomly selected locations.

- **Debris Mound:** A vertical corehole will be drilled into the mound at each of four evenly spaced locations. Each corehole will be drilled to the interface between the mound and the original land surface. The entire core will be screened for radiation and checked for HE. Three 2-in. segments (one from the mound surface, one from the mound/land surface interface, and one from either the center of the core or any area of the core that showed elevated radiation) will be submitted to the analytical laboratory. Analyses will include isotopic plutonium (see 5.3.1.2). In addition, if HE was found during the field screening, a sample from that part of the core will also be sent for analysis.

- **Wash:** One surface sample (2-in. depth) will be collected from a location near the mouth of the wash, near the road edge.

Sampling locations are shown in Figure 5-15, and a summary of the field surveys, field screenings, and analyses to be done are in Table 5-6.

5.3.4.1.3.3 Excavated Soil Dump

A low-energy-gamma or beta-gamma radiation survey will be conducted over the full extent of the soil dump, including the segment of the stream channel that has cut into part of the dump. The dump and stream channel segment will be sampled by means of ten coreholes; eight of these will be evenly spaced over the area (see Figure 5-16), and two will be from any area(s) exhibiting elevated radiation. At least one corehole will be in the stream channel. (If no elevated radiation levels are found, all ten locations will be evenly spaced over the dump area, with at least one in the stream channel.) Each core will be drilled into the interface between the dumped material and the original surface. (This depth will vary from one area of the dump to another, but we estimate the maximum depth to be about 15 ft.) Each core will be screened for radiation and checked for HE. Three 2-in.-deep samples will be taken for laboratory analysis: one from the surface, one from the dump/land surface interface, and one from either the center of the core or the area of the core that showed the highest radiation. In addition, if HE was found during the field screening, a sample from that part of the core will also be sent for analysis.

The sampling locations are shown in Figure 5-16, and the field surveys, field screening, and laboratory analyses to be done are summarized in Table 5-6.

5.3.4.2 Phase II Investigations

If the results of Phase I sampling indicate the presence of contamination, and especially the possibility of contaminant movement into the stream channel (which means potentially into the Rio Grande), Phase II sampling will be done. This second phase would include more detailed analysis of contaminant distribution and characterization of transport pathways in the Ancho Canyon system.

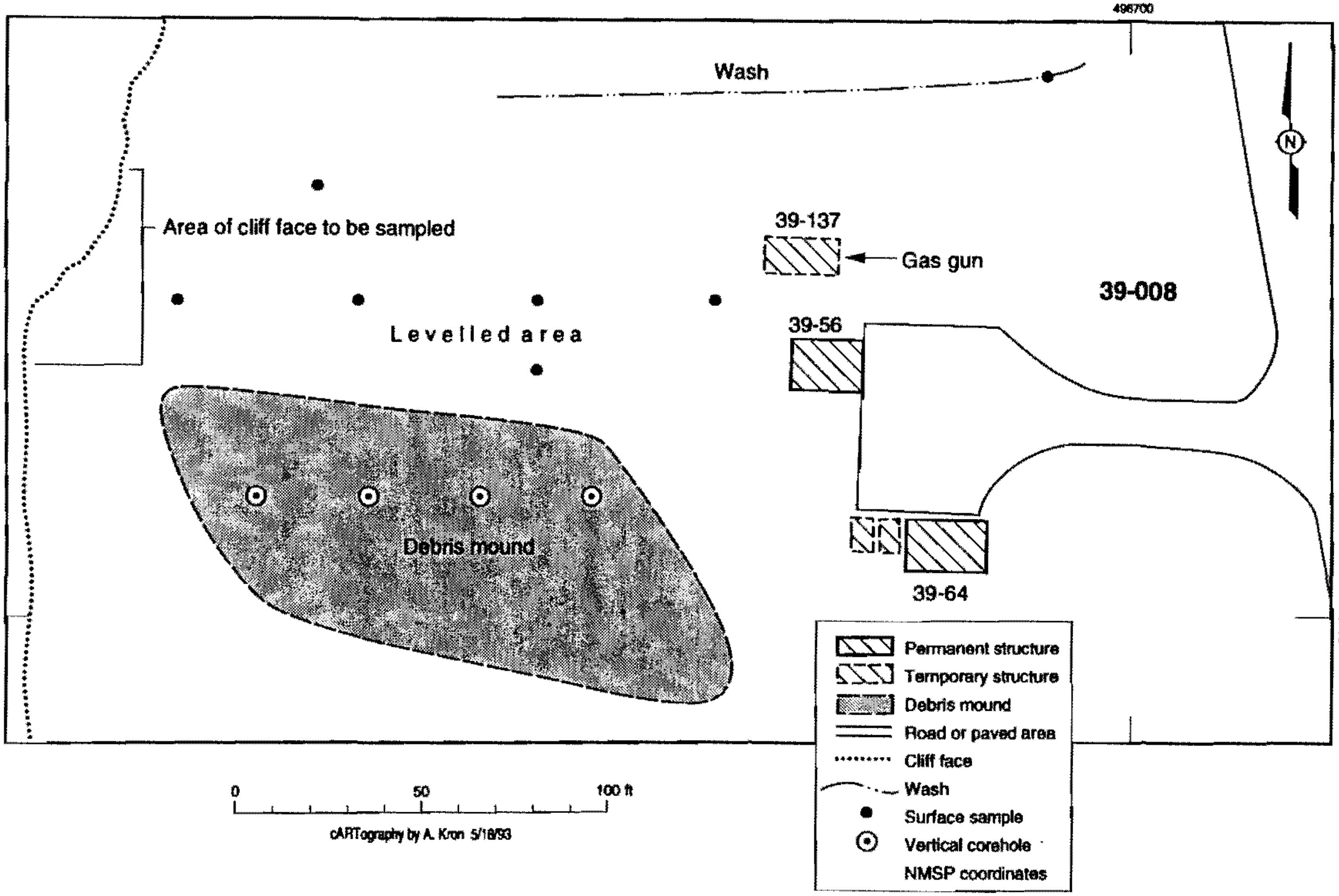

Figure 5-15. Single-stage gas-gun site (PRS 39-008): estimated locations for surface samples and coreholes.

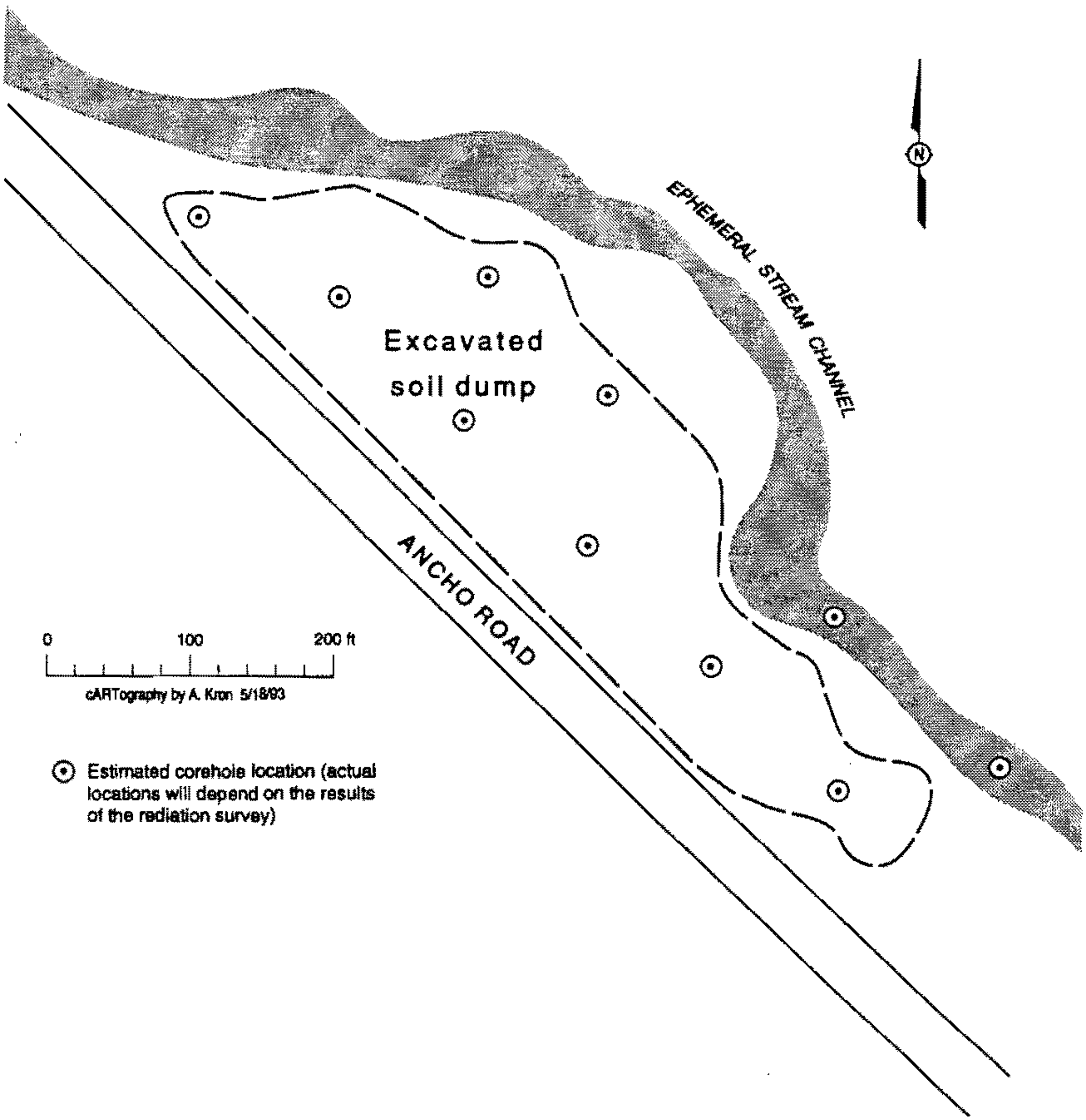

Figure 5-16. Estimated sampling locations for excavated soil dump.

5.4 Aggregate 4: Septic Systems and Seepage Pits

5.4.1 Background

5.4.1.1 Description and History

5.4.1.1.1 Septic Systems

OU 1132 includes three septic systems—two active and one inactive. Each consists of a septic tank, associated pipes and drainlines, and a sand filter or a leach field. The SWMU designated 39-006(a) consists of an inactive septic system and the active system that replaced it (see Figure 5-17). PRS 39-006(b), the other active system, has received only sanitary waste and is proposed for NFA (see Chapter 6). Most of the information in the following two sections was obtained by Francis (1992, 18-0007).

5.4.1.1.1.1 PRS 39-006(a) *Inactive*

This septic system, constructed in 1952 -1953, was connected only to Building TA-39-2; it consisted of an 1800-gal. reinforced-concrete septic tank (TA-39-12), drainlines, and a subsurface sand filter. The tank was located about 100 ft east of TA-39-2 and was connected to the sand filter southeast of TA-39-2 by approximately 260 ft of vitrified clay pipe. The sand filter discharged via an outfall into Ancho Canyon, south of State Road 4.

Photographic processing chemicals were routinely dumped into this system, at the rate of about 65 gal. per year, which eventually caused it to malfunction. There are reports that discharges to the sand filter were coming to the surface. To correct the problem, a separate seepage pit for the photo processing chemicals was put in place in 1973. In addition, the septic tank was enlarged and a new subsurface sand filter was put in on the south side of State Road 4. The old sand filter was abandoned. By 1978 the new sand filter had become clogged and had to be replaced.

Other hazardous wastes possibly generated and disposed of on site include processing solvents and various laboratory chemicals. Further, because research involving radionuclides has been carried out at TA-39, the presence of radioactive contaminants must also be investigated.

5.4.1.1.1.2 PRS 39-006(a) *Active*

In 1985 the original septic tank was abandoned; the waste was removed and the tank filled with sand. A new 2500-gal. precast concrete septic tank (TA-39-104) and drainline were installed, the line running through the original tank. At the same time the sand filter south of State Road 4 was redesigned and replaced—the second sand filter replacement in 12 years. New piping was added (the 4-in. pipe under State Road 4 was retained to avoid tearing up the road, and the new pipe was tied into it). About 1989, to ensure compliance with EPA regulations concerning surface discharges, the outfall from the new sand filter was plugged. At present, then, there is no discharge into the canyon.

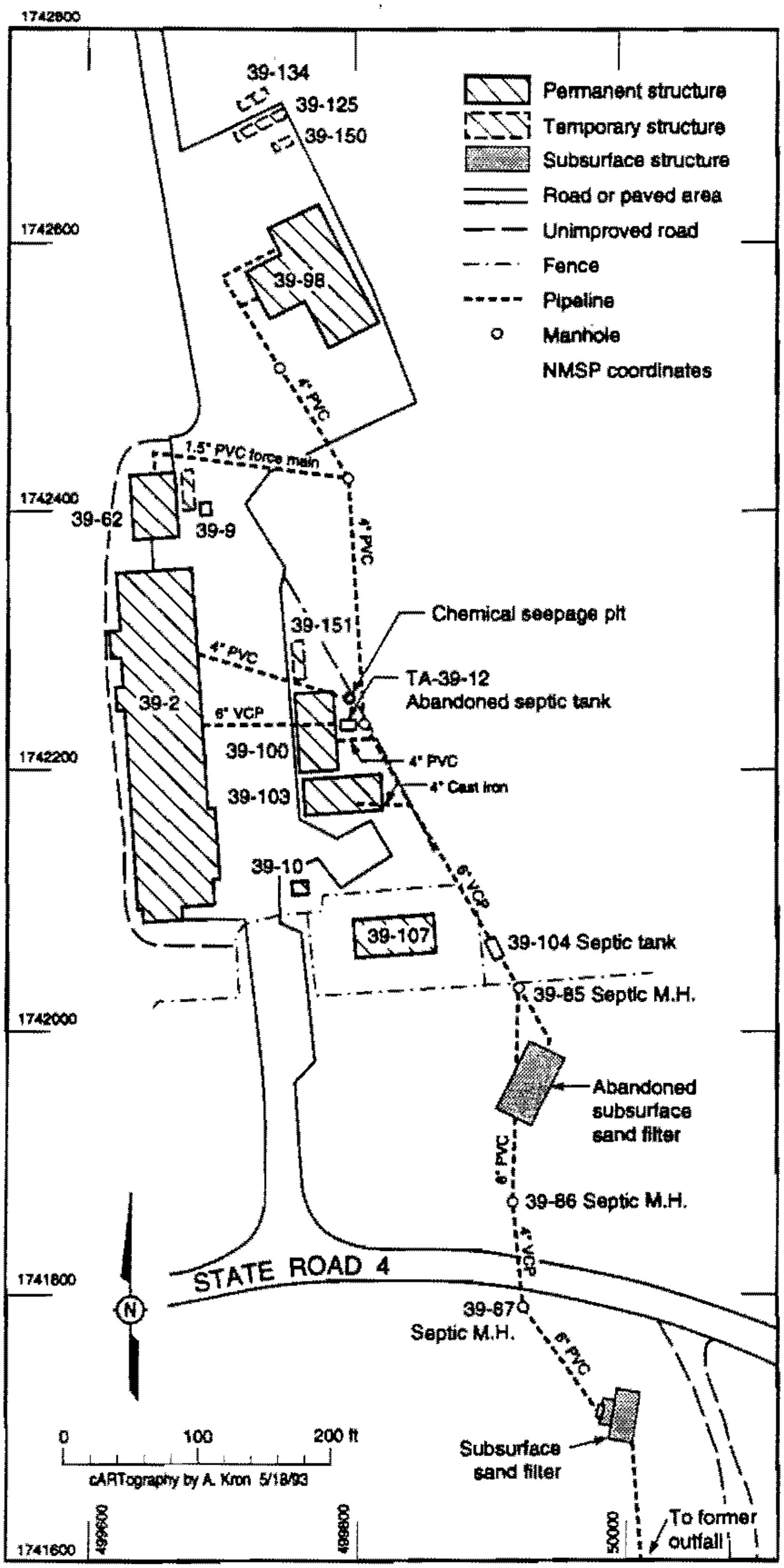

Figure 5-17. Locations of PRS 39-006(a) and chemical seepage pit.

Even in the case of this newer system, disposal of hazardous and/or radioactive materials cannot be categorically ruled out. Soils and sediments underlying and surrounding any of the components of the active as well as the inactive system may have become contaminated via overflow, leakage, and /or seepage.

Table 5-7 gives operational information for this PRS.

TABLE 5-7
OPERATIONAL INFORMATION: PRS 39-006(a)

Structure Number	Buildings Served	Operational Status	Period of Use	Effluent
TA-39-104	TA-39-2 TA-39-62 TA-39-98 TA-39-1 TA-39-103 TA-39-107	Active	1985-present	Sand filter
TA-39-12	TA-39-2	Inactive	1952-1985	First sand filter 1952-1973; second sand filter 1973-1985

5.4.1.1.2 Seepage Pits

Seepage pits are holes in the ground filled with gravel, into which waste-containing liquids are discharged. The liquids either evaporate or drain into the surrounding soil. Two such pits were constructed at OU 1132.

5.4.1.1.2.1 PRS 39-005: HE Seepage Pit

According to Francis (1992, 18-0006), this PRS is the site of a former seepage pit used for the disposal of HE-contaminated decant from operations at TA-39-4, an explosives operations building (see Figure 5-18). There is no indication that other hazardous materials were disposed of in this pit. The seepage pit measured about 5 ft x 5 ft x 7 ft deep, and the bottom was not lined or otherwise contained. The gravel and soil that filled the pit were removed in 1986 or 1987. The SWMU Report also notes that all HE-contaminated soil was removed at that time. The remaining soil was tested for HE, and little or none was found (McCormick 1993, 18-0015). However, because we have no reliable documentation demonstrating that this PRS has been adequately remediated, we will do Phase 1 sampling.

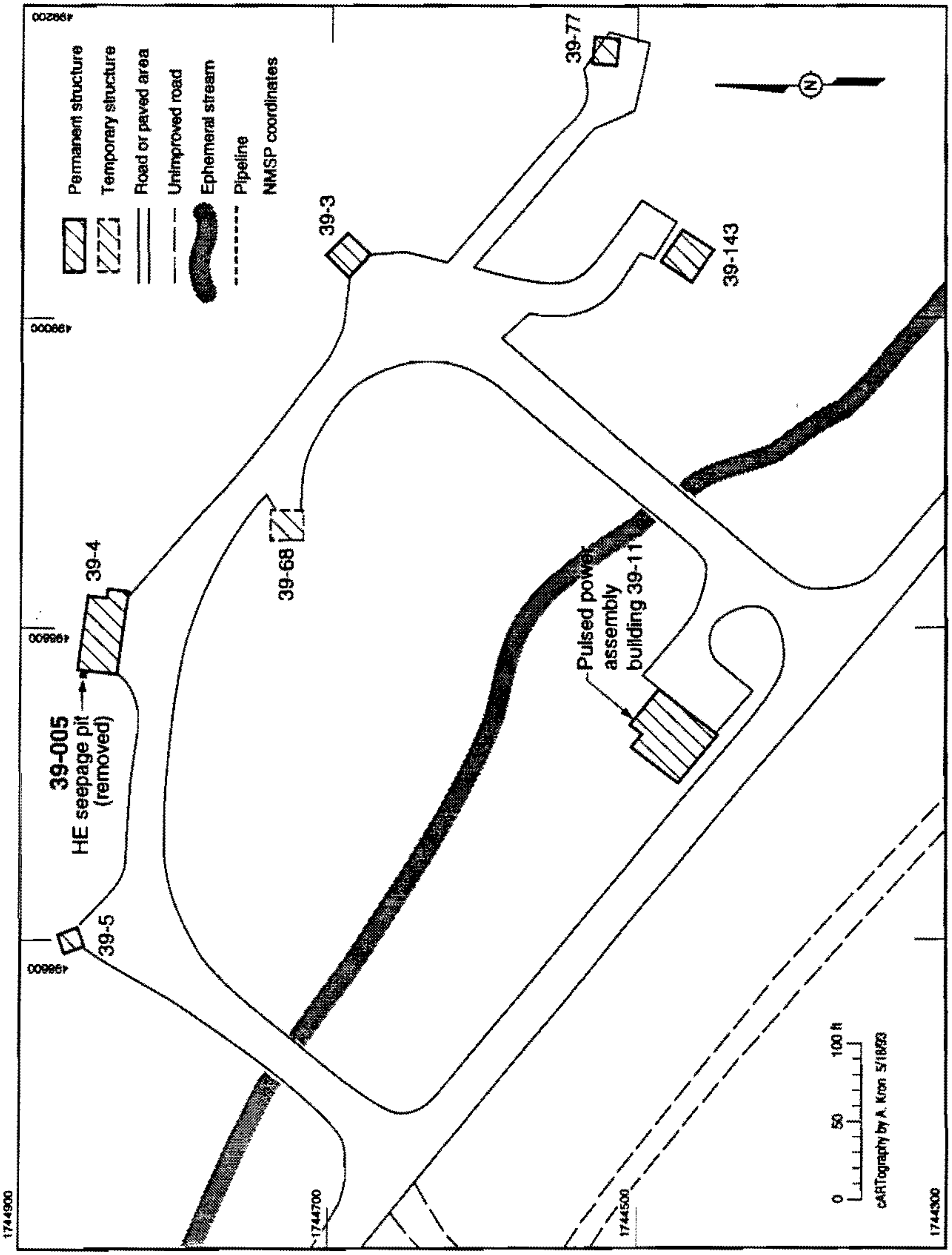

Figure 5-18. Location of PRS 39-005.

5.4.1.1.2.2 Chemical Seepage Pit (Proposed SWMU)

This seepage pit (see Figure 5-17) was put in specifically for the disposal of photographic processing chemicals (up until 1973, these chemicals were dumped into the septic system, but they interfered with the sewage digestion processes in the septic tank and eventually caused the system to fail). The drainline from the photo laboratories in Building TA-39-2 was disconnected from the septic system and connected to the seepage pit, which is located about 120 ft east of TA-39-2 and about 20 ft north of the now-abandoned septic tank (TA-39-12) (Francis 1992, 18-0010). About 75 gal./year of photographic processing chemicals were being disposed of in this pit until 1992.

5.4.1.2 Existing Data on Nature and Extent of Contamination

Table 5-8 summarizes the existing data on the types of wastes known or suspected to have been disposed of in the septic systems and seepage pits, and the potential for contaminant release from each.

TABLE 5-8
NATURE OF WASTES AND POTENTIAL FOR CONTAMINANT RELEASE: SEPTIC SYSTEMS AND SEEPAGE PITS

SWMU Designation	Nature of Wastes Disposed of	Potential Contaminant Release	
		Hazardous	Radioactive
39-006 (a) (active septic system)	Sanitary waste; photographic processing chemicals	Suspected	Unknown
39-006(a) (inactive septic system)	Sanitary waste; solvents; photographic processing chemicals	Suspected	Unknown
39-005 (inactive HE seepage pit)	HE	Suspected	None
Chemical seepage pit (proposed SWMU)	Photographic processing chemicals	Suspected	None

5.4.2 Conceptual Exposure Model

An overall conceptual model for OU 1132 is given in Chapter 4.

Sources from which contaminants may migrate are drainlines, septic tanks, sand filters, and contaminated soils and gravels. Contaminants may reside in soils and sediments underlying and adjacent to septic system components; air; and/or plants. Transport mechanisms include surface water, subsurface water, wind, and uptake by plants. Receptors include animals and humans. Potential routes of exposure of receptors include inhalation (especially when the site is disturbed); ingestion (in particular, receptors living on site may be exposed by eating plants growing in contaminated soils); and skin contact with contaminated soils or sediments.

5.4.3 Potential Remediation Alternatives

Remediation alternatives for the active septic system will differ from those for the inactive septic system and the seepage pits. The active system will continue in operation until no longer needed. No plans exist for decommissioning this system or the buildings it serves. The likely remediation alternatives for the system are removal at the time of decommissioning (deferred action) and NFA. The system will be sampled during the RFI to obtain the data for evaluating current risk. If no risk is found, further action will be deferred until decommissioning. If a risk is found, Phase II sampling will further define the risk and provide data to support the likely decision for deferred action (or to make a case for earlier remediation in the very unlikely event that the risk level is judged unacceptable).

For the inactive septic system and the seepage pits, if contamination is found in any of the system components further investigations will be undertaken to determine whether a baseline risk assessment should be done or whether VCA (removal and disposal of contaminated components and/or materials) would be more time- and cost-effective. If the levels of potential contaminants are found to be below screening action levels, NFA will be recommended.

5.4.4 Sampling Plan

5.4.4.1 Phase I Investigations

5.4.4.1.1 Data Needs and Objectives

During Phase I, data will be gathered to characterize contamination associated with the septic systems and seepage pits and to determine whether the level of contamination poses a risk to human health and/or the environment.

5.4.4.1.2 Effects of Environmental Setting

No data on topographic, geologic, etc. characteristics are needed for Phase I decisions. (Investigations to determine the presence or absence of a perched alluvial reservoir will be carried out as part of the landfills RFI.) If secondary contamination is found in soil or sediments, Phase II investigations may need to include environmental data to characterize migration pathways.

5.4.4.1.3 Characterization of Contamination

Engineering drawings and preliminary field investigations (field surveys, geophysical surveys, and/or trenching) will be used to locate the septic tanks, drainlines, sand filters, and seepage pits. Land surveys will also be used to update maps of the septic systems. A radiological field survey will be done on the sand filters with hand-held instruments; the specific type of survey (gross beta-gamma or low-energy gamma) will be decided by the site health physicist on the basis of the particular conditions at the site. In addition, selected locations on the grid—or other layout—used for the radiological survey (e.g., locations showing elevated radiation) will be checked for metals by XRF measurement.

See Appendix B for detailed information on the techniques and instruments that will be used for the field surveys.

5.4.4.1.3.1 Active Septic System

The potential contamination levels of the active septic system will be evaluated by sampling the soils surrounding the tank and in the outflow from the tank (the sand filter and the former outfall). The areas receiving outflow are the most likely to retain any hazardous materials discharged into a septic system. The tank is a poorer indicator because solids are removed when they reach a specified level. Information on contamination at outflow areas will be used to decide whether and to what extent sampling will be done on other parts of the system.

Soil cores will be taken at three widely spaced locations on the sand filter, to a depth of 2 ft below the fill/native-material interface. One 3-ft-deep core will be taken from the former outfall area, no more than 6 ft from the now-plugged pipe opening. All cores will be field-screened for radiation, HE, and organic vapors. If no contamination is found, two samples for laboratory analysis will be taken from each core: the surface 6 inches and the bottom 6 inches (plus, for the sand-filter cores, a 6-in. segment from the fill/native-material interface). If contamination is found, at least an equal number of samples, from the depths showing the highest readings, will be sent for laboratory analysis.

The area surrounding the septic tank will also be examined: A 3-ft-deep core will be taken within 3 ft of the tank on the downgradient side. Three samples—from the surface 6 inches, the bottom 6 inches, and the 6 inches representing the bottom of the tank—will be analyzed in the laboratory.

Details of the sampling and analyses for the active septic systems are given in Table 5-9.

5.4.4.1.3.2 Inactive Septic System

Samples will be collected from the soil surrounding the tank—at the outlet, the bottom of the tank, and 2 ft below the tank. (Some excavation will be necessary to collect these samples.) If any structural flaws are noted, additional soil samples will be taken in the areas that would have been affected if leaks had occurred. All soil samples will be screened for radioactive contamination, organic vapors/gases, and HE. If any of the field screenings show potential contamination, samples from the soil areas that yielded those readings will be submitted for laboratory analysis. Otherwise, one soil sample will be taken for laboratory analysis from each of the three areas. The inactive sand filter will be sampled in the same way as the active sand filter.

TABLE 5-9

PHASE I SAMPLING PLAN FOR PRS AGGREGATE 4 (SEPTIC SYSTEMS AND SEEPAGE PITS)

PRS	Cores		No. of Sample Locations	Area of Site or Part of Core Sampled	Sampling Method	Field Survey			Field Screening			Laboratory							
	No.	Depth				Radiological/XRF	Geophysical (surface)	Land mapping	Radiological	Organic vapor/gases	HE (M-1 kit)	Radiological (γ spectrometry)	Uranium	Volatile organics (SW 8240)	Semivolatiles (SW 8270)	Metals & cyanide (SW 6010)	HE (USATHAMA)	PCBs (SW 8080)	Petroleum hydrocarbons
39-006(a)																			
ACTIVE SEPTIC SYSTEM				core areas with highest readings		X		X											
Sand filter	3	2 ft below fill/natural material interface	9 (3/core)	OR surface 6 in.; bottom 6 in.; 6 in. at interface	hand auger (or equivalent)				X	X	X	X	X	X*	X	X	X	X	X
Outfall	1	3 ft	2	surface 6 in. and bottom 6 in.	hand auger (or equivalent)				X	X	X	X	X	X*	X	X	X	X	X
Soil surrounding tank	1	3 ft	3	surface 6 in.; bottom 6 in.; tank-bottom level	hand auger (or equivalent)				X	X	X	X	X	X*	X	X	X	X	X
INACTIVE SEPTIC SYSTEM						X		X											
Sand filter	3	2 ft below fill/natural material interface	9 (3/core)	areas with highest readings OR surface 6 in.; bottom 6 in.; 6 in. at interface	hand auger (or equivalent)				X	X	X	X	X	X*	X	X	X	X	X
Soil surrounding tank			3	tank outlet; tank bottom; 2 ft below tank	hand auger (or equivalent)				X	X	X	X	X		X	X	X	X	X
Drainlines			2/drainline	inside each end of line	scraping	X						X	X		X	X	X	X	X
CHEMICAL SEEPAGE PIT	3	12 ft (deeper if needed)	15 (5/core)	areas of highest readings OR surface (0–6 in.); every 3 ft	hand auger or coring device			X	X	X	X				X	X			
39-005: HE SEEPAGE PIT	1–3	12 ft (deeper if needed)	5–15	core areas w/highest readings OR surface & every 3 ft	hand auger or coring device			X	X		X						X		

*except surface sample

cARTography by A. Kron 5/18/93

If laboratory analysis of these soil samples reveals contamination, further investigations will be done. These could include baseline risk assessment to determine whether system components should be removed; or, VCA may be proposed if it appears the most time- and cost-effective solution. Only if it is decided that the tank must be removed will the drainlines be sampled, by screening each end for radiation and taking one swipe or scraping for analysis from inside each end. Again, if contamination is found, either baseline risk assessment will be done to determine whether the drainlines can stay in place or must be removed, or VCA may be proposed. Any components removed will be inspected for signs of leakage; if any are found, soil samples will be taken from the area(s) that would have been in contact with the damaged part(s), for laboratory analysis.

In the case that both radioactive and hazardous contamination is found, removal of components (if necessary) will be deferred until an appropriate mixed-waste disposal site is available.

Table 5-9 shows the detailed surveys, screenings, and analyses to be done for the inactive septic system.

5.4.4.1.3.3 Chemical Seepage Pit (Inactive)

Engineering drawings and field surveys (including geophysical if needed) will be used to locate as precisely as possible the boundaries of the seepage pit. Three cores will be dug to a depth of 12 ft on the downslope side of the pit, within 2 ft of the perimeter, where the zone of maximum contaminant accumulation is most likely to be (taking three cores increases the possibility of finding this zone). Sampling inside the pit itself would be difficult because of its large-cobble fill—and would be unlikely to provide a better indication of contaminant presence or absence than coring just outside the pit.

Radioactive or HE contamination is considered unlikely, but soil materials will be field-screened for both. If any contamination is detected by this screening, laboratory analyses will be performed on samples from the areas of the core having the highest readings. If no elevated readings are found, samples for laboratory analysis will be taken at the surface and at 3-ft intervals. Each sample will include sufficient material (taken from equal distances above and below the selected depth) to ensure accurate analytical results. If field screening and laboratory analysis indicate the presence of contamination at 12 ft, the sampling will go deeper. See Table 5-9 for a summary of the sampling and analyses.

5.4.4.1.3.4 HE Seepage Pit (Inactive)

Engineering drawings and field surveying, including visual inspection, will be used to locate this pit. Contamination is considered unlikely, but soil materials (from a 12-ft-deep core taken in the area judged most likely to be contaminated) will be field-screened for radioactivity and HE. If any contamination is found, two additional cores will be taken, to a depth of 12 ft. (Should contamination be present at 12 ft, the coring will go deeper.) The cores will be sampled for laboratory analysis at the locations showing the highest readings when screened or, if no elevated readings are found, at the surface and at 3-ft intervals; each sample will include sufficient material—taken from equal distances above and below the selected depth—to ensure accurate analytical results. See Table 5-9 for a summary of the sampling and analyses to be done.

5.4.4.2 Phase II Investigations

If contamination is found in any of the septic systems, seepage pits, or surrounding soils, a Phase II investigation will be designed to determine the precise nature of the contaminants, the extent of their migration, and whether they pose any current risk.

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Executive Summary

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Introduction

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Background Information for OU 1132

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Environmental Setting of TA-39

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Chapter 6

- PRS 39-003: Incinerator
- PRSs 39-002 and 39-007: Storage Areas
- PRS 39-009: Outfall

6.0 UNITS PROPOSED FOR NO FURTHER ACTION

In this chapter, we discuss those OU-1132 PRSs that we propose for no further action (NFA) because the risks they present are negligible. The criteria for NFA are discussed in Chapter 4 of the IWP (LANL 1992, 0768) and in Chapter 4 of this work plan.

The PRSs proposed for NFA are listed in Table 6-1 and discussed below. See Figure 6-1 for their locations.

TABLE 6-1
PRSs PROPOSED FOR NFA

PRS Number	Description
39-003	Incinerator
39-006(b), Area 2	Septic system
39-002(g)	Storage area
39-007(b)	Storage area
39-007(c)	Storage area
39-007(e)	Storage area
39-009	Outfall

6.1 PRS 39-003: Incinerator

6.1.1 Description and History

From about 1955 to 1977 a small incinerator (3 ft x 3 ft x 4 ft high) was located between the south wall of Building TA-39-2 and the south perimeter security fence. It was used primarily to burn office waste, and there is no indication that it was ever used for disposal of hazardous materials. In 1977, when an addition was built onto the south end of Building TA-39-2, necessitating relocation of the perimeter security fence about 60 ft south of the addition, the incinerator was removed and buried in one of the TA-39 landfill pits. (Francis [1992, 18-0004] believes that it was probably buried in Pit 2 of 39-001(b), which was in use in 1977.) The SWMU Report (LANL 1990, 0145) states that the incinerator was checked for radioactivity at that time and found to be clean; and that the incinerator site was cleaned. The area between the new addition and the relocated fence—which includes the former incinerator site—was backfilled to a new elevation several feet higher. The new access road was capped with 4 in. of gravel.

6.1.2 Rationale for Proposal of NFA

There is no evidence that hazardous materials were disposed of in the incinerator. If any were, however, checking for the presence of residual contamination would be very expensive and difficult, because the exact location of the former incinerator site is not known and several feet of compacted fill now cover the entire area, prohibiting extensive field screening. We believe that the negligible risk potential from this PRS makes an extensive and costly investigation unjustifiable. Moreover, it should be noted that because the incinerator itself is buried in the TA-39 landfill, the RFI investigations for the landfills will include the incinerator.

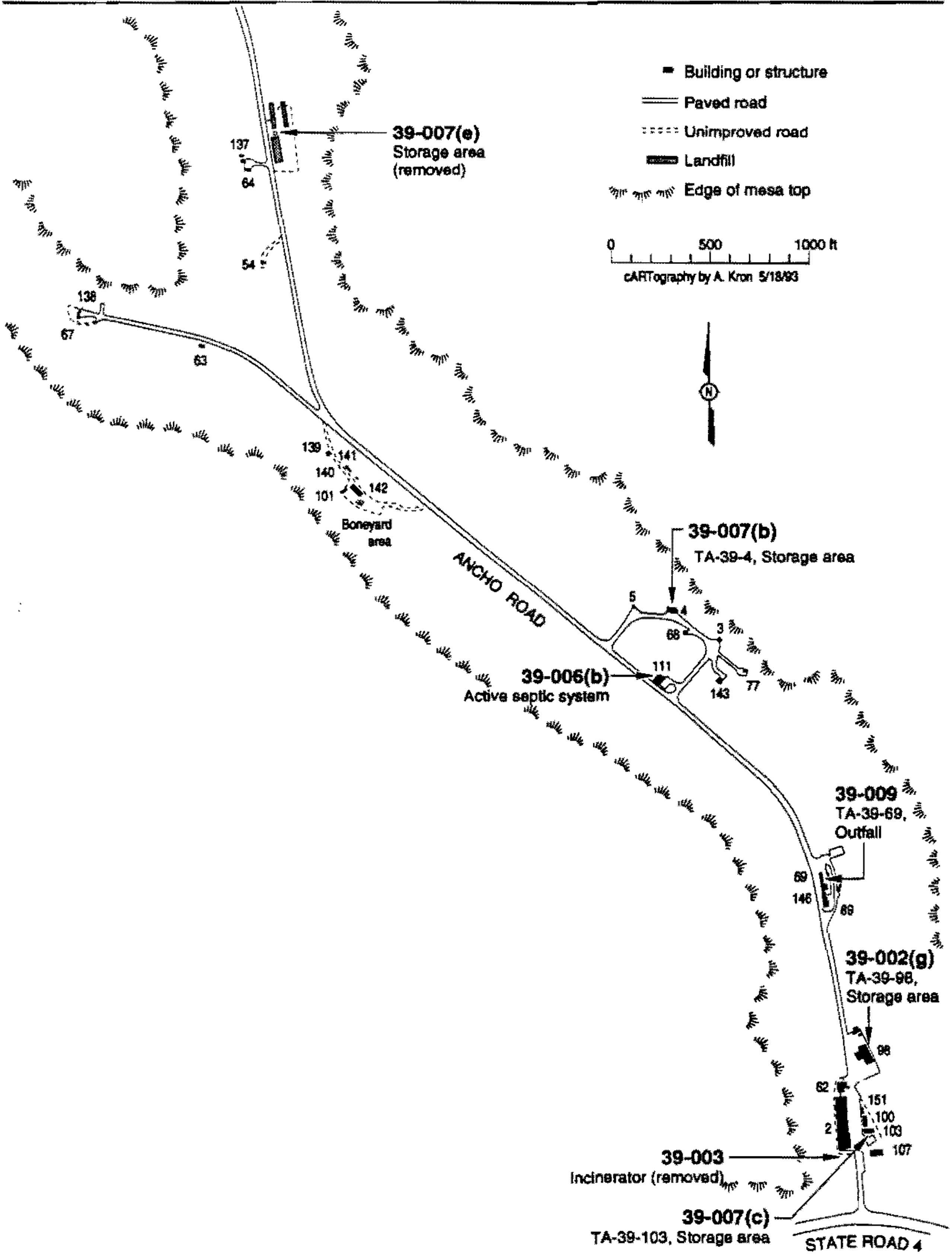

Figure 6-1. Location of PRSs proposed for no further action.

6.2 PRS 39-006(b): Active Septic System

6.2.1 Description and History

This active septic system serves Building TA-39-111 (the Pulsed Power Assembly Building) and was part of the original construction of the building in 1989. It is located northwest of TA-39-111 and consists of a 1000-gal. reinforced-concrete septic tank (TA-39-132), a distribution box, and a leach field. This system was designed for sanitary waste disposal only.

6.2.2 Rationale for Proposal of NFA

The only potentially hazardous materials used in Building TA-39-111 have been small quantities of acetone and ethyl alcohol, used to wipe clean various components. Administrative procedures for disposal of hazardous materials in proper containers have been in place since the building's inception (the waste would consist almost exclusively of paper or cloth wipes used with the solvents). Dumping of hazardous liquids down drains is forbidden, and signs stating this appear above all sinks. It is highly unlikely that anything other than sanitary waste has been disposed of in this system.

6.3 PRSs 39-002 and 39-007: Storage Areas

We propose NFA for four storage areas at OU 1132.

6.3.1 Description and History

6.3.1.1 PRS 39-002(g)

This is a storage area inside of Building TA-39-98, which is an active shop. It is on a maintained concrete floor. There are no known or documented releases from this site.

6.3.1.2 PRS 39-007(b)

Building TA-39-4 was identified as an inactive storage area in the SWMU Report. In fact, this building is not a storage area, but is used for assembling explosives experiments. Unboxed components are permitted to be stored when necessary for operations, and certain specified items may be kept in the building when it is not in use for experiments (Shock Wave Physics Group 1990, 18-0013, and 1991, 18-0014).

The SWMU Report states that this building has residual HE contamination, although the CEARP Report (DOE 1987, 0264) stated that it did not. Our inquiry revealed that technical staff at TA-39 consider anything that has come into contact with HE to be "contaminated with residual HE," even though the contamination is confined to the work benches and these are cleaned after each job (Wheat 1993, 18-0019). This building, with its original benches, has been in use since 1953; there are no current plans to discontinue its use.

6.3.1.3 PRS 39-007(c)

This is a room in Building TA-39-103 that was used for storage of blueprint-machine fluid. The material safety data sheet lists the components of this fluid as ethylene glycol, ethanolamine, and 2-(2-aminoethoxy) ethanol. Both the machine and the stored fluids have been removed from this area. No evidence or documentation exists of any releases.

6.3.1.4 PRS 39-007(e)

This storage area, an open-front metal shed measuring about 8 ft × 4 ft, was located north of Pit 3; it received hazardous waste inappropriate for disposal at the landfills. The entire structure was removed with its contents when the last landfill pit was covered up. Its former site will be investigated as part of Phase I investigations of the landfills (see Chapter 5, Section 5.1.4.1.3.1).

6.3.2 Rationale for Proposal of NFA

Two of the storage areas (39-002[g], and 39-007 [c]) are located inside buildings, so that there is little if any threat of releases. PRS 39-007(b) is not used for storage except on a temporary basis, and those areas where HE is a component of the waste are carefully cleaned and controlled. PRS 39-007(e) was removed. Its former site will be investigated as part of Phase I investigations of the landfills (see Chapter 5) to be sure no residual contamination is present.

6.4 PRS 39-009: Outfall

6.4.1 Description and History

This is a line from Building TA-39-69 that drains water used for cooling three pieces of equipment (a LASER power supply used, as required, with temporary hook-ups; a "Stokes" vacuum pump; and a diffusion pump). The latter two devices are permanently installed in an equipment room on the east side of the building.

The cooling water, which comes from a potable water supply Francis 1992, 18-0009), circulates through cooling coils that are in contact with the three pieces of equipment. It is then discharged via the drainline onto the asphalt parking lot east of the building.

6.4.2 Rationale for Proposal of NFA

This outfall is permitted under NPDES number EPA-04A-41.

Because the water is potable and has no direct contact with any of the equipment, there is no opportunity for contamination.

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Executive Summary

Chapter 1
Introduction

Chapter 2
Description of Operable Unit 1132

Chapter 3
Environmental Setting of TA-39

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Units Proposed for No Further Action

Annexes

Appendices

Annex I

Project Management Plan

1.0 PROJECT MANAGEMENT PLAN

This annex provides the technical approach, schedule, reporting requirements, budget, organization, and responsibilities for the implementation of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) for Operable Unit (OU) 1132. This project management plan (PMP) is an extension of Los Alamos National Laboratory's Program Management Plan described in Annex I of the Installation Work Plan (IWP) (LANL 1992, 0768) and follows the DOE's basic management philosophy outlined in DOE Order 4700.1, Project Management System (DOE 1987, 0069). This annex discusses the requirements for PMPs set forth in the Hazardous and Solid Waste Amendments (HSWA) Module (Task II, E, p. 39) of the Laboratory's permit to operate under the RCRA (EPA 1990, 0306) as they pertain to OU 1132. Qualifications of key personnel, including contractors, are also provided.

1.1 Technical Approach

The technical approach to the RFI for OU 1132 is described in Chapter 4 of this work plan. This approach is based on the Environmental Restoration (ER) Program's overall approach to the RFI/corrective measures study (CMS) process as described in Chapter 4 of the IWP. The following key features characterize the ER Program's approach:

- use of preselected "screening action levels" as criteria to trigger voluntary corrective action (VCA) or Phase II investigations;
- site characterization based on a "sample and analysis" approach;
- use of decision analysis and cost effectiveness studies in selecting remedial corrective measures and their remedial alternatives; and
- the application of an "observational," or "streamlined," approach to the RFI/CMS process.

The general philosophy of the RFI/CMS process is to develop and iteratively refine the OU 1132 conceptual exposure model through carefully planned stages of investigation and data interpretation. This will be followed by a study that investigates and proposes various methods for addressing potential release sites (PRSs) that are determined to need remediation. Another objective is to use the minimum data necessary to support either interim corrective measures or a CMS.

1.2 Technical Objectives

The technical objectives of this work plan, and the subsequent RFI, are to

- locate, or confirm the location of, each PRS within OU 1132;
- through Phase I investigations, identify contaminants present at each PRS and their concentrations within structures and environmental media;
- conduct VCAs and propose no further action (NFA) or Phase II investigations as appropriate;

- determine the vertical and horizontal extent of the contamination at each PRS during Phase II investigations, as may be required;
- identify contaminant migration pathways during Phase II investigations;
- acquire sufficient information to allow quantitative assessment of (1) migration pathways and (2) the associated risk for all PRSs carried forward to Phase II investigations; and
- determine whether a CMS is required.

2.0 SCHEDULE

The plan and schedule for the RFI/CMS process were developed as a joint effort between the operable unit project leader (OUPL) and the management information system (MIS) staff of the ER Program Office. The initial step was to develop and agree on an ER Program-wide work breakdown structure (WBS) at the upper levels (i.e., Level 1 down through Level 3, which included all the OUs). Level 3 was expanded for OU 1132 and all the necessary activities were graphically laid out on a detailed logic diagram. All of the activities were related to each other by sequence (i.e., before, after, or in parallel with). Duration (in working days) and cost estimates (in dollars) were made for each of the activities. The schedule and cost estimate were calculated as a function of time and were calculated first as a financially unconstrained case and were then replanned to account for constrained funding, which was already allocated for FY 92. Key milestones for the RFI are presented in Table I-1.

TABLE I-1

SCHEDULE FOR OU 1132 RCRA FACILITY INVESTIGATION AND CORRECTIVE MEASURES STUDY

Milestone	Date
Start RFI Work Plan	10/01/91
Formal DOE Review of Draft RFI Work Plan Completed	04/02/93
EPA/New Mexico Environment Department (NMED) RFI Work Plan Submitted	06/18/93
EPA/NMED Draft of Phase I Report Completed	05/02/95
EPA/NMED Draft of RFI Report Completed	02/20/97

Implementation of RFI activities is contingent on regulatory review and approval of this work plan and on available funding. The assumptions used to generate this schedule include the following:

- Review and approval of the work plan and supporting project plans by regulatory agencies are scheduled to be completed by September 1, 1993.

- Certain tasks may be initiated before the regulatory agencies grant final approval of the work plan.
- PRSs expected to require subsequent investigations have been scheduled earlier in the RFI to allow time for data assessment and subsequent investigations.
- The schedule assumes that an adequate number of support personnel (e.g., health and safety technicians, trained drilling contractors) will be available for conducting necessary tasks.
- EPA review and comments on phase reports/work plan modifications are assumed to take two months. Another month is allowed for Laboratory revision and EPA final approval.
- Adequate funding is available to accomplish the work shown in the plan and schedule.

3.0 REPORTING

Results of the RFI field work will be presented in four principal documents:

- Quarterly technical progress reports.
- Phase reports/work plan modifications.
- RFI report.
- CMS report (as required).

The purpose of each of these reports is discussed in the following sections. A schedule for submission of draft and final reports is presented in Table I-2.

TABLE I-2
REPORTS PLANNED FOR THE OU 1132 RFI

Report Type and Subject	Draft Date	Final Date (Yearly)
Quarterly Technical Progress Reports		02/15
(Summary of Technical Activities and Data)		05/15
		08/15
		11/15
Phase Reports/Work Plan Modifications		
• Phase I Report	05/02/95	
• Phase II Report		
RFI Report (Final)	02/20/97	

3.1 Quarterly Technical Progress Reports

As the OU 1132 RFI is implemented, technical progress will be summarized in quarterly technical progress reports submitted by the ER Program, as required by the HSWA Module of the Laboratory's RCRA Part B operating permit (Task V, C, p. 46). Detailed technical assessments will be provided in phase reports/work plan modifications.

3.2 Phase Reports/Work Plan Modifications

Phase reports/work plan modifications will be submitted at the end of each phase for work conducted on PRSs in this operable unit. The first of these reports will (1) summarize Phase I results on initial site characterization and (2) describe the proposed follow-on activities of Phase II, including any modifications to field sampling plans suggested by the Phase I results. This report will also identify any PRSs proposed for NFA. A Phase II report (as distinct from a final RFI report) will be prepared only if Phase III investigations are proposed. The standard outline for a phase report/work plan modification is presented in Section 3.5.1.2 of the IWP (LANL 1992, 0768) and may be modified as needed.

3.3 RFI Report

The RFI report will summarize all field work conducted during the 1.6-year duration of the RFI. The RFI report will describe the procedures, methods, and results of field investigations and will include information on the types and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support the delisting of NFA sites and corrective action decisions.

3.4 CMS Report

If a CMS is needed, the CMS report will propose methods of remediation for selected PRSs listed in the RFI report. Not all PRSs will need remediation because some will have been delisted on the basis of recommendations made in the RFI report. The CMS report will describe the proposed remediation methods, procedures, and expected results, along with a plan, schedule, and cost estimate.

4.0 BUDGET

It is impractical (almost impossible) to separate schedule and cost because changing one affects the other. For example, the start and end dates for OU 1132 were fixed by the ER Program Office on the basis of a combination of regulations. These schedule decisions affect the cost as a function of time.

The detailed planning, scheduling, and cost estimating were done in late FY 91. As stated previously, the schedule and cost estimates were calculated first as a financially unconstrained case and were then replanned to account for constrained funding that was allocated for FY 92. DOE funding decisions are set 2 years in advance (in this case, for FYs 92 and 93). Therefore, the first year that the OU 1132 RFI is not constrained by past budget decisions could be

FY 94. Funding requests for FY 94 and beyond will reflect the schedule and cost that are the most efficient (unconstrained) for executing the work plan.

Table I-3 presents project costs for completion of the OU 1132 RFI. Each activity on the logic network was assigned one or more resources (i.e., people, materials, or equipment). Through a rate table, the resources were converted to dollars. The estimated costs are escalated for all years beyond FY92 and do not include contingency. (To avoid adversely affecting the performance analysis calculations, contingency is held in a management reserve account.)

The plan, schedule, and budget (allocation) for FY 92 are now baselined by the DOE's Albuquerque Operations Office. The outyears, FY 93 through 98, are not baselined and cannot be until allocations are made by DOE.

TABLE I-3

ESTIMATED COSTS OF COMPLETING OU 1132 RFI

Estimate to Complete	$13 785 000
Escalation	$1 946 000
Prior Years	$437 000
Total at Completion	$16 168 000

5.0 OU 1132 ORGANIZATION AND RESPONSIBILITIES

The organizational structure for the ER Program is presented in Chapter 3 of the IWP (LANL 1992, 0768). ER Program personnel are identified to the technical team leader (TTL) and OUPL level in Figure 3-2 of the IWP, which is reproduced here as Figure I-1. Section 3.3 of the IWP identifies line authority and personnel responsibilities for each position identified in the figure. Records of qualifications and training of all personnel working on the OU 1132 RFI will be kept as ER records. Summaries of their qualifications are presented in Section 6.0 of this annex. Contributors to the work plan are listed in Appendix C.

The management organization for field investigations is shown in Figure I-2. Positions indicated *TBD* (to be determined) in the figure have not yet had individuals assigned to them. The following sections define the responsibilities of the positions identified in Figure I-2.

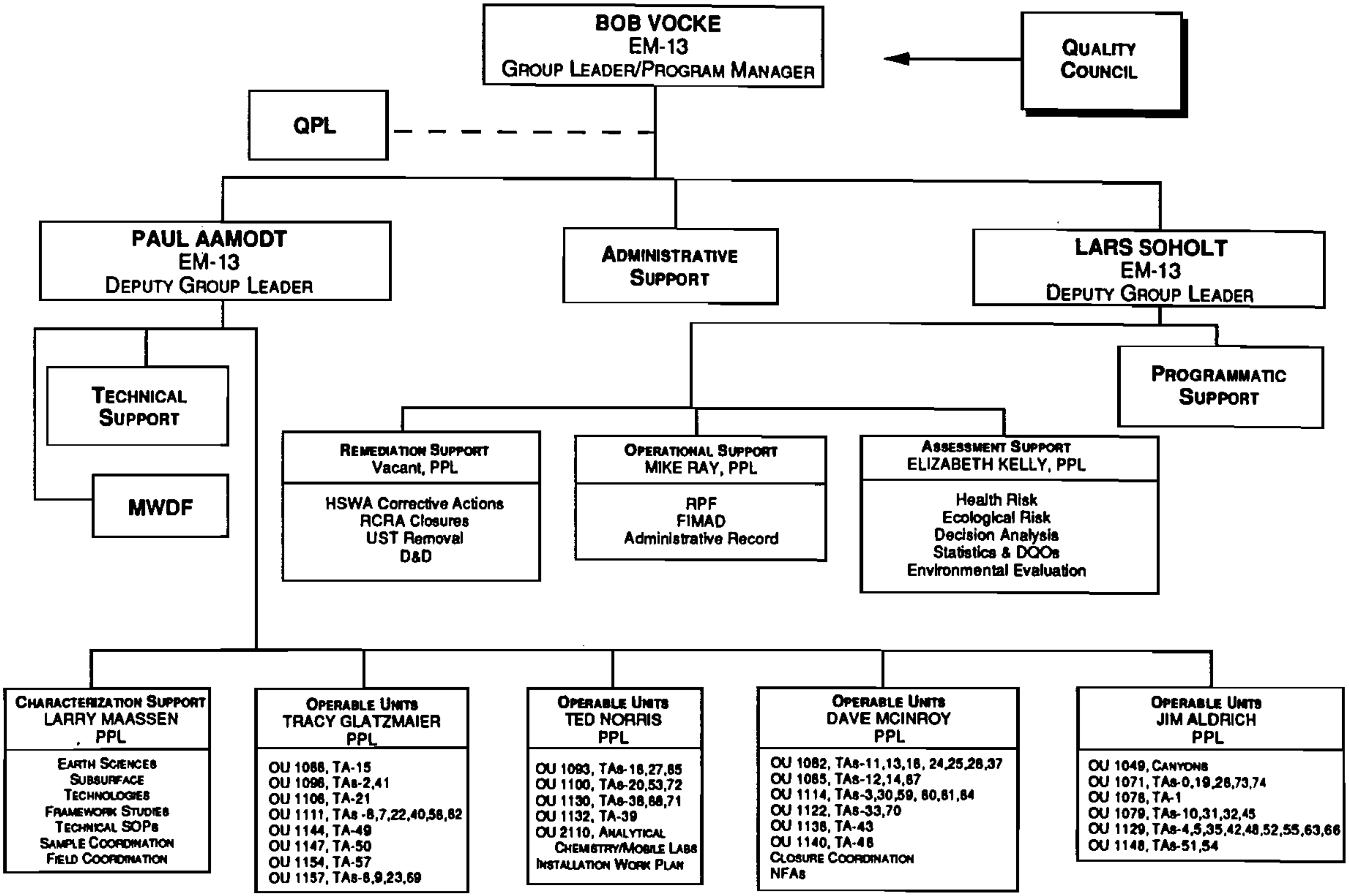
5.1 Operable Unit Project Leader

The responsibilities of the OUPL are to

- oversee day-to-day operations, including planning, scheduling, and reporting of technical and administrative activities;
- ensure advance preparation of scientific investigation planning documents and procedures;
- prepare monthly and quarterly reports for the ER Program Manager;

Figure I-1

ENVIRONMENTAL RESTORATION PROGRAM



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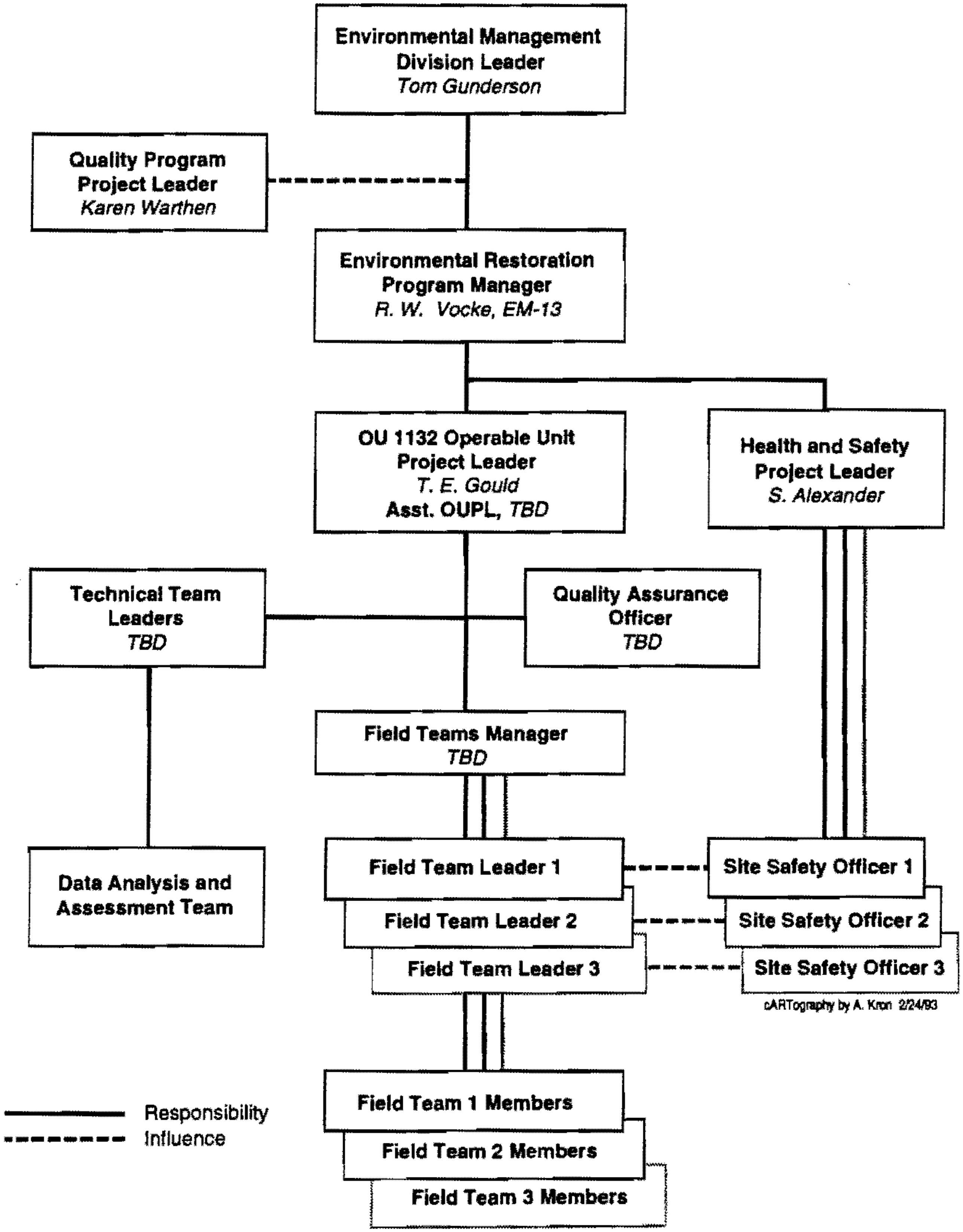

Figure I-2. Operable Unit 1132 Field Organization Chart.

- coordinate with TTLs;
- oversee RFI field work and manage the field teams manager;
- oversee subcontractors, as appropriate;
- conduct technical reviews and direct preparation of final reports.
- comply with the Laboratory's technical requirements for the ER Program;
- interface with the ER quality program project leader (QPPL) to resolve quality concerns and participate with the quality assurance (QA) staff on audits; and
- comply with the ER Program requirements for health and safety (H&S), records management, and community relations.

5.2 Assistant to Operable Unit Project Leader

The assistant to the OUPL assists the OUPL and acts in the absence of the OUPL.

5.3 Health and Safety Project Leader

The health and safety project leader sets policies and standards of health and safety for the OU 1132 RFI and supervises the site safety officer(s).

5.4 Quality Assurance Officer

The quality assurance program that governs the design and implementation of the RFI for OU 1132 is described in Annex II, Quality Assurance Project Plan. The quality assurance (QA) officer is responsible for ensuring that these plans are properly incorporated into the implementation of the field investigation, including the selection and location of sampling points, sample collection and processing, data handling, and reporting of results. As shown in the project organization chart, the QA officer reports directly to the OUPL, ensuring the independence of the QA officer from field activities. Although the field team leader has the responsibility of ensuring that all necessary procedures are followed, this independent oversight by the QA officer will provide an extra measure of assurance that the QA program is properly implemented at all stages of the investigation.

5.5 Field Teams Manager

The field teams manager directs day-to-day field operations and conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapter 5.

5.6 Technical Team Leader(s)

Technical team leaders are responsible for providing support in their discipline throughout the RFI/CMS process. During the OU 1132 RFI, the TTLs will participate in (1) the development of the work plan, (2) the development of the individual field sampling plans, and (3) the field work, data analysis, report preparation, work plan modifications, and planning of subsequent investigations, as necessary.

The OU 1132 technical team requires these primary disciplines: hydrogeology, statistics, geochemistry, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the OU 1132 RFI changes.

5.7 Field Team Leader(s)

The field team leaders will implement work assignments in the field from the field teams manager. Each field team leader will direct the execution of field sampling activities, using crews of field team members as appropriate. Field team leaders may be contractor personnel.

5.8 Site Safety Officer(s)

The site safety officers observe, advise, and document the execution of the health and safety aspects of the OU 1132 work. They report any procedural violations to the health and safety project leader.

5.9 Field Team Members

Field team members may include sampling personnel, geologists, hydrologists, health physicists, and personnel from other required disciplines.

All field team members require access to a site safety officer and a qualified field sampler. They are responsible for conducting the work detailed in field sampling plans, under the direction of the field team leaders. Field team members may be contractor personnel.

5.10 Data Analysis and Assessment Team

This team analyzes, or manages the analysis of, sample data. The team also assesses the sample results and requests additional samples, when appropriate.

6.0 PERSONNEL QUALIFICATIONS

The following personnel hold key positions in the development and implementation of the RFI work plan for OU 1132. Complete resumes for these individuals are available in the ER Program files.

Dale E. Conover—Field Sampling Coordinator

Mr. Conover is a Senior Geohydrologist/Geological Engineer with Morrison-Knudsen Co., Environmental Services Division. He holds a BS in Geology and a BS in Geological Engineering (1980) from the University of Idaho, and an MS in Engineering Geology from Texas A&M University (1985); he is a registered professional engineer (State of Idaho); and he has received Hazmat training at both the worker and supervisor level, as well as Laboratory ES&H Program training, including site environmental orientation (GET), hazardous waste generation, and radiation protection.

Mr. Conover has 14 years' experience in the environmental investigation and remediation of soil and groundwater contamination. He has supervised the installation of monitoring well networks and designed studies to identify and remediate groundwater plumes; designed, installed, and tested ground vapor detection and recovery systems; conducted vadose-zone hydrocarbon plume mapping and characterizations; and characterized and designed a recovery system for a liquid diesel and heavy fuel oil contaminant plume. He has worked with clients in complying with EPA requirements for both Remedial Investigation/Feasibility Study (RI/FS) programs and Engineering Evaluation/Corrective Action Study (EE/CA) programs.

Mr. Conover also has experience in soil sampling and testing, including standard foundation investigation studies for a variety of structures (following ASCE and ASTM standard test methods).

His most recent project involved the development, for DOE, of a field and laboratory hydraulic property evaluation program for soils at a site to be used for the construction of a RCRA-type low-level radioactive and chemical waste containment cell in Missouri.

Edward H. Essington—Soil Chemist

Mr. Essington received an MS degree from the University of California, Los Angeles, in Plant Science (1964) and a BS in Soil Science from California State Polytechnic University (1958). He has received training in areas pertinent to environmental restoration, including (1) hazardous waste operations and emergency response, (2) packaging and transportation of hazardous materials, (3) hazardous waste generation, (4) HAZCOM, and (5) radiation protection.

From 1957 to 1963, Mr. Essington was employed by the University of California, Environmental Radiation Division, as a senior technician studying fallout distribution at the Nevada Test Site (NTS), contaminant solubility and migration in soils, and contaminant uptake by plants. From 1964 to 1972, he was employed by Isotopes Inc., a Teledyne company, as a geochemist and as principal investigator for programs dealing with contaminant migration. He also served as plant safety and radiation protection officer.

Mr. Essington has been employed at the Laboratory since 1973. As a member of the Waste Management Group (1973-1977), he worked on developing analytical procedures for the analysis of plutonium in environmental matrices and determining the inventory and distribution of plutonium dispersed at NTS. In 1977, he joined the Environmental Sciences Group, where he was the principal investigator for soils studies and the quality assurance task of the Basic Environmental Compliance and Monitoring Program (BECAMP) at NTS, which included evaluation of the mechanisms of contaminant redistribution. During this period, he was also coinvestigator for studies in contaminant movement and distribution at various sites.

Mr. Essington currently serves as a member of the Technical Support Group for risk assessment in the plutonium separation demonstration project at NTS and as associate investigator for tracer migration evaluation at Yucca Mountain. In addition, he assumes the Laboratory and ES&H duties of Building Manager, Facilities Manager, Laboratory Safety Supervisor, Spill Coordinator, HAZCOM Coordinator, HAZPACT Coordinator, and Radioactive Source Custodian.

T. E. (Gene) Gould—Operable Unit Project Leader

Mr. Gould holds a BA in history from New Mexico Institute of Mining and Technology (1972) and has earned graduate credits in accounting and business law from the College of Santa Fe. He has received additional training in program management planning and control, management skills development, and indirect cost accounting.

He has been employed at the Laboratory since May 1974, where he has held positions as assistant group leader for M-3 (Detonation Physics), assistant division leader for M-Division (Dynamic Testing), and technical coordinator for the Los Alamos ICF Program. He was appointed OUPL for OU 1132 in July 1991.

Vivienne Hriscu—Technical Editor

Mrs. Hriscu received a BA degree in English from Wellesley College and an MA in Prehistoric Archaeology from the Institute of Archaeology, University of London.

Following five years as a Business Editor in management consulting (Boston Consulting Group and McKinsey & Co.), in 1980 she joined Intermedics, Inc. of Freeport, Texas, as a medical/technical writer-editor. Her work included writing and editing physician's manuals, technical memoranda, and other product documentation; coordinating the translation of manuals and other documents into French, German, Spanish, and Italian; checking the translations for technical accuracy; and overseeing the production and printing of technical documents.

Mrs. Hriscu has been employed by the Laboratory since 1989 as a technical writer-editor. For the past two years, she has been assigned to the Environmental Restoration Program, editing work plans and related documents.

Wilfred L. Polzer—Soil Chemist

Dr. Polzer received a Ph.D from Michigan State University in soil chemistry (1960), preceded by an MS in agronomy (1955) and a BS in plant and soil science (1953) from Texas A&M University.

Dr. Polzer was employed by the US Geological Survey from 1960 to 1967, working on an understanding of the interaction between environmental waters and the geologic media in contact with the waters. From 1967 to 1976, he was employed by the US ERDA (now US DOE) at the Idaho National Engineering Laboratory, working on the migration of waste radionuclides (including plutonium and americium) from the solid waste burial site and from liquid waste disposal areas. His work also involved the interpretation and documentation of environmental monitoring data. From 1976 to the present, as an employee of the Laboratory, he has worked on and managed numerous projects focused on understanding waste contaminant migration in the environment. His special emphasis during these projects was the study of retardation of contaminants through sorption on geologic media.

Bradford P. Wilcox—Hydrologist

Dr. Wilcox received BA (1978) and MA (1982) degrees, both in range management, from Texas Tech University. He earned a Ph.D in rangeland hydrology from New Mexico State University in 1986. Before coming to the Laboratory in 1991, he was a visiting assistant professor in watershed management at Colorado State University and then was employed as a hydrologist in the USDA Agricultural Research Service Northwest Watershed Research Center, Boise, Idaho. His research focused on understanding runoff and erosion processes in semiarid environments. As a member of the Environmental Sciences Group at the Laboratory, Dr. Wilcox is continuing this line of research, with a special focus on relating movement of water and sediment on the Pajarito Plateau to contaminant transport.

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Annex II

Quality Assurance Project Plan

1.0 SIGNATURE PAGE

Approval for Implementation

1. NAME: Robert Vocke
   TITLE: ER Program Manager, Los Alamos National Laboratory

   SIGNATURE: ________________________________ DATE:________

2. NAME: A. E. Norris
   TITLE: Acting Quality Program 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 6, Environmental Protection Agency

   SIGNATURE:________________________________ DATE:________

6. NAME: Alva Smith
   TITLE: Chief of Office of Quality Assurance, Region 6, Environmental Protection Agency

   SIGNATURE:________________________________ DATE:________

7. NAME: T. E. Gene Gould
   TITLE: Operable Unit Project Leader, Mechanical & Electrical Engineering (MEE-4),
   Los Alamos National Laboratory

   SIGNATURE:________________________________ DATE:________

2.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) work plan for OU 1132 was written as a matrix (Table II-1) that is based on the Los Alamos National Laboratory (the Laboratory) Environmental Restoration (ER) Program Generic QAPjP (LANL 1991, 0412).

The Laboratory ER Program Generic QAPjP describes the format for the individual OU QAPjPs. In the Generic QAPjP, Section 1.0 is the Signature Page, which is included in the front of this annex. Section 2.0 of the Generic QAPjP is a Table of Contents, which was omitted from this annex because the OU 1132 QAPjP is presented as a matrix. Section 3.0 of the Generic QAPjP is the Project Description, and Subsection 3.1 is the Introduction. This introduction will serve as the equivalent of Subsection 3.1 and the matrix (Table II-1) will begin with Subsection 3.2, Facility Description.

The OU 1132 QAPjP matrix (Table II-1) appears as a table in which the Generic QAPjP criteria are listed in the first column; these criteria correspond to the sections of the Generic QAPjP. The second column lists the specific requirements of the Generic QAPjP that the OU 1132 QAPjP must meet; the subsection titles and numbers in the second column correspond directly with those contained in the Generic QAPjP. Sections of the Generic QAPjP that do not contain specific requirements are not included in the matrix, e.g., 3.4. The third column lists the location of information in the IWP and/or the OU 1132 work plan that fulfills the requirements in the Generic QAPjP. If OU 1132 will be following the requirements in the Generic QAPjP and no further information is necessary, the column contains the phrase "Generic QAPjP accepted." In some cases, a standard operating procedure (SOP) and/or a clarification note is included.

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TABLE II-1
OU 1132 QAPjP MATRIX

Generic QAPjP Criteria	Generic QAPjP Requirements by Subsection	OU 1132 Incorporation of Generic QAPjP Requirements
Project Description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP, Chapter 2, and OU 1132 Work Plan, Chapter 2
	3.3 ER Program	LANL ER Program IWP, Chapter 3.
	3.4.1 Project Objectives	OU 1132 Work Plan, Chapters 1 and 5.
	3.4.2 Project Schedule	OU 1132 Work Plan, Annex I.
	3.4.3 Project Scope	OU 1132 Work Plan, Chapters 1 and 5.
	3.4.4 Background Information	OU 1132 Work Plan, Chapters 1-3, 5, and 6.
	3.4.5 Data Management	OU 1132 Work Plan, Annex IV, and LANL ER Program IWP, Annex IV.
Project Organization	4.1 Line Authority	OU 1132 Work Plan, Annex I.
	4.2 Personnel Qualifications, Training, Resumes	OU 1132 Work Plan, Annex I, and ER Project Files.
	4.3 Organizational Structure	LANL-ER-QPP, Section 2, and OU 1132 Work Plan, Annex I. See also *Note 1*.
Quality Assurance Objectives for Measurement Data in Terms of Precision, Accuracy, Representativeness, Completeness, and Comparability	5.1 Level of Quality Control	Generic QAPjP accepted.
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPjP accepted.
	5.3 QA Objectives for Precision	Generic QAPjP accepted. See also *Note 2*.
	5.4 QA Objectives for Accuracy	Generic QAPjP accepted.
	5.5 Representativeness, Completeness, and Comparability	Generic QAPjP accepted.
	5.6 Field Measurements	Generic QAPjP accepted.
	5.7 Data Quality Objectives	OU 1132 Work Plan, Chapter 5.
Sampling Procedures	6.0 Sampling Procedures	OU 1132 Work Plan, Chapters 4 and 5, and Appendix B; ER Program SOPs.
	6.1 Quality Control Samples	Generic QAPjP accepted, including ER Program SOP-01.05.
	6.2 Sample Preservation During Shipment	Generic QAPjP accepted, including ER Program SOP-01.02.

TABLE II-1 (continued)
OU 1132 QAPjP MATRIX

Generic QAPjP Criteria	Generic QAPjP Requirements by Subsection	OU 1132 Incorporation of Generic QAPjP Requirements
	6.3 Equipment Decontamination	Generic QAPjP accepted, including ER Program SOP-01.06.
	6.4 Sample Designation	Generic QAPjP accepted, including ER Program SOP-01.04.
Sample Custody	7.1 Overview	Generic QAPjP accepted, including ER Program SOP-01.04.
	7.2 Field Documentation	Generic QAPjP accepted, including ER Program SOP-01.04.
	7.3 Sample Coordination Facility	Generic QAPjP accepted.
	7.4 Laboratory Documentation	Generic QAPjP accepted.
	7.5 Sample Handling, Packaging, and Shipping	Generic QAPjP accepted, including ER Program SOP-01.03.
	7.6 Final Evidence File Documentation	Generic QAPjP accepted.
Calibrations Procedures and Frequency	8.1 Overview	Generic QAPjP accepted.
	8.2 Field Equipment	Generic QAPjP accepted.
	8.3 Laboratory Equipment	Generic QAPjP accepted.
Analytical Procedures	9.1 Overview	Generic QAPjP accepted.
	9.2 Field Testing and Screening	Generic QAPjP accepted, including ER Program SOP-06.02.
	9.3 Laboratory Methods	Generic QAPjP accepted. Sampling plans are described in OU 1132 Work Plan, Chapter 5.
Data Reduction, Validation, and Reporting	10.1 Data Reduction	Generic QAPjP accepted.
	10.2 Data Validation	Generic QAPjP accepted.
	10.3 Data Reporting	Generic QAPjP accepted.
Internal Quality-Control Checks	11.1 Field Sampling Quality Control Checks	Generic QAPjP accepted. See also *Note 2*.
	11.2 Laboratory Analytical Activities	Generic QAPjP accepted. See also *Note 2*.
Performance and System Audits	12.0 Performance and System Audits	Generic QAPjP accepted.

TABLE II-1 (continued) OU 1132 QAPjP MATRIX		
Generic QAPjP Criteria	**Generic QAPjP Requirements by Subsection**	**OU 1132 Incorporation of Generic QAPjP Requirements**
Preventive Maintenance	13.1 Field Equipment	Generic QAPjP accepted.
	13.2 Laboratory Equipment	Generic QAPjP accepted.
Specific Routine Procedures Used to Assess Data Precision, Accuracy, Representativeness, and Completeness	14.1 Precision	Generic QAPjP accepted. See also ***Note 2.***
	14.2 Accuracy	Generic QAPjP accepted.
	14.3 Sample Representativeness	Generic QAPjP accepted. See also ***Notes 2 and 3.***
	14.4 Completeness	Generic QAPjP accepted.
Corrective Action	15.1 Overview	Generic QAPjP accepted, including LANL-ER-QP-01.3Q.
	15.2 Field Corrective Action	Generic QAPjP accepted.
	15.3 Laboratory Corrective Action	Generic QAPjP accepted.
Quality Assurance Reports to Management	16.1 Field Quality Assurance Reports to Management	Generic QAPjP accepted. See also ***Note 4.***
	16.2 Laboratory Quality Assurance Reports to Management	Generic QAPjP accepted.
	16.3 Internal Management Quality Assurance Reports	Generic QAPjP accepted.

Note 1: Section 4.0 Project Organization and Responsibility
The organizational structure of the ER Program is presented in Chapter 2.0 of the LANL ER Quality Program Plan (QPP) to the Programmatic Project Leader (PPL) level, including quality assurance functions. The OU 1132 Work Plan, Annex I, describes the organizational structure from the PL level down and presents an organizational chart to demonstrate line authority.

Note 2: For target analytes that are particulate in nature (such as uranium at the OU 1132 firing sites), a measure of analytical precision cannot be obtained from replicate aliquots of the soil sample—whether the aliquots are taken in the field or after mixing of the sample in the laboratory. However, if the analyte is first extracted from the soil sample, analysis of replicate aliquots of the extract will yield data from which analytical precision can be calculated.

Note 3: Section 14.3 Sample Representativeness
The field sampling plans presented in the OU 1132 work plan, Chapter 5.0, were developed to meet the sample representativeness criteria described in Subsection 14.3 of the Laboratory ER Program Generic QAPjP (LANL 1991, 0412).

Note 4: Section 16.1 Field Quality Assurance Reports to Management
The OU 1132 QA Officer, or a designee, will provide a monthly field progress report to the Laboratory ER Program Manager. This report will consist of the information identified in Subsection 16.1 of the ER Program Generic QAPjP (LANL 1991, 0412).

References for Annex II

LANL (Los Alamos National Laboratory), May 1991. "Generic Quality Assurance Project Plan," Rev. 0, Environmental Restoration Program, Los Alamos, New Mexico. (LANL 1991, 0412)

Executive Summary

Chapter 1
Introduction

Chapter 2
Description of Operable Unit 1132

Chapter 3
Environmental Setting of TA-39

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Units Proposed for No Further Action

Annexes

Appendices

Annex III

Health and Safety Project Plan

Final editing of the OU 1132 Health and Safety Plan is not complete. The following section is the latest available version. We expect the fully edited version to be ready by June 7th, when it will be substituted for this one.

1.0 INTRODUCTION

1.1 Purpose

This Operable Unit Health and Safety Plan (OUHSP) describes how to recognize, evaluate, and control potential safety and health hazards. The purpose is to eliminate injuries and illness—by minimizing exposure to such hazards during environmental restoration (ER) activities and by ensuring that rapid-response action programs are in place to deal with accidental exposures.

Project managers, health and safety professionals, Laboratory managers, and regulators should use the OUHSP as a source of information on health and safety programs and procedures for the operable unit (OU) as a whole. In addition, detailed Site-Specific Health and Safety Plans (SSHSPs) and procedures will be developed.

The Health and Safety Division Hazardous Waste Operations Program of the Los Alamos National Laboratory (the Laboratory) establishes Laboratory policies covering health and safety at ER sites. The hierarchy of health and safety documents for the ER Program, in order of increasing specificity and detail, is as follows:

1. Installation Work Plan, Health and Safety Program Plan (IWPHSPP)
2. Operable Unit Work Plan, Health and Safety Plan
3. SSHSP

Although designed to be stand-alone documents, each of these also includes references to other documents, which should always be considered when making decisions.

1.2 Applicability

All on-site personnel (Laboratory employees, contractors, subcontractors, regulators, and visitors) participating in ER-Program activities at OU 1132 must adhere to the provisions of this plan. There are no exceptions.

1.3 Regulatory Requirements

Government-owned, contractor-operated facilities must comply with Occupational Safety and Health Administration (OSHA) regulations, U.S. Environmental Protection Agency (EPA) regulations, and U.S. Department of Energy (DOE) orders. Those related to hazardous and radioactive wastes are summarized in the following paragraphs.

The first federal effort to address hazardous waste problems came with the passage of the Resource Conservation and Recovery Act of 1976 (RCRA), which mandated the development of federal and state programs to regulate the generation, treatment, storage, transportation, and disposal of hazardous wastes.

Over the past 40 years or so, many hazardous waste sites were abandoned. In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as "Superfund," to clean up and reclaim these sites. Because of the health and safety risks posed for workers engaged in these operations, the issue of worker protection was addressed in the Superfund Amendments and Reauthorization Act of 1986 (SARA). SARA required the Secretary of Labor to promulgate worker-protection regulations. The result was OSHA regulation 29 CFR Part 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), published in March 1989; it included input from many organizations, including EPA, OSHA, the U.S. Coast Guard, and the National Institute for Occupational Safety and Health (NIOSH).

DOE Orders 5480.4 and 5483.1A require DOE employees and contractors to comply with federal OSHA regulations. DOE 5480.11 sets radiation protection standards for all DOE activities. The DOE Radiological Control Manual provides guidance for the conduct of radiological control activities at all DOE sites and is used by DOE to evaluate the performance of contractors.

In addition, the Laboratory Director's policies *Environment, Safety, and Health* and *Environmental Protection and Restoration*, both dated September 1991, stipulate compliance with federal regulations, DOE orders, and state and local laws.

1.4 Variances From Health and Safety Requirements

Under special conditions, the Site Safety Officer (SSO) may submit to the Health and Safety Project Leader (HSPL) a written request for variance from a specific health and safety requirement. If the HSPL agrees with the request, it will be reviewed by the Operable Unit Project Leader (OUPL) or a designee. Higher levels of management may be consulted as appropriate. If these individuals also agree, the HSPL will grant the variance in writing. The variance will specify that the requirements may be modified only under the particular conditions cited in the request, and it will become part of the SSHSP.

1.5 Review and Approval

This OUHSP will become effective after it has been reviewed and approved by the appropriate Laboratory subject matter experts. Signatures of approval are required.

The OUHSP will be reviewed at least annually and revised to reflect changes in scope of work, methods of work, site conditions, policies, and/or procedures. Changes must be approved by the HSPL and OUPL. The plan will also be fully reviewed if Phase II investigations and/or remediation are to be done.

2.0 ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health (ES&H) Manual delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities for ER activities are summarized in the IWP HSPP (LANL 1992, 0768). Line management is responsible for ensuring that health and safety requirements are met.

Anyone observing an operation that presents a clear and imminent danger to the environment or to the safety and health of employees, subcontractors, visitors, or the public has the authority to initiate a *stop-work action*. The criteria, reporting requirements, responsibilities, and procedures for stop-work actions and for the restart of activities are established in Laboratory Procedure (LP) 116-01.0. All activities related to the stop-work action shall be documented on the Stop-Work Report Form and the log for Stop-Work Reports. All ER Program personnel shall comply with the Laboratory's stop-work policy and the requirements of LP 116-01.0. In addition, upon initiation of a stop-work action, the affected ER Program personnel shall notify the SSO, the ER Program HSPL, and the OUPL.

Before field work begins, the HSPL will organize a meeting to decide on responsibility, authority, lines of communication, and scheduling. The HSPL has the authority to delay field work until the meeting has been held.

The OUPL must complete a field readiness review before field work begins. The HSPL must approve the health and safety section of this review.

2.2 Individual Responsibilities

Figure III-1 illustrates the organization chart for the OU 1132 RCRA Field Investigations (RFI).

2.2.1 Environmental Management and Health and Safety Division Leaders

The Environmental Management (EM) and Health and Safety (HS) division leaders are responsible for addressing programmatic health and safety concerns. They shall promote a comprehensive health and safety program that includes radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

2.2.2 Environmental Restoration Program Manager

The ER Program Manager (EM-13) is responsible for the establishment and implementation of the overall health and safety program plan and for overseeing the day-to-day implementation and support of health and safety measures.

2.2.3 Health and Safety Project Leader

The HSPL is responsible for

- preparing and updating the IWPHSPP;
- helping the OUPL identify resources to be used in the preparation and implementation of the OUHSP;
- reviewing and giving final approval to the IWPHSPP, OUHSP, and SSHSP; and

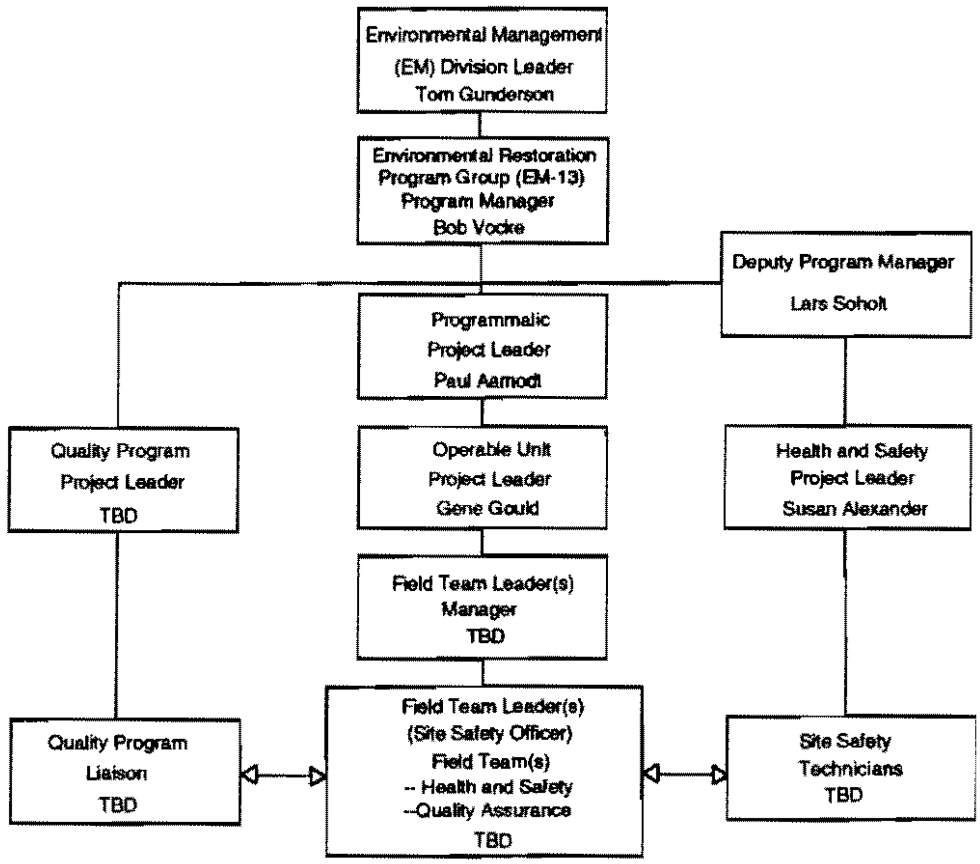

Figure III-1. Organization Chart for OU 1132 RFI.

- in conjunction with the field team leaders, overseeing daily health and safety activities in the field, including scheduling, tracking of deliverables, and use of resources.

2.2.4 Operable Unit Project Leader

The OUPL is responsible for all RFI activities for his/her assigned OU. Specific health and safety responsibilities include:

- preparing, reviewing, implementing, and revising OUHSPs;
- interfacing with the HSPL to resolve health and safety concerns; and
- notifying the HSPL of schedule and project changes.

2.2.5 Operable Unit Field Team Leader

The OU field team leader is responsible for:

- scheduling tasks and manpower,
- conducting site tours,
- overseeing engineering and construction activity at the sites, and
- overseeing waste management.

2.2.6 Field Team Leader

The field team leader is responsible for implementing the sampling and analysis plan, the OUHSP, and the project-specific Quality Assurance Project Plan (Annex II). He/she may also serve as the SSO. Safety responsibilities include:

- ensuring the health and safety of the field team members,
- implementing emergency response procedures and fulfilling notification requirements, and
- notifying the HSPL of schedule changes.

2.2.7 Site Safety Officer

The SSO is responsible for ensuring that trained and competent personnel are on site, including industrial hygiene and health physics technicians and first aid/CPR responders. (The SSO may fill any or all of these roles.)

In addition, the SSO has the following responsibilities:

- advising the HSPL and OUPL on health and safety issues;
- performing and documenting initial inspections of all site equipment;
- notifying proper Laboratory authorities of injuries or illnesses, emergencies, or stop-work actions;
- evaluating the results of analyses for health and safety concerns;
- determining protective clothing (PC) requirements;
- determining personal dosimetry requirements;
- maintaining first aid supplies;
- maintaining a current list of telephone numbers for emergency situations;
- providing an operating radio transmitter/receiver in case telephone service is interrupted;

- maintaining an up-to-date copy of the SSHSP;
- ensuring that all personnel are trained in the appropriate safety procedures, are familiar with the SSHSP, and follow the SSHSP during the RFI;
- conducting daily health and safety briefings for field team members;
- establishing and enforcing safety requirements for visitors to the site;
- briefing visitors on health and safety issues and requirements;
- maintaining a logbook of workers who enter the site;
- determining whether workers can perform their jobs safely under prevailing weather conditions;
- managing emergency situations in collaboration with Laboratory personnel; and
- stopping work when unsafe conditions develop or an imminent hazard is perceived.

2.2.8 Field Team Members

Field team members are responsible for following safe work practices, notifying their supervisor or the SSO if unsafe conditions exist, and immediately reporting any injury, illness, or unusual event that could affect the health and safety of site personnel.

2.2.9 Visitors

Access to the site will be controlled: only verified team members and approved visitors will be allowed in work areas or areas where potentially hazardous materials or conditions exist. Special passes or badges may be issued. Visitors are categorized as (1) those who are on site to collect samples, and (2) those who are on site for other purposes.

Visitors who are on site to collect samples must meet the same health and safety requirements as any other field sampling team for that site. They must comply with the provisions of the SSHSP, and sign an agreement to that effect, and they must comply with relevant OSHA requirements (such as medical monitoring, training, and respiratory protection).

Visitors who are on site for reasons other than sample collection must

1. report to the SSO upon arrival at the site;
2. log in/out upon entry/exit to the site;
3. receive abbreviated site training from the SSO regarding
   - site-specific hazards,
   - site protocol,
   - emergency response actions, and
   - muster areas;
4. be escorted at all times by the SSO or another trained individual. The escort will also ensure that the visitor is not permitted to enter the exclusion zone (see Section 5.3.1).

If a visitor in either category fails to comply with the requirements, the SSO will ask the visitor to leave the site and will record the noncompliance in the site log.

2.2.10 Contractors and Subcontractors

Each RFI subcontractor will be responsible for developing a health and safety plan for his or her specific project assignment. At a minimum, the plan shall conform to the requirements of this OUHSP. Deficiencies in a health and safety plan must be corrected before the subcontractor begins work.

Each RFI contractor will provide his or her own health and safety functions unless other contractual arrangements have been made. Such functions may include, but are not limited to

- providing qualified health and safety officers for site work;
- creating a corporate health and safety environment for employees;
- providing health and safety training for employees specific to their tasks;
- ensuring safe work practices;
- supplying equipment (such as calibrated industrial hygiene and radiological monitoring instruments);
- supplying approved respiratory and personal protective equipment (PPE); and
- implementing an approved medical surveillance program.

Laboratory personnel will monitor the subcontractors to ensure that they adhere to the requirements of all applicable health and safety plans. A subcontractor who fails to comply may be asked to stop work until compliance is achieved.

2.3 Personnel Qualifications

The HSPL will establish minimum training and competency requirements for on-site personnel. These requirements will meet or exceed OSHA 29 CFR 1910.120 regulations.

2.4 Health and Safety Oversight

The Health and Safety Division is responsible for developing and implementing a program for ensuring compliance with regulatory requirements. The frequency of field verifications will depend on the characteristics of the site, the equipment used, and the nature and scope of the activities.

2.5 Off-Site Work

The HSPL and the OUPL will review health and safety requirements and procedures for off-site work. Alternate approaches may be used if they are in the best interest of the public and the Laboratory. Each case will be considered individually.

3.0 PHASE I RFI FOR OU 1132

This OUHSP addresses the tasks in the Phase I RFI. If additional phases are judged necessary, the tasks for those phases will be addressed in revisions to this document.

OU 1132 consists of 27 potential release sites (PRSs): 25 SWMUs and 2 proposed SWMUs. Some PRSs are recommended for no further action (NFA) and are discussed in Chapter 6. Descriptions and histories of the remaining sites, for which an RFI will be done, can be found in Chapter 5. They have been grouped, on the basis of similarity of site characteristics, sampling requirements, and potential remediation alternatives, into four aggregates:

1. Landfills
2. Storage Areas
3. Firing Sites
4. Septic Systems and Seepage Pits

Table III-1 lists these sites by aggregate, the potential contaminants at each, and the RFI work planned at this time.

TABLE III-1
SUMMARY OF PRSs IN OU 1132 PROPOSED FOR RFI

Description	Tasks	Potential Contaminants
Aggregate 1: Landfills		
PRS 39-001(a) PRS 39-001(b)	Radiation and geophysical survey; surface and subsurface sampling; hydrological studies (using trenches and boreholes)	Lead, mercury, barium, PCB-containing oils, high explosives, solvents, volatile organics, metals, chromium, uranium, and potassium-40
Aggregate 2: Storage Areas		
PRS 39-002(a)	Radiation survey; field survey; surface soil sampling	Solvents, adhesives, vacuum-pump oil, transformer oil, radioactive materials
PRS 39-002(b)	Radiation survey; field survey; surface soil sampling	Solvents, transformer oil, vacuum grease, photographic waste; no radionuclides identified
PRS 39-002(c)	Radiation survey; field survey; surface soil sampling	Paper, cloth contaminated with solvents and vacuum grease, photographic waste; no radionuclides identified
PRS 39-002(d)	Radiation survey; field survey; surface soil sampling	Photographic waste, paper and cloth contaminated with solvents, vacuum grease, transformer oil; no radionuclides identified
PRS 39-002(e)	Radiation survey; field survey; surface soil sampling	Spent propellant, lead, polyethylene, ethanol, carbon, quartz, paraffin, Polaroid film; no radionuclides identified

TABLE III-1 (continued)

Description	Tasks	Potential Contaminants
PRS 39-002(f)	Radiation survey, field survey; surface soil sampling	Solvents, transformer oil, vacuum grease, photographic waste; no radionuclides identified
PRS 39-007(a)	Radiation survey; field survey; surface soil sampling	Waste oil; no radionuclides identified
PRS 39-007(d)	Radiation survey; field survey; surface soil sampling	Oil, solvents, lead; no radionuclides identified
Aggregate 3: Firing Sites		
PRS 39-004(a) PRS 39-004(b) PRS 39-004(c) PRS 39-004(d) PRS 39-004(e) Proposed SWMU: Excavated Soil Dump	Geomorphological and soils characterization; radiation survey; field screening; surface and subsurface sampling	High explosives, beryllium, lead, mercury, copper, iron, thallium, cadmium, chromium (VI), dielectric oil, thorium, natural and depleted uranium
PRS 39-008 (Gas-Gun Site)	Radiation survey; field screening; surface and subsurface sampling	Beryllium, lead, depleted uranium, plutonium
Aggregate 4: Septic Systems and Seepage Pits		
PRS 39-006(a): Active Septic System	Radiation survey; land survey; field screening; surface and subsurface sampling	Sanitary wastes, photographic chemicals, possibly other hazardous wastes; no radionuclides identified
Inactive Septic System	Radiation survey; land survey; field screening; sampling of septic tank (walls and fill), drainlines, and surrounding soil	Sanitary wastes, photographic chemicals (esp. silver), possibly other hazardous wastes; no radionuclides identified
PRS 39-005: HE Seepage Pit	Land survey; field screening; surface sampling	HE
Proposed SWMU: Chemical Seepage Pit	Radiation survey; land survey; field screening; surface and subsurface sampling	Photographic chemicals (esp. silver); probably no radionuclides

4.0 HAZARDS

4.1 Identification of Hazards

The SSO will monitor field conditions and exposure of personnel to physical, chemical, biological, and radiological hazards. If a previously unidentified hazard is discovered, the SSO will notify the field team leader and the HSPL. A safety analysis will be done to assess the potential risk and formulate measures to reduce the risk; the analysis will be reviewed by the HSPL, the OUPL, the field team leader, and appropriate field team members. After final approval by the HSPL and the OUPL, the analysis will become an amendment to this plan.

4.2 Physical Hazards

Physical hazards are frequently responsible for minor or major injuries—most of which can be prevented. Some physical hazards are easily recognized (open trenches, loud noises), whereas others are less apparent (excessive temperatures, defective or unguarded machinery).

Table III-2 lists the physical hazards most typical of ER work and therefore likely to be of concern at OU 1132. Detailed information about these potential hazards can be found in Health and Safety Division HAZWOP Program documentation or in industrial hygiene references such as *Fundamentals of Industrial Hygiene*, 1988). The table is not inclusive; any other physical hazards identified by the SSO should be added to it. The table also gives some identification/monitoring techniques and preventive measures.

Two of the physical hazards listed in Table III-2 are not typical of most environmental restoration sites: high explosives and altitude sickness. These are discussed in more detail in the following sections.

4.2.1 High Explosives

Areas that may contain high explosives (HE) will be clearly identified. The following precautions will be taken during the RFI:

1. Before sampling begins, the area will be surveyed for radiation and organic vapors, and the ground will be sprayed with water to minimize the potential for sparks or particulate dispersion.
2. For surface sampling, a nonsparking device will be used, with minimum turning as it is pushed into the ground.
3. Field personnel will handle materials in the area only with the authorization of the explosives safety expert and as specifically indicated in the sampling plan.
4. Persons collecting samples will wear latex gloves and safety glasses.
5. Anyone coming into accidental contact with materials possibly contaminated with HE will immediately wash thoroughly with soap and water.
6. Trained personnel will screen each sample for HE.

TABLE III-2
POTENTIAL PHYSICAL HAZARDS AT OU 1132

Hazard	Identification/Monitoring Equipment and Techniques	Prevention/Protection PPE	Prevention/Protection Other Equipment and Methods
Noise	Sound-level meter, noise dosimeter	Ear plugs, ear muffs	Engineering controls (mufflers, noise absorbers)
Vibration	Accelerometers and mechanoelectrical transducers with electronic instrumentation	Gloves, absorbing materials	Prevention or attenuation; isolation; distance from source
Trenches (digging, working in)	Visual inspection; oxygen meter; determination of soil type	Hard hats, safety shoes, safety glasses	Protective shoring; proper access and egress
Confined space entry	Combustible gas indicator (CGI); oxygen meter	Gloves, boots, full-body suit, supplied-air or self-contained breathing apparatus, safety glasses, lifeline	Ventilation, monitoring of air
High explosives	Visual inspection, screening tests	Latex gloves, safety glasses	Blast shields; worker training
Fire/Explosion	CGI	Hard hat, gloves, face shield, fire-resistant full-body suit	Ventilation, containment of fuel source, isolation/ insulation from ignition source and heat
Compressed gas cylinders	Visual inspection; CGI; photoionization detector	Face shield, gloves, safety shoes	Protection of cylinders from weather; use of protective caps; no regulators to be used
Welding/Cutting/ Brazing	Sampling for metal fumes	Appropriate fire-resistant clothing (gloves, aprons, coveralls, leggings), welding helmets or goggles	Ventilation, worker training
Lifting/moving heavy loads	Weighing or estimating weight of loads	Hard hat, safety shoes, gloves	Limits on weight; lifting aids; correct lifting procedures; rest periods
Walking/Working surfaces	Visual inspection	Safety shoes	Maintenance (cleaning, keeping dry)

TABLE III-2 (cont'd)

Hazard	Identification/Monitoring Equipment and Techniques	Prevention/Protection: PPE	Prevention/Protection: Other Equipment and Methods
Machinery	Visual monitoring by supervisor	Face shield, gloves, safety shoes	Interlocks on guards; maintenance of guards
Motor vehicles	Regular vehicle inspections	Seatbelt	First aid kit; defensive driving training; prudence in adverse conditions; vehicle maintenance
Energized equipment	Circuit-test light/meter, grounding stick	Gloves, safety shoes, safety glasses	Operator training; lockout/tagout; distance from source
Heavy equipment	Regular equipment inspections	Hard hat, safety shoes, gloves, safety glasses, dust filtration device	Operator/worker training; keeping other personnel at safe distance; equipment maintenance
Heat stress	Wet-bulb globe thermometer	Hat, cooling vest	ACGIH work/rest regimens; water supply
Sunburn	Solar load estimates	Hat, safety sunglasses, protective clothing	Full-body protection, sunscreen
Cold stress	Temperature and wind-speed measurement; wind-chill chart	Hat, gloves, insulated boots, coat, face protection	ACGIH work/warm-up schedule; heated shelters
Altitude sickness	Self-monitoring for symptoms	None	Acclimatization ascent/descent schedule
Lightning	Weather reports, visual observation	None	Grounding of all equipment. Stop-work in effect during thunderstorms; shelter
Flash floods	Weather reports, visual observation	None	Shelter on high ground

7. Before samples are sealed in containers they will be checked to ensure that moisture content is at least 10 percent.
8. For transport, sample containers will be packed in vermiculite–padded paint cans; the cans will be kept in a cooler with ice packs.
9. Samples will be exposed to light and heat as little as possible and will be handled only in well-ventilated areas.

If noticeable surface or buried HE residues or fragments are found in the immediate vicinity of a drilling location, drilling will be halted. Either a blast shield must be installed or a backhoe used to obtain samples (the decision will be made by the field team leader and the SSO). The HSPL shall be notified before field activities are resumed.

4.2.2 Altitude Sickness

Personnel coming to the Laboratory from significantly lower elevations may experience altitude sickness, especially workers who must perform heavy physical labor.

A unit of work requires the same amount of oxygen regardless of altitude, and oxygen flow to body tissues must remain constant to maintain that level of work. Increased respiration and cardiovascular response can only partially compensate for the reduced atmospheric pressure and the resultant smaller number of oxygen molecules per unit volume of air at higher altitudes. Working capacity at higher altitude depends on

- actual altitude (low, moderate, high)
- time allowed for acclimatization
- individual factors

At the Laboratory's moderate altitude (approximately 7500 feet), acclimatization should be rapid (1-2 weeks). Because all workers will be enrolled in a medical surveillance program, individuals having existing conditions that would put them at higher risk (such as respiratory or cardiovascular disease) can be identified.

4.3 Chemical Hazards

Table III-3 lists potential chemical contaminants at OU 1132. The SSO will be responsible for adding newly identified chemicals to this list and for notifying field personnel as needed.

Each SSHSP will include information on known chemical contaminants at that site. The following information is mandatory: American Conference of Governmental Industrial Hygienists' (ACGIH) threshold limit values (TLV); immediately dangerous to life and health (IDLH) concentrations; exposure symptoms; ionization potential and relative response factor for commonly used screening instruments (reevaluated when the particular instrument is selected); and the instrument considered best. More detailed information can be obtained from reliable sources, such as Patty's Industrial Hygiene and Toxicology.

Table III-3 here

Table III-3 (cont'd) here

4.4 Radiological Hazards

Individuals may be exposed to radioactivity during field investigations principally by

- inhalation or ingestion of radionuclide particles or vapors,
- dermal absorption of radionuclide particulates or vapors, and/or
- exposure to direct gamma radiation from contaminated materials.

Table III-4 provides information relating to the radionuclides of concern at OU 1132, including type of emission and half-life. As concentrations of these radionuclides are determined and as additional radionuclides are identified, the table will be updated. The SSO will be responsible for adding radionuclides to this table and for notifying field personnel as needed.

TABLE III-4
RADIONUCLIDES OF CONCERN AT OU 1132

Radionuclide	Major Radiation	DAC* (μCi/mL)	Radioactive Half-life	Monitoring Instrument
Plutonium-238	Alpha, gamma	3×10^{-12}	87.7 years	Alpha scintillometer, FIDLER**
Plutonium-239	Alpha, gamma	2×10^{-12}	2.4×10^{4} years	Alpha scintillometer, FIDLER
Plutonium-240	Alpha, gamma	2×10^{-12}	6537 years	Alpha scintillometer, FIDLER
Potassium-40	Beta, gamma	2×10^{-7}	1.26×10^{9} years	Thin-window GM B scintillometer
Thorium-232	Alpha	5×10^{-13}	1.4×10^{10} years	Alpha scintillometer
Uranium-235	Alpha, gamma	2×10^{-11}	7×10^{8} years	Alpha scintillometer, FIDLER
Uranium-238	Alpha, gamma	2×10^{-11}	4.5×10^{9} years	Alpha scintillometer, FIDLER

*DAC = derived air concentration (DOE Order 5480.11)
**FIDLER = field instrument for the detection of low-energy radiation.

4.5 Biological Hazards

Table III-5 summarizes potential biological hazards for OU 1132.

4.6 Task-by-Task Risk Analysis

OSHA CFR 1910.120 requires a risk analysis of each of the RFI tasks. In addition to the analyses included below, the SSHSP should include a risk analysis of each site-specific task.

TABLE III-5
BIOLOGICAL HAZARDS OF CONCERN, OU 1132

Hazard	PPE	Prevention Methods
Snake bites (rattlesnake)	Long pants, snake leggings, boots	Use of PPE and caution where uneven terrain limits vision; avoiding blind reaches
Animal bites (dog, cat, coyote, mountain lion, bear)	Long pants, boots	Avoiding wild or domestic animals
Ticks (may cause Lyme disease or tick fever)	Long pants, long-sleeved shirts, boots	Inspecting for ticks after working in brushy or wooded areas
Rodents (prairie dogs and squirrels may carry plague-infected fleas)	Long pants, boots	Not handling rodents (live or dead)
Human sewage (may contain pathogenic bacteria)	Disposable coveralls and gloves	Use of protective gear when sampling septic systems; proper disposal of gear; washing hands thoroughly after contact
Bloodborne pathogens (blood, blood products, and human body fluids may contain Hepatitis B virus or HIV)	Latex gloves, mouthguards, protective eyewear	Using trained personnel only to perform first aid; following Laboratory bloodborne pathogen control procedures
Poisonous plants (poison ivy)	Gloves, long pants, long-sleeved shirts, boots	Ability to recognize plants; avoiding contact; washing hands and garments thoroughly after accidental contact
Waterborne infectious agents (stream water may contain giardia lamblia)	None	Drinking water only from potable sources
Spiders (brown recluse, black widow)	Gloves, long pants, long-sleeved shirt, boots	Using caution around wood or debris piles and in dark, enclosed places

5.0 SITE CONTROL

5.1 Initial Site Reconnaissance

The initial site reconnaissance, which will include ecological risk assessment, may involve surveyors, archaeologists, biological resource personnel, and others. To ensure that health and safety measures are in place to protect these persons, the OUPL and HSPL will identify the potential hazards and develop a plan for responding to them.

5.2 Site-Specific Health and Safety Plans

Each site within an OU requires an SSHSP, because the planning, special training, supervision, protective measures, and oversight needs are different for each.

The standard outline for an SSHSP follows OSHA requirements. The plan identifies the safety and health hazards of each phase of site operations and describes the requirements and procedures necessary to protect personnel. The OUHSP initiates development of the SSHSP by providing detailed information to project managers, Laboratory managers, regulators, and health and safety professionals about health and safety programs and procedures applicable to that OU. Those performing the field work are responsible for completing the plans.

Changes to an SSHSP shall be made in writing and approved by the HSPL. (The SSO will maintain a record of all approved changes.) Site personnel shall be informed of changes through the daily safety meetings (see Section 5.6).

5.3 Work Zones

The SSO will demarcate the work zones within an OU. Each SSHSP will include maps that identify these zones, and the designators of their boundaries (red or yellow tape, fences, barricades, etc.) will be identified in the plan. Each work zone must have an evacuation route (upwind or crosswind of the exclusion zone) and a muster area, clearly shown on SSHSP maps.

5.3.1 Exclusion Zone

The exclusion zone is the area that either is known or likely to contain contamination or, because of work activities, will present a potential hazard to personnel. Anyone entering the exclusion zone must use PPE.

5.3.2 Decontamination Zone

Personal and equipment decontamination takes place in the decontamination zone, which acts as a buffer between contaminated and clean areas. Anyone entering this zone must use PPE (as defined in the decontamination plan—see Section 11.2).

5.3.3 Support Zone

The support zone is a clean area, in which personnel have little possibility of coming into contact with hazardous materials or conditions. PPE is not required, except for safety equipment appropriate to the tasks performed (safety glasses, protective footwear, etc.).

5.4 Secured Areas

Site maps shall clearly show the locations of secured areas, and procedures and responsibilities for maintaining these areas shall be documented. Contractors and visitors who enter secured areas shall first be processed through the badge office, and all personnel shall follow standard Laboratory security procedures for entry. The OUPL is responsible for ensuring that contractor personnel have badges, and each Laboratory employee is responsible for enforcing security measures.

5.5 Communications Systems

Portable telephones, CB radios, and two-way radios may be used for on-site communications, *except in areas where there may be HE.*

5.6 General Safe Work Practices

All site personnel will be trained in safe work practices for the tasks and equipment specific to each project. The training will include daily safety meetings, at the beginning of the shift.

The following requirements, for ensuring protection of field workers while on site, will be reiterated in SSHSPs. (Some requirements may be added, and others deleted, depending on site-specific conditions.)

- The buddy system will be used; each worker should consider himself a safety backup to his partner.
- Visual contact must be maintained between buddies. Hand signals will be established and used.
- All personnel should be aware of the particular dangerous situations that may develop and how to recognize them.
- In areas designated contaminated, any practice that increases the probability of hand-to-mouth transfer and ingestion of potentially contaminated material (such as eating, drinking, chewing gum or tobacco, smoking) is prohibited. Personnel needing to take prescription drugs while in these areas must have written approval from a qualified physician.
- Workers should be careful to avoid contact with contaminated or potentially contaminated surfaces. They should not walk through puddles, mud, or discolored ground surfaces; they should not kneel, lean, or sit on the ground; they should not place equipment on drums, containers, vehicles, or the ground.
- Alcoholic beverage intake is prohibited during the work day.
- Whenever possible, workers will use disposable clothing to minimize the risk of cross-contamination.
- Only workers having the proper safety equipment will be allowed to enter the site.
- The number of personnel and amount of equipment in a contaminated area should be kept to the minimum needed for effective site operations.
- Good housekeeping will be practiced to prevent workers from being injured by tripping over objects, being hit by falling objects, or being exposed to combustion of accumulated materials.
- Wind-direction indicators will be strategically located on site.
- Work areas and procedures will be established for the various operational activities (equipment testing, decontamination, etc.). These will be subject to change if site conditions change.
- Motorized equipment will be inspected regularly to ensure that brakes, hoists, cables, and other mechanical components are operating properly.
- Procedures for emergency exit will be established and documented for each contaminated area. Workers shall review these procedures before entering the area.
- Proper decontamination procedures will be followed before leaving the site, except in emergencies.

- Any medical emergency supersedes routine safety requirements.
- All personnel must comply with the safety policy and procedures established by the Field Safety Coordinator. Anyone who does not will be immediately dismissed from the site.

5.7 Specific Safe-Work Practices

5.7.1 Electrical Power Sources

Personnel can prevent accidental contact with electricity either by de-energizing the system or by maintaining a safe distance from energized parts and/or lines. OSHA regulations specify minimum distances: a person working near power lines must stay (or must keep any conductive materials or tools, such as a pole) at least 10 ft from overhead lines of up to 50 kilovolts (kV), adding 4 in. for every 10 kV over 50 kV.

A secondary protective measure is *grounding*—ensuring a low-resistance path to ground in case of an electrical equipment failure. All electrical equipment must possess a properly installed ground wire or a ground fault circuit interrupter.

5.7.2 Lockout/Tagout

The Laboratory's standard operating procedure for control of hazardous energy sources is AR 8-6, Procedure 106-01.1, the Lockout/tagout procedure. Hazardous energy sources may be electrical, mechanical, thermal, chemical, radiant, hydraulic, pneumatic, or any combination of these.

5.7.3 Confined Space

Personnel entering and working in confined spaces shall follow the procedures found in the Laboratory's Confined Space Entry Program. Key requirements are (1) a Confined Space Entry Permit shall be obtained and posted at the work site; (2) the atmosphere shall be tested for oxygen content, flammable vapors, carbon monoxide, and other hazardous gases; and (3) monitoring for these constituents shall be continuous if site conditions or activities could cause them to be continually released into the air.

5.7.4 Handling Drums and Containers

Drums and containers used during cleanup shall meet U.S. Department of Transportation, OSHA, and EPA specifications. Work practices, labeling requirements, spill-containment measures, and precautions for opening drums and containers shall be in accordance with 29 CFR 1910.120. Drums and containers that contain radioactive material must, *in addition*, be labeled in accordance with AR 3-5 (*Shipment of Radioactive Materials*), AR 3-7 *(Radiation Exposure Control)*, and Article 412 of the DOE Radiological Control Manual *(Radioactive Material Laboratory)*. The SSHSP shall clearly provide for ensuring that all applicable requirements are met.

5.7.5 Illumination

Illumination requirements are given in Table H-120.1, 29 CFR 1910.120.

TABLE III-6
ILLUMINATION REQUIREMENTS

Foot-candles	Area/Operations
5	General site areas
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling areas, and field maintenance areas
5	Indoors: warehouses, corridors, hallways, and exitways
5	Tunnels, shafts, and other underground work areas. (Exception: a minimum of 10 ft-candles is required at tunnel and shaft headings during drilling, mucking, and scaling. Bureau of Mines-approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms)
30	First aid stations, infirmaries, and offices

5.7.6 Sanitation

Potable water shall be adequately supplied at the site. Nonpotable water sources shall be clearly marked as not suitable for drinking or washing. Potable and nonpotable water systems shall be meticulously isolated from one another.

At remote sites, at least one toilet facility shall be provided, unless workers have readily available transportation to nearby facilities.

Adequate washing facilities shall be provided when personnel are potentially exposed to hazardous substances. Washing facilities shall be in areas where levels of hazardous materials are below permissible exposure limits (PELs) and where employees may decontaminate themselves before entering clean areas. When showers and change rooms are required, they shall be provided and shall meet the requirements of 29 CFR 1910.141. Employees shall be required to shower when leaving the decontamination zone.

5.7.7 Packaging and Transport

Disposal of hazardous wastes generated from a project will be handled by HS-7. To ensure that wastes are properly packaged, stored, and transported, i.e., in compliance with ARs 10-2 and 10-3, the OUPL should contact HS-7.

5.7.8 Government Vehicle Use

Only government vehicles can be driven onto contaminated sites. No personal vehicles are allowed. All personnel must wear a seat belt when the vehicle is moving.

5.7.9 Extended Work Schedules

Personnel needing to schedule work outside normal work hours must have the prior approval of the OUPL and SSO.

5.8 Permits

A number of RFI activities require permits—in some cases, Special Work Permits (SWPs). The SSHSP shall specifically address the permits needed.

5.8.1 Excavations

All excavating at OU sites requires a permit and must be done in accordance with Laboratory AR 1-12 *(Excavation or Fill Permit Review)*. The field team leader is responsible for deciding when an excavation permit is required and, along with the OUPL, for requesting the permit (Form 70-10-00.1) from the support services contractor. The form should include, at the top, the information that this is an ER Program activity. HS- and EM-division personnel review the permit for environmental safety and health concerns.

5.8.2 Other Permits

Other types of permits that may be required are

- Radiation Work Permit (SWP)
- Spark/Flame-Producing Operations Permit (SWP)
- Confined Space Entry
- Lockout/Tagout (SWP)

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General Requirements

PPE shall be selected, provided, and used as specified in this section. Contractors shall provide their own PPE.

PPE is required for situations in which engineering controls and safe work practices alone do not provide sufficient protection against hazards. Use of PPE is covered by OSHA regulations in 29 CFR Part 1910 Subpart I (see Table III-7), which are reinforced by EPA regulation 40 CFR Part 300. The latter requires private contractors working on Superfund sites to conform to applicable OSHA provisions and to any other federal or state safety requirements deemed applicable by the agency overseeing the work.

TABLE III-7
OSHA STANDARDS FOR PPE USE

Type of protection	Regulation
General	29 CFR Part 1910.132 29 CFR Part 1910.1000 29 CFR Part 1910.1001-1045
Eye and face	29 CFR Part 1910.133(a)
Hearing	29 CFR Part 1910.95
Respiratory	29 CFR Part 1910.134
Head	29 CFR Part 1910.135
Foot	29 CFR Part 1910.136
Electrical protective devices	29 CFR Part 1910.137

The use of PPE for radiological protection shall be governed by the Radiation Work Permit (or Safety Work Permits/RW). (See AR 3-7, Article 325, Article 461, Table 3.1, and Appendix 3C of the DOE Radiological Control Manual for guidelines.) To the extent possible, disposable PPE used exclusively for radiological work should be protected from contamination by hazardous chemicals, to avoid needless generation of mixed waste. (At sites having both types of contaminants, this may not be possible.)

6.1.1 PPE Programs

PPE programs, which provide training in correct use of PPE, help to protect workers from the illnesses and injuries that can result from incorrect use and/or malfunction of PPE. The programs teach workers how to identify hazards, monitor the environment, and recognize and deal with medical problems; they also cover selection criteria, uses, maintenance, and decontamination of PPE.

6.1.2 Medical Certification

Certain kinds of PPE can be used only with the approval of a physician. See Section 9.0 for details.

6.2 Levels of Protection

Individual PPE components are assembled in various combinations to provide suitable protection for workers from site-specific hazards while minimizing any hazards or drawbacks of the PPE. Attachment A lists combinations of components as specified for the widely used EPA Levels of Protection A, B, C, and D. Although these lists can be used as a general guide for creating a protective ensemble, each ensemble must be tailored to the specific situation if it is to provide maximum protection.

The types of equipment used and the overall level of protection should be reevaluated periodically as information about the site increases and workers move into new and different activities. For chemical PPE, workers should be able to upgrade or downgrade the level of protection with the concurrence of the SSO. For radiological PPE, the level of protection may be changed only as specified in the Radiation Work Permit (or Safety Work Permits/RW). Typical reasons for upgrading are

- dermal hazards are known or suspected to be present,
- gas or vapor emissions are known or likely to occur,
- a change in tasks has increased the possibility of contact with hazardous materials, and/or
- the individual performing the task has requested additional protection.

Typical reasons for downgrading are

- new information indicates that the situation is less hazardous than was originally thought,
- a change in site conditions has decreased the hazard, or
- a change in tasks has reduced the possibility of contact with hazardous materials.

6.3 Selection, Use, and Limitations

PPE for a particular activity will be selected according to the conditions at the site where the activity will take place; that is, it will be selected to protect against chemical and/or radiological hazards known or suspected to be present and to which workers may be exposed.

6.3.1 Chemical Protective Clothing

Chemical PC will be selected by evaluating the suitability of the clothing for the specific task: practicality, level of protection against the potential hazards identified, and durability.

6.3.2 Radiological Protective Clothing

PC is prescribed by the Radiological Work Permit. It should be selected on the basis of the contamination level in the work area, the anticipated activity, and health considerations. Nonradiological hazards that may be present should also be considered. Table III-8 presents general guidelines for selection. A full set of PC includes coveralls, cotton glove liners, gloves, shoe covers, rubber overshoes, and a hood. A double set of PC includes two coveralls, cotton glove liners, two pairs of gloves, two pairs of shoe covers, rubber overshoes, and a hood.

1. Cotton glove liners do not by themselves give any protection. They may be worn inside standard gloves for comfort but should not be worn alone.

TABLE III-8
GUIDELINES FOR SELECTING RADIOLOGICAL PROTECTIVE CLOTHING

	Contamination Value (Removable)*		
Work activity	**Low (1 to 10 times the value)**	**Moderate (10 to 100 times the value)**	**High (>100 times the value)**
Routine	Full set of PC	Full set of PC	Full set of PC, double gloves, double shoe covers
Heavy	Full set of PC, work gloves	Double set of PC, work gloves	Double set of PC, work gloves
Involves pressurized or large volume liquids, closed system breach	Full set of non-permeable PC	Double set of PC (outer set non-permeable), rubber boots	Double set of PC and non-permeable outer clothing, rubber boots

*See Table III-10.

2. Shoe covers and gloves should be sufficiently durable for the task. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for more demanding activities or activities involving abrasion.
3. Hard hats should be used as specified in the Radiological Work Permit. When used in areas having radioactive contamination, they should be distinctly colored or marked.

6.3.3 Protective Equipment

All protective equipment (such as eyewear, shoes, head gear, hearing protection, splash protection, life lines, and safety harnesses) must meet American National Standards Institute (ANSI) standards.

6.4 Respiratory Protection Program

When engineering controls cannot maintain airborne contaminants at acceptable levels, appropriate respiratory protective measures shall be instituted. The Health and Safety Division administers the respiratory protection program, which defines respiratory protection requirements; verifies that personnel have met the criteria for training, medical surveillance and fit testing; and maintains the appropriate records.

All contractors and subcontractors shall submit written documentation of a respiratory protection program to the Industrial Hygiene Group (HS-5) for review and signature approval before using respirators on-site.

7.0 HAZARD CONTROLS

7.1 Engineering Controls

Engineering controls are mechanical means for reducing hazards to workers, such as guards for machinery and ventilation for entry into confined spaces. OSHA regulations state that whenever possible, engineering controls should be workers' first line of defense against hazards.

7.1.1 Airborne Dust

Airborne dust can be a health threat, either as nuisance dust or as a carrier of radionuclides and/or hazardous substances that become attached to the soil particles.

Localized dust generated by drilling or similar activities can be controlled to some extent by spaying water or water amended with surfactants onto the soil with a sprayer. Frequent spraying may be needed to keep the soil moist.

Further, if there are high winds and the area has little or no vegetation and/or is relatively open, small quantities of water will not be effective. A water truck could be used, but frequent spraying may still be necessary, and using large amounts of water can have drawbacks: it can create mud that makes work more difficult, and it may contribute to the spread of contamination (in runoff or in mud tracked off site on vehicle tires). For these reasons, water use needs to be carefully controlled.

Other measures that may be effective in reducing workers' exposure to dust are windscreens, which can be useful in relatively small earth-moving operations; positive-air-pressure cabs for equipment operators; and, under extreme conditions, construction of a temporary enclosure for workers in the open (this last is the most expensive type of control, and it may also increase the level of PPE required for workers in the enclosure).

7.1.2 Airborne Volatiles

RFI activities such as drilling, trenching, and soil- and tank-sampling can expose workers to gases, fumes, or mists. A natural engineering control is to locate workers upwind of the volatile-producing activity whenever possible, so that the wind will carry the contaminants away from them.

In closed or confined spaces, ventilation usually has to be produced mechanically. A fan or blower may be attached to a large hose to either push clean air into, or pull contaminated air from, the space. (Pulling air is more effective at removing vapors, whereas pushing air into the area more effectively maintains oxygen levels.)

7.1.3 Noise

Drilling and trenching are the RFI activities likely to produce the highest noise levels. On most rigs, noise is greatest near the side of the rig, which is left open to cool the engine. A possible engineering control would be to keep workers toward the front or rear of the rig, where the engine is covered. Construction of barriers is another possibility for reducing noise. Finally, providing insulated cabs on equipment can adequately protect operators from noise.

7.1.4 Trenching

Field personnel should avoid entering a trench deeper than 5 ft unless entry is absolutely necessary for obtaining essential information. OSHA regulations for trenches and excavations specify the use of engineering controls, such as benching, sloping, and shoring, to prevent cave-ins.

- *Benching* consists of digging a series of steps around the excavation at a specified angle of repose (determined by the soil type). It is typically used in very large excavations, such as surface mining operations.
- *Sloping* is similar to benching, but with this method the soil is stabilized along a continuous slope (again, the angle of repose is determined by the soil type), rather than in a stepped configuration. Sloping is generally used for medium-size excavations, such as would be needed to remove an underground tank.
- *Shoring* can be done in several different ways, but all use the same basic technique of supporting the sides of the excavation with some type of braced wall. This method is most often used for deep, narrow trenches, such as those in which water pipes or drainage systems are laid, and for exploratory trenching.

7.1.5 Drilling

Persons working with and around drill rigs are exposed to a number of hazards from moving parts and hazardous energy. Engineering controls include use of guards wherever possible to prevent workers from coming in contact with dangerous components and a program of regular inspections to ensure that worn or broken parts are promptly replaced. Rigs should be inspected at the beginning of a job and periodically during the job.

7.2 Administrative Controls

Administrative controls focus on controlling the degree of exposure of workers to hazardous conditions (e.g., how long a worker remains exposed; how close he or she is to the hazard). They are used in cases for which engineering controls are not feasible. Rotation of workers shall not be used to achieve compliance with PELs or dose limits.

7.2.1 Airborne Chemical and Radiological Hazards

Personnel working in the exclusion zone should remain in the zone only as long as necessary to complete their tasks. They should continuously monitor their environment for chemical and radiological hazards. They should immediately leave the area if concentrations of radionuclides or toxic substances exceeds acceptable limits. Only when concentrations return to acceptable levels (by means of natural or mechanical ventilation) may they re-enter the zone.

7.2.2 Noise

The two principal administrative controls for noise are (1) limiting the time of exposure and (2) increasing the distance from the source. Rotation of workers is not a good practice, because it can mean that larger number of workers suffer small hearing losses instead of a small number suffering greater loss. Providing workers with rest and lunch areas where noise levels do not exceed 70 dB can help them recover from temporary exposure to higher levels. (Those exposures should never exceed the limits given in 29 CFR 1910.95, *Occupational Noise Exposure*, Table G-16.)

7.2.3 Trenching

Because trenches less than 5 ft deep generally do not require protective systems (sloping, benching, or shoring), this depth should not be exceeded unless absolutely necessary. However, at 4 ft deep the trench must be monitored and a means of egress provided every 25 ft. Tools, soil piles, and debris must be kept at least 2 ft from the edge of the excavation. Access should be restricted when the area is not occupied, by placing warning signs in appropriate locations near the excavation. Before any field team member is allowed to enter an excavation, the area must be carefully inspected by a qualified individual.

7.2.4 Working Near the Mesa Edge

To avoid accidents, workers shall get no closer than 5 ft to the edge of the mesa. Good housekeeping should be practiced in the work area near the mesa edge and, if necessary, ropes or guards used to delineate this restricted area.

7.2.5 Sampling Canyon Walls

Workers doing canyon-wall or outfall sampling must be equipped with life lines before being allowed to descend over the edge. Another individual trained in the use of this equipment must always be present.

8.0 SITE MONITORING

Each site shall be monitored for chemical, physical, and radiological agents and the information used to delineate work zone boundaries, select appropriate levels of PPE, ensure the effectiveness of decontamination processes, and protect the public. (Biological monitoring is covered in Sections 9.0 and 10.0.)

The OU-wide monitoring program shall meet the requirements of 29 CFR 1910.120. A detailed monitoring strategy, describing the frequency and duration of sampling activities as well as the types of samples to be collected, shall be incorporated into each SSHSP.

If exposures exceed acceptable limits, the ER Program Manager and the HSPL will be notified. As soon as possible, the Health and Safety Division will investigate the source, and the levels of exposure of personnel working in the OU and in adjoining areas, conduct any bioassay or other medical evaluations needed, and assess environmental impacts.

Contractors will be responsible for providing their own monitoring equipment and for ensuring the safety of their employees during the RFI. The Laboratory will be responsible for overall supervision of these activities. Laboratory-approved sampling, analysis, and recordkeeping methods must be used.

8.1 Airborne Chemical Hazards

DOE has adopted OSHA PELs and ACGIH TLVs as standards for defining acceptable levels of exposure. The more stringent of the two limits applies.

8.1.1 Monitoring the Work Site

Historical site data should be used to decide whether the site needs to be monitored for specific chemical agents. If not, screening for a wide range of chemicals should be done, using instruments such as the organic vapor analyzer, combustible gas indicator (CGI), and HNu. The initial air monitoring, which will characterize levels of contaminants to which workers may be exposed, will be used to determine the levels of PPE needed. Further monitoring should be done whenever

- work is initiated in a different part of the site,
- unanticipated contaminants are identified,
- a different type of operation is initiated (e.g., soil boring instead of drum opening), or
- spills or leakages are discovered.

Workers' breathing zones should be screened as accurately as possible. (Those working closest to a source of contamination have the greatest potential for exposure to concentrations above acceptable limits). If each individual situation cannot be analyzed, the worst-case conditions will be assumed for all workers in designing a monitoring and safety program.

8.1.2 Monitoring the Perimeter Areas

The perimeter of the site (i.e., the boundary of the OU) should be monitored to characterize concentrations of airborne chemical contaminants in adjoining areas. If it appears that contaminants are moving off site, control measures must be reevaluated.

8.2 Physical Hazards

Potential physical hazards that can be readily measured include noise, vibration, and temperature. These must be monitored to prevent illness or injury from overexposure. Most of the instruments used to measure these potential hazards are direct reading, and many have the ability to take both short-term and integrated longer-term measurements. Typically, an initial survey is done wit short-term measurements; these are used to decide whether longer-term (i.e., full shift) monitoring is warranted.

8.3 Radiological Hazards

Sites known or suspected to contain radiological hazards shall be monitored as necessary to ensure that levels do not exceed the limits specified in DOE Order 4380.11 and are as low as reasonably achievable (ALARA). Such monitoring includes airborne radioactivity, external radiation fields, and surface radioactive contamination. The Laboratory's workplace monitoring program is described in AR 3-7 (*Radiation Exposure Control*). The success of this program in controlling worker exposure is measured by the personnel dosimetry and bioassay programs. Chapter 3, Part 7, of the DOE *Radiological Control Manual* provides additional guidelines for radiological control during construction and restoration projects. All monitoring shall be carried out in accordance with approved procedures, and all monitoring instruments shall meet the Laboratory's requirements for sensitivity, calibration, and quality assurance.

8.3.1 Airborne Radioactivity

The air shall be monitored in all occupied areas having a potential for airborne radioactivity. Instruments used may include portable high- and low-volume samplers, continuous air monitors, and personnel breathing-zone samplers. Where concentrations are likely to exceed 10% of any derived air concentration listed in DOE Order 5480.11, air monitoring shall be real-time and continuous. Action levels based on air monitoring results shall be established to increase dust suppression activities, upgrade PPE, and stop work.

8.3.2 External Radiation Fields

Areas will be monitored for external radiation fields with portable survey instruments capable of measuring beta-gamma radiation over a wide range. In areas where radiation is expected to exceed a preset action levels, monitoring should be continuous. Additional action levels shall be established based on external radiation monitoring results.

8.3.3 Surface Contamination

Whenever a new surface is uncovered in an area suspected to be radioactively contaminated (i.e., the levels may exceed the surface contamination limits in DOE Order 4380.11), it will be monitored for surface contamination. Personnel and equipment shall be monitored whenever there is reason to suspect contamination and upon exit from an area suspected to be radioactively contaminated. Action levels for decontamination shall be established.

8.3.4 External Exposure of Personnel

DOE Order 5480.11 requires dosimetry for all OU workers who may, over a 1-yr period, be exposed to external radiation exceeding any of the following:

- 100 mrem (0.001 sievert) effective dose equivalent to the whole body;
- 5 rem (0.05 sievert) dose equivalent to the skin;
- 5 rem (0.05 sievert) dose equivalent to any extremity; and/or
- 1.5 rem (0.015 sievert) dose equivalent to the lens of the eye.

These workers will be monitored by means of thermoluminescent dosimeters (TLDs), provided either by the Laboratory or by the subcontractor (subcontractor TLDs shall meet DOE requirements). (See Section 10 for information on monitoring personnel for internal exposure.)

8.3.5 ALARA Program

To ensure that ALARA levels are maintained in the workplace, near-real-time personnel exposure should be monitored frequently. The ALARA program for the RFIs has two components:

8.3.5.1 Workplace ALARA Efforts

Judicious application of basic time, distance, physical controls, and PPE principles will be used to limit exposures to ALARA levels. To verify that established control is adequate, workplace monitoring for radioactive materials and field instrument detectable chemicals will be conducted in direct proportion to expected and/or observed levels of exposure. Activities that result in unexpectedly high potential exposures will be terminated until provisions are made that permit work to proceed in acceptable ALARA fashion.

8.3.5.2 Programmatic ALARA Efforts

External and internal exposures of record are comprised of TLD badges and bioassay data, respectively. Field dose calculation, direct-reading pocket meters, and event-based lapel air sampling data are used to maintain estimates of personnel exposures to both radioactive materials and hazardous chemicals. These estimates are correlated with job-specific activities (work location and work category) and individual-specific activities (job function).

Periodic reviews of personnel exposure estimates are conducted to identify unfavorable trends and unexpectedly high potential exposures. Activities (as functions of work location, work categories, and job functions) that indicate unfavorable trends will be investigated, and recommendations will be made for additional administrative and/or physical controls, as appropriate.

All unfavorable trends and unexpectedly high potential exposures must be reported to the HSPL, who will make recommendations for corrective action.

9.0 MEDICAL SURVEILLANCE PROGRAM

Medical surveillance is required by 29 CFR 1910.120 for personnel who are or may be exposed to hazardous substances at or above established PELs for 30 days in a 12-month period; for personnel whose duties require the use of respirators; and for personnel having symptoms that may indicate overexposure to hazardous substances.

The Laboratory's ES&H Manual, AR 2-1, specifies medical surveillance for employees who work with asbestos, beryllium, carcinogens, hazardous waste, or lasers; in high-noise environments; or in other circumstances that expose them to health and safety hazards.

The medical surveillance program shall conform with DOE Order 5480.10, OSHA 29 CFR 1910.120, AR 2-1, and any criteria established by the Occupational Medicine Group (HS-2) at the Laboratory. It will include initial medical evaluations to determine fitness for duty, ongoing monitoring, and treatment if required. All RFI field team members shall participate in the program.

Line managers must enroll an employee in the medical surveillance program before the employee begins duties that require medical surveillance, by completing Form 1492, "Hazardous Waste or Emergency Response Worker Surveillance Questionnaire," and sending it to HS-2. An occupational and medical history will be taken and a baseline examination done for each employee, to determine fitness for duty. The examining physician shall provide a report to the OUPL that includes

- approval or disapproval for work on hazardous waste sites,
- approval or disapproval for use of respiratory protective equipment, and
- a statement of work restrictions.

The physician will decide the content and frequency of periodic exams on the basis of site conditions, current and expected exposures, job tasks, and the individual's medical history. The line manager will submit an updated Form 1492 annually as long as the employee continues to work in a hazardous environment and when the employee is reassigned or ceases work in that environment. A final medical examination will be done at termination of duties.

9.1 Certification

In addition to the above medical surveillance requirements, medical certification is required for employees whose work assignments include respirator use, Level A chemical PC, and/or operation of cranes and heavy equipment. Employees become certified and maintain their certification through medical evaluations, as specified by HS-2.

9.2 Treatment

Any employee who is injured on the job, develops signs or symptoms of exposure, or has been exposed at or above PELs in an uncontrolled or emergency situation shall receive immediate medical attention. See Section 12 for detailed information on medical emergencies.

9.3 Contractor and Subcontractor Employees

Contractors and subcontractors are responsible for establishing medical surveillance programs for their workers. They shall provide adequate documentation that their program complies with all applicable standards, DOE orders, and Laboratory requirements. The Health and Safety division will review the documentation; the program must be approved before work begins.

9.4 Recordkeeping

An accurate record of the medical surveillance will be maintained in accordance with 29 CFR 1910.20 and will meet the criteria specified therein.

10.0 BIOASSAY PROGRAM

RFI activities will include intrusion into areas that are highly likely to be contaminated. Because the level of contamination to which workers could be exposed is unknown, the project internal exposure monitoring program is based on the assumption that these levels will be significant, whether of radioactive or hazardous chemical constituents, or both. Whereas the latter are covered by the medical surveillance program, monitoring and control of workers' exposure to radioactive contamination is covered by the project internal dosimetry (or bioassay) program, under the direction of the Health Physics Group (HS-12).

10.1 Baseline Bioassays

Individuals who carryout field activities and those who visit or inspect field activities are assigned one of the following job categories:

I. Work involving full-time on-site activities.
II. Work involving support activities (e.g., supervision or inspection).
III. Work involving routine or frequent visits (e.g., observing, auditing, etc.).
IV. Work involving nonroutine or infrequent visits (e.g., management observations).

Individuals in the first three categories must submit urine samples and undergo whole-body counting before they are permitted on the site. The urine samples provide a baseline for the solubility Class D and Class W compounds that could reasonably be expected to be encountered at the Laboratory, and the whole-body counts for the gamma-emitting radionuclides that could reasonably be expected to be encountered at the Laboratory.

The results of these baseline analyses are evaluated by the health physics specialist for evidence of previous exposure. If any is found, the individual will be permitted to enter OU sites only if his or her further exposure will not result in radiation doses above applicable regulatory limits. This evaluation may include additional, rigorous sampling and/or counting to establish the physical and temporal parameters necessary to adequately assess the committed effective dose equivalent.

10.2 Routine Bioassays

Routine bioassays are done to ensure that respiratory protection is adequate and effective. How often these are done will be decided by the health physics specialist on the basis of the employee's potential for exposure to airborne radioactive materials. If bioassay indicates that respiratory protection is inadequate, the respective field operation(s) will be investigated. The HSPL is responsible for the investigation, for identifying probable causes of the respiratory protection failure, and for recommending corrective actions.

11.0 DECONTAMINATION

11.1 Introduction

Decontamination may be defined as removal or neutralization of contaminants from personnel and equipment. Decontamination is critical to health and safety at hazardous waste sites. If not removed or neutralized, hazardous substances could eventually permeate PC, respiratory equipment, tools, vehicles, and other equipment used on site. They could be carried into clean areas or off the site; and they could become mixed with incompatible chemicals, creating even more hazardous conditions.

All personnel and equipment leaving an exclusion zone will be monitored to verify that they are free of significant contamination.

Personnel are monitored in accordance with Health and Safety Division requirements. If the monitoring indicates chemical, biological, or radioactive contamination, the employee's immediate supervisor shall notify the SSO. The SSO will record the details of the incident, determine whether any injury is involved, initiate decontamination, and, if necessary, notify the OUPL and HSPL. The SSO shall also immediately report the incident, following the Occurrence Reporting Program requirements, so that all appropriate persons or groups are notified promptly and emergency response actions are taken.

The SSO is also responsible for ensuring that tools and equipment are surveyed for contamination, and decontaminated if necessary, before they are removed from the site or released for unrestricted use.

11.2 Site Decontamination Plan

A decontamination plan is mandatory for each site, as part of the SSHSP. The plan must include

- the number and location of decontamination stations,
- the decontamination methods to be used,
- the decontamination equipment needed,
- procedures for preventing contamination of clean areas,
- methods and procedures for removing contaminated PC in a way that minimizes contact with contaminants, and
- methods for disposing of clothing and equipment that cannot be completely decontaminated.

The plan should be revised whenever the type of personal PC or equipment changes, site conditions change, or site hazards are re-assessed on the basis of new information. The SSO is responsible for enforcement of the plan.

11.3 Decontamination Stations

11.3.1 Personnel

The SSO will verify that decontamination stations are maintained in acceptable condition and that decontaminating agents, equipment, and other materials—including showers and clean work clothing—are adequately supplied. When necessary, stations will contain an area where Health and Safety Division personnel can assist in decontaminating individuals. All wash solutions shall be disposed of appropriately. The integrity of clean areas shall be carefully maintained.

11.3.2 Emergency Personnel Decontamination Facilities

Emergency shower facilities, capable of serving at least two individuals at a time, shall be available for initial decontamination of persons who have become contaminated with highly caustic, strongly acidic, and/or highly radioactive materials (100 mrad/hour). Appropriate medical and radiation safety personnel assist in decontamination as needed. Emergency decontamination facilities shall meet, and be used in accordance with, Health and Safety Division requirements.

11.4 Decontamination Methods

Specific decontamination methods will be determined individually for each site. Cost, availability, and ease of implementation will influence the choice of method, but the primary determinants are (1) effectiveness for the specific substances involved and (2) lowest possible level of health or safety risk from the method itself. Typical methods are removal and inactivation.

Removal

- Contaminant removal
  - Water rinse (pressurized or gravity-flow)
  - Chemical leaching and extraction
  - Evaporation/vaporization
  - Pressurized air
  - Scrubbing/scraping (using brushes, scrapers, or sponges and water-compatible solvent cleaners)
  - Pressurized steam
- Removal of contaminated surfaces
  - Disposal of deeply permeated materials, e.g., clothing, floor mats, and seats)
  - Disposal of protective coverings/coatings

Inactivation

- Chemical detoxification
  - Halogen stripping
  - Neutralization
  - Oxidation/reduction

- Thermal degradation
- Disinfection/sterilization
  - Chemical disinfection
  - Dry heat sterilization
  - Gas/vapor sterilization
  - Irradiation
  - Steam sterilization

11.4.1 Physical Removal

The preferred ways of physically removing gross contamination are rinsing, scrubbing or scraping/wiping off, and evaporation. Rinsing removes contaminants through dilution, physical attraction, and solubilization. Continuous rinsing with a large volume of solution is the most effective method, but multiple rinses with clean solution is more effective than a single rinse of the same total volume. Methods involving high pressure and/or heat (pressurized air, steam) should be used only when necessary and with caution, because they can spread contamination and cause burns. Loose contaminants, many kinds of adhering contaminants, and volatile liquids can be removed by physical means.

- **Loose contaminants.** Dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of clothing fabrics, can be removed with water or a liquid rinse. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with antistatic solutions (available commercially as wash additives or antistatic sprays).
- **Adhering contaminants.** Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and with temperature. Contaminants such as glues, cements, resins, and muds have much greater adhesive properties than elemental mercury; these are difficult to remove by physical means such as scraping, brushing, and wiping. In many cases, removal can be enhanced through solidification—either moisture removal (adsorption or absorption, using powdered lime, ground clay, cat litter, etc.), freezing (e.g., dry ice or ice water), or chemical reaction (polymerization catalysts and chemical reagents).
- **Volatile liquids.** Volatile liquid contaminants can be removed from PC or equipment by evaporation (which can be enhanced with steam jets) followed by a water rinse. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

11.4.2 Chemical Removal

Physical removal of gross contamination should be followed by washing or rinsing with a chemical cleaning solution. These solutions typically employ either solvents or surfactants.

Solvent-based cleaners dissolve surface contaminants. It is important that the solvent be chemically compatible with the equipment being cleaned, especially in the case of personnel PC. Some organic solvents are flammable or potentially toxic.

Halogenated solvents are generally incompatible with PPE and are toxic. They should be used for decontamination only in extreme cases, when other cleaning agents will not remove the contaminant.

Care must always be taken in using flammable or toxic solvents, as well as in disposing of them.

Table III-9 provides a general guide to the solubility of several contaminants in four types of solvents: water, dilute acids, dilute bases, and organic solvents. Because of the potential hazards, decontamination using chemicals should only be performed if recommended by an industrial hygienist or other qualified health professional.

TABLE III-9
GENERAL GUIDE TO CONTAMINANT SOLUBILITY

Solvent	Soluble Contaminants
Water	Low-chain hydrocarbons, inorganic compounds, salts, some organic acids and other polar compounds
Dilute acids	Basic (caustic) compounds, amines, hydrazines
Dilute bases —detergent —soap	Acidic compounds, phenols, thiols, some nitro and sulfonic compounds
Organic solvents[a] —alcohols —ethers —ketones —aromatics — straight-chain alkanes (e.g., hexane) —common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)

[a]WARNING: Some organic solvents can permeate and/or degrade the PC.

Surfactants, such as household detergents, augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned and by preventing redeposit of the contaminants. Some detergents can be used with organic solvents to hasten the dissolution of contaminants and their dispersal into the solvent.

Chemical disinfectants are a practical means of inactivating infectious agents. Because standard sterilization techniques are generally impractical for large equipment and for personal PC, however, disposable PPE is recommended for workers who may come into contact with infectious agents.

The effectiveness of chemical decontamination should be checked by random sampling and analysis of the final rinse solution.

11.2 Personnel

All personnel leaving the exclusion zone of a site must be decontaminated to remove any harmful chemicals or infectious organisms that may have adhered to them. Decontamination methods either (1) physically remove contaminants, (2) inactivate contaminants by chemical detoxification or disinfection/sterilization, or (3) remove contaminants by a combination of both physical and chemical means.

The SSO is responsible for enforcing the decontamination plan.

11.2.1 Radiological Decontamination

Persons leaving any area in which they could have become contaminated from radioactivity (including radiological buffer areas established for contamination control be excluding areas containing only radionuclides such as tritium, that cannot be detected using hand-held or automatic frisking equipment) shall frisk for contamination.

The frisking equipment used should be capable, under laboratory conditions, of detecting total contamination at least to the values specified in Table III-10. Automatic monitoring units that meet this requirement are recommended.

If contamination (other than noble gases or natural background radioactivit is detected on the skin or clothing of any individual, that individual should be promptly decontaminated.

11.3.3 Equipment

Before being allowed off site, tools and equipment contaminated with removable radioactive and chemical materials will be decontaminated at the field location. Any that cannot be adequately field-decontaminated (to below applicable limits) may, with the approval of the HSPL, be appropriately packaged and removed to a decontamination facility.

11.4.3.2 Equipment

Contaminated tools, equipment, and materials (i.e., those having removal or total radioactivity above the levels in Table III-10) must be decontaminated in accordance with approved procedures. Any item that cannot be decontaminated promptly shall be posted as specified in AR 3-7.

Radiological Work Permits and technical work documents shall include provisions to control contamination at the source, to minimize the amount of decontaminated needed; ????

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TABLE III-10
MINIMUM REQUIRED DETECTION LIMITS[a] FOR RADIONUCLIDES

Nuclide	Removable (dpm/100 cm^2)[b,c]	Total (fixed + removable) (dpm/100 cm^2)
Natural uranium, uranium-235, uranium-238, and associated decay products	1 000 alpha	5 000 alpha
Transuranics, radium-226, radium-228, thorium-230, thorium-228, protactinium-231, actinium-227, iodine-125, and iodine-129	20	500
Natural thorium, thorium-232, strontium-90, radium-223, radium-224, uranium-232, iodine-126, iodine-131, and iodine-133	200	1 000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except strontium-90 and others noted above. Includes mixed fission products containing strontium-90	1 000 beta-gamma	5 000 beta-gamma
Tritium organic compounds, surfaces contaminated by HT, HTO, and metal tritide aerosols	10 000	10 000

[a]The limits in this table apply to radioactive contamination deposited on but not incorporated into the interior of the contaminated item. Where contamination by both alpha-and beta-gamma-emitting nuclides exists, the limit established for each applies independently.

[b]Direct scan surveys are used to measure total residual contamination levels. If they are below the values for removable contamination, decontamination is not required (except in the case of transuranics, radium-228, actinium-227, thorium-228, thorium-230, protactinium-231, and alpha emitters. If they exceed these values, the amount of removable material per 100 cm^2 of surface area is determined by swiping the area with dry filter or soft absorbent paper, using moderate pressure, and measuring the radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface is swiped (the activity per unit area is based on the actual surface area).

[c]The levels may be averaged over 1 m^2 if the maximum activity in the area of 100 cm^2 is less than three times the guide values.

11.3.4 Chemical

Chemical decontamination is performed in accordance with the product labels. Random sampling and analysis of final rinse solutions may be performed to check the effectiveness of the decontamination procedures.

11.4 Waste Management

Fluids and materials resulting from decontamination processes will be contained, sampled, and analyzed for contaminants. Those materials determined to be contaminated in excess of appropriate limits are packaged in approved containers and disposed of in accordance with EM Division procedures.

12.0 EMERGENCIES

12.1 Introduction

Emergency response, as defined by OSHA regulation 29CFR 1910.120, will be handled by Laboratory personnel. ER contractors are responsible for developing and implementing their own emergency action plans as defined in OSHA regulation 29CFR 1910.38a.

12.2 Emergency Action Plan

An emergency action plan provides emergency information for contingencies that may arise during the course of field operations. It provides site personnel with instructions in the appropriate sequence of responses in the event of either site emergencies or nonsite emergencies. The following elements, at a minimum, shall be included in the written plan:

- emergency escape procedures and emergency escape routes;
- procedures to be followed by personnel who remain to operate critical equipment before they evacuate;
- procedures to account for all employees after evacuation;
- rescue and medical duties for those who are to perform them;
- names of those who can be contacted for additional information on this plan;
- alarm system that complies with 1910.165;
- types of evacuation to be used;
- training to assist in evacuation;
- dissemination of emergency action plan to employees initially, whenever the plan changes; and
- agreement with local medical facilities to treat injuries/illnesses.

12.3 Emergency Response Plan

This section describes the emergency response plan, contingency plans for specific types of emergencies, actions required by the Laboratory in the event of a release of radioactive and/or toxic materials, and requirements for notification and documentation of emergencies. Additional references for this section include Laboratory AR 1-1, Accident/Incident Reporting; AR 1-2, Emergency Preparedness; AR 1-8, Working Alone; and TB 101, Emergency Preparedness.

The SSO, with assistance from the field team leader, will have the responsibility and authority for coordinating all emergency response activities until the proper authorities arrive and assume control. A copy of the emergency response plan will be available at the site at all times, and all personnel working at the site will be familiar with the plan.

The following sections describe the elements of the emergency response plan for this OU. The detailed plan will be part of the SSHSP.

12.3.1 Emergency Contacts

The names of persons and services to contact in case of emergency will be provided in the SSHSPs. This emergency contact form will be completed by the SSO before field work begins and will be copied and posted at the site in prominent locations. Two-way radio communication will be maintained at remote sites when possible.

12.3.2 Site Map

A copy of the site map will be modified to indicate the following areas of importance in the emergency response plan:

- hazardous areas (especially potential IDLH atmospheres);
- site terrain (topography, buildings, barriers);
- site accessibility by road and air (indicating current detours);
- work zones/work crew locations;
- surrounding population/environment;
- shelters and muster areas; and
- evacuation routes.

Current maps of evacuation and emergency facilities will be included in the SSHSPs and will be posted on-site at conspicuous locations.

12.3.3 Site Security and Control

In an emergency, the field team leader (or a designee) is responsible for controlling the entry of personnel into hazardous areas and accounting for all individuals on-site. Depending on the nature and size of the area, a checkpoint will be established in advance for control. The buddy system will remain in effect at all times for personnel working on-site. If a security problem occurs, one short blast will be sounded from an air horn, and field team members will remain in place to await instructions from security.

12.3.4 Communications

Internal communication refers to communication between field team members. The objectives of internal communication are to alert workers to danger, convey safety information, and maintain site control. Routine communications will depend on the area represented by the work zones and the tasks associated with that area. Where there is substantial distance between the workers providing support and the workers conducting sampling activities, two-way radio communication will be employed. A set of predetermined hand signals will be used if radio communication fails. This contingency is especially important for workers wearing Levels A, B, and C protective equipment.

Emergency communication will also be established for the site. Three long blasts from an air horn will notify field team members of the following conditions:

- major fire,
- major release of hazardous substances,
- minor fire or release, or
- security problem.

A description of all signals will be posted at the site in a prominent location.

External communication will be necessary to request assistance or to notify the appropriate authorities about hazardous conditions that may impact public or environmental safety. The names and phone numbers of appropriate contacts will be posted in a prominent location. A cellular telephone will be available on-site. All site personnel must be informed of its location.

Communication protocols will be explained at the daily tailgate safety meetings and reviewed at least once a week for the duration of sampling activities.

12.3.5 Evacuation Routes and Procedures

If a fire, explosion, or release of potentially hazardous materials occurs, field team members may need to retreat to a muster area or evacuate the site. Procedures for evacuation will depend on the nature and size of the area under investigation. Field team members will assemble at a predesignated muster site if an evacuation is necessary.

If the area is relatively small and/or unconstrained, field team members will be able to exit the exclusion zone at the most convenient point, preferably in the upwind direction. Areas that are expected to be safe will be indicated on the site map. At sites in which a relatively large exclusion zone exists or in areas that are constrained in some way (e.g., surrounded by a fence, located within a trench, bordered by steep cliffs), evacuation routes will be established in advance and illustrated on the site map. In either case, all field team members will report to a designated checkpoint to be accounted for by the field team leader. All field team members will be informed of the evacuation procedures.

12.3.6 Emergency Equipment and Supplies

The SSO (or designee) will be responsible for maintaining emergency equipment and for restocking supplies. The type and amount of emergency equipment will be selected on the basis of the potential hazards.

12.4 Specific Emergencies

12.4.1 Fire/Explosion

For fires or explosions, evacuation will be signaled by three long blasts. Field team members will report to a specified location (such as evacuation vehicles) and proceed away from the fire. Field team members will meet and be counted at a designated muster area. One individual will locate the nearest phone at a safe distance and call the Los Alamos County Fire Department at 911. If an explosion occurs, all personnel will be evacuated and no one will re-enter the work area until it has been cleared by Laboratory explosives safety personnel.

12.4.2 Radiation/Chemical Exposures

A release of potentially hazardous materials will be indicated by three long blasts. All personnel will assemble at the designated muster area and be counted by the field team leader (or a designee). The SSO will issue further instructions.

Three long blasts will alert field team members to a major release involving hazardous or radioactive materials. Field team members will meet at a predetermined muster area on the basis of wind direction. A portable wind sock or streamer will be positioned at each site. If the source of the release is directly upwind, field team members will move to the exit and away from the plume. Once the team achieves a safe distance, the field team leader and SSO will account for all site personnel. The SSO will determine a further course of action.

Exposure to radiation and/or chemicals will be reported to the Laboratory's Occupational Medicine Group HS-2. The Los Alamos County Medical Center will be notified of life-threatening or serious exposures.

12.4.3 Injuries

Trained personnel may treat minor injuries on-site. Seriously injured victims will be transported to a medical facility as soon as possible. The Los Alamos County Fire Department provides emergency transport services.

If an injured person has been contaminated with chemicals, decontamination will be performed only if it will not aggravate the injury. Section 11 discusses emergency decontamination.

12.4.4 Vehicle Accidents/Property Damage

In addition to the required police report, a vehicle accident report must be filed in accordance with DOE. These requirements are described in Section 10.4. Injuries incurred in an accident will be treated in the manner described in Section 11.0.

12.5 Provisions for Public Health and Safety

Emergency planning is presented in the Laboratory's ES&H Manual (LANL 1990, 0335). The Laboratory identifies four situations in which hazardous materials may be released into the environment. These categories are founded in part on Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association and on the basis of the maximum concentration of toxic material that can be tolerated for up to 1 hour.

The types of emergencies are defined as follows:

- **Unusual Event**. An event that has occurred or is in progress that normally would not be considered an emergency but that could reduce the safety of the facility. No potential exists for significant releases of radioactive or toxic materials off-site.

- **Site Alert**. An event that has occurred or is in progress that would substantially reduce the safety level of the facility. Off-site releases of toxic materials are not expected to exceed the concentrations defined in ERPG-1.

- **Site Emergency**. An event that has occurred or is in progress that involves actual or likely major failures of facility functions necessary for the protection of human health and the environment. Releases of toxic materials to areas off-site may exceed the concentrations described in ERPG-2.

- **General Emergency**. An event that has occurred or is in progress that substantially interferes with the functioning of facility safety systems. Releases of radioactive materials to areas off-site may exceed protective response recommendations, and toxic materials may exceed ERPG-3.

12.6 Notification Requirements

Field team members will notify the SSO of emergency situations, who will notify the appropriate emergency assistance personnel (e.g., fire, police, and ambulance), the OUPL, the HSPL, the Laboratory Health and Safety Division Office according to DOE Order 5500.2 (DOE 1991, 0736), and DOE Albuquerque Operations Office (AL) Order 5000.3 (DOE/AL 1991, 0734). The Laboratory Health and Safety Division Office is responsible for implementing notification and reporting requirements according to DOE Order 5484.1 (DOE 1990, 0773).

12.7 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental, safety, or health protection significance. Examples of unusual occurrences include any substantial degradation of a barrier designed to contain radioactive or toxic materials or any substantial release of radioactive or toxic materials.

The Laboratory principal investigator will submit a completed DOE Form F 5484.X for any of the following accidents and incidents, according to Laboratory AR 1-1:

- **Occupational Injury**. An injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment. Note: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.

- **Occupational Illness**. Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- **Property Damage Losses of $1,000 or More**. Regardless of fault, accidents that cause damage to DOE property or accidents wherein DOE may be liable for damage to a second party are reportable where damage is $1,000 or more including damage to facilities, inventories, equipment, and properly parked motor vehicles but excluding damage resulting from a DOE-reported vehicle accident.

- **Government Motor-Vehicle Accidents With Damages of $150 or More or Involving an Injury.** Unless the government vehicle is not at fault or the occupants are uninjured. Accidents are also reportable to DOE if:

  - damage to a government vehicle not properly parked is greater than or equal to $250;
  - damage to DOE property is greater than or equal to $500, and the driver of a government vehicle is at fault;
  - damage to any private property or vehicle is greater than or equal to $250, and the driver of a government vehicle is at fault; or
  - any person is injured, and the driver of a government vehicle is at fault.

The HSPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the appropriate Laboratory group, as required by DOE orders. The reports are as follows:

- DOE-AL Order 5000.3 (DOE 1990, 0253), Unusual Occurrence Reporting
- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.5, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.6, Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1 (DOE 1990, 0733)
- DOE Form EV-102A, Summary of DOE and DOE Contractor Occupational Injuries and Illnesses, Attachment 8, DOE Order 5484.1 (DOE 1990, 0773)
- DOE Form F5821.1, Radioactive effluent/onsite discharges/unplanned releases; Attachment 12, DOE Order 5484.1 (DOE 1990, 0773)

Copies of these reports will be stored with the appropriate Laboratory group. Specific reporting responsibilities are given in Chapter 1, General ARs, of the Laboratory ES&H Manual (LANL 1990, 0335).

13.0 PERSONNEL TRAINING

13.1 GET and Site Orientation

All Laboratory employees and contractors must successfully complete Laboratory general employee training (GET). GET training is performed by the Health and Safety Division and is offered weekly. The OUPL is responsible for scheduling GET training for contractors.

13.2 Visitors

Visitors to the site shall receive a safety briefing by the SSO. Visitors should not be permitted in the exclusion zone unless they have been trained, fit-tested, and medically approved for respirator use. Other visitors may not enter the exclusion zone. They may observe site conditions from the clean area, using binoculars for example.

13.3 OSHA Requirements

OSHA's HAZWOPER standard (29 CFR 1910.120) regulates the health and safety of employees involved in hazardous waste operations. This standard requires training commensurate with the level and function of the employee. Persons shall not participate in field activities until they have been trained to a level required by their job function and responsibility. The SSO is responsible for ensuring that all persons entering the exclusion zone are properly trained.

13.3.1 Pre-Assignment Training

At the time of job assignment, all general site workers shall receive a minimum of 40 hours of initial instruction off-site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Occasional site workers shall receive a minimum of 24 hours of initial instruction. Workers who may be exposed to unique or special hazards shall be provided additional training. The level of training provided shall be consistent with the employee's job function and responsibilities.

13.3.2 On-Site Management and Supervisors

On-site management and supervisors directly responsible for or who supervise employees engaged in hazardous waste operations shall receive training as provided in Section 13.3.1 and at least 8 hours of specialized training on managing such operations at the time of job assignment.

13.3.3 Annual Refresher

All persons identified in Sections 13.3.1 and 13.3.2 shall receive 8 hours of refresher training annually.

13.3.4 Emergency Response Personnel

Persons responsible for responding to hazardous emergency situations that may expose them to hazardous substances shall be trained on how to respond to expected emergencies.

TABLE III-10
TRAINING TOPICS

Initial site-specific	Weekly	Periodic as warranted	
X		X	Site Health and Safety Plan, 29 CFR 1910.120(e)(1)
X		X	Site Characterization and Analysis, 29 CFR 1910.120(i)
X		X	Chemical Hazards, Table 1
X		X	Physical Hazards, Table 2
X		X	Medical Surveillance Requirements, 29 CFR 1910.120(f)
X	X		Symptoms of Overexposure to Hazards, 29 CFR 1910.120(e)(1)(vi)
X		X	Site Control, 29 CFR 1910.120(d)
X		X	Training Requirements, 29 CFR 1910.120(e)
X	X	X	Engineering and Work Practice Controls, 29 CFR 1910.120(g)
X	X	X	Personal Protective Equipment, 29 CFR 1910.120(g), 29 CFR 1910.134
X	X	X	Respiratory Protection, 29 CFR 1910.120(g), 29 CFR 1910.134, ANSI Z88.2-1980
X		X	Overhead and Underground Utilities
X	X	X	Scaffolding, 29 CFR 1910.28(a)
X	X		Heavy Machinery Safety
X		X	Forklifts, 29 CFR 1910.27(d)
X		X	Tools
X		X	Backhoes, Front End Loaders
X		X	Other Equipment Used at Site
X		X	Pressurized Gas Cylinders, 29 CFR 1910.101(b)
X	X	X	Decontamination, 29 CFR 1910.120(k)
X		X	Air Monitoring, 29 CFR 1910.120(h)
X		X	Emergency Response Plan, 29 CFR 1910.120(l)
X	X		Handling Drums and Other Containers, 29 CFR 1910.120(j)
X		X	Radioactive Wastes
X		X	Explosive Wastes
X		X	Shock Sensitive Wastes
X		X	Flammable Wastes
X	X	X	Confined Space Entry
X			Illumination, 29 CFR 1910.120(m)
X	X	X	Buddy System, 29 CFR 1910.120(a)
X		X	Heat and Cold Stress
X		X	Animal and Insect Bites

13.3.5 Site-Specific Training

Prior to granting site access, personnel must be given site-specific training. Attendance and understanding of the site-specific training must be documented. A weekly health and safety briefing and periodic training (as warranted) will be given. Training should include the topics indicated in Table 13.1 in accordance with 29 CFR 1910.120 (i)(2)(ii).

13.4 Radiation Safety Training

Basic radiation worker training is required for all employees (radiation workers) (1) whose job assignments involve operation of radiation-producing devices, (2) who work with radioactive materials, (3) who are likely to be routinely occupationally exposed above 0.1 rem (0.001 sievert) per year, or (4) who require unescorted entry into a radiological area. This training is a 4-hour extension to GET for new employees.

Radiation protection training is required for all Laboratory employees, contractors, visiting scientists, and DOE and Department of Defense personnel. This is a 1-hour presentation as part of GET.

13.5 Hazard Communication

Laboratory employees shall be trained in accordance with Health and Safety Division requirements. Contractors shall provide training to their employees in compliance with OSHA 29 CFR 1910.120.

13.6 High Explosives Training

At PRSs where high explosives are known or suspected to be present, additional safety training may be required.

13.7 Site-Specific Training

Site-specific training will be provided to all personnel working at the site. Daily tailgate safety meetings will be used to update workers about changes in the OUHSP and to reinforce knowledge of safe work practices.

13.8 Records

Records of training shall be maintained by the Health and Safety Division and in the project file to confirm that every person assigned to a task has had adequate training for that task and that every employee's training is up-to-date. The SSO or his designee is responsible for ensuring that persons entering the site are properly trained.

Site access will be controlled such that only verified team members and previously approved visitors will be allowed in work areas or areas containing potentially hazardous materials or conditions. Special passes or badges may be issued. There are two types of visitors: those that collect samples and those who do not.

Any visitors who are on-site to collect samples or split samples must meet all the health and safety requirements of any field sampling team for that site. Visitors must comply with the provisions of the SSHSP and sign an acknowledgment agreement to that effect. In addition, visitors will be expected to comply with relevant OSHA requirements, such as medical monitoring, training, and respiratory protection.

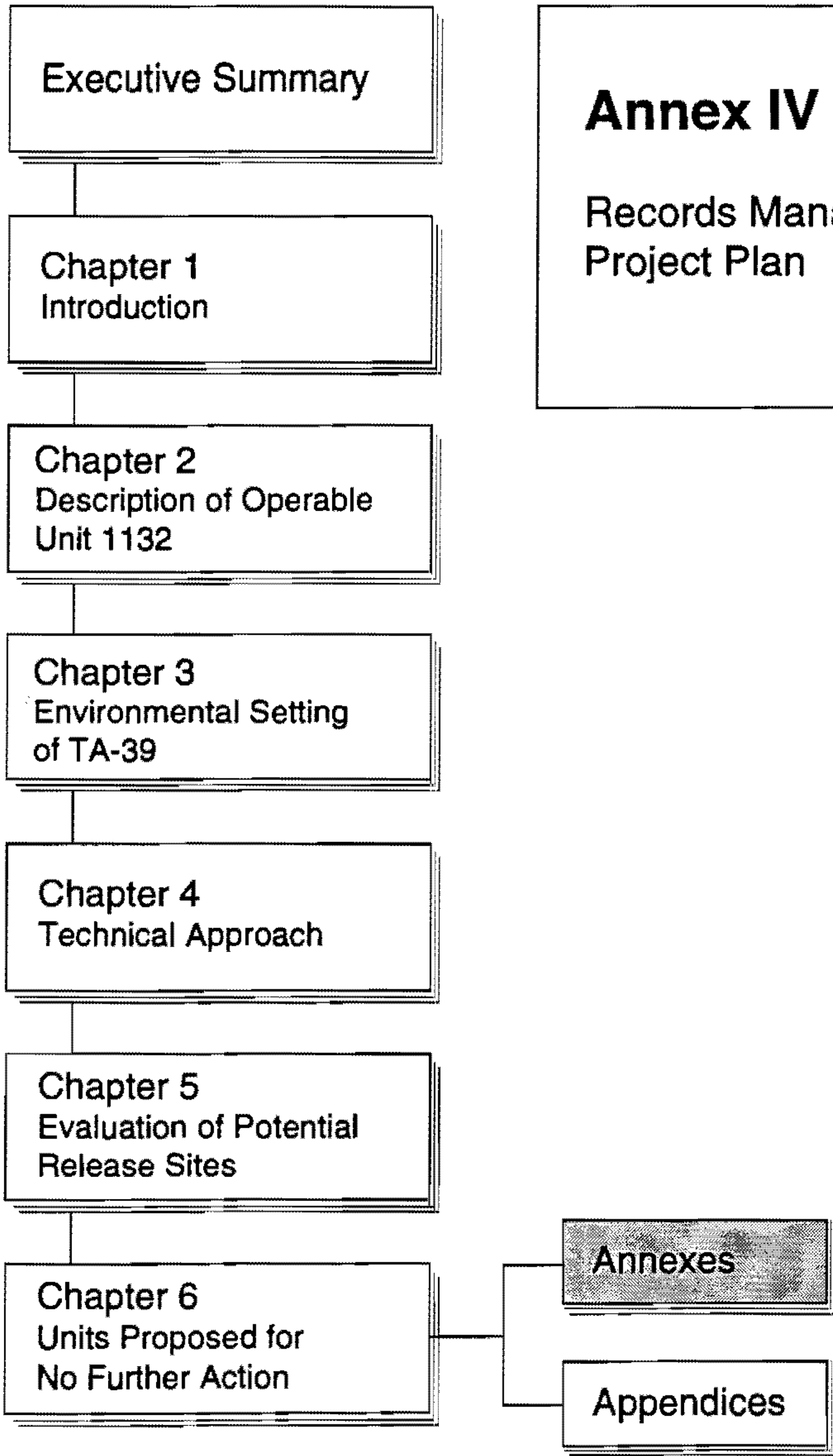
The following rules govern the conduct of site visitors who will not be collecting samples. The site visitor will:

- Report to the SSO upon arrival at the site.
- Login/out upon entry/exit to the site.
- Receive abbreviated site training from the SSO on the following topics:
- site-specific hazards,
- site protocol,
- emergency response actions, and
- muster areas.
- Not be permitted to enter the exclusion zone.
- Receive escort from SSO or other trained individuals at all times.

If a visitor does not adhere to these requirements, the SSO will request the visitor to leave the site. All nonconformance incidents will be recorded on the site log.

Annex IV

Records Management Project Plan



This work plan will follow the records management program plan provided in Annex IV of Revision 2 of the Installation Work Plan (LANL 1992, 0768). (This sentence is the complete text of Annex IV.)

References for Annex IV

LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration," Revision 2, Los Alamos National Laboratory Report LA-UR-92-3795, Los Alamos, New Mexico. (LANL 1992, 0768)

Annex V

Community Relations Project Plan

Executive Summary

Chapter 1
Introduction

Chapter 2
Description of Operable Unit 1132

Chapter 3
Environmental Setting of TA-39

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Units Proposed for No Further Action

Annexes

Appendices

This work plan will follow the community relations program plan provided in Annex V of Revision 2 of the Installation Work Plan (LANL 1992, 0768). The ER Program's public reading room is located at 1450 Central Avenue, Suite 101, Los Alamos, New Mexico. The community relations project leader can be reached at (505) 665-5000 for additional information. (This paragraph is the complete text of Annex V.)

References for Annex V

LANL (Los Alamos National Laboratory), November 1992. "Installation Work Plan for Environmental Restoration," Revision 2, Los Alamos National Laboratory Report LA-UR-92-3795, Los Alamos, New Mexico. (LANL 1992, 0768)

Appendix A

Engineering Drawings and SOPs

Executive Summary

Chapter 1
Introduction

Chapter 2
Description of Operable Unit 1132

Chapter 3
Environmental Setting of TA-39

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Sites

Chapter 6
Units Proposed for No Further Action

Annexes

Appendices

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO G. Gould, MEE-4, MS G787

DATE November 16, 1992

FROM W. Francis

MAIL STOP/TELEPHONE J495/7-3331

SYMBOL EES15-92-642

SUBJECT **LIST OF DRAWINGS REVIEWED TO OBTAIN INFORMATION ABOUT THE SOLID WASTE MANAGEMENT UNITS AT TA-39**

The following lists of drawings are categorized by Architext/Engineer and were used by me to locate and write a short history for each Solid Waste Management Unit at TA-39.

1. Holmes & Narver
   Title - Pulsed Power Assembly Building
   Lab Job - 8604-39

A/E Drawing No.	LANL Drawing No.
G-1 Sheet 1 of 13	Eng-C 45527
C-1 Sheet 2 of 13	

2. The Zia Company
   a. Title - Separation of Film Processing Water and Domestic Sewage - Bldg. 2, TA-39
   Lab Job - None

A/E Drawing No.	LANL Drawing No.
Z-4504 Sheet 1 of 1	None

   b. Title - Tech Area Septic Tank Improvements
   Lab Job - None

A/E Drawing No.	LANL Drawing No.
Z-4504 1B	None

3. W. F. Turney & Associates
   Title - TA-39, Ancho Canyon Site - Seepage Pit Detail and Sewage System Improvements
   Lab Job - None

A/E Drawing No.	LANL Drawing No.
LA-MY-M14 Sheet 16 of 18	None
LA-MY-M15 Sheet 17 of 18	None

4. Max Flato - Jason Moore
   Title - Buildings and Facilities, TA-39, Project-A
   Lab Job - 776

A/E Drawing No.	LANL Drawing No.
LA-1 - 1/2 Sheet 2 of 73	Eng-C 11058

G. Gould -2- November 17, 1992
EES15-92-642

5. Pan American World Services, Inc.
   Title - Utilities - Sewer System, TA-39
   Lab Job - None
   A/E Drawing No. — LANL Drawing No.
   R-8008 SE-47 — None

6. Los Alamos Scientific Laboratory
   A. Title - Material Waste Area, Area Y, TA-39
      Lab Job - 1757
      Drawing No. — Sheet No.
      Eng-R3562 — 1 of 1
      Eng-R4480
   B. Title - Light Gas Gun Facility
      Lab Job - 3438-39
      Drawing No. — Sheet No.
      Eng-C31691 — 1 of 1
      Eng-C36117 — 1 of 2
      Eng-C36162 — 4 of 14
   C. Title - Buildings and Facilities, TA-39
      Lab Job - 776
      Drawing No. — Sheet No.
      Eng-C11113 thru C11129 — 57 thru 73
   D. Title - Storage Area Remodeling, Bldg. AC-2
      Lab Job - 5553-39
      Drawing No. — Sheet No.
      Eng-C42895 — 1 of 7
   E. Parking Area and Drainage Improvements, TA-39
      Lab Job - 3672-39 (?)
      Drawing No. — Sheet No.
      Eng-C35524 (?) — 1 of 2
   F. Utility Location Plan, TA-39
      Lab Job - 1438
      Drawing No. — Sheet No.
      Eng-R1423 thru R1437 — 1 thru 15

7. Los Alamos National Laboratory
   Title - Structure Location Plan, TA-39
   Lab Job - None
   Drawing No. — Sheet No.
   Eng-R5120 (10/28/83) — 2 of 2
   Eng-R5120 (07/25/89) — 1 thru 5

WCF:lb

cy: Bill Wheat, MEE-4, MS G787
    Brad Wilcox, EES-15, MS J495

LIST OF ER PROGRAM SOPs TO BE USED IN PHASE I RFI AT OU 1132

SOP-01.01	General Instructions for Field Investigations
SOP-01.02	Sample Containers and Preservation
SOP-01.03	Handling, Packaging, and Shipping of Samples
SOP-01.04	Sample Control and Field Documentation
SOP-01.05	Field Quality Control Samples
SOP-01.06	Management of RFI-Generated Wastes
SOP-02.07	General Equipment Decontamination
SOP-02.17	Near Surface and Soil Sample Screening for Low-Energy Gamma Radiation Using the FIDLER
SOP-03.02	General Surface Geophysics
SOP-03.08	Geomorphic Characterization
SOP-04.01	Drilling Methods and Drill Site Management
SOP-04.02	Excavating Methods
SOP-04.03	Test Pit Logging, Mapping and Sampling
SOP-04.04	General Borehole Logging
SOP-05.01	Monitor Well Construction
SOP-05.02	Well Development
SOP-06.01	Pumping of Wells for Representative Sampling of Groundwater
SOP-06.03	Sampling for Volatile Organics
SOP-06.07	Soil Moisture Measurement
SOP-06.09	Spade and Scoop Method for Collection of Soil Samples
SOP-06.10	Hand Auger and Thin-Wall Tube Sampler
SOP-06.11	Stainless Steel Surface Soil Sampler
SOP-09.03	Operation of the Siemens X-Ray Diffractometer
SOP-09.04	Calibration and Alignment of the Siemens Diffractometer
SOP-09.05	Clay Mineral Separation for X-Ray Diffraction Analysis
SOP-10.01	Screening for PCBs in Soil
SOP-10.04	Total Alpha Surface Contamination Measurements
SOP-10.05	Screening Soil Samples for Alpha Emitters
SOP-11.01	Measurement of Bulk Density, Dry Density, Water Content, and Porosity in Soil
SOP-11.02	Particle-Size Distribution of Soil/Rock Samples
SOP-11.04	Soil and Core pH
SOP-11.05	Total Organic Carbon
SOP-11.06	Cation Exchange Capacity
SOP-12.01	Field Logging, Handling, and Documenting Borehole Materials
SOP-12.02	Transport and Receipt of Borehole Sampling by the Curatorial Management Facility
SOP-TBW	Detecting High Explosives with the LANL M-1 Explosives Test Kit
SOP-TBW	Detecting Combustible Gases
SOP-TBW	Beta-Gamma Radiation Measurements Using a Geiger-Mueller Detector (Micro-R Meter)
SOP-TBW	Preparation of Soil Samples for Analysis

Appendix B

Field Sampling Protocols

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 sample collection, field surveys, field screening, or equipment decontamination. LANL ER-SOPs to be followed for this field investigation are listed in Appendix A. (See *Environmental Restoration Standard Operating Procedures* [LANL 1991, 0411] for the complete text of these SOPs.) All field teams should follow the general instructions found in ER SOP-01.01. All sampling and analysis operations carried out will be covered by an approved SOP.

1.1 Health and Safety

Annex III presents the Health and Safety Plan for all field activities at TA-39. The plan gives OU-specific information on known and/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 described in Section 2.2 below, *Field Screening*, will be used. In particular, each sample or sampling location will be monitored for gross alpha and for gross beta-gamma radiation. In addition, during sampling of Aggregates 1 and 4, the air in the open borehole will be monitored routinely for organic vapors and combustible gases. Certain samples from all aggregates may be screened for HE.

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. The Laboratory's ES&H Questionnaire process will guide the evaluations, and depending on the results, a DOE Environmental checklist for either categorical exclusion or environmental assessment will be completed. (See Chapters 3 and 4.)

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, surveying locations of sampling points and drill holes; laying protective pads for large sampling equipment; laying down gravel mulch; excavating with backhoes and front-end loaders; excavating sampling plots; drilling cores; moving pallets of containerized contaminants (e.g., from auger cuttings and decontamination solutions); and setting up signs and warning notices around the perimeter of the work area.

1.4 Excavation Permits

The Laboratory requires that a permit be obtained for any excavation or drilling deeper than 12 in. 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. The acquisition procedure includes clearly marking in the field each area designated for excavation or drilling.

1.5 Sample Control, Documentation, and Coordination

Guidelines for sample handling (packaging, chain of custody, documentation, etc.) are discussed in the Generic Quality Assurance Project Plan (QAPjP) (LANL 1991, 0412), Sections 6.0 and 7.0. These activities are conducted according to SOP-01.03 and SOP-01.04. Guidance on appropriate sample containers and preservation techniques is given in SOP-01.02.

The ER Program has established a Sample Coordination Facility in EM-9 to ensure consistency for all investigations. The system is described in the Generic QAPjP (LANL 1991, 0412).

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 the QAPjP and detailed in SOP-01.05.

1.7 Equipment Decontamination

Decontamination is a quality assurance (good scientific practices) measure and a safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for personnel. Equipment may be decontaminated at the site or at special decontamination facilities. Smaller items, such as sampling tools, are decontaminated by washing, rinsing, and drying; larger equipment, such as 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 collected and transferred to the liquid waste treatment plant where they are processed for disposal (See Sec. 1.8, below). Decontamination procedures are described in SOP-02.07.

1.8 Waste Management

Wastes produced during sampling may include 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 containers). Any of the following waste categories may be encountered at TA-39: hazardous waste, low-level radioactive waste, and mixed waste. Requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste are provided in SOP-01.06. In addition, waste-minimization practices (described in Appendix B of the IWP [LANL 1992, 0768]) will be followed.

1.9 Monitoring Wells

Groundwater monitoring will be necessary for determining whether or not a perched alluvial reservoir exists at TA-39. To provide for monitoring, one or more of the coreholes drilled for sampling will be cased with PVC to an appropriate depth following extraction of the core, to allow access to the zone of interest: the boundary between the alluvium and the underlying tuff. The bottom 2-5 ft of the hole will be screened to allow water levels to be measured and samples to be collected. The well(s) will be inspected periodically for standing water. If water is present, the levels will be recorded—periodically or continuously—over a 2-year period to document the effects of seasonal and storm precipitation on water flow in the alluvium (particularly through and away from the landfills). Monitoring wells will be installed in accordance with SOP-05.01 and will conform to EPA requirements for monitoring wells. No other special well installation requirements apply.

Guidance on installation and sampling of the wells is given in Appendix M of the IWP (LANL 1992, 0768) as well as SOPs-04.01, -05.01, -05.02, and -06.01.

2.0 FIELD SURVEYS, FIELD SCREENING, AND SAMPLE ANALYSIS

2.1 Field Surveys

These are primarily walking scans of the land surface, using direct reading or recording instruments. For TA-39, field surveys will include radiological surveys and, depending on the site, geophysical, geomorphological, seismic, and/or land surveys. Typically, these surveys provide Level I data (see the IWP, Section 4.4.9 [LANL 1992, 0768], for a discussion of the EPA-established levels of data classification). 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.

2.1.1 Radiological Surveys

2.1.1.1 Gross Beta-Gamma

Field instruments available for beta-gamma surveys include micro-R meters and Geiger-Mueller detectors. The preferred instrument is the micro-R meter, which is capable of measuring to 5 mR/hr. The surveyor carries the instrument at a fixed height close to the ground surface and, moving at a slow walking pace, observes and records the rate-meter response. Measurements may also be made at fixed points at ground level to detect localized sources. Measurements are compared with reference measurements from a nearby location devoid of the target radionuclides; an elevated reading may signify the presence of a radioactive source. These surveys will be conducted according to an approved LANL ER-SOP.

2.1.1.2 Low-Energy Gamma

In addition to the gross beta-gamma surveys, low-energy gamma surveys can provide information on the presence and distribution of radioactive materials. Instruments commonly used for these surveys are the FIDLER, the PHOSWICH, and the VIOLINIST. (The last, a modified version of the other two, can not only locate the measurement point using a ranging system, but can record the location and the level of radiation on electronic data storage media.) These instruments are optimized for the detection of low-energy photons, such as the x rays that accompany the decay of most heavy radionuclides (e.g., uranium, thorium). Any of these instruments may be used at TA-39. To scan the area for the presence of radiation, the surveyor carries the instrument close to the ground surface while observing the rate meter. Measurements are made at fixed points on the ground surface to detect localized sources or, in areas where sources may be buried (such as a stream channel), in shallow profiles. In the latter case the detector may be collimated to reduce the detection of stray radiation from sources other than those in the profile. Low-energy gamma measurements are made according to SOP-02.17.

2.1.2 Geomorphic Surveys

Geomorphic characterization includes identification of landform features, stream channels, drainage patterns, sites of active or potentially active surface erosion or accumulation, and potential infiltration areas. The characterization will also indicate soil series, colluvium and artificial fill, and degree of soil profile development. The information from this characterization will be used to generate a 1:36 000-scale map of TA-39 that emphasizes erosion and deposition areas. Stream-channel descriptions will include bed material, deposition zones, and scour zones. Site maps, contour maps, and three-dimensional aerial photographs aid in the on-site observation of features critical to an understanding of the potential for contaminant movement. Guidance for conducting these surveys is given in SOP-03.08.

2.1.3 Geophysical Surveys

Instruments that can detect anomalies may be used to locate buried objects or features (such as metal, trench boundaries, or other discontinuities) that may be —or may indicate the presence of—contaminants. A combination of geophysical measurements may be required in order to estimate the locations of features of interest. Whether any of the available techniques, or combination of techniques, will yield the desired results at TA-39 is unknown; some trials will have to be conducted to determine the usefulness of these surveys. The applicable SOP is 03.02.

2.1.3.1 Metal Detection

Metal objects can be detected by standard metal detectors if those objects are on or near the soil surface. The operator typically walks along transect lines spaced to cover the area as thoroughly as possible.

For buried objects, an electromagnetic survey instrument is used. The detection capability of these instruments depends on the size and depth of burial of the metallic object (the deeper the object, the larger it must be to enable detection). For example, a 2-in.-diameter metal line can be detected as deep as 5 ft below the surface. The survey is done along transects or grids spaced according to the estimated size and depth of objects thought to be buried in the area (such objects may or may not be associated with—or be themselves—target contaminants).

2.1.3.2 Ground-Penetrating Radar (GPR) Surveys

GPR may be used to locate trenches and other large buried features. GPR responds to discontinuities in subsurface features (e.g., changes in porosity, groundwater table, bulk density) that can be used to help delineate the edges and bottom of buried trenches and pits.

2.1.3.3 Resistivity Surveys

The resistivity (electrical conductivity) of most soils and rocks depends on the conduction paths created by fluids in the pore spaces. Resistivity is influenced by physical and chemical properties of the ground (for example, porosity, saturation, and salinity) that affect the distribution and movement of contaminants. Measurement of differences in resistivity from one location to another, in combination with other measurements, can aid in detecting not only conditions favoring contaminant presence and/or migration, but also trench boundaries, perched groundwater, and some forms of buried waste.

2.1.3.4 Seismic Surveys

Seismic measurements furnish data on the elastic and acoustic parameters of the subsurface. The instruments are most sensitive to the mechanical properties of soil materials and to stratigraphy; they are relatively insensitive to chemical makeup. Used in conjunction with other survey methods, seismic measurements can help detect anomalies and discontinuities created by buried wastes.

2.1.4 Land Surveys

Land surveys will be used to (1) update maps of existing structures and features, (2) determine and document locations for sampling and for various measurements (electromagnetic and seismic), (3) determine and document the location of concentrations of contaminants, and (4) document the locations of former or buried structures.

2.2 Field Screening

Field screening measurements produce Level I and, where quantitative analysis kits are used, Level II data (see Section 4.4.9 of the IWP). These measurements are taken at the point of sample collection, in open boreholes, and in excavations, to identify gross contamination and to assess conditions that might affect the health or safety of field personnel. (Applications of screening for personnel health and safety are discussed in Annex III, *Health and Safety Plan.*) Every sample taken at TA-39 will be screened for gross alpha and gross beta-gamma radioactivity, and selected excavations and boreholes will be monitored for combustible gases and organic vapors. A noninstrument form of sample screening, lithological logging (which may include photographs), will be performed for certain coreholes.

In addition to its role in identifying gross contamination or situations of concern for health and safety, sample screening information can serve as a basis for selecting samples for further analysis, deciding whether to do further sampling, or determining what analyses should be done.

2.2.1 Radiological Screening

Certain field samples will be screened on site for gross beta-gamma and/or gross alpha radiation to guide selection of samples for laboratory analysis. All samples selected for laboratory analysis will be more specifically screened for radioactivity by ER Sample Coordination Facility or analytical laboratory personnel.

2.2.1.1 Gross Beta-Gamma

Field samples are screened for gross beta-gamma radioactivity by means of a hand-held Geiger-Mueller detector (Micro-R meter) or other appropriate detector and rate meter. When held close to a sample or core, the instrument is capable of identifying elevated concentrations of certain radionuclides (indicated by rate-meter readings above instrument background levels). Because quantification of the readings is difficult, they are best interpreted as gross indicators of potential contamination. Gross beta-gamma activity will be measured in accordance with an approved SOP.

2.2.1.2 Gross Alpha

Field samples are screened for gross alpha contamination (specific radionuclides cannot be identified) using a hand-held alpha scintillation detector and a rate meter. The detector is held close to (almost in contact with) the sample or core. For best results, the sample should be dry. (For a damp soil sample, detection capability is only about 100-200 pCi/g.) Gross alpha activity will be measured in accordance with an approved SOP.

2.2.2 High-Explosives Screening

Certain suspect samples and sampling points are screened for the presence of HE using the Los Alamos M-1 Explosives Field Test Kit. HE will be measured in accordance with an approved SOP.

2.2.3 Organic Vapors and Combustible Gases

An instrument such as the Foxboro Model OVA-128 organic-vapor detector is used at the point of collection to screen borehole air and core samples for organic vapors. A combustible-gas indicator (CGI), such as the Gastech Model 1314, is used to measure the level of combustible gases present in an atmosphere as a percentage of the lower explosive limit (LEL) or the lower flammability limit (LFL). The combustible-gas measurements indicate the potential for combustion or explosion of unknown atmospheres during drilling and other intrusive activities. Organic-vapor and combustible-gas levels are measured in accordance with approved SOPs.

2.2.4 Lithological Logging

A lithological log is a description of the physical nature of a core. It is done by a geologist capable of describing subsurface lithologies and differentiating strata and other signs that may relate to the presence of contaminants. Guidance for conducting lithological logging is provided in SOP-04.03 and SOP-04.04.

2.2.5 Metals Screening

Energy dispersive X-ray fluorescence (XRF) measurement is a method for estimating concentrations of metal elements by exciting the elements with a radioactive source and then detecting their unique X-ray emissions. The element concentrations can be quantified by calibrating the instrument with suitable matrix standards. A portable XRF unit includes a probe for activation and detection and a multichannel pulse-height analyzer for data collection, analysis, and storage. The probe is placed on a smooth area of soil surface; it detects metal elements in the top few millimeters. Table B-1 lists metals detectable by XRF, their proposed screening action levels, and their approximate detection levels as compared with the detection levels of two laboratory analysis techniques.

2.3 Analytical Laboratory Analysis

For many of the sampling plans, the lack of existing data from a PRS creates the need to verify the presence or absence of a wide spectrum of possible contaminants and to determine physical and chemical characteristics of the site. 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. The Sample Coordination Facility also ensures that all samples are screened for radioactivity before analysis.

TABLE B-1
DETECTION LIMITS OF FIELD X-RAY FLUORESCENCE SCREENING COMPARED WITH THOSE OF LABORATORY ANALYSIS

Metal	Screening Action Level (mg/kg)	XRF Detection Limit (mg/kg)	Laboratory Detection Limits (mg/kg)	
			ICPES Method	Atomic Adsorption Method
Antimony	32	33	3	
Arsenic	0.4	2	2	.02
Barium	5600	10	0.1	
Beryllium	0.16	ND	0.05	
Cadmium	80	2	0.5	0.01
Chromium	400	8	0.5	
Copper	3 000	3	0.5	
Lead	500	10	4	
Manganese	8 000	174	0.1	
Mercury	24	30		0.02
Nickel	1600	4	1.5	
Selenium	400	17	3	
Silver	400	17	3	
Thallium	6.4	15	2	0.2
Uranium	240	10		
Vanadium	560	10	0.7	
Zinc	24 000	34	0.2	
Cyanide	1600	ND		

2.3.1 Contaminants

The procedures that will be used to analyze samples for potential contaminants at OU 1132 are the following:

1. *Gamma Emitters* (LANL EM-9 procedure ER130): Quantification of radionuclides by measurement of photon emissions from homogenized, fixed-geometry samples. Its primary use will be to determine the presence of radionuclides other than uranium.

2. *Uranium:* Analysis for total uranium uses either EPA method 3050 or delayed neutron counting (LANL EM-9 procedure ER300); analysis for isotopic uranium uses LANL EM-9 procedure ER290: radiochemical separation of uranium from soil followed by either alpha spectrometry or inductively coupled plasma (ICP) mass spectrometry.

3. *Isotopic Thorium* (LANL EM-9 procedure ER200) Radiochemical separation of thorium from soil is followed by alpha spectrometry to quantify each isotope. Alternatively, the isotope composition of the separated thorium is determined by ICP mass spectrometry.

4. *Isotopic Plutonium* (LANL EM-9 procedure ER-160): Radiochemical separation of plutonium from soil followed by alpha spectrometry to quantify individual isotopes.

5. *Volatile Organics* (EPA SW-846/8240): The standard EPA method for quantifying volatile organic compounds. It will be used primarily for solvents.

6. *Semivolatiles* (EPA SW-846/8270): The standard EPA method for quantifying semivolatile organic compounds.

7. *Target Analyte List (TAL) Metals and Cyanide* (EPA SW-846/6010): The standard EPA method for quantifying metals and cyanide. The TAL List includes the metals most likely to be contaminants at OU 1132.

8. *PCBs* (EPA SW-846/8080): The standard EPA method for quantifying PCBs and pesticides. (Only the PCB results are of interest for this work plan.)

9. *TCLP (Toxicity characteristic leaching procedure) 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.

10. *High Explosives* (USATHAMA): Determined using the US Army Toxic and Hazardous Materials Agency's High Performance Liquid Chromatography method (Refer to the ER QAPjP—LANL 1991, 0412—for additional information).

11. *Petroleum Hydrocarbons* (LANL EM-9, IH274): Extracted from soil using fluorocarbon-113 and measured by infrared spectrophotometry.

2.3.2 Physical/Chemical Characteristics

2.3.2.1 Hydrogeological Measurements

1. *Gravimetric water content* (Method ASTM D-4531-86): Measured by weighing the moisture lost during oven drying.

2. *Soil Moisture* (Method ASTM D2216 [1980] or SOP-06.07): Soil materials and undisturbed cores (or crushed core materials) are analyzed for moisture content by weighing moisture lost during drying.

3. *Bulk density, dry density, and porosity* (Method ASTM D-4531-86): calculated from the gravimetric water content data.

4. *Porosity (He injection):* measured quantitatively using the American Petroleum Institute Method (API 40, Section 3.58).

5. *Saturated hydraulic conductivity:* quantitatively measured using Method ASTM D-2434-68.

6. *Moisture characteristic curve:* Wetting and drying cycles are measured using the American Society of Agronomy method (Chapter 24). A psychrometer is used for verification when drying is complete.

7. *Air/water relative permeability:* The van Genuchten method is used to calculate the value from the saturated hydraulic conductivity and moisture characteristic curve data.

8. *Particle Size Distribution* (Method ASTM D-422-63 or SOP-11.02: The distribution of particles in a soil or sediment sample is measured.

2.3.2.2 Geochemical Measurements

1. *Mineralogy:* X-ray diffraction analysis on powdered rock or soil samples yield data on type and relative abundance of clay minerals (kaolinite, illite, and montmorillonite); matrix minerals (silica polymorphs, alkali feldspars, and volcanic glass); carbonate minerals; and iron and manganese minerals. These analyses follow SOPs-09.03, -09.04, and -09.05.

2. *Total organic carbon* (Method ASTM D-2974 or SOP-11.05)*:* Total organic carbon in crushed rock or soil samples is measured by combustion.

3. *Cation exchange capacity* (EPA method 9080 or SOP-11.06)*:* The cation exchange capacity of core or soil materials is measured on crushed samples by sodium adsorption.

4. *Slurry pH* (Method ASTM DG657 or SOP-11.04)*:* pH is measured in a crushed-core and deionized-water slurry.

2.4.2.3 Open-Borehole Geophysical Measurements

1. *Gamma density log:* Rock properties that alter and scatter gamma radiation are measured continuously using a sealed radiation source. The measured values are directly related to the bulk density of the rock. (Refer to SOP-04.04).

2. *Spectral gamma radiation log:* Natural gamma radiation and gamma-emitting contaminants are measured at various depths in an open or cased borehole. The spectrum, obtained by means of a gamma detector and pulse-height analyzer, is used for stratigraphic correlation. The log allows detection of natural uranium, thorium, potassium, and gamma-emitting radionuclide contaminants.

3. *Pulsed-neutron gamma spectral analysis:* Certain natural or contaminant elements can be neutron-activated. Gamma spectrometry is then used to identify nuclides, by the different energies or combinations of energies they exhibit. In addition, the height of the gamma peaks at those energies can be used to determine the amount of the nuclide present.

3.0 SOIL SAMPLING

Soil samples, taken as described below, are used for field screening and analytical laboratory measurements and analysis. After appropriate lithological investigation, all samples for analysis are crushed and homogenized, in the field or in the laboratory, to components measuring less than 1 in. Samples may include soil and cobbles. Unused collected materials will be stored for possible future analysis or investigation (no special storage conditions will be required; any future investigations are not expected to involve environment [condition]-sensitive components).

Sufficient sample material will be collected to fullfill all analytical and QA/QC requirements. Samples collected from specified depths or locations or to investigate features that may serve as a basis for judgments or decisions (e.g., discoloration, interfaces) should include material from either side of the feature or depth but should not include excess material, which could dilute the concentrations of target constituents.

3.1 Surface Soils

Samples of disturbed surface soil are taken using one of the sampling methods described in SOP-06.09. The basic requirement for surface soil sampling is that the sample be representative of the total volume of soil to the specified depth. The hole should go only to the prescribed depth, the sides should be cut vertically, and the material collected should be a well-mixed representation of the total volume.

3.2 Near-Surface Soils

The spade-and-scoop method (SOP-06.09) is used to obtain near-surface soil samples from depths to about 20 in. Spades and shovels are used to remove surficial material to the required depth, then a clean stainless-steel or Teflon scoop is used to collect the sample. (Devices plated with target metals, such as chrome, are not acceptable for sample collection.) Unless otherwise specified, each sample will be 2 in. deep, from the specified depth. The volume of the sample is determined by the amount of soil material required for the suite of analyses requested, including sample replication. Care will be taken to ensure that, for each sample, the full depth is attained, the sides of the hole are cut vertically, and the material collected is representative of the total area.

Small-volume soil samples can be recovered from depths of up to 20 ft by using a hand auger or a thin-wall tube sampler (SOP-06.10). The latter is used when lithologic information is required; it provides a sample that is less disturbed 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 tube sampler.

3.3 Subsurface Soils and Rock

3.3.1 Vertical Coreholes

Undisturbed soil samples will be collected from vertical coreholes with a continuous, split-barrel sampler driven by a truck-mounted hollow-stem auger (or similar equipment). See SOP-04.01.

3.3.2 Shallow-Angle Coreholes

Angle drilling, for the collection of undisturbed core, is employed when the drill rig cannot be placed directly over the point of interest or when the sampling point can be reached only by this method. 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 with split-barrel sampler may be used with the angle rig.

3.3.3 Trenching

Trenching is used to expose deeper soils for geomorphological 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.

Because the trench locations at TA-39 will be in valley fill, shoring and sloping will be necessary for trenches deeper than 4 ft. OSHA standards 29 CFR 1926.650, for shoring and sloping, and 1910.146, for operating in confined spaces, will be followed as required. Each trench will be inspected by a competent engineer to ensure that there is no potential for cave-in. The maximum trench depth will be 15 ft. Instructions for establishing and working in trenches are contained in SOP-04.02.

4.0 DATA ANALYSIS

4.1 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 emerging from 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.

4.2 Screening Action Levels

The screening action levels concept is based on the EPA's proposed 40 CFR 264, Subpart S. (Proposed screening action levels are listed in Appendix J of the IWP.) Screening action levels will be used at TA-39 as described in Sec. 4.2.2 of the IWP (LANL 1992, 0768), in conjunction with background levels, to assess the presence, magnitude, and importance of environmental contamination from individual PRSs. Sample analysis results will be compared with screening action levels as part of the process of deciding whether remediation should be initiated or whether further characterization is needed.

4.3 Decision Analysis

The decision analysis methodology for the Los Alamos ER Program is currently being developed. Pending completion of that methodology, the DQO process (see the IWP, Section 4.1.2 and Appendix H) 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-39 RFI work plan.)

References for Appendix B

LANL (Los Alamos National Laboratory), May 1991. "Environmental Restoration Standard Operating Procedures," Vols. I, II, and III, Los Alamos, New Mexico. (LANL 1991, 0411)

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Appendix C

List of Contributors

LIST OF CONTRIBUTORS TO RFI WORK PLAN FOR OU 1132

LABORATORY PERSONNEL

Kenneth Bostick, Environmental Sciences Group (EES-15)

T. E. Gene Gould, Mechanical and Electrical Engineering Group (MEE-4)

Edward Essington, Environmental Sciences Group (EES-15)

Grant Heiken, Geology and Geochemistry Group (EES-1)

Vivienne Hriscu, Communication Resources Group (IS-1)

Patricia Leyba, Communication Resources Group (IS-1)

Lia Mitchell, Environmental Sciences Group (EES-15)

C. Randall Mynard, Mechanical and Electrical Engineering Group (MEE-4)

Wilfred Polzer, Environmental Sciences Group (EES-15)

Sylvia Romero, Environmental Sciences Group (EES-15)

George Trujillo, Environmental Sciences Group (EES-15)

Billie M. Wheat, Mechanical and Electrical Engineering Group (MEE-4)

Bradford P. Wilcox, Environmental Sciences Group (EES-15)

EXTERNAL CONTRACTORS

Dirk Decker, Radian Corporation, Oak Ridge, Tennessee

William C. Francis, Los Alamos, New Mexico

Andrea J. Kron, cARTography, Los Alamos, New Mexico

Jeffrey Miller, Radian Corporation, Oak Ridge, Tennessee

Wilette M. Wehner, ICF Kaiser Engineers, Los Alamos, New Mexico

Merlin L. Wheeler, ICF Kaiser Engineers, Los Alamos, New Mexico

APPROXIMATE CONVERSION FACTORS
FOR SELECTED SI (METRIC) UNITS

Multiply SI (Metric) Unit	By	To Obtain US Customary Unit
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.)
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal.)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (mg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Degrees Celsius (°C)	9/5 + 32	Degrees Fahrenheit (°F)