RFI Work Plan for Operable Unit 1082

Environmental Restoration Program

Addendum I

July 1994

A Department of Energy
Environmental Cleanup Program

FINAL DRAFT

Los Alamos
NATIONAL LABORATORY

LA UR 94 1580

Executive Summary

EXECUTIVE SUMMARY

Purpose

The primary purposes of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan are to determine if a release has occurred, and/or the nature and extent of releases of hazardous waste or hazardous constituents from solid waste management units (SWMUs) in Operable Unit (OU) 1082, and to determine the need for corrective measures studies (CMSs). Secondly, this document satisfies part of the regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA.

OU 1082 includes active Technical Areas (TAs) 11, 16, 28, and 37. These TAs are located in Los Alamos County. There are ~~415~~ 425 potential release sites (PRSs) in OU 1082, which are located on land owned by the Department of Energy (DOE).

<u>Because of the large number of PRSs in OU 1082, this work plan is written in three parts. The first part is the complete work plan delivered in 1993. The second part is Addendum 1 delivered in 1994 and the third part is Addendum 2 to be delivered in 1995. Addendum 1 consists of updated versions of the Executive Summary, Chapters 1,2,3 and 4, and Appendix E. Chapters 5 and 6 contain only the additions to the 1993 edition of these chapters. Appendix C is revised to denote the contributors to this addendum. Appendix E, Maps, contains only new maps produced for Addendum 1. The table of contents, list of figures and tables, and the list of acronyms and abbreviations are all updated.</u>

<u>Except for Subsections 5.18 through 5.25 of Chapter 5, the reference list for Chapter 5, and Subsections 6.4 through 6.5 of Chapter 6, text that has been added to the 1993 work plan is underlined and text deleted from the 1993 work plan has been struck through. New tables or figures are distinguished by the addition of a letter to the table or figure number.</u>

The Hazardous and Solid Waste Amendments (HSWA) Module, Module VIII of the permit, and schedules of the permit issued by the Environmental Protection Agency (EPA), address potential corrective action requirements for SWMUs at the Laboratory. These permit requirements are addressed by the Department of Energy's Environmental Restoration (ER) Program at the Laboratory.

This document describes the field sampling plans that will be followed to implement the RFI at OU 1082. ~~This document, together with nine work plans to be submitted to the EPA in 1993, and nine work plans previously submitted, meets the requirement in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by August 27, 1993.~~ This document, together with four work plans to be submitted to EPA in 1994, and nineteen work plans previously submitted, meets the requirements in the HSWA Module to address all Table A SWMUs in RFI work plans by 1994.

Installation Work Plan

The HSWA Module requires the Laboratory to prepare an installation work plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, corrective measures studies, and corrective measures. This requirement was satisfied by submitting the Installation Work Plan for Environmental Restoration to the EPA in November 1990. That document is updated annually, and the most recent revision (Revision ~~2~~ 3) was published in ~~November 1992~~ November 1993. The IWP identifies the Laboratory's PRSs, describes their aggregation into twenty-four OUs, and presents the Laboratory's overall management plan and technical approach for meeting requirements of the HSWA Module. When information relevant to this work plan has already been provided in the IWP, the reader is referred to a version of that document.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. Sites that were not defined as SWMUs but may potentially contain hazardous substances, including non-RCRA materials, are called areas of concern (AOCs). The term PRS is the generic name for both SWMUs and AOCs.

The work plan includes sites that are not identified in Module VIII of the operating permit and are outside the regulatory scope of the permit. These units are included to ensure that all potential environmental problems at each OU are investigated and to present to the public and the regulators a unified plan that addresses all potential environmental problems on site. Inclusion of these sites in the work plan does not confer additional regulatory responsibility or authority for these sites to the regulators and does not bind the Laboratory to additional commitments outside the scope of the permit. The Laboratory will consider all comments received on this work plan.

Background

The technical areas composing OU 1082 were established during World War II to develop, fabricate (cast and machine), and test explosive components employed in the United States' nuclear weapons development and testing program. Present use of the technical areas is essentially unchanged. The facilities have undergone extensive expansion and upgrading as explosive and manufacturing technologies have advanced. Almost all of the work conducted at OU 1082 during World War II was in support of developing, testing, and producing explosive charges for the implosion method.

Development and testing of explosive formulations, fabrication of explosive charges, and assembly of weapon test devices have continued to the present. A wide variety of explosives ~~are~~ is currently used.

The PRSs in OU 1082 fall into three general categories as follows:

- surface contamination areas where contaminants were released at, or to, the land surface, such as debris from a firing site, surface spills, residues from burning operations, razing and burning of a decommissioned building, and surface solid waste disposal areas;
- surface and subsurface liquid releases, such as discharges from septic systems and industrial drainage systems; and,
- subsurface contamination areas, such as material disposal areas (MDAs) and landfills where solid wastes were placed or buried as a result of programmatic experiments or disposal of wastes from those experiments.

The predominant potential contaminants of concern at OU 1082 are high explosives (HE) and the burn, detonation, and degradation products of HE, including barium. Other potential contaminants of major concern associated with former Laboratory operations include uranium, beryllium, plutonium, cobalt-60, radium-226, silver, lead, mercury, photographic chemicals, cyanide, and solvents.

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. However, selected PRSs are investigated individually. This work plan presents the description and operating history of each PRS or aggregate, together with an evaluation of the existing data, if any, in order to develop a preliminary conceptual exposure model for the site. For some sites, no further action (NFA) can be proposed on the basis of this review; these sites are discussed in Chapter 6 of this work plan. For other, currently active sites, this review is sufficient to determine that investigation (and remediation, if required) may be deferred until the site is decommissioned; these sites are also discussed in Chapter 6. The remaining sites, for which RFI fieldwork and/or voluntary corrective actions (VCAs) are proposed, are discussed in Chapter 5.

This work plan's technical approach to field sampling includes collecting data to determine if sites present a potential hazard or should be recommended for NFA, refining the conceptual exposure models for PRSs or aggregates to a level of detail sufficient for a baseline risk assessment, and evaluating remedial alternatives (including 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 cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation, with opportunities for additional sampling, if required.

At PRSs for which there are no existing data and little or no historical evidence that a release has occurred, the Phase I sampling strategy for OU 1082 will focus on determining the presence or absence of hazardous and/or radioactive contaminants. If contaminants are detected at concentrations above conservative screening action levels, a baseline risk assessment may be required or a VCA may be proposed. The baseline risk assessment would be used to determine the need for a corrective measures study or VCA. If the data collected during Phase I are insufficient to support a baseline risk assessment, additional RFI Phase II sampling will be undertaken to characterize the nature and extent of the release in more detail.

For some PRSs in OU 1082, there are existing data and/or strong historical evidence to support the hypothesis that a release has occurred. In these cases, the existing information has been evaluated to determine whether there is a need for a baseline risk assessment and/or the evaluation of remedial alternatives. If the information for these sites is deemed insufficient, Phase I data will be collected to refine the site conceptual exposure model.

To ensure that the right type, amount, and quality of data are collected, data quality objectives to support the required decisions are developed for the RFI Phase I sampling and analysis plans. Fieldwork for many sites includes field surveys and field screening of samples upon which the selection of samples for laboratory analysis will be based. Laboratory analyses will be performed in mobile and fixed analytical laboratories.

The body of this work plan is followed by five annexes that consist of project plans corresponding to the program plans in the IWP: project management, quality assurance, health and safety, records management, and ~~community relations~~ public involvement.

Schedule, Costs, and Reports

The RFI fieldwork described in this document and ~~two~~ one subsequent ~~work plans~~ addendum ~~will~~ would have required five years (Fig. ES-1) to complete. An updated estimate (Fig. ES-1a) for Addendum 1 is included. A single phase of fieldwork is expected to be sufficient to complete the RFI for most PRSs; however, a second phase will occur if warranted by the results of the first phase. This second phase is built into the ~~five-year~~ updated estimates. Because of the large number of PRSs in OU 1082, ~~additional~~ field activities ~~will be~~ are defined in ~~three segments of~~ this work plan delivered in 1993 and two addenda to this work plan ~~deliverable~~ delivered in 1994, and to be

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	FISCAL YEAR 93 94 95 96 97 98 99 00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18
07016M050	1082: Start bench/pilot studies	1 Oct 92		07016M050 1082: Start bench/pilot studies
07012M131	1082: EPA/NMED draft complete		25 May 93	07012M131 1082: EPA/NMED draft complete 1st RFI WP
07012M151	1082: RFI work plan complete		30 Sep 93	07012M151 1082: RFI work plan complete 1st RFI WP
07013M000	1082: Start RFI	1 Oct 93		07013M000 1082: Start RFI
07012M132	1082: EPA/NMED draft complete		7 Jul 94	07012M132 1082: EPA/NMED draft complete 2nd RFI WP
07012M152	1082: RFI work plan complete		15 Dec 94	07012M152 1082: RFI work plan complete 2nd RFI WP
07012M133	1082: EPA/NMED draft complete		7 Jul 95	07012M133 1082: EPA/NMED draft complete 3rd RFI WP
07012M153	1082: RFI work plan complete		15 Dec 95	07012M152 1082: RFI work plan complete 2nd RFI WP
07014M300	1082: Start developing RFI report	4 Sep 96		07014M300 1082: Start developing RFI report
07014M115	1082: DOE draft of report complete		12 Jan 98	07014M115 1082: DOE draft of Phase I report complete
07014M130	1082: EPA/NMED draft of Phase I report		27 Mar 98	07014M130 1082: EPA/NMED draft of Phase I report complete
07013M500	1082: RFI fieldwork complete		16 Oct 98	07013M500 1082: RFI fieldwork complete
07014M315	1082: DOE draft of RFI report		3 Sep 99	07014M315 1082: DOE draft of RFI report complete
07014M330	1082: EPA/NMED draft; complete		19 Nov 99	07014M330 1082: EPA/NMED draft; complete
07015M100	1082: Start development of CMS	22 Nov 99		07015M100 1082: Start development of CMS
07014M350	1082: Revised RFI report complete		28 Feb 00	07014M350 1082: Revised RFI report complete
07028M000	1082: Start VCA soils remediation	1 Mar 00		07028M000 1082: Start VCA soils remediation
07015M105	1082: Receipt of EPA CMS notification		28 Mar 00	07015M105 1082: Receipt of EPA CMS notification
07015M115	1082: DOE draft of CMS plan complete		24 Apr 00	07015M115 1082: DOE draft of CMS plan complete
07015M130	1082: EPA/NMED draft of CMS plan		21 Jun 00	07015M130 1082: EPA/NMED draft of CMS plan
07015M150	1082: EPA approved CMS plan		13 Oct 00	07015M150 1082: EPA approved CMS plan
07016M100	1082: Start CMS field study	16 Oct 00		07016M100 1082: Start CMS field study
07016M150	1082: CMS field study complete		28 Aug 01	07016M150 1082: CMS field study complete
07017M100	1082: Start development of CMS	29 Aug 01		07017M100 1082: Start development of CMS
07017M115	1082: DOE draft of CMS report		11 Jan 02	07017M115 1082: DOE draft of CMS report
07017M130	1082: EPA/NMED draft; complete		28 Mar 02	07017M130 1082: EPA/NMED draft; complete
07017M135	1082: EPA notification of CMI		30 May 02	07017M135 1082: EPA notification of CMI
07017M150	1082: Assessment complete		27 Jun 02	07017M150 1082: Assessment complete
07017M450	1082: Revised CMS report complete		27 Jun 02	07017M450 1082: Revised CMS report complete
07023M000	1082: Start corrective measure	30 Oct 05		07023M000 1082: Start corrective measure
07023M500	1082: Corrective measures implement		30 Sep 10	07023M500 1082: Corrective measures implementation compl.
07028M500	1082: VCA soils remediation complete		28 Sep 18	07028M500 1082: VCA soils remediation complete
07028M750	1082: Project complete		28 Sep 18	07028M750 1082: Project complete

Fig. ES-1. RFI/CMS milestone chart for OU 1082.

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
07011FY94	1082: Start FY94 activities	1 Oct 93	
07012M132	1082: EPA draft complete		7 Jul 94
07012M151	1082: RFI work plan complete		26 Aug 94
07012M133	1082: EPA draft complete		6 Jul 95
07013M000	1082: Start RFI	1 Aug 95	
07023M100	1082: MDA-P submit to NMED for review		6 Sep 95
07012M152	1082: RFI work plan complete		1 Nov 95
07012M153	1082: RFI work plan complete		30 Oct 96
07023M450	1082: MDA-P DOE submits final CLS plan		23 Dec 96
07023M500	1082: MDA-P project completion		23 Dec 96
07014M300	1082: Start developing RFI report	8 Jul 97	
07014M115	1082: DOE draft of Phase 1 report complete		9 Feb 00
07028M000	1082: Start VCA soils remediation	1 Mar 00	
07014M130	1082: EPA draft of Ph 1 report complete		24 Apr 00
07028M500	1082: VCA soils remediation complete		29 Sep 00
07013M500	1082: RFI field work complete		1 Aug 01
07014M315	1082: DOE draft of RFI report		20 Jun 02
07014M330	1082: EPA draft: Completion of RFI		4 Sep 02
07015M100	1082: Start development of CMS	5 Sep 02	
07014M350	1082: Revised RFI report complete		9 Dec 02
07015M105	1082: Receipt of EPA CMS notification		10 Jan 03
07015M115	1082: DOE draft of CMS plan complete		7 Feb 03
07015M130	1082: EPA draft of CMS plan complete		6 Jun 03
07015M150	1082: EPA approved CMS plan		9 Jan 04
07016M100	1082: Start CMS field study	12 Jan 04	
07016M150	1082: CMS field study complete		10 Jan 05
07017M100	1082: Start development of CMS	11 Jan 05	
07017M115	1082: DOE draft of CMS report		18 May 05
07017M130	1082: EPA draft: Completion of		2 Aug 05
07017M135	1082: EPA notification of CMI		4 Oct 05
07017M150	1082: Assessment complete		2 Nov 05
07017M450	1082: Revised CMS report complete		2 Nov 05
07023M000	1082: Start corrective measures	3 Nov 05	
07023M750	1082: Project complete		30 Sep 09
07023M500	1082: CMI complete		30 Sep 09

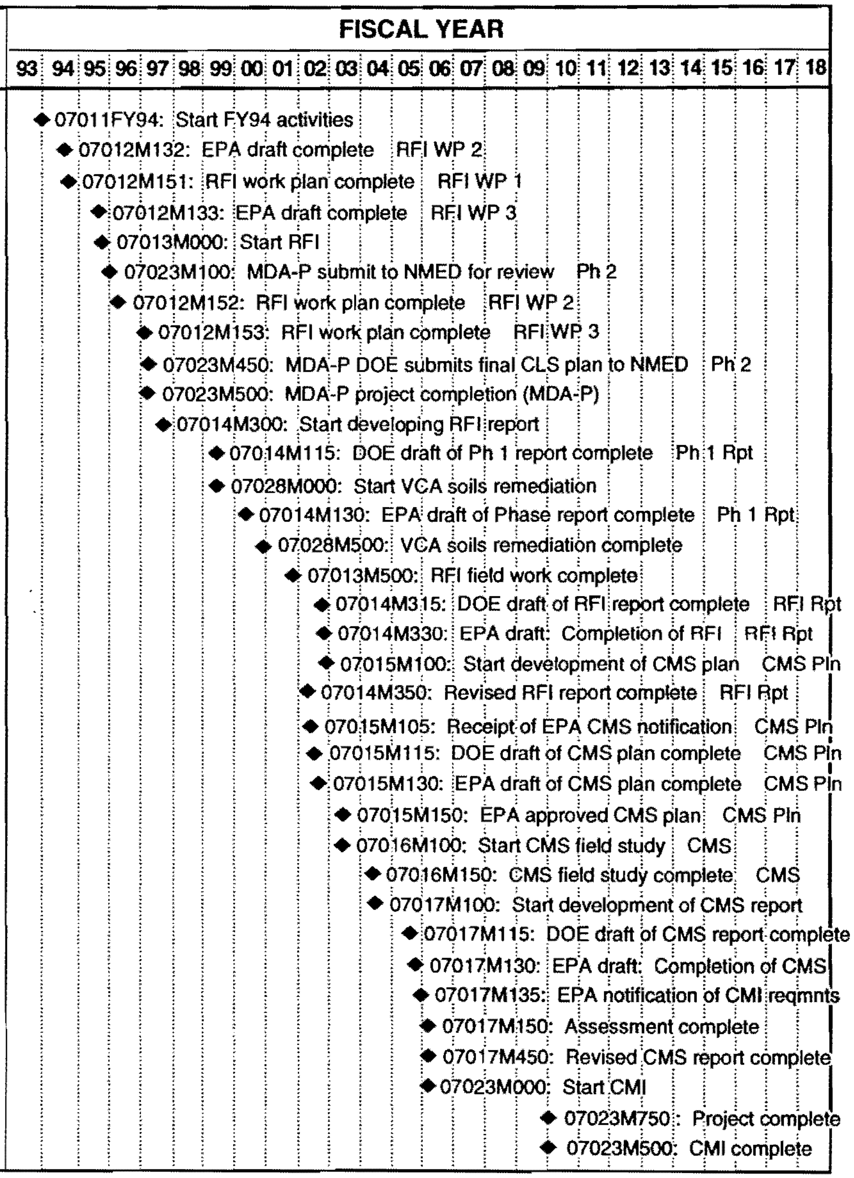

Fig. ES-1a. RFI/CMS milestone chart updated for Addendum 1 for OU 1082.

delivered in 1995. All Table A SWMUs were addressed in the 1993 work plan.

Previous C cost estimates for baseline activities for OU 1082 are provided in Table ES-1 and updated cost estimates are in Table ES-1a. ~~The estimated escalated cost for implementing the RFI and reporting is $73.1 million. If a CMS is necessary, the estimated escalated cost for implementation and reporting is $5.8 million. The total estimated escalated cost for the corrective action process at OU 1082 is approximately $0.3 million.~~

TABLE ES-1

ESTIMATED COSTS OF BASELINE ACTIVITIES AT OU 1082 (ASSESSMENT PHASE ONLY)

TASK	BUDGET ($K)	SCHEDULED START	SCHEDULED FINISH
RFI work plans	6 199	10/01/91	07/07/95
RFI	42 723	10/01/93	10/16/98
RFI report	9 618	09/04/96	02/28/00
CMS plan	1 537	11/22/99	10/13/00
CMS	1 343	10/01/92	08/28/01
CMS report	1 388	08/29/01	06/27/02
Activity data sheet (ADS) management	1 916	10/01/91	07/27/02
Voluntary corrective action	236	10/01/91	09/30/99
Total	64 960		
Estimate to completion	63 485		
Escalation	14 202		
Prior years	1 475		
Total at completion	79 162		

TABLE ES-1A

ESTIMATED COSTS OF BASELINE ACTIVITIES AT OU 1082 (ASSESSMENT PHASE ONLY)

TASK	BUDGET ($K)	SCHEDULED START	SCHEDULED FINISH
RFI work plans	5 095	10/01/91	10/30/96
RFI	12 825	10/01/93	8/01/01
RFI report	6 464	7/08/97	12/08/02
CMS plan	986	9/05/02	12/09/02
CMS report	1 036	1/11/05	12/02/05
Activity data sheet (ADS) management	1 717	10/01/93	9/15/04
Voluntary corrective action	1 259	10/03/94	12/29/97
Total	29 382		
Estimate to completion	29 314		
Escalation	6 663		
Prior years	3 018		
Total at completion	38 995		

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

- a partial summary of the results of initial site characterization activities;
- vehicles for proposing modifications to the sampling plans suggested by the initial findings;
- work plans that describe the next phase of sampling, when such sampling is required;
- vehicles for recommending VCA or no further action as mechanisms for delisting PRSs shown by the RFI to have acceptable health-based risk levels; and,
- summary reports of the sampling plans.

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

Public Involvement

Regulations issued pursuant to HSWA Module VIII of the Laboratory's hazardous waste operating permit mandate public involvement in the corrective action process. 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 the 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~~ Laboratory's public reading room at 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

ACGIH	American Conference of Governmental Industrial Hygienists
ADS	Activity data sheet
AEA	Atomic Energy Act
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
ANSI	American National Standards Institute
AOC	Area of concern
CDC	Centers for Disease Control
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
CMI	Corrective measures implementation
CMS	Corrective measures study
COC	Contaminant of concern
cpm	Counts per minute
D&D	Decontamination and decommissioning
DA	Deferred action
dB	Decibel
DNB*	Dinitrobenzene
DNT*	Dinitrotoluene
DOE	US Department of Energy
DOE/AL	US Department of Energy/Albuquerque Operations Office
DQO	Data quality objective
EIS	Environmental impact statement
EM	Environmental Management (Division)
EPA	US Environmental Protection Agency
ER	Environmental Restoration (Program)
FID	Flame ionization detector
FY	Fiscal year
GC	Gas chromatography
HAZWOP	Hazardous Waste Operations Program
HAZWOPER	Hazardous Waste Operations and Emergency Response
HE	High explosive(s)
HMX*	Cyclotetramethylenetetranitramine
HPLC	High-pressure liquid chromatography
HSWA	Hazardous and Solid Waste Amendments
IDLH	Immediately dangerous to life and health
IWP	Installation work plan
kV	Kilovolt
LAAO	Los Alamos Area Office (a branch of the Department of Energy)
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (the Laboratory before January 1, 1981)
LIBS	Laser-induced breakdown spectroscopy
MCL	Maximum contaminant level
MDA	Material disposal area
MSDWF	Mixed-waste storage and disposal facility
MWDF	Mixed-waste disposal facility
NEPA	National Environmental Policy Act
NFA	No further action
NIOSH	National Institute of Occupational Safety and Health

NMED	New Mexico Environment Department (NMEID prior to April 1991)
NPDES	National Pollutant Discharge Elimination System
OEL	Occupational exposure limit
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader
PAH	Polycyclic aromatic hydrocarbon or polynuclear aromatic hydrocarbon
PBX	Plastic-bonded explosives
PCB	Polychlorinated biphenyl
PCOC	Potential contaminant of concern
PEL	Permissible exposure limit
PETN*	Pentaerythritol tetranitrate
PID	Photoionization detector
ppb	Parts per billion
PPE	Personal protective equipment
PRS	Potential release site
PVC	Polyvinyl chloride
QA	Quality assurance
QAPjP	Quality assurance project plan
QC	Quality control
QP	Quality procedure
RCRA	Resource Conservation and Recovery Act
RDX*	Cyclonitrite, cyclotrimethylenetrinitramine
RESRAD	Residual radioactive material
RFA	RCRA facility assessment
RfD	Reference dose
RFI	RCRA facility investigation
RME	Reasonable maximum exposure
RSD	Risk-specific dose
SAL	Screening action level
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard operating procedure
SPCC	Spill Prevention Control and Countermeasure Plan
SSO	Site safety officer
SVOC	Semivolatile organic compount
SWMU	Solid waste management unit
TA	Technical area
TAL	Target analyte list
TATB*	Triaminotrinitrobenzene
TCL	Target compound list
TLD	Thermoluminescent dosimeter
TLV	Threshold limit value
TNB*	Trinitrobenzene
TNT*	Trinitrotoluene
TPH	Total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSD	Treatment, storage, disposal
UST	Underground storage tank
VCA	Voluntary corrective action
VOC	Volatile organic compound
XRF	X-ray fluorescence

*Other HE abbrevations are provided in Appendix D

Executive Summary

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Introduction

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Appendices

Chapter 1

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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 this statute, the Laboratory's permit to operate includes a section, referred to as the HSWA Module, that prescribes a specific corrective action program for the Laboratory (EPA 1990, 0306). 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) (DOE 1989, 0078).

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 182 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. These sites may contain radioactive materials and other hazardous substances listed under CERCLA. SWMUs and AOCs are collectively referred to as PRSs. The Environmental Restoration (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 in groupings called operable units (OUs). The Laboratory has established twenty-four OUs, and an RFI work plan is prepared for each. This work plan for OU 1082 addresses PRSs located in three of the Laboratory's active technical areas (TAs): TAs 11, 16, and 37. ~~This plan, together with nine other work plans to be submitted to EPA through August 1993, and nine plans submitted in 1990 and 1991, meets the schedule requirement 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 priority SWMUs listed in Table B~~ This plan, together with four other work plans to be submitted to EPA through July 1994 and nineteen plans previously submitted, meets the schedule requirements of the HSWA Module, which is to address a cumulative total of 100% of the SWMUs in Table A and a cumulative total of 100% of the priority SWMUs listed in Table B.

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), 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.

TABLE 1-1

RCRA FACILITY INVESTIGATION GUIDANCE FROM THE HSWA MODULE

SCOPE OF THE RCRA FACILITY INVESTIGATION*	ER PROGRAM EQUIVALENT	
The RFI consists of 5 tasks:	*Laboratory Installation RI/FS* Work Plan:*	*Laboratory Task/Site RI/FS:*
Task I: Description of Current Conditions A. Facility background B. Nature and extent of contamination	**I. Laboratory Installation RI/FS Work Plan** A. Installation background B Tabular summary of contamination by site	**I. OU 1082 Work Plan** A. Task/Site background B. Nature and extent of contamination
Task II: RFI Work Plan A. Data Collection/Quality Assurance Plan B. Data Management Plan C. Health and Safety Plan D. Community Relations Plan	**II. Laboratory Installation RI/FS Work Plan** A. General Standard Operating Procedures for Sampling Analysis and Quality Assurance B. Technical Data Management Program C. Health and Safety Program D. Public Involvement Project Plan	**II. Laboratory Task/Site RI/FS Documents** A. Quality Assurance Project Plan and Field Sampling Plan B. Records Management Project Plan C. Health and Safety Project Plan D. Public Involvement Project Project Plan
Task III: Facility Investigation A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification	**III. Task/Site Investigation** A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification	**III. Task/Site Investigation** A. Environmental setting B. Source characterization C. Contamination characterization D. Potential receptor identification
Task IV: Investigative Analysis A. Data Analysis B. Protection standards	**IV. Laboratory Task/Site Investigative Analysis** A. Data Analysis B. Protection standards	**IV. Laboratory Task/Site Investigative Analysis** A. Data Analysis B. Protection standards
Task V: Reports A. Preliminary and Work Plan B. Progress C. Draft and Final	**V. Reports** A. Laboratory Installation RI/FS Work Plan B. Annual Update of Laboratory Installation RI/FS Work Plan C. Draft and Final	**V. Laboratory Task/Site Reports** A. Quality Assurance Project Plan, field Sampling Plan, Technical Data Management Plan, Health and Safety Plan, Public Involvement Project Plan B. Laboratory Task/Site RI/FS documents and Laboratory Monthly Management Status Report C. Draft and Final

*RFI = RCRA Facility Investigation, RI = remedial investigation, FS = feasibility study

TABLE 1-2

LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA MODULE REQUIREMENTS FOR RFI WORK PLANS	INSTALLATION WORK PLAN[1] AND OTHER PROGRAM DOCUMENTS	DOCUMENTS FOR OPERABLE UNIT 1082
Task I: Description of Current Conditions		
A. Facility background	IWP Subsection 2.1	A. RFI Work Plan Chapters 2, 3, and 5
B. Nature and extent of contamination	IWP Subsection 2.4 and Appendix F	B. RFI Work Plan Chapter 5
Task II: RFI Work Plan		
A. Data Collection/Quality Assurance Plan	IWP Annex II (Quality Program Plan)[2]	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 Involvement 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 Subsection 4.2	RFI Work Plan Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data Analysis	IWP Subsection 4.2	Phase reports and RFI report
B. Protection standards	IWP Subsection 4.2à	RFI report
Task V: Reports		
A. Preliminary and Work Plan	IWP Rev. 0	Work plan
B. Progress	Monthly reports, quarterly reports, annual revisions of IWP	Phase reports
C. Draft and Final		Draft and final RFI report

[1]LANL 1992, 0768

[2]Annex II of the IWP addresses these requirements by reference to ~~controlled~~ documents: The Generic Quality Assurance Project Plan (LANL 1991, 0553), and the ER Program's standard operating procedures (LANL 1993, 0875).

1.2 Installation Work Plan

The HSWA Module requires that the Laboratory prepare a master plan, called the 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 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~~ 3 of the IWP (LANL ~~1992, 0768~~ 1993, 1017).

The IWP describes the aggregation of the Laboratory's PRSs into twenty-four OUs (Subsection 3.4.1). It presents a facilities description in Chapter 2 and a description of the structure of the Laboratory's 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 Assurance Program Plan (LANL 1991, 0840), Health and Safety Program Plan, Records Management Program Plan, and the ~~Community Relations Program Plan~~ Public Involvement 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 appropriate revision of the IWP.

1.3 Description of OU 1082

OU 1082 is located in Los Alamos County in north-central New Mexico (Fig. 1-1). OU 1082 consists of four operating technical areas: 11, 16, 28, and 37. Four additional technical areas, 13, 24, 25, and 29, are inactive. TA-13 and TA-25 have been absorbed into TA-16. TA-24 was abandoned and has been decommissioned and is now also absorbed into TA-16. TA-29 was decommissioned and absorbed into TA-16. Only TAs 11, 16, and 37 contain PRSs (Fig. 1-2). Detailed contour maps with PRS locations are found in Appendix E.

OU 1082 covers approximately 2 410 acres lying at the southwestern corner of the Los Alamos National Laboratory complex. OU 1082 lies at elevations between about 7 100 and 7 700 ft above sea level. It is located mostly on a

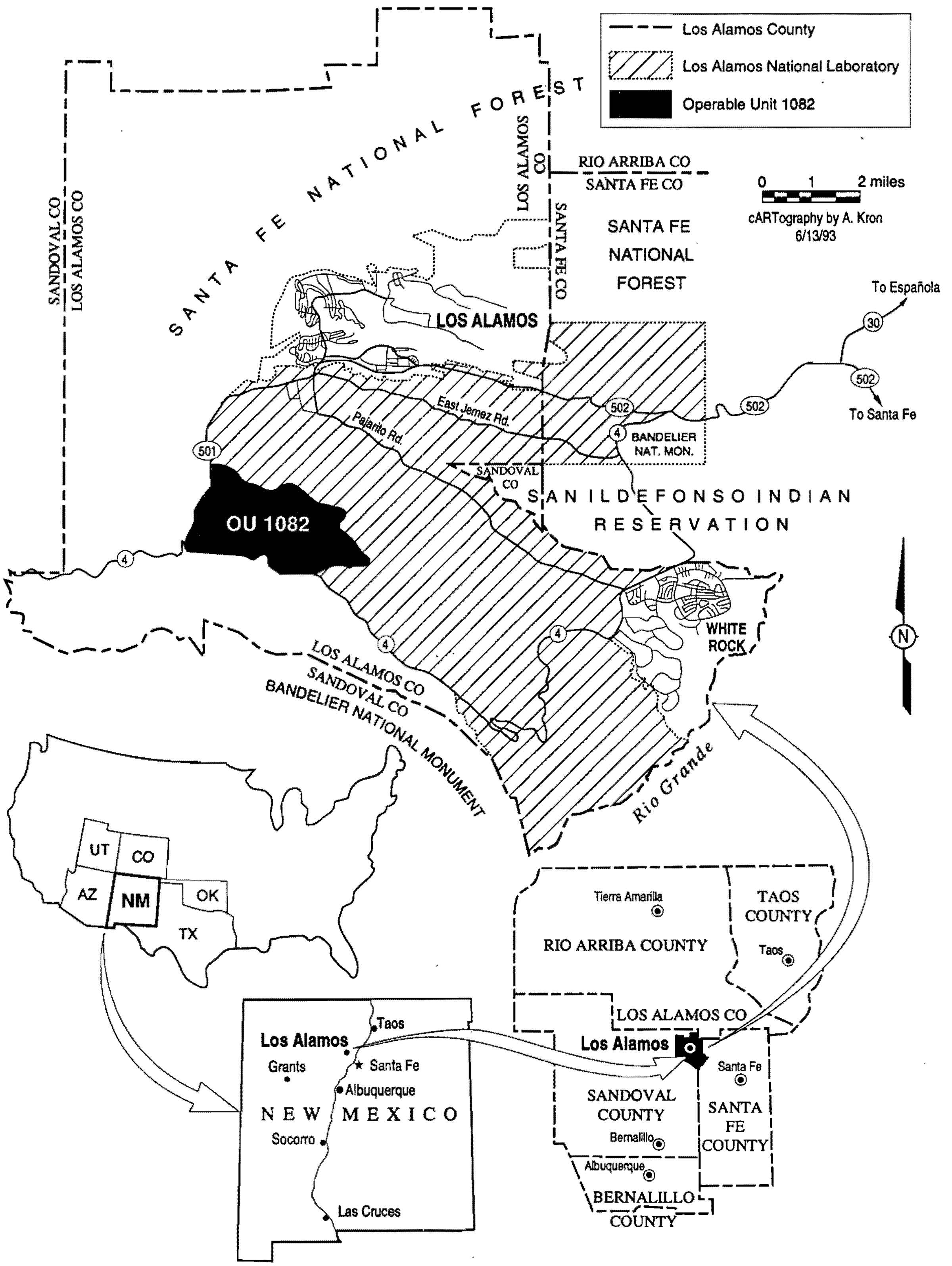

Fig. 1-1. Location of Operable Unit 1082.

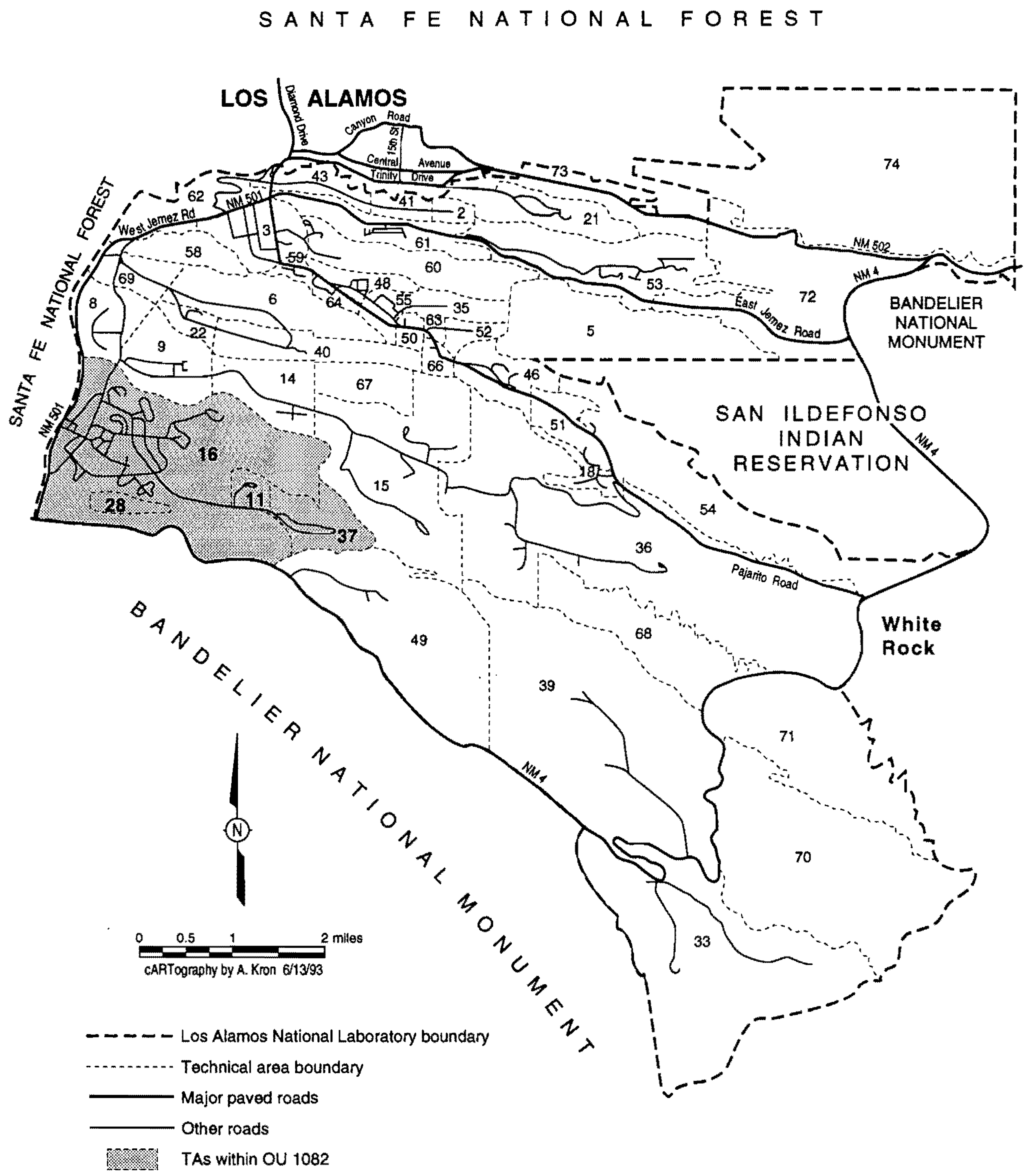

Fig. 1-2. Location of Operable Unit 1082 with respect to Laboratory technical areas and surrounding landholdings.

broad mesa that is bounded on the north by Cañon de Valle and on the south by Water Canyon. The southern boundary of OU 1082 is south of Water Canyon at the Laboratory boundary at State Road 4. The mesa also slopes eastward toward branches of Water Canyon and Cañon de Valle. Canyon walls are steep in this area.

Because of the large number of PRSs (264 SWMUs and 161 AOCs) in OU 1082, the RFI work plan ~~will be~~ is being written in three segments. The first segment ~~will address~~ addresses all of the HSWA Module Table A and Table B SWMUs (Table 1-3) and ~~is scheduled for delivery~~ was delivered to the Environmental Protection Agency in 1993 (EPA 1990, 0432). A number of SWMUs not in the HSWA Module are also addressed as a matter of efficiency and cost containment (Table 1-3). The portion of Cañon de Valle north of OU 1082 is treated in the first segment of the work plan.

The second segment (Addendum 1) addresses a number of SWMUs and AOCs associated with World War II activities, all of which are numbered according to the 1990 SWMU Report (Table 1-3a) (LANL 1990, 0145).

The remaining SWMUs and AOCs will be covered in the additional segment~~s~~ (Addendum 2) that will be delivered as an RFI addendum no later than July 1995. ~~The portion of Cañon de Valle north of OU 1082 is treated in the first segment of the work plans;~~ Water Canyon and the remainder of Cañon de Valle will be covered in the OU 1049 Work Plan, Canyons.

This work plan also addresses radioactive and other hazardous substances not regulated by RCRA, but defined in CERCLA, as well as other environmental laws. The goal of the Environmental Restoration Program at the Laboratory is to comply with ~~primarily~~ RCRA, but also address CERCLA, the Atomic Energy Act (AEA), the National Environmental Policy Act (NEPA), and other applicable regulations (LANL ~~1992, 0768~~ 1993, 1017).

The PRSs in OU 1082 are located on property owned by the Department of Energy (DOE).

A brief description of current activities follows:

TABLE 1-3

1993 WORK PLAN SWMU CROSS-REFERENCE LIST

HSWA PERMIT SWMUs		RENUMBERED SWMUs			CURRENT SWMUs
TABLES A and B	TABLE B	OLD NUMBER	NEW NUMBER	NEW SWMUs	1990 SWMU REPORT
11-011(a-c)					11-001(a-c)
11-002					11-002
					11-003(a,b) [1]
11-004(a-e)	11-004(a-e)				11-004(a-f)
11-005(a,b)	11-005(a,b)				11-005(a,b)
				11-005(c)	11-005(c)
11-006(a-d)	11-006(a-d)				11-006(a-d)
11-007					11-007
				11-008	11-008 [1]
11-009					11-009
				11-010(a,b)	11-010(a,b) [1]
				11-011(a-d)	11-011(a-d) [1]
				11-012(a-d)	11-012(a-d) [1]
				13-001	13-001 [1]
13-002					13-002
					13-003(a,b) [1]
13-004	13-004				13-004
16-001(a-e)					16-001(a-e)
16-003(a-o)					16-003(a-o)
16-003(p-v)		16-003(p-v)	16-029(a-g)		16-029(a-g)
16-004(a-f)					16-004(a-f)
		16-005(i)	16-005(g)		16-005(g)
16-006(a)	16-006(a)	16-006(a)	16-005(n)		16-005(n)
16-006(b)	16-006(b)	16-006(b)	16-006(a)		16-006(a)
16-006(c)		16-006(c)	16-006(b)		16-006(b)
16-006(d)	16-006(d)	16-006(d)	16-006(c)		16-006(c)
16-006(e-f)	16-006(e-f)	16-006(e-f)	16-006(d-e)		16-006(d-e)
16-006(g)	16-006(g)	16-006(g)	16-005(o)		16-005(o)
16-006(h)	16-006(h)	16-006(h)	16-006(f)		16-006(f)
16-007	16-007	16-007	16-007(a)		16-007(a)
				16-007(b)	16-007(b) [1]
16-008(a,b)	16-008(b)				16-008(a,b)
16-009(a)		16-009(a)	16-009		16-009
16-009(b)		16-009(b)	16-019		16-019 [2]
16-010(a-m)					16-010(a-m)
16-010(n)				16-010(n)	16-010(n) [1]
16-012(a-y)					16-012(a-y)
				16-012(a2)	16-012(a2) [1]
16-013(a)		16-013(a)	16-013		16-013
16-013(b)		16-013(b)	16-012(z)		16-012(z)
16-016(a-c)	16-016(a-c)				16-016(a-c)
16-018	16-018				16-018
16-019	16-019				16-019 [2]
16-020	16-020				16-020
16-021	16-021	16-021	16-021(a)		16-021(a)
				16-021(c)	16-021(c) [1]
				16-026(b-e)	16-026(b-e) [1]
				16-026(h2)	16-026(h2) [1]
				16-026(j2,v)	16-026(j2,v) [1]
				16-030(d)	16-030(d) [1]
				16-030(g)	16-030(g) [1]
				16-030(h)	16-030(h) [1]
				16-035	16-035 [1]
				16-036	16-036 [1]
				37-001	37-001 [1]

1 These SWMUs or SWMU subunits were not originally listed in either Table A or B of the HSWA Module, but are now listed in the1990 SWMU Report (LANL 1990, 0145).

2 Although the HSWA Module lists 16-009(b), the 1988 SWMU Report (International Technology Corporation 1988, 0329) says it is probably MDA R (SWMU 16-019), which is also in the HSWA Module. This work plan treats SWMU 16-009(b) as SWMU 16-019.

TABLE 1-3A

ADDENDUM 1 SWMU CROSS-REFERENCE LIST

OLD NUMBER (1988)	NEW NUMBER (1990)	CURRENT SWMU 1990 SWMU REPORT	INCLUDED IN THE MAY 19, 1994 PERMIT MODIFICATION
16-005(a)		16-005(a)	yes
16-005(b)		16-005(b)	yes
16-005(c)		16-005(c)	yes
16-005(d)		16-005(d)	yes
16-005(e)		16-005(e)	yes
16-005(f,g,h)	16-005(f)	16-005(f)	yes
16-005(j)	16-005(h)	16-005(h)	yes
16-005(k)	16-005(i)	16-005(i)	yes
16-005(l)	16-005(j)	16-005(j)	yes
16-005(n)	16-005(k)	16-005(k)	yes
16-005(o)	16-005(l)	16-005(l)	yes
	16-005(m)	16-005(m)	yes
25-002(a)	16-006(g)	16-006(g)	yes
25-002(b)	16-006(h)	16-006(h)	yes
	16-006(i)	16-006(i)	yes
16-011		16-011	no
16-015(a)		16-015(a)	no
16-015(b)		16-015(b)	no
16-015(c)		16-015(c)	no
16-015(d)		16-015(d)	no
16-017		16-017	yes
16-023(a)		16-023(a)	no
16-023(b)		16-023(b)	no
	16-024(b)	16-024(b)	no
	16-024(c)	16-024(c)	no
	16-024(d)	16-024(d)	no
	16-024(e)	16-024(e)	no
	16-024(f)	16-024(f)	no
	16-024(g)	16-024(g)	no
	16-024(h)	16-024(h)	no
	16-024(k)	16-024(k)	no
	16-024(l)	16-024(l)	no
	16-024(m)	16-024(m)	no
	16-024(n)	16-024(n)	no
	16-024(o)	16-024(o)	no
	16-024(p)	16-024(p)	no
	16-024(q)	16-024(q)	no
	16-024(r)	16-024(r)	no
	16-025(a)	16-025(a)	yes
	16-025(a2)	16-025(a2)	yes
	16-025(b)	16-025(b)	yes
	16-025(b2)	16-025(b2)	yes
	16-025(c)	16-025(c)	yes
	16-025(c2)	16-025(c2)	yes
	16-025(d)	16-025(d)	yes
	16-025(e)	16-025(e)	yes
	16-025(g2)	16-025(g2)	yes

TABLE 1-3A (continued)

ADDENDUM 1 SWMU CROSS-REFERENCE LIST

OLD NUMBER (1988)	NEW NUMBER (1990)	CURRENT SWMU 1990 SWMU REPORT	INCLUDED IN THE MAY 19,1994 PERMIT MODIFICATION
	16-025(f)	16-025(f)	yes
	16-025(g)	16-025(g)	yes
	16-025(h)	16-025(h)	yes
	16-025(i)	16-025(i)	yes
	16-025(j)	16-025(j)	yes
	16-025(k)	16-025(k)	yes
	16-025(l)	16-025(l)	yes
	16-025(m)	16-025(m)	yes
	16-025(n)	16-025(n)	yes
	16-025(o)	16-025(o)	yes
	16-025(p)	16-025(p)	yes
	16-025(q)	16-025(q)	yes
	16-025(r)	16-025(r)	yes
	16-025(s)	16-025(s)	yes
	16-025(t)	16-025(t)	yes
	16-025(u)	16-025(u)	yes
	16-025(v)	16-025(v)	yes
	16-025(w)	16-025(w)	yes
	16-025(x)	16-025(x)	yes
	16-025(y	16-025(y)	yes
	16-025(z)	16-025(z)	yes
	16-026(i2)	16-026(i2)	yes
	16-026(m)	16-026(m)	yes
	16-026(n)	16-026(n)	yes
	16-026(o)	16-026(o)	yes
	16-026(p)	16-026(p)	yes
	16-026(q)	16-026(q)	yes
	16-026(s)	16-026(s)	yes
	16-026(w)	16-026(w)	yes
	16-028(a)	16-028(a)	yes
	16-029(a2)	16-029(a2)	no
	16-029(b2)	16-029(b2)	yes
	16-029(c2)	16-029(c2)	no
	16-029(d2)	16-029(d2)	no
	16-029(e2)	16-029(e2)	no
	16-029(f2)	16-029(f2)	yes
	16-029(g2)	16-029(g2)	yes
	16-029(h2)	16-029(h2)	no
	16-029(k)	16-029(k)	yes
	16-029(l)	16-029(l)	yes
	16-029(m)	16-029(m)	no
	16-029(n)	16-029(n)	no
	16-029(o)	16-029(o)	no
	16-029(p)	16-029(p)	no
	16-029(q)	16-029(q)	yes
	16-029(r)	16-029(r)	no

TABLE 1-3A (continued)

ADDENDUM 1 SWMU CROSS-REFERENCE LIST

OLD NUMBER (1988)	NEW NUMBER (1990)	CURRENT SWMU 1990 SWMU REPORT	INCLUDED IN THE MAY 19,1994 PERMIT MODIFICATION
	16-029(s)	16-029(s)	yes
	16-029(t)	16-029(t)	yes
	16-029(u)	16-029(u)	yes
	16-029(v)	16-029(v)	yes
	16-029(w)	16-029(w)	no
	16-029(x)	16-029(x)	yes
	16-029(y)	16-029(y)	no
	16-029(z)	16-029(z)	no
	16-031(c)	16-031(c)	yes
	16-031(d)	16-031(d)	yes
	16-031(g)	16-031(g)	yes
	16-032(a)	16-032(a)	no
	16-032(b)	16-032(b)	no
	16-032(c)	16-032(c)	no
	16-032(d)	16-032(d)	yes
	16-032(e)	16-032(e)	yes
	16-034(a)	16-034(a)	yes
	16-034(b)	16-034(b)	yes
	16-034(c)	16-034(c)	yes
	16-034(d)	16-034(d)	yes
	16-034(e)	16-034(e)	yes
	16-034(f)	16-034(f)	yes
	16-034(g)	16-034(g)	yes
	16-034(l)	16-034(l)	yes
	16-034(m)	16-034(m)	yes
	16-034(n)	16-034(n)	yes
	16-034(o)	16-034(o)	yes
	16-034(p)	16-034(p)	yes
	25-001	25-001	no

TA-11, known as K-Site, is the location of the high explosives (HE) test area. Facilities in this technical area are used to test HE systems and components under a variety of conditions (Pava 1990, 0368).

TA-16 operations center around nuclear weapons warhead research (including design, development, prototype manufacturing, environmental testing, and stockpiling) and conventional weapons/chemical explosives research and processing. The area is also the principal waste treatment site for explosives and explosives-contaminated waste (Pava 1990, 0368).

TA-28 is a magazine area used for explosives storage (Pava 1990, 0368). Because of the historic care in storing HE at this site, no PRSs exist.

TA-37, called Magazine Area C, is used for explosives storage (Pava 1990, 0368).

SWMUs that are similar in physical characteristics, use, or waste type are described in the SWMU Report as sub-SWMUs within a larger SWMU description. Sub-SWMUs were grouped to eliminate repetition of information. Each sub-SWMU is considered to be a SWMU for the purposes of corrective actions and this work plan. The 1990 SWMU Report (LANL 1990, 0145) identifies 32 SWMUs in TA-11, 5 in TA-13 (now part of TA-16), 301 in TA-16, 0 in TA-24, 1 in TA-25 (now part of TA-16), 0 in TA-28, and 1 in TA-37. Table 1-3 provides a SWMU cross-reference of HSWA Module tables and Laboratory SWMU Reports for those SWMUs covered in ~~this~~ the work plan as of July 1993. Table 1-3a provides similar information for the PRSs covered in this addendum. As noted above, the remaining PRSs will be covered through RFI addenda no later than July 1995.

Laboratory activity and SWMU and AOC identification for those SWMUs and AOCs addressed in this work plan were verified during a series of tours conducted by the OU 1082 project team in late 1991 and early 1992.

All PRSs in the first part of this work plan have been aggregated based on their common characteristics and/or the common approach that can be applied to them in the RFI work plan. The seventeen aggregates and their locations in Chapter 5 of the RFI work plan are tabulated in Table 1-4. All PRSs in Addendum 1 have been aggregated based on geographic co-location. The eight aggregates and their locations in Chapter 5 of the RFI work plan are tabulated in Table 1-4a.

Subsection 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 PRS needs no further investigation. Table 1-3 includes the Tables A and B SWMUs to be addressed in this work plan. Tables 1-5 and 1-5a lists~~s~~ the PRSs ~~proposed for~~ recommended for no current RCRA facility investigation as NFA or deferred action. Those SWMUs from Tables A and B of the HSWA Module proposed for NFA are listed in Table 1-6; EPA's approval of this work plan demonstrates EPA's concurrence with the Laboratory that these units are viable candidates for a permit modification to remove these units from the ER Program.

TABLE 1-4

PRSs, PRS AGGREGATES, AND LOCATION IN CHAPTER 5

PRS, DESCRIPTION	PRS AGGREGATE	SUB-SECTION
16-001(a,b,d), dry wells/tank 16-001(c), dry well	Blowdown tanks and dry wells in administration area	5.1
16-001(e), dry well 16-003(a,b,d,e,f,g,h,i,j,l,m), active high explosives (HE) sumps 16-026(b,c,d,e,v,h2,j2), inactive outfalls 16-029(a,b,c,d,e,f,g), inactive HE sumps 16-030(d,h,g,), active outfalls 16-003(c,n,o), active HE sumps	HE sumps and outfalls	5.2
16-003(k), active HE sumps 16-021(c), operational release	HE sumps and outfall at TA-16-260	5.3
16-006(a,c,d,e), active/inactive septic systems 13-003(a,b), septic system 11-005(a,b), active septic systems	Septic tanks	5.4
16-021(a), operational release 16-020, silver recovery/outfall region	Operational releases (2 aggregates)	5.5 5.6
16-004(a), Imhoff tank 16-004(b), trickling filter 16-004(c), final tank 16-004(d), sludge drying bed 16-004(e), screen 16-004(f), sludge drying bed	Sanitary waste treatment plant	5.7
16-010(a,h,i,k,l,m,n), inactive burn and treatment area 16-016(c), surface disposal	Burning ground	5.8
Cañon de Valle	Cañon de Valle	5.9
16-019, Material Disposal Area (MDA) R	MDA R	5.10
16-009, decommissioned burn area 16-016(a,b), landfill/surface disposal	Landfills, surface disposal, burn pit	5.11
16-007(a), decommissioned waste pond 16-008(a), inactive surface impoundment	Ponds	5.12
13-001, firing site 13-002, landfills 13-004, burn site 16-035, soil contamination from former control bunker 16-036, soil contamination from battleship bunkers	P-Site	5.13
11-001(a,b), firing pits 11-002, burn site 11-003(b), mortar impact area 11-004(a-f), drop tower complex 11-006(a-d), sumps and catch basin systems C-11-001, soil contamination	K-Site Aggregate A	5.14
11-005(c), outfall and drain line 11-011(a,b), inactive outfalls 11-011(d), active outfall	K-Site Aggregate B	5.15
11-01(c), firing pit 11-012(a-d), soil contamination C-11-002, soil contamination	K-Site Aggregate C	5.16
16-013, decommissioned waste storage area	Spill	5.17

TABLE 1-4A

PRSs, PRS AGGREGATES, AND LOCATION IN CHAPTER 5

PRS, DESCRIPTION	PRS AGGREGATE	SUB-SECTION
16-005(c,d), decommissioned septic systems 16-024(e), soil contamination from decommissioned magazines 16-025(e,f,g,h,i,j,k,l,p,q,r,u,v), soil contamination at decommissioned HE facilities 16-026(q,w), inactive outfalls from building drains 16-029(m,n,o,p,r,z,f2,h2), inactive HE sumps 16-032(a,c), decommissioned HE sumps 16-034(a), soil contamination from miscellaneous buildings	Decommissioned sumps, outfalls, and associated buildings in the GMX-3 area	5.18
16-011, incinerators 16-023(b), decommissioned incinerator 16-024(b,c,d), soil contamination from decommissioned magazines 16-025(a,b,d,s), soil contamination at decommissioned HE facilities 16-031(d), inactive outfalls cooling towers and industrial lines 16-034(l,p), soil contamination from miscellaneous buildings C-16-006, former location of equipment building C-16-064, 065,067, former locations of chemical storage	Structures in GMX-3 area without sumps	5.19
16-005(e), decommissioned septic systems 16-015(c,d), laundry and steam washing 16-024(k,l,m,n,o,p,q,r), soil contamination from decommissioned magazines 16-025(t,w,y,z,a2,b2,c2), soil contamination at decommissioned HE facilites 16-029(v,y,a2,b2,c2,d2,e2), inactive HE sumps 16-034(m,n,o), soil contamination from miscellaneous buildings C-16-005, former optical equipment storage building C-16-069, former location of machine shop trailer	GMX-2 area	5.20
16-015(a,b), laundry and steam washing 16-026(s), inactive outfalls from building drains C-16-028, former location of instrument shop C-16-030, tank holding C-16-031, diesel waste building	Adminstration area	5.21
16-005(a,h,k,l), decommissioned septic systems	Septic tanks	5.22
16-026(m,n,o,p), inactive decommissioned septic systems 16-029(k,l,q,s,t,u), inactive HE sumps	Inactive sumps and outfalls in the GMX-3 area	5.23
16-005(j,m), decommissioned septic systems 16-024(f,g,h),soil contamination from decommissioned magazines 16-025(m,n,o), soil contamination at decommissioned HE facilites 16-034(b,c,d,e,f), soil contamination from miscellaneous buildings C-16-017, former location of steam plant	TA-24 (T-Site)	5.24
16-006(g), active/inactive septic system 16-025(x), soil contamination at decommissioned HE facilities 16-029(w,x), inactive HE sumps 16-031(c), inactive outfalls cooling towers and industrial lines C-16-068, former building operation associated with beryllium C-16-074, drum storage	TA-25 (V-Site)	5.25

TABLE 1-5

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION

PRS AGGREGATE(S), DESCRIPTION(S)	SUBSECTION
16-010(b,c,d,e,f,j), interim status open burn/open detonation units; 16-005(g), filter bed	6.1.1.1
16-008(b), inactive surface impoundment	6.1.2.1
16-010(g), filter/treatment unit	6.1.3.1
16-012(a2), interim storage area	6.1.3.2
16-012(d,i,j,l,m,n,t,u,x), satellite storage areas	6.1.3.2
16-012(p), less-than-ninety-day storage area	6.1.3.2
16-018, MDA P	6.1.4.1
11-007, surface disposal	6.1.5.1
11-009, MDA S	6.1.5.2
16-005(n), decommissioned septic system	6.1.5.3
16-005(o), decommissioned septic system	6.1.5.4
16-006(b), active septic system	6.1.5.5
16-006(f), active septic system	6.1.5.6
11-010(a), container storage area	6.2.1.1
11-001(c), boiler discharge	6.2.1.2
16-007(b), decommissioned waste pond	6.2.2.1
11-003(a), mortar impact area	6.2.3.1
11-008, boneyard	6.2.3.2
37-001, septic system	6.2.3.3
C-11-003, lanthanum spill	6.2.3.4
11,001(a,b), 11-002, 11-003(b), 11-004(a-f), C-11-001, drop tower complex	6.3.1

1.4 Organization of This Work Plan and Other Useful Information

This work plan follows the generic outline provided in Table ~~3-3~~ 3-1 of the IWP (LANL ~~1992, 0768~~ 1993, 1017). Following this introductory chapter, Chapter 2 provides background information on OU 1082, 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. Chapter 4 presents the technical approach to the field investigation. Chapter 5 contains an evaluation of all the PRSs in OU 1082, which includes a description and history of each

TABLE 1-5A

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION IN ADDENDUM 1

PRS AGGREGATE(S), DESCRIPTION(S)	SUBSECTION
16-006(h), inactive septic system (pump pit)	6.4.1.1
16-017, World War II HE complex	6.4.1.1
16-006(i), active septic system	6.4.2.1
16-034(g), soil contamination	6.4.2.2
16-026(i2), inactive outfall from building drain	6.4.2.3
16-032(d), decommissioned HE sump	6.4.2.4
16-005(i), septic tank	6.4.2.5
16-028(a), outfall	6.4.2.6
16-005(b), decommissioned septic system	6.4.3.1
16-025(c), soil contamination	6.4.3.2
16-005(f), decommissioned septic system	6.4.3.4
16-031(g), inactive outfall cooling tower	6.4.3.4
16-025(g2), magazine	6.4.3.5
16-029(g2), inactive HE sump	6.4.3.5
16-032(e), decommissioned HE sump	6.4.3.6
16-023(a), incinerator	6.5.1.1
25-001, pit	6.5.1.2
16-032(b), decommissioned HE sump	6.5.1.3
C-25-001, beryllium operations	6.5.1.4
C-16-004, hose house	6.5.2.1
C-16-032, hose house	6.5.2.1
C-16-039, hose house	6.5.2.1
C-16-040, hose house	6.5.2.1
C-16-021, administrative support building	6.5.2.2
C-16-022, administrative support building	6.5.2.2
C-16-024, administrative support building	6.5.2.2
C-16-025, Zia shop	6.5.2.3
C-16-026, Zia shop	6.5.2.3
C-16-027, Zia shop	6.5.2.3
C-16-029, Zia shop	6.5.2.3
C-16-023, warehouse	6.5.2.4
C-16-033, warehouse	6.5.2.4
C-16-037, product storage area	6.5.2.4
C-16-038, product storage area	6.5.2.4
C-16-066, storage area	6.5.2.4
C-16-003, latrine	6.5.2.5

TABLE 1-5A (continued)

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION IN ADDENDUM 1

PRS AGGREGATE(S), DESCRIPTION(S)	SUBSECTION
C-16-007, tank stand	6.5.2.6
C-16-055, manhole	6.5.2.6
C-16-056, manhole	6.5.2.6
C-16-057, manhole	6.5.2.6
C-16-059, electrical pit	6.5.2.7
C-16-042, manhole	6.5.2.8
C-16-043, manhole	6.5.2.8
C-16-045, manhole	6.5.2.8
C-16-048, manhole	6.5.2.8
C-16-052, manhole	6.5.2.8
C-16-053, manhole	6.5.2.8
C-16-054, manhole	6.5.2.8

TABLE 1-6

SWMUs PROPOSED FOR DELETION FROM TABLES A AND B OF THE HSWA MODULE

SWMU, DESCRIPTION	SUBSECTION
16-010(b,c,d,e,f,j), interim status open burn/open detonation units	6.1.1.1
16-008(b), inactive surface impoundment	6.1.2.1
16-012(d,i,j,l,m,n,t,u,x), satellite storage areas	6.1.3.2
16-012(p), less-than-ninety-day storage area	6.1.3.2
11-007, surface disposal	6.1.5.1
11-009, MDA S	6.1.5.2
16-005(n), decommissioned septic system	6.1.5.3
16-005(o), decommissioned septic system	6.1.5.4
16-006(b), active septic system	6.1.5.5
16-006(f), active septic system	6.1.5.6
16-012(a,b,c,e,f,g,h,k,o,q,r,s,v,w,y,z), rest houses	6.1.5.7
16-007(b), decommissioned waste pond	6.2.2.1

PRS, a conceptual exposure model, remediation alternatives and evaluation criteria, data needs and data quality objectives, and a sampling plan. Chapter 6 of this work plan provides a brief description of each PRS proposed for NFA or deferred action (DA) and the rationale 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 (LANL 1991, 0553), health and safety, records management, and ~~community relations~~ public involvement. Appendix A contains the cultural resource summary, Appendix B contains the biological resource summary, Appendix C contains a list of contributors to this work plan, Appendix D is an introduction to high explosives used at the S-Site complex, and Appendix E contains contour maps with PRS locations. A separate reference list is included at the end of each chapter, annex, and appendix where appropriate.

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 (Table 1-7). 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 list of acronyms precedes Chapter 1. A glossary of unfamiliar terms is provided in the IWP (LANL ~~1992, 0768~~ 1993, 1017) and in this work plan.

TABLE 1-7

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)
Celsius (°C)	9/5 + 32	Fahrenheit (°F)

REFERENCES

DOE (US Department of Energy), October 6, 1989. "Comprehensive Environmental Response, Compensation, and Liability Act Requirements," DOE Order 5400.4, Washington, DC. **(DOE 1989, 0078)**

EPA (US Environmental Protection Agency), May 1989. "Interim Final RCRA Facility Investigation (RFI) Guidance, Volume I of IV, Development of an RFI Work Plan and General Considerations for RCRA Facility Investigations," EPA/530-SW-89-031, OSWER Directive 9502.00-6D, Office of Solid Waste, Washington, DC. **(EPA 1989, 0088)**

EPA (US Environmental Protection Agency), April 10, 1990. RCRA Permit No. NM0890010515, EPA Region 6, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. **(EPA 1990, 0306)**

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55. **(EPA 1990, 0432)**

International Technology Corporation, December 1988. "Solid Waste Management Units Report," Los Alamos National Laboratory, Los Alamos, New Mexico," Volumes I-IV prepared by International Technology Corporation, Project No. 301215.02.01, Los Alamos, New Mexico. **(International Technology Corporation 1988, 0329)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

LANL (Los Alamos National Laboratory), June 1991. "Los Alamos National Laboratory Quality Program Plan for Environmental Restoration Activities," Rev. 0, Los Alamos National Laboratory Report LA-UR-91-1844, Los Alamos, New Mexico. **(LANL 1991, 0840)**

LANL (Los Alamos National Laboratory), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory Report LA-UR-91-3310, Los Alamos, New Mexico. **(LANL 1991, 0553)**

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)**

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

LANL (Los Alamos National Laboratory), January 1993. "Environmental Restoration Standard Operating Procedures," Los Alamos, New Mexico. **(LANL 1993, 0875)**

Pava, D. S., September 1990. "Los Alamos National Laboratory Site Development Plan 1990," Los Alamos National Laboratory Report LA-CP-90-0405, Los Alamos, New Mexico. **(Pava 1990, 0368)**

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Site Aggregates

Chapter 6
Units Proposed for No Current RCRA Facility Investigation

Annexes

Appendices

Chapter 2

- Description
- Operational History
- Waste Management Practices

2.0 BACKGROUND INFORMATION FOR OPERABLE UNIT 1082

This chapter of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan provides background information on Operable Unit (OU) 1082, which consists of four operating technical areas (TAs), 11, 16, 28, and 37. Programmatic activities are described from the earliest-known Laboratory activity to the present. Four TAs, 13, 24, 25, and 29, are inactive. TA-13, TA-25, and TA-29 have been absorbed into TA-16. TA-24 was abandoned and has been decommissioned. Descriptions of activities provide the basis, not only for evaluation of present conditions and environmental impacts, but also for proposed characterization study plans.

This work plan addresses all solid waste management units (SWMUs) and areas of concern (AOCs) identified in the "Solid Waste Units Management Report," (LANL 1990, 0145). Only TAs 11, 16, and 37 contain potential release sites (PRSs). During the course of the site characterization, new PRSs may be identified that will be addressed as they are identified.

2.1 Description

OU 1082 is located in the southwest corner of the Laboratory (Fig. 2-1 and Fig. 2-2). The land is a portion of that which was acquired by the Department of the Army for the Manhattan Project in 1943; it was used prehistorically by the ancestral Indians of the Pajarito Plateau and, prior to World War II, for farming and a sawmill operation. OU 1082 is bordered by Bandelier National Monument along State Road 4 to the south and the Santa Fe National Forest along State Road 501 to the west. To the north and east, the OU is bordered by other Laboratory property; specifically, TAs 8, 9, 14, 15, and 49. The unit is fenced and posted along State Road 4. Water Canyon, a 200-ft-deep ravine with steep walls, separates State Road 4 from active sites in OU 1082. Security fences surround production activities.

OU 1082 occupies 2 410 acres, or 3.8 square miles. A contour map showing the technical area boundaries and SWMU locations is contained in Appendix E. The operable unit is under the jurisdiction of Engineering and Science Applications (ESA) Division ~~WX (Design Engineering)~~ of Los Alamos National Laboratory (LANL), although Group ~~M-1~~ DX-16 (Explosives Technology) and the Laboratory's protective force have operations in several buildings.

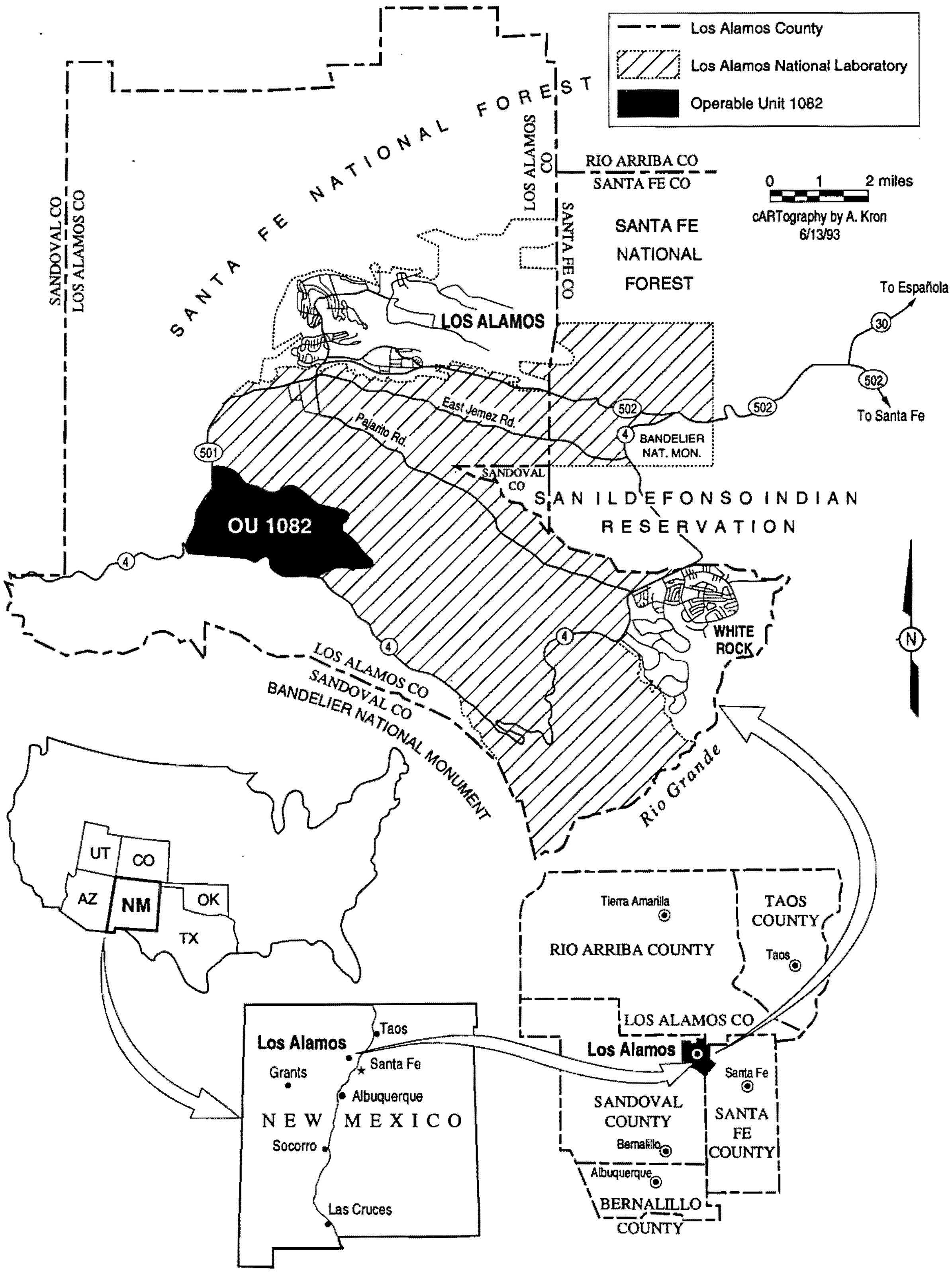

Fig. 2-1. Location of Operable Unit 1082.

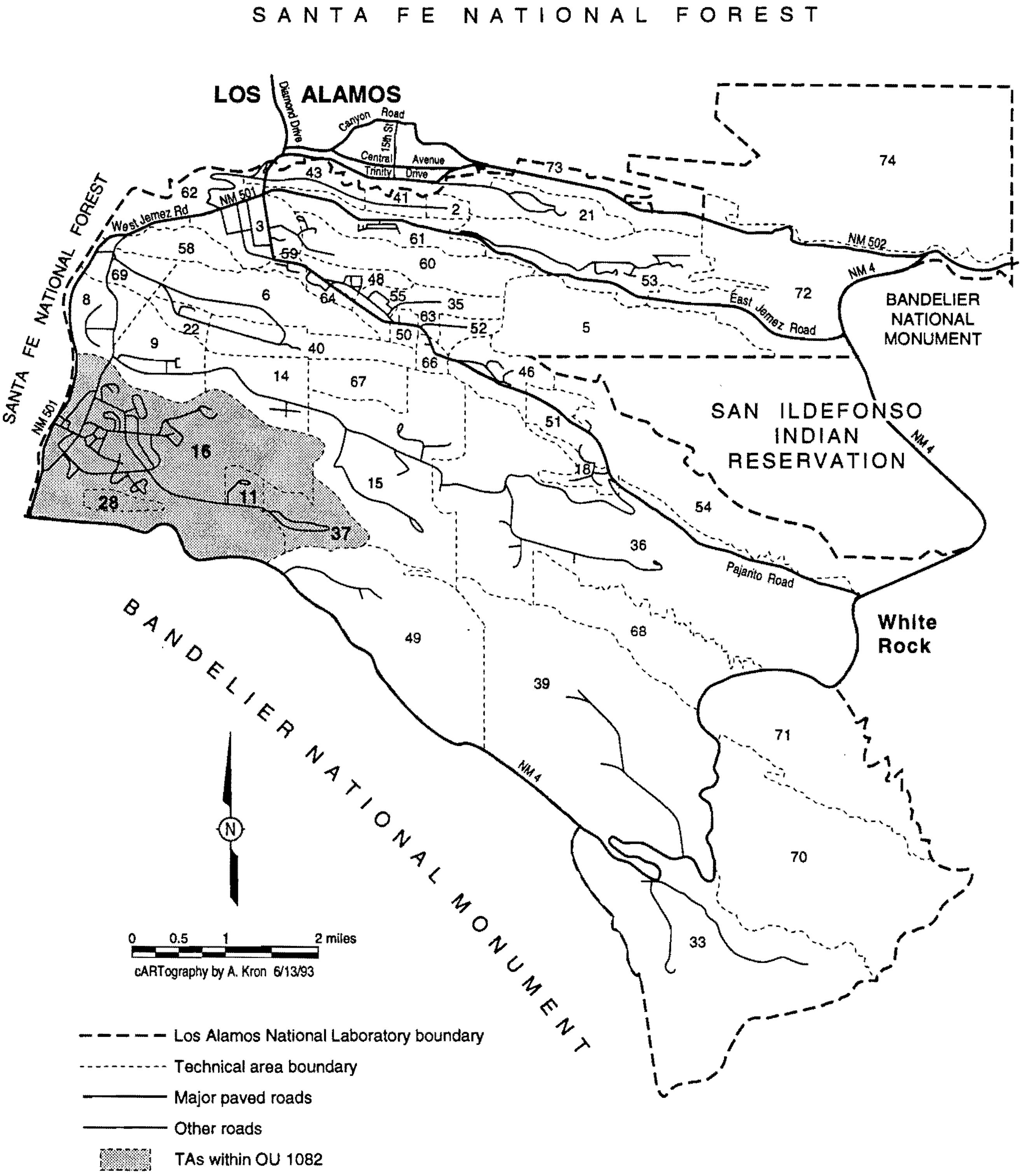

Fig. 2-2. Location of Operable Unit 1082 with respect to Laboratory technical areas and surrounding landholdings.

OU 1082 consists of eight technical areas, two of which were absorbed into TA-16 and two of which were decommissioned (Fig. 2-3 and Fig. 2-4). Those sites that have been absorbed into TA-16 or have been decommissioned and demolished are no longer shown on any figures or maps. The technical areas are listed below with their site designations given in parentheses. All facilities are located within or contiguous to the boundaries of TA-16 (S-Site). Thus, the area is commonly known as the S-Site complex.

The technical areas that compose S-Site are as follows:

TA-11	(K-Site)	Active
TA-13	(P-Site)	Absorbed into TA-16
TA-16	(S-Site)	Active
TA-24	(T-Site)	Decommissioned
TA-25	(V-Site)	Absorbed into TA-16
TA-28	(MAA, Magazine Area A)	Active
TA-29	(MAB, Magazine Area B)	Decommissioned and absorbed into TA-16
TA-37	(MAC, Magazine Area C)	Active

2.2 Operational History

The technical areas composing OU 1082 were established during World War II to develop, fabricate (cast and machine), and test explosive components employed in the United States' nuclear weapons program. Almost all of the work conducted at OU 1082 during World War II was in support of developing, testing, and producing explosive charges for the implosion method. Present use of the technical areas is essentially unchanged. The facilities have undergone extensive expansion and upgrading as explosive and manufacturing technologies have advanced.

Development and testing of explosive formulations, fabrication of explosive charges, and assembly of weapons test devices continues to the present. A variety of explosives have been used at the S-Site complex (Gibbs and Popolato 1980, 15-16-369).

Technical Area 29, Magazine Area B. TA-29 was an abandoned Civilian Conservation Corps camp where two magazines were constructed in 1944 (Bradbury 1947, 15-16-320). All structures were removed in 1957 (Dunning

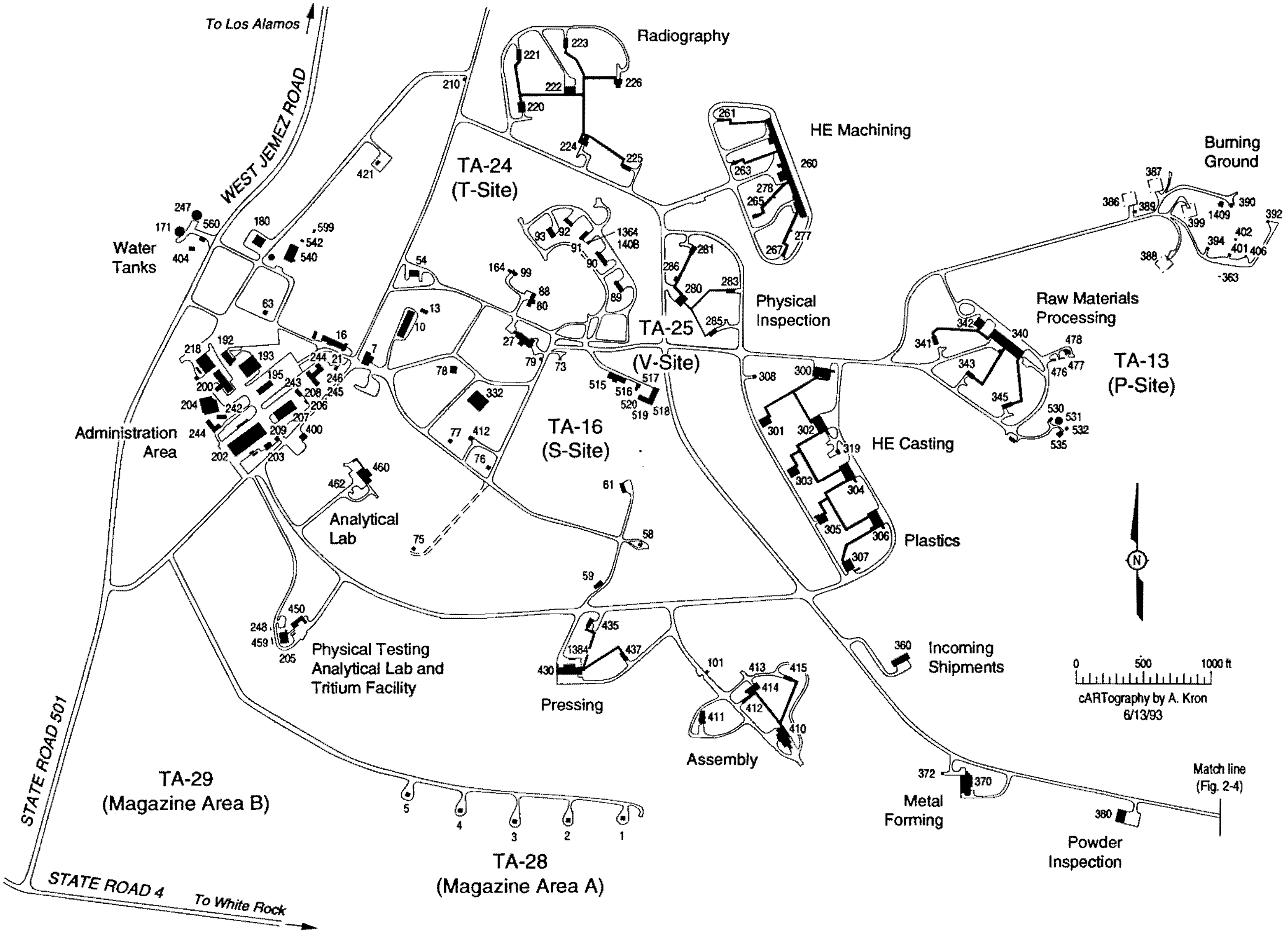

Fig. 2-3. **<u>Existing structures</u> location map of TA-16 (S-Site) and TA-28 (Magazine Area A).**

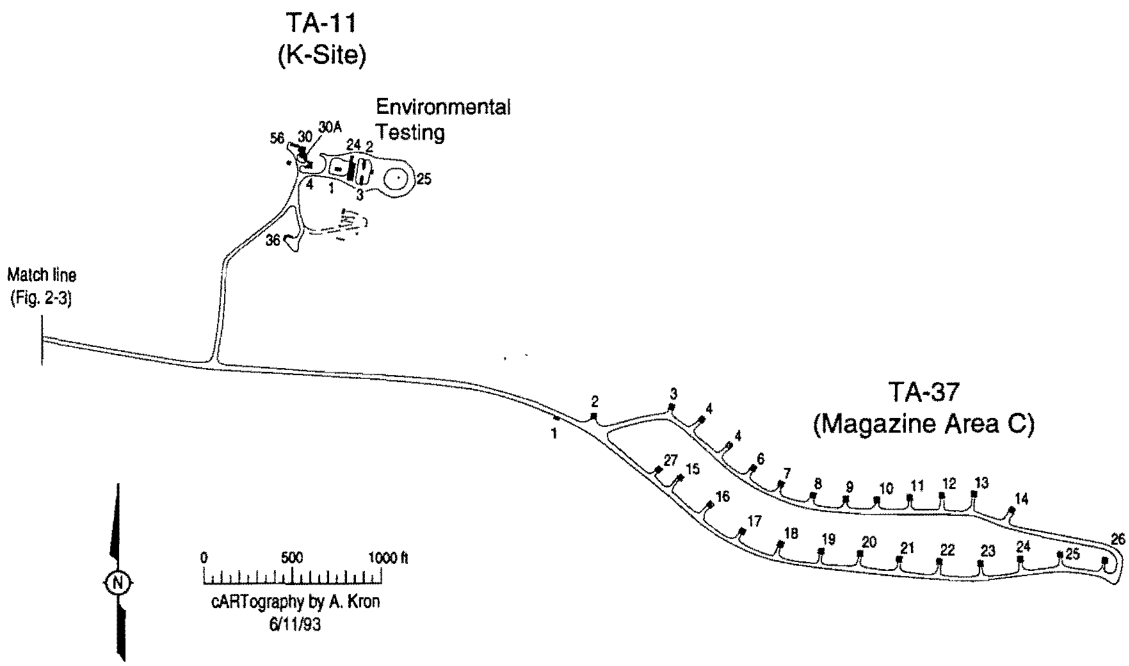

Fig. 2-4. Location map of TA-11 (K-Site) and TA-37 (Magazine Area C).

1957, 15-16-442). TA-29 was decommissioned in 1958-59 and absorbed into TA-16.

Technical Area 11 (K-Site). TA-11 was originally built to house a betatron and a cloud chamber used to study implosion symmetry of high-explosive charges. It has also contained photofission experiment facilities, a mortar impact area, an air gun firing facility, a burning ground, laboratories, storage buildings, sumps, and a material disposal area (MDA S). The major facilities currently at TA-11 are a drop tower and a vibration table that are used for conducting environmental and effects tests on high explosives (HE) systems and components. Drop tests to study impact initiation of explosives may cause HE to fracture or detonate, becoming scattered about the drop tower pad. The resulting debris in the immediate vicinity of the drop tower is picked up and removed for disposal at the TA-16 burning ground. In addition to explosives, radioactive materials, such as natural and depleted uranium, have been used in some drop experiments at the area.

A long-term test of explosive decomposition in soil is being conducted at MDA S. It includes burial of a series of high explosives, which are periodically examined to determine the degree of decomposition.

Technical Area 13 (P-Site). TA-13 was decommissioned and absorbed into TA-16. It was constructed in 1944 to conduct flash x-ray studies of the implosion of HE test devices. It consisted of an office and shop building, laboratory and test buildings, an experimental chamber, a magazine, and a storage building. By the 1950s, most of the buildings had been removed. The remaining buildings were absorbed into the S-Site complex, and were renumbered TA-16-476, -477, and -478. These buildings are now used for HE machining safety studies.

Technical Area 16 (S-Site). Operations at TA-16 center around the production of HE for weapons and non-weapons research and development. TA-16 is a large complex, with over 200 buildings and structures divided into separate operational complexes or building groups, connected by roads. Operations include casting, pressing, and machining of HE; assembly of explosive test devices; fabrication of plastic components; development of new materials; and non-destructive examination. A new high-pressure tritium facility was recently constructed at TA-16. No PRSs are associated with this new facility. Material storage, division and group administration offices, and machine shop facilities are also located at the site. TA-16 includes the locations of former Technical Areas 13, 24, 25, and 29. HE magazines (TAs 28 and 37) are located within the boundaries of the S-Site complex. TA-11 (K-Site) is also generally included as part of the S-Site complex.

Technical Area 24 (T-Site). TA-24 has been decontaminated and decommissioned; the site now lies within TA-16. It was used for x-ray examination of HE charges during the 1940s. Explosives storage magazines and laboratories were part of the facility.

Technical Area 25 (V-Site). TA-25 is no longer operational. It was constructed in 1944 for experimental work in connection with special assemblies. In 1945, the site was altered and became part of TA-16 to allow process work on explosive charges. Structures at the site include an assembly bay, laboratory buildings, an equipment building, and a warehouse. A trial assembly of the Trinity device was conducted at TA-25 in 1945.

Technical Area 28 (MAA; Magazine Area A). TA-28 consists of five magazines used for the storage of HE.

Technical Area 37 (MAC; Magazine Area C). TA-37 consists of twenty-four magazines used for the storage of HE.

2.3 Waste Management Practices

2.3.1 Past Waste Management Practices

Historical waste management practices at the S-Site complex conformed to standard procedures of the day. These procedures focused on safety and minimizing hazards to operating personnel.

The major emphasis was placed on safe disposal of HE and HE-contaminated material. To this end, an extensive system of HE sumps has been used to separate HE from process waste streams. Larger fragments of HE scrap generated by processes not directly associated with the waste stream are also carefully collected for disposal. A detailed description of HE sumps and their operation can be found in Chapter 5, Subsection 5.2.1, of this work plan. While this description is for current activities, the historic operations relied on the same principles.

As disposal quantities of HE or HE-contaminated materials were collected, the waste was taken to one of a number of burning grounds that have existed at S-Site over the years. A detailed description of burning activities, including estimates on typical throughputs, are included in Subsection 5.8.1. Residuals and noncombustible materials from the burning grounds were typically placed in a landfill adjacent to the burning ground or taken to another Laboratory disposal area.

Building drains and septic systems that may have received HE or chemically-contaminated wastes were often connected to outfalls, discharging into canyons either directly or through drain fields.

Many of the buildings at S-Site are equipped with fume hoods that are vented through stacks and blowers. However, no PRSs at OU 1082 are associated with stack emission.

2.3.2 Current Waste Management Practices

Waste-generating operations at S-Site conform to Laboratory waste management policies as described in Administrative Requirements AR-1 through AR-6 of the Laboratory Environment, Safety, and Health Manual (LANL 1990, 0335). These requirements provide for the minimization, segregation, and disposal of mixed waste, low-level radioactive waste, chemical waste, hazardous waste, sanitary landfill waste, and transuranic waste. These Laboratory waste policies are derived from and meet the requirements of appropriate DOE orders, RCRA, State of New Mexico Hazardous Waste Management regulations, and Laboratory practices.

REFERENCES

Bradbury, N. E., September 11, 1947. "General Background Data Concerning the Los Alamos Scientific Laboratory," LASL report to the Manager (US Atomic Energy Commission) from the Director of LASL, Los Alamos, New Mexico. **(Bradbury 1947, 15-16-320)**

Dunning, R. E., July 1, 1957. "Return of Structures, TA-29 and TA-0," LASL Memorandum to John Bolton (ENG-DO) from R. E. Dunning (LAAO), Los Alamos, New Mexico. **(Dunning 1957, 15-16-442)**

Gibbs, T. R., and A. Popolato (Editors), 1980. *Los Alamos Scientific Laboratory Explosive Property Data Handbook*, University of California Press, Berkeley/Los Angeles, California. **(Gibbs and Popolato 1980, 15-16-369)**

LANL (Los Alamos National Laboratory), 1990. "Environmental, Safety, and Health Manual," Los Alamos, New Mexico. **(LANL 1990, 0335)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No, LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

3.0 ENVIRONMENTAL SETTING

This chapter provides a detailed description of the environmental setting at Operable Unit (OU) 1082. It is organized so that the solid waste management unit- (SWMU) specific sampling plans in Chapter 5 can be based on all available relevant information concerning environmental conditions at OU 1082. The environmental setting of the Laboratory as a whole is discussed in detail in Subsection 2.5 of the Installation Work Plan (IWP), Overview of the Environmental Setting (LANL ~~1992, 0768~~ 1993, 1017). This chapter makes specific reference to information contained in the IWP, where such information has relevance to this RCRA facility investigation (RFI) work plan.

Subsections 3.1 through 3.5 of this chapter provide a foundation for the conceptual geologic/hydrologic model in Subsection 3.6. This model pictorially summarizes environmental factors that are likely to influence contaminant migration in OU 1082. This model, hence, is a framework for consideration of remediation alternatives (Chapters 4 and 5), conceptual exposure models (Chapters 4 and 5), and SWMU-specific sampling plans (Chapter 5).

Chapter 2 of the IWP (LANL ~~1992, 0768~~ 1993, 1017) briefly covers regional data on surface water and groundwater quality, air quality, penetrating radiation levels, and chemical and radiation levels in soils where these data are required later in the RFI work plan. These data address environmental conditions beyond the immediate range of effects of TA-16 operations, but may be needed to provide a basis against which TA-16-specific data can be compared.

OU 1082-wide data needs required to understand the behavior of hazardous contaminants in the environment will be addressed in Chapter 5. One goal of the SWMU-specific sampling plans described within Chapter 5 is to identify the nature of environmental transport of hazardous contaminants in the TA-16 region. These results will be used to refine the risk-assessment models in an iterative fashion, and may be used to define the nature and scope of Phase II investigation, voluntary corrective actions, or corrective measures studies.

3.1 Physical Description

Operable Unit 1082 is the westernmost aggregation of technical areas (TAs) at Los Alamos National Laboratory. It is located on an unnamed mesa due east of the Jemez Mountains. The western TAs (13, 16, 24, and 25) within OU 1082 lie at an average elevation of approximately 7 500 to 7 600 ft. TA-11 (K-Site), the burning ground, and Magazine Area C (TA-37), which form the eastern part of the operable unit, lie at a slightly lower elevation (7 200 to 7 500 ft) (Fig. 3-1).

OU 1082 is bounded on the west by the fault scarp of the Frijoles segment of the Pajarito fault zone. This fault yields a fairly steep topographic break at the base of the Jemez Mountains of up to 200 ft. Further discussion of this fault zone is provided in Subsection 3.4 (Geology).

OU 1082 is bounded on the northeast by Cañon de Valle and on the south by State Highway 4. Water Canyon transects the southern half of OU 1082 from west to east. Cañon de Valle runs through OU 1082 south of TA-16-222. These canyons converge at the southeast end of the OU due east of the TA-37 magazines. Cañon de Valle also forms the southern boundary of TAs 9, 14, and 15; thus, sample contamination in this canyon may include contaminants from operations at these sites and TA-16. Bandelier National Monument lies due south of State Highway 4 abutting TA-16, and no other Laboratory operations have occurred up drainage from TA-16 in Water Canyon. Thus, any contamination of this canyon in the TA-16 area is likely to be from operations at TA-16.

Water Canyon extends from the Jemez Mountains to the Rio Grande. Cañon de Valle is a tributary canyon to Water Canyon that also heads in the Jemez Mountains. The former trends roughly from west to east and the latter trends northwest to southeast. Both canyons have steep walls; Water Canyon is as many as 200 ft deep in the TA-16 area (see large topographic map in Appendix E). Water Canyon cuts the Bandelier Tuff along much of its length, the Cerros del Rio basalts in its eastern portion, and Tschicoma Formation dacites in its western portion. Thus, natural metal background in the canyon drainages will reflect the variety of trace elements typical of volcanic tuffs, dacites, and basalts. The drainage area is estimated to be approximately 12.8 square miles of which TA-16 is a small fraction. Both Cañon de Valle

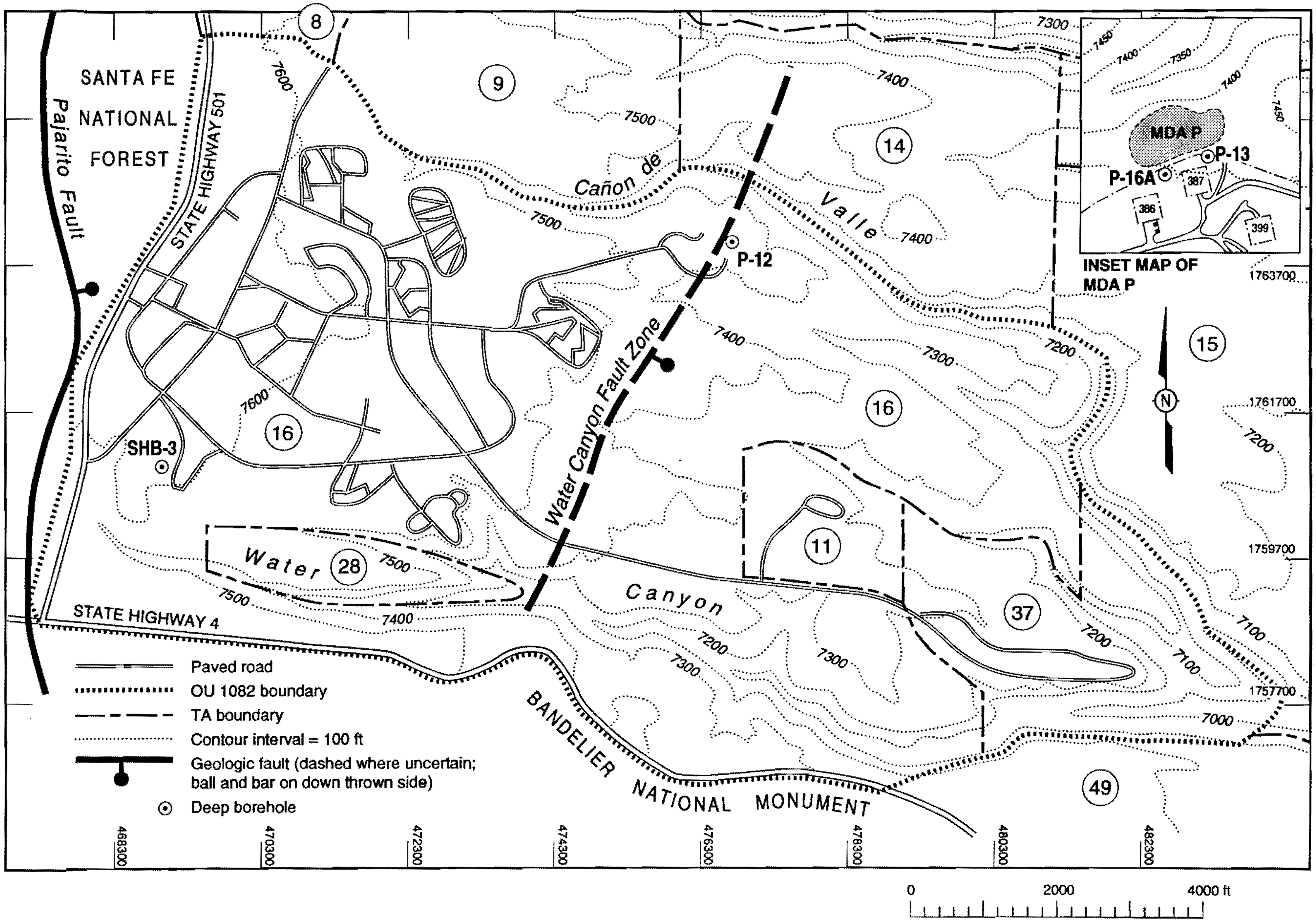

Fig. 3-1. Structural geology and topography of OU 1082 and surroundings.

and Water Canyon are characterized by ephemeral and intermittent runoff of both snowmelt and rainwater. Occasionally such runoff reaches the Rio Grande in Water Canyon. Smaller surface drainages on the TA-16 mesa top are generally oriented north, south, or east, and feed the two larger OU-bounding canyons.

Aerial photographs of the TA-16 area were taken in September 1991 at a scale of (1:7 200), and aerial orthophotographs (1:1 200) with two-foot contour resolution have recently been prepared for the site. This topographic map coverage should be adequate for the majority of investigations associated with this work plan.

3.2 Climate

Los Alamos County has a semiarid, temperate, mountain climate that is described in detail in Bowen (1990, 0033) and in Chapter 2 of the IWP (LANL ~~1992, 0768~~ 1993, 1017).

3.3 Cultural And Biological Resources

Summaries of cultural and biological resources are provided in Appendices A and B.

3.4 Geology

This subsection provides OU-specific information regarding the geology in OU 1082.

3.4.1 Bedrock Stratigraphy

The mesa surfaces of OU 1082 are immediately underlain by the Bandelier Tuff of Pleistocene Age, which outcrops in a few places on the mesa tops and is exposed in canyon walls. Stratigraphic relations within OU 1082 are inferred from shallow and deep core holes, logs of which are depicted in Fig. 3-2 and Fig. 3-3.

A series of 17 shallow boreholes was drilled in the vicinity of the Area P landfill (see Subsection 6.1.4.1) during the summer of 1987 (Brown et al. 1988, 0034). Drilling depths ranged from 35 to 205 ft. Borehole logging of lithologies was done based on four characteristics of the tuff: 1) color, 2) degree of welding, 3) shape and abundance of pumice lapilli, and,

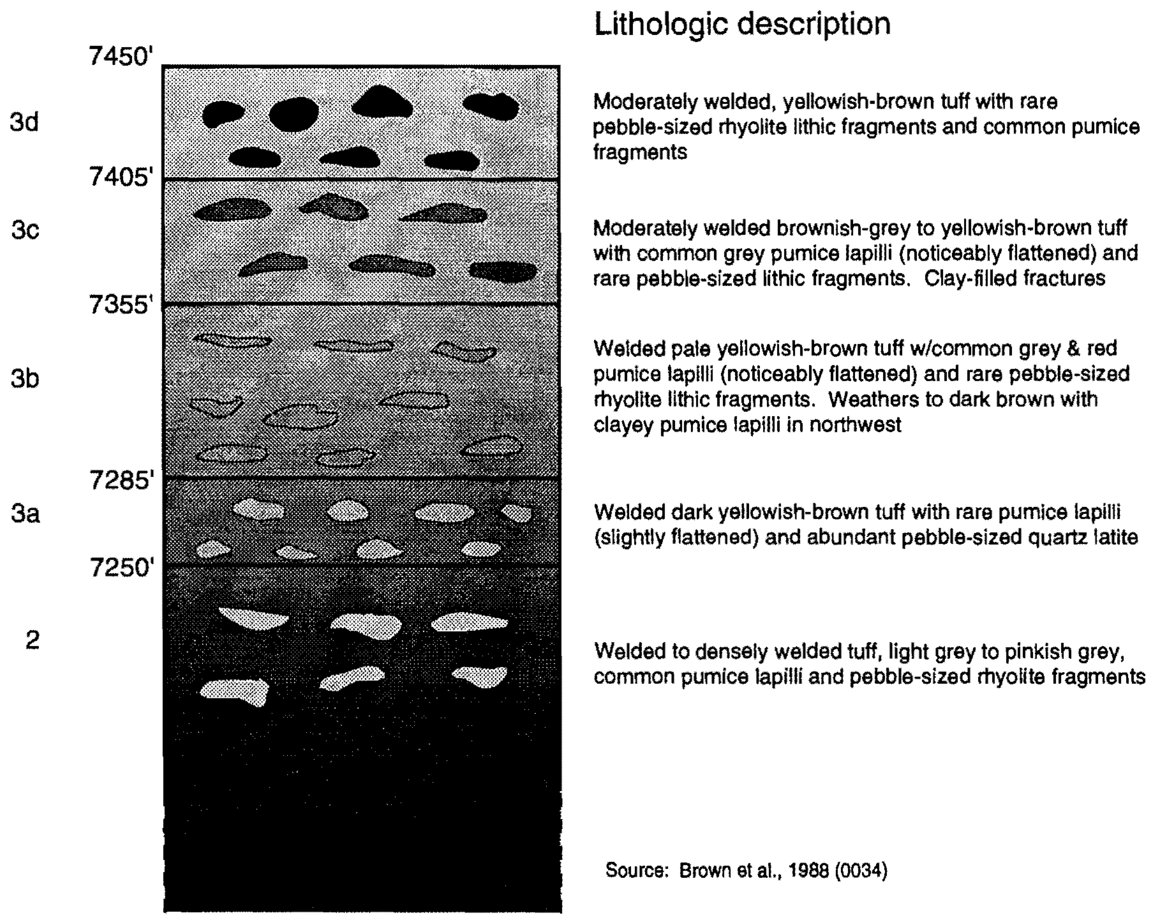

Fig. 3-2. Composite lithologic log of Area P core holes.

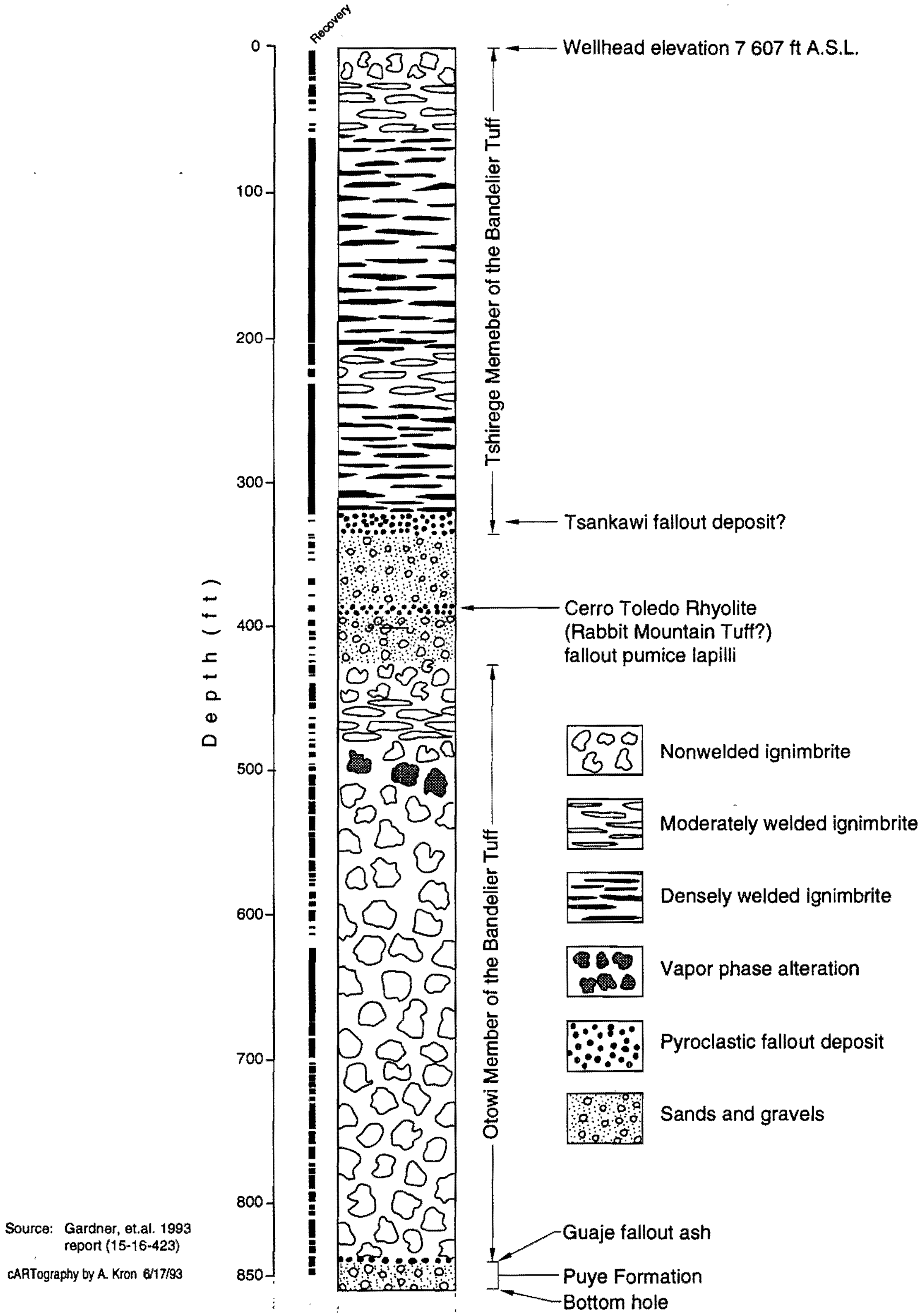

Fig. 3-3. Graphic lithologic log for core hole SHB-3.

4) distribution of lithic fragments. Two major units called Unit 3 and Unit 2 were logged, as were four subunits within Unit 3 (Brown et al. 1988, 0034). A composite stratigraphic log for the Area P landfill area is provided in Fig. 3-2. In general, Bandelier Tuff units surrounding and underlying Area P range from welded to moderately welded, yellowish-brown to gray tuff containing abundant porphyritic quartz latite, to gray to red rhyolitic lithic fragments. Mapped Unit 3d is overlain locally by El Cajete pumice.

A deep borehole (SHB-3) was drilled at TA-16 in November 1991 as part of the Laboratory's Seismic Hazards Program. The drilling site is located in the southwest corner of TA-16 (see Fig. 3-1) with a total accessible depth of 860 ft. Core recovery from this drill hole was nearly 70%. The stratigraphy of this hole is depicted in Fig. 3-3 and summarized below (Gardner et al. 1993, 15-16-423).

Borehole SHB-3 penetrates the Tshirege Member of the Bandelier Tuff in its uppermost 335 ft. At this locality the Tshirege Member is over 95% welded tuff, primarily densely welded material. Cooling breaks between subunits of the tuff are few, with one at a depth of 60 ft and another at a depth of 230 ft. Examination of the core of SHB-3 and lithologic descriptions of core drilled near the burning ground suggest that the cooling break at 230 ft in SHB-3 probably correlates with the top of Unit 3a (Brown et al. 1988, 0034). The lowermost 15 ft of the Tshirege Member in this hole apparently contains the non-welded base of this unit and an unknown thickness of Tsankawi pumice.

Underlying the Tshirege Member of Bandelier Tuff is an almost 100-ft-thick sequence of unconsolidated sands and sandy gravels. These units are lithologically identical to the older Puye Formation and represent epiclastic alluvial deposits shed off the Sierra de los Valles dacite highlands during the hiatus between eruption of the Otowi and Tshirege Members of the Bandelier Tuff. Interbedded with this epiclastic sequence is a coarse, sand-sized pumice fall deposit containing obsidian fragments. This unit is probably genetically related to the Rabbit Mountain Tuff of the Cerro Toledo rhyolite. An unconsolidated alluvial unit such as this would be a likely site for a perched aquifer.

The Otowi Member of the Bandelier Tuff extends from about 424 to 839 ft in SHB-3. It consists almost entirely of non-welded tuff with a zone of minor welding from 450 to 480 ft. The Guaje pumice unit is only one foot thick at the base of the Otowi Member in SHB-3.

Puye Formation sands and boulder-rich gravels underlie the Otowi Member from a depth of 839 ft to the bottom of the drill hole. Cobbles and clasts of these epiclastic alluvial deposits consist primarily of dacitic lithologies of the Tschicoma Formation in the Sierra de los Valles. The main aquifer lies within the lower Puye Formation and the Santa Fe Group at a likely depth of greater than 1 000 ft.

3.4.2 Structure

Two large, near-vertical faults, the Frijoles segment of the Pajarito fault zone and the Water Canyon fault, have been mapped within or near OU 1082. The former, located due west of the western boundary of OU 1082, is the largest segment of the Pajarito fault system in the Los Alamos area, with down-to-the-east displacement ranging up to 400 ft during the last 1.1 million years (Gardner and House 1987, 0110) (Fig. 3-1). The Laboratory's Seismic Hazards Program is currently investigating the nature and timing of movement along this fault system, including a trench near S-Site.

The Water Canyon fault, which is mapped as passing through the TA-16 burning ground (Fig. 3-1), is inferred in the subsurface from interpretation of seismic lines (Dransfield and Gardner 1985, 0082) and has been tentatively identified as offsetting units in the Bandelier Tuff (Brown et al. 1988, 0034) (Fig. 3-1). However, unpublished mapping south of TA-16 (Hickmott 1993, 15-16-402) suggests that the fault does not break the surface south of Water Canyon along its projected trace. Broad zones of intense fracturing superimposed on primary cooling joints are associated with major faults in the Los Alamos region (Vaniman and Wohletz 1990, 0541). Analogous clay-filled vertical fractures were mapped in Subunit 3c (Brown et al. 1988, 0034). Unlike cooling joints, such tectonic fractures are likely to cross flow units and may provide a deeply penetrating flow path for groundwater migration.

3.4.3 Surficial Deposits

3.4.3.1 Alluvium and Colluvium

A general description of alluvial and colluvial deposits around the Laboratory are provided in the IWP, Subsection ~~2.6.1.6~~ 2.6.1.2.10 (LANL ~~1992, 0768~~ 1993, 1017).

Surficial deposits on the plateau surface of OU 1082 consist of coarse-grained colluvium on steep hill slopes and along the bases of cliffs, finer-grained alluvial and colluvial sediments with a thin cover of eolian sediments on the flatter parts of mesa surfaces, and alluvial to colluvial fan deposits at the mouths of steeper drainages or on escarpments related to post-Bandelier faulting. Deposits in the major canyons (Cañon de Valle and Water Canyon) consist of colluvial materials on and at the base of cliffs and canyon walls, representing large volume mass wasting, and fluvial sediments deposited by intermittent streams along the axes of canyon floors.

A more than 100 ft long by 10 ft deep trench was excavated within OU 1082 during June 1992 as part of the Laboratory's Seismic Hazards Program. The trench exposed colluvial wedges derived from the Sierra de los Valles west of the Pajarito fault system. At least four major colluvial deposits, each overlain by a soil horizon, are exposed in the trench. The underlying colluvial unit is 4-ft thick and tapers westward. It is overlain by a well-developed paleosol horizon, which is overlain in turn by a second, thinner (up to 3 ft) colluvial wedge consisting of coarse-grained poorly-sorted El Cajete pumice fragments.

3.4.3.2 Soil

The nature and thickness of soils at TA-16 may influence the transport of hazardous contaminants in the local environment. Soil mineralogy, permeability, grain size, organic content, and chemistry are all factors that may impede or enhance the movement and concentration of individual hazardous constituents within the operable unit.

Soils in Los Alamos County were mapped and described by Nyhan et al. (1978, 0161). The soils were all formed in a semiarid climate and include material derived from Bandelier Tuff bedrock. Table 3-1 and Fig. 3-4 show the spatial distribution and nature of soils at TA-16 (Nyhan et al. 1978, 0161).

TABLE 3-1

TA-16 SOILS

ABBRE-VIATION	NAME	LOCATION	PERMEABILITY	WATER HOLDING	THICKNESS
TC	Typic Eutroboralfs skeletal	Administration area	Low	Low	46-122+ cm
TS	Typic Eutroboralfs fine	260-Line, 340-Line	Low/moderate	Medium	51-94 cm
TO	Tocal very fine sandy loan	Burning ground, WW II area	Low/moderate	Low	28-36 cm
TR	Typic Ustorthents	South TA-16	Moderate	Low	13-35 cm
PG	Pogna fine sandy loam	Scattered	Moderate/high	Low	13-30 cm
TV	Totavi gravelly loam	Scattered	Very high	Low	0-152 cm
SA	Sanjue-Arriba complex	Rare-east	High/very high	Very low	46-153 cm
FR	Frijoles very fine sandy loam	East S-Site	Very high in subsoil	Very low	46-152+ cm
CR	Carjo loam	TA-37	Moderate	Medium	51-102 cm

A wide variety of soil types occurs at TA-16 (Table 3-1). These include: Typic Eutroboralfs (both clayey-skeletal and fine), Tocal very-fine sandy loam, Frijoles very-fine sandy loam, Pogna fine sandy loan, Totavi gravelly loam, Sanjue-Arriba complex, Carjo loam, and Rabbit-Tsankawi rock outcrop (Fig. 3-4). These soil units grade into outcrops of Bandelier Tuff along the margins of the mesa tops. Soils are generally thicker in the western portions of OU 1082 (Fig. 3-5).

Chapter 2 of the IWP (LANL 1992, 0768) states that an impermeable clay zone often forms at the soil-tuff interface on the Pajarito Plateau. Supposedly, this layer provides an effective barrier to the movement of groundwater from the soil into the underlying tuff (Weir and Purtymun 1962, 0228; Abeele et al. 1981, 0009). However, disturbed areas, where soils have been scraped off and bedrock exposed, would not effectively seal off infiltration of surface waters into tuff.

3.4.3.3 Erosional Processes

Erosion on the mesa tops in OU 1082 is caused primarily by shallow runoff on the relatively flat mesa surfaces, by deeper runoff in channels cut into the mesa surfaces, and by rock falls and colluvial transport from the steep

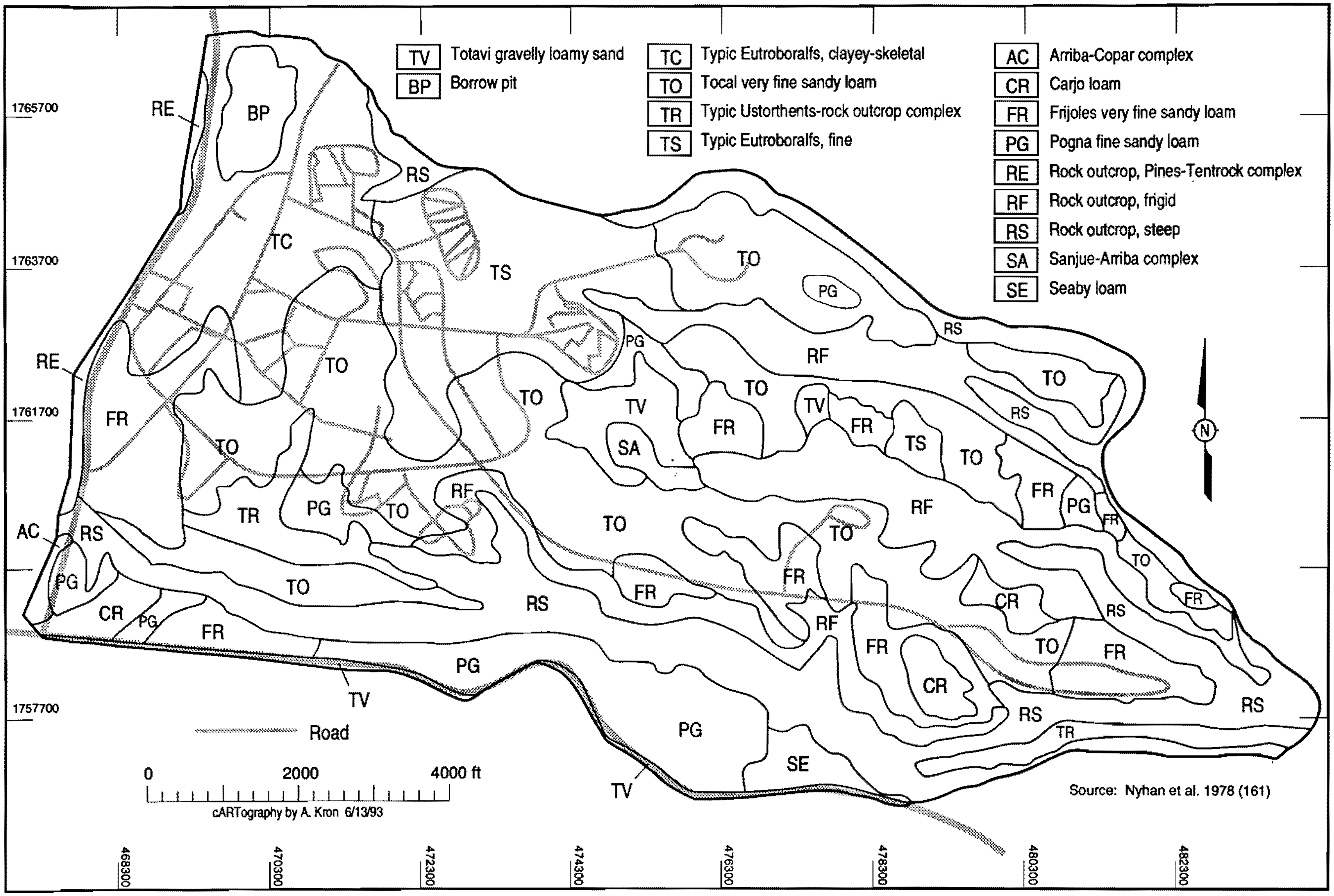

Fig. 3-4. Soil map for OU 1082.

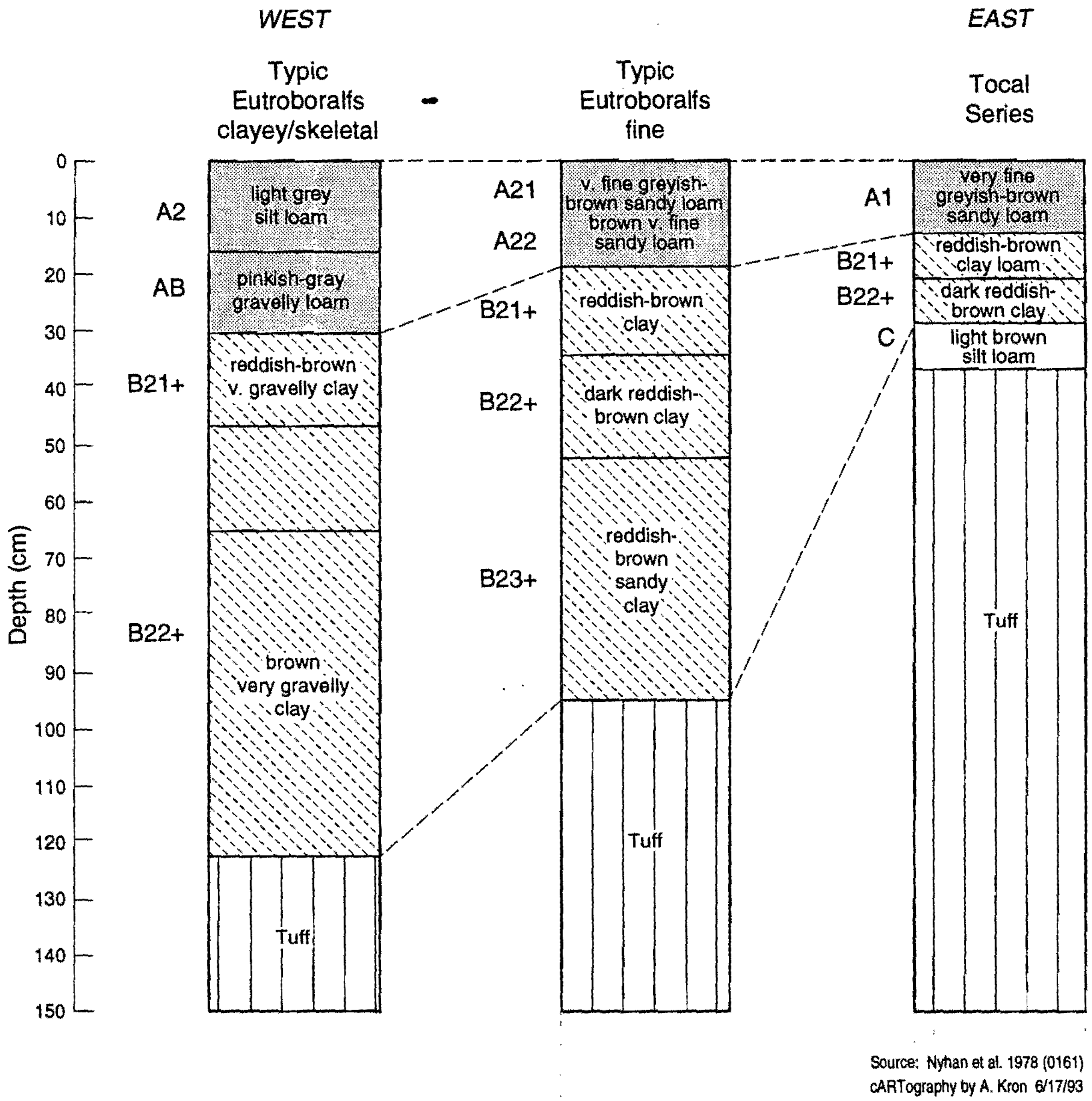

Fig. 3-5. Typical sections of common soils at TA-16 (S-Site).

canyon walls. Erosion within the canyon bottoms occurs primarily by channelized flow along stream courses on the canyon floors.

Erosion of colluvial materials may occur as: 1) small masses of material that tumble down canyon walls, 2) small debris flows that issue from the mouths of subsidiary channels to the main canyon drainages, or 3) slides of large, relatively coherent landslide blocks from the steeper mesa edges.

Contaminants stored in sediments on mesa tops may be transported into the canyons, and potentially off site, by large-scale runoff events on the mesa surfaces, or may be carried in large masses of rock and debris as they slide down valley walls into the canyon bottoms. Contaminated sediments in the canyon bottoms are most likely to be transported off site in major runoff events. Waste sites in OU 1082 most likely to be susceptible to off-site mobilization are those that lie close to the edges of mesas or near active channels in canyon bottoms.

3.5 Conceptual Hydrologic Model

The groundwater pathway is unlikely to be an important transport pathway at TA-16 because of the great depth to the main aquifer (>1 000 ft). However, surface and vadose zone hydrology may strongly influence the stability and movement of contaminants in the TA-16 area.

3.5.1 Surface Water Hydrology

Surface water runoff and infiltration into soil are the most important hydrologic transport pathways at TA-16. Both high explosives (HE) and barium, the principal contaminants at TA-16, are moderately to strongly soluble (Layton et al. 1987, 15-16-447; Brown et al. 1992, 15-16-389), and thus may be transported in surface water. Aspects of the surface hydrology at TA-16 that may be relevant to contaminant transport include: 1) the location of pathways of surface water runoff and associated sediment deposition; 2) rates of soil erosion, transport, and sedimentation; 3) the effects of operational disturbances on surface hydrology; 4) the relative importance of surface runoff versus infiltration as a transport pathway in different soil types; 5) the solubility behavior of TA-16 contaminants (particularly HE and barium) in surface aquifers; 6) the nature of interactions between soils and water-borne TA-16 contaminants; and, 7) the ultimate fate of surface water at TA-16.

3.5.1.1 Surface Water Runoff

Surface water runoff is an effective means of transporting many contaminants, particularly highly soluble contaminants, in environmental media at TA-16. Runoff can mobilize contaminants and transport them off site or concentrate dispersed surficial contaminants through solution and reprecipitation or sorption processes. Surface water runoff from TA-16 flows from ephemeral streams on the mesa tops into Cañon de Valle and Water Canyon and ultimately into the Rio Grande, or infiltrates downgradient. There is no evidence for the hydraulic connection of surface water and the regional aquifer at TA-16 or elsewhere at the Laboratory (IWP, Chapter 2), although it is possible there is a connection between discharge sinks in canyon bottoms and the main aquifer east of OU 1082. Permanent alluvial aquifers are not known in Cañon de Valle or Water Canyon, but surface runoff may occasionally recharge short-lived alluvial systems.

As described in the IWP, the heaviest precipitation on the Pajarito Plateau occurs during summer thunderstorms. These thunderstorms can produce transient high discharge rates that may transport dissolved material, colloids, and contaminated sediments. Both these rain-induced events and snowmelt may yield ephemeral stream flows in the major canyons that could reach the Rio Grande.

No comprehensive study of surface runoff from the mesa tops and canyons constituting the surface watershed of the Pajarito Plateau has been completed. A recent experimental study (Nyhan et al. 1984, 0165; Nyhan and Lane 1986, 0159) suggests that runoff is up to three times greater from backfilled soil than from naturally vegetated areas. Much of TA-16 has been disturbed by construction, so that runoff will be a significant transport pathway in the operational section of this technical area.

Water quality data have been collected downstream from TA-16 in Water Canyon for the past 30 years. Water chemistry analyses over this period have generally shown that contaminant abundances are below levels of concern (Environmental Protection Agency, New Mexico Environment Department, and Department of Energy standards) for barium and other metals. It is interesting to note that soluble barium concentration at the confluence of Water Canyon with the Rio Grande is larger (0.187 mg/L) than in the other sampled Canyons: Pajarito, 0.043 mg/L; Ancho, 0.043 mg/L; and Frijoles, 0.015 mg/L (Environmental Protection Group 1992, 0740).

3.5.1.2 Surface Water Infiltration

Surface water infiltration is a potential mechanism for surface contaminants to move into subsurface soils and tuffs and eventually reach perched or regional aquifers. Surface water infiltration is considered to be a minor transport mechanism at the Laboratory because of the great depth to the regional aquifer, the high evaporative potential of the upper tuff, the likelihood of vegetative transpiration, and the resulting naturally low moisture content and high porosity of the tuffs (LANL 1992, 0768).

3.5.2 Hydrogeology

The hydrogeology of the Laboratory and the occurrence of surface water and groundwater are summarized in Subsection 2.6 of the IWP (LANL ~~1992, 0768~~ 1993, 1017). Canyon and mesa topography and the ash deposits of the Bandelier Tuff control the hydrogeology of OU 1082. The hydrology (occurrence and movement of water in surface and subsurface environments) of individual SWMUs in OU 1082 is controlled by the physiographic location of each SWMU in canyon bottoms, canyon rims, or mesa tops. The majority of OU 1082 SWMUs lie on the mesa tops, although a few SWMUs, such as SWMU 16-018 (MDA P), are located on the rims of the canyons. The following discussion presents site-specific information on the hydrologic conditions in Water Canyon and on the mesa top of OU 1082.

3.5.2.1 Vadose Zone

The mesa top of OU 1082 overlies at least 850 ft of unsaturated Bandelier Tuff, interbedded epiclastic sediments and pumice falls, and underlying Puye Formation sediments. The hydrology of the mesa top vadose zone is discussed in Subsection ~~2.6.3~~ 2.6.2 of the IWP (LANL ~~1992, 0768~~ 1993, 1017). In general, the IWP suggests that the Bandelier Tuff is not saturated, except in very shallow and localized areas. The low moisture content and extensive thickness of unsaturated rock is believed to impede movement of fluids downward to the main aquifer (LANL 1992, 0768).

Hydrologic characteristics of unfractured Bandelier Tuff depend on degree of welding, with porosity and hydraulic conductivity generally decreasing with increased degree of welding. Brown et al. (1988, 0034) investigated hydraulic conductivity and gravimetric moisture for tuff samples recovered during 1987 drilling operations at Area P. Samples obtained during drilling at Area P were not saturated, according to these workers. At Los Alamos, saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7 ft/day and for a welded tuff ranges from 0.009-0.26 ft/day (Abeele et al. 1981, 0009). However, because fracture density is generally greatest in welded tuffs, saturated hydraulic conductivities are often highest in the welded parts of ash flow deposits (Crowe et al. 1978, 0041).

Table 3-2 summarizes gravimetric moisture data collected for Unit 3 by Brown et al. (1988, 0034). Nyhan (1989, 0154) reports volumetric water content data for three of the monitoring wells at Area P (Fig. 3-1), which are summarized in Fig. 3-6. In Bandelier Tuff samples, Nyhan reports low volumetric water contents in the background well (P-12), and significantly higher (up to 36%) volumetric water contents in core holes nearer the landfill (P-13 and P-16). He ascribes these higher volumetric water contents to an unlined drainage ditch that traverses the southern landfill boundary.

TABLE 3-2

AVERAGE GRAVIMETRIC MOISTURE CONTENTS

SUBUNIT	MEAN (%)	STANDARD DEVIATION	RANGE (%)
3d	5.2	3.6	2.2-17.7
3c	6.1	3.5	1.9-24.7
3b	5.7	2.1	2.3-11.4
3a	3.8	1.4	2.3-5.8
Total unit	5.8	3.0	1.9-24.7

All data are from Brown et al. 1988, 0034

Although the range of 1.9% to 24.7% for background volumetric water content is considered low, these values exceed gravimetric moisture contents for technical areas further to the south and east (5 to 11% at TA-33, 2 to 20% for TA-54; Brown et al. 1988, 0034) and values reported in the IWP (5%). This higher range may be a result of increased rainfall at TA-16 relative to

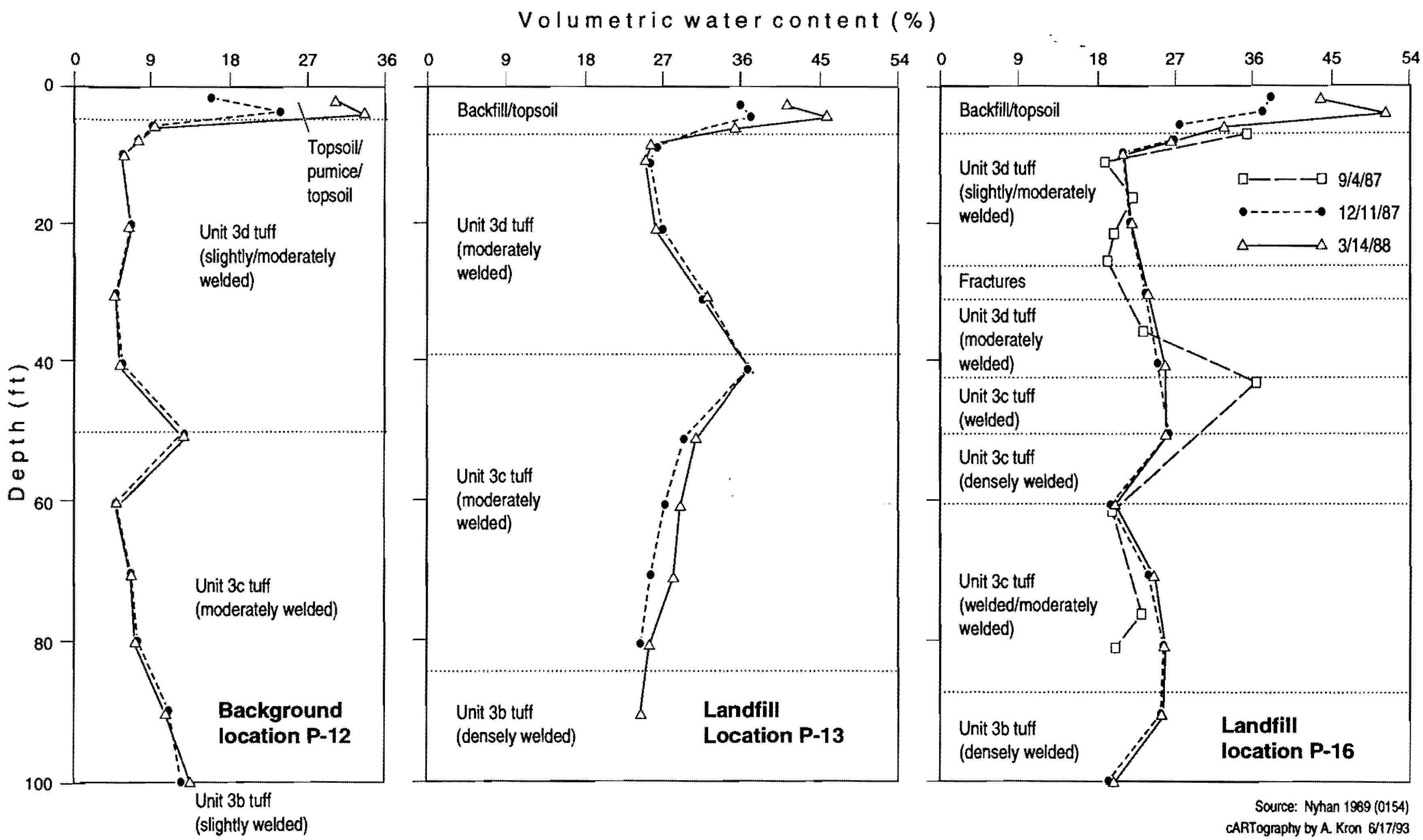

Fig. 3-6. Volumetric water content data from representative drill holes for the Area P landfill area.

the eastern portions of the Laboratory. Saturation of the Tshirege Member of the Bandelier Tuff, and thus groundwater, occurs at a gravimetric moisture content of 29% (Abrahams 1963, 0011). When moisture content is below 7%, there is no water movement; between 7 to 21% moisture is redistributed by diffusion; between 21 to 29% it is mobilized by gravity and capillarity; and above 29%, movement is by gravity drainage. Thus, at Area P the primary mechanism of moisture movement is by diffusion.

3.5.2.2 Alluvial Aquifers

Surface water in saturated alluvium within canyons is discussed in Subsection ~~2.6.4~~ 2.6.2 of the IWP (LANL ~~1992, 0768~~ 1993, 1017). Surface water occurs primarily as ephemeral streams in the two major canyons adjacent to OU 1082, although perennial water flow occurs in parts of Cañon de Valle and Water Canyon because of spring discharge and process water discharged from TA-16-260 and other buildings. Stream flow moves downgradient into the alluvium for an unknown distance. Stream loss caused by infiltration into the underlying alluvium typically prevents water flow from discharging across the eastern boundary of the OU. During periods of voluminous stream runoff or snowmelt, surface flow may reach the Rio Grande. The possible existence of perennial aquifers in these canyons has not been investigated. Such aquifers occur in other canyons on the Pajarito Plateau (LANL ~~1992, 0768~~ 1993, 1017).

3.5.2.3 Perched Aquifer

Perched water may occur in epiclastic sediments and basalts in the Pajarito Plateau (IWP, Subsection ~~2.6.5~~ 2.6.2.3) (LANL ~~1992, 0768~~ 1993, 1017). Seismic Hazards Well SHB-3 (see Fig. 3-1) erupted large volumes of water following air injection at a depth of 750 ft (Gardner et al. 1993, 15-16-423). Either the main aquifer or a perched aquifer was reached at this depth. Analysis of these fluids suggests that they represent groundwater, based on the absence of drilling additives in the fluid. Calculations suggest that the top of the groundwater column filling SHB-3 could have been no deeper than 365 ft. This result implies that the groundwater system has sufficient head to drive water up natural conduits such as faults and fractures, potentially forming a perched aquifer. The possible nature and location of perched aquifers in and around OU 1082 is not known. Further investigation of fluids in SHB-3 is required to determine whether the fluids represent perched water or the main aquifer. Ongoing chemical and isotopic studies of fluids from this hole may provide information on the sources of these materials.

3.5.2.4 Main Aquifer

The depth to the main aquifer at OU 1082 has not been determined. The hydrology of the main aquifer beneath the Pajarito Plateau is described in Subsection ~~2.6.6~~ 2.6.2.3 of the IWP (LANL ~~1992, 0768~~ 1993, 1017). According to the IWP, the main aquifer is located primarily in the Santa Fe Group and Puye Formation at depths of several hundred to greater than 1 000 ft below the mesa tops. Based on current knowledge of the hydrology of the Plateau as reflected in the IWP, the potential for impact on the main aquifer or the municipal drinking water supply from the SWMUs in OU 1082 is thought to be extremely low.

3.6 Conceptual 3-D Geologic/Hydrologic Model of OU 1082

A conceptual model for OU 1082 has been developed based on the discussion of environmental setting presented in Subsections 3.1 through 3.5 of this chapter. The conceptual model is presented in simplified diagrammatic form in Fig. 3-7. The physical processes and major pathways included in the model are based on current knowledge of the OU environment and the types of SWMUs present at OU 1082. The processes and pathways discussed below provide the basis for the SWMU-specific conceptual models for potential contaminant releases presented in Chapters 4 and 5. The primary release mechanisms and migration pathways of concern are:

- surface runoff and sediment transport,
- erosion and surface exposure,
- infiltration and transport in the vadose zone, and,
- atmospheric dispersal of particulates.

These pathways are believed to provide the greatest potential for release and transport of contaminants to the environment at OU 1082. Additional release migration pathways of lesser concern are fluid transport via alluvial aquifers, perched water, springs, and seeps.

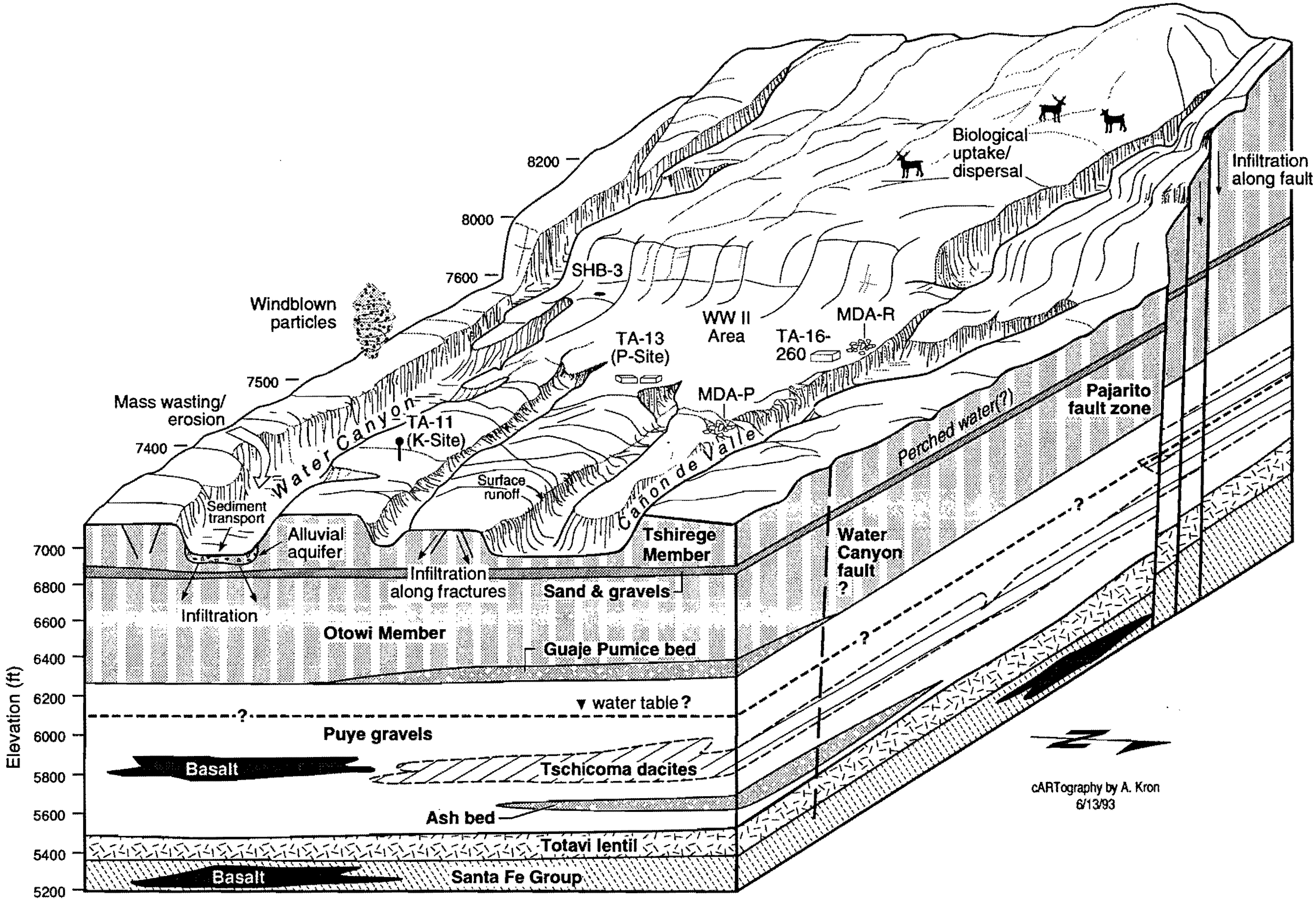

Fig. 3-7. Conceptual hydrogeologic model of OU 1082.

3.6.1 Surface Water Runoff and Sediment Transport

Surface water runoff and sediment transport are the migration pathways of greatest concern for transport of contaminants to off-site receptors. Surface water runoff is concentrated by natural topographic features and man-made diversions, and flows toward the canyons. A topographic low can cause runoff to pond and infiltrate into the mesa top, or facilitate sorption of contaminants onto finer-grained clay-rich sediments or organic particles. Contaminant transport by surface water runoff can occur in solution, by adsorption on suspended colloids, or with movement of heavier bedload sediments. Surface soil erosion and sediment transport are functions of soil properties and runoff intensity. Contaminants transported in runoff can disperse or concentrate in sediment traps in drainages. Erosion of drainage channels can disperse contaminants downgradient in a drainage.

3.6.2 Erosion and Surface Exposure

Soil erosion and mass wasting are long-term release mechanisms that may expose subsurface contaminants or allow water to access previously contained wastes. Erosion of surface soils depends on soil properties, vegetative cover, slope, exposure, intensity and frequency of precipitation, and seismic activity. Mass movements of rock from canyon walls is a discontinuous process that generally proceeds at a slow rate, but can be an important mechanism for exposing subsurface contaminants located near canyon rims.

3.6.3 Infiltration and Transport in the Vadose Zone

Infiltration into surface soils and tuffs depends on the rates of precipitation and snowmelt, the amount of ponding, the nature of vegetation, *in situ* moisture content, and the hydraulic properties of soil and tuff. Joints and faults may provide pathways for infiltration and release of contaminants into the shallow subsurface. Movement of liquids in soil and tuff is dominated by transient, unsaturated flow processes influenced by infiltration and evapotranspiration. The movement of contaminants by liquids in the unsaturated zone can occur in a free-liquid phase, in solution, or by adsorbed particles on colloids. Contaminants may be retarded as a result of adsorption on tuff or on organic material present in soil or alluvium. Precipitation of insoluble, contaminant-rich minerals such as barite may also retard the mobility of specific contaminants. Lateral flow or perched water may occur at unit contacts, between layers whose hydraulic properties differ, and in alluvial aquifers. Saturated lateral flow may discharge as springs or seeps on canyon walls or in canyon bottoms. Vapor phase movement in the unsaturated zone is a potentially important transport mechanism for volatile contaminants. Movement of contaminants in the vapor phase is influenced by concentration gradients, temperature gradients, density gradients, and/or air pressure gradients. Fractures may enhance liquid-phase or vapor-phase contaminant transport in the subsurface.

3.6.4 Atmospheric Dispersion

Wind entrainment of contaminated particulates, detonation or burn products, material releases from point sources such as stacks, or volatile organic compounds is a potential pathway for atmospheric dispersal of contaminants. This dispersal mechanism is limited to HE detonation and combustion by-products, surface contaminants, and vapors released from soil pore gases, as well as point sources. Entrainment and deposition of particulates is controlled by soil properties, surface roughness, vegetative cover, terrain, and atmospheric conditions including wind speed, wind direction, and precipitation. Vapor dispersion is controlled by similar factors.

Not all release mechanisms and migration pathways discussed in this subsection are believed to be significant for all SWMUs. The generic conceptual models in Chapter 4 and the SWMU-specific conceptual models in Chapter 5 indicate for which SWMUs these contaminant dispersal processes may operate.

REFERENCES

Abeele, W. V., M. L. Wheeler, and B. W. Burton, October 1981. "Geohydrology of Bandelier Tuff," Los Alamos National Laboratory Report LA-8962-MS, Los Alamos, New Mexico. **(Abeele et al. 1981, 0009)**

Abrahams, J. H., Jr., January 1963. "Physical Properties of and Movement of Water in the Bandelier Tuff, Los Alamos and Santa Fe Counties, New Mexico," US Geological Survey Administrative Release, Albuquerque, New Mexico. **(Abrahams 1963, 0011)**

Bowen, B. M., May 1990. "Los Alamos Climatology," Los Alamos National Laboratory Report LA-11735-MS, Los Alamos, New Mexico. **(Bowen 1990, 0033)**

Brown, F., W.D. Purtymun, A. Stoker, and A. Barr, February 1988. "Site Geology and Hydrology of Technical Area 16, Area P," Los Alamos National Laboratory Report LA-11209-MS, Los Alamos, New Mexico. **(Brown et al. 1988, 0034)**

Brown, R. A., B. Martin, and D. Hickmott, 1992. "Barium Transport at S-Site and Laser-induced Breakdown Spectroscopy (LIBS): Its Application to Field Screening of Barium in Soils," unpublished report. **(Brown et al. 1992, 15-16-389)**

Crowe, B. M., G. W. Linn, G. Heiken, and M. L. Bevier, April 1978. "Stratigraphy of the Bandelier Tuff in the Pajarito Plateau, Applications to Waste Management," Los Alamos Scientific Laboratory Report LA-7225-MS, Los Alamos, New Mexico. **(Crowe et al. 1978, 0041)**

Dransfield, B. J., and J. N. Gardner, May 1985. "Subsurface Geology of the Pajarito Plateau, Española Basin, New Mexico," Los Alamos National Laboratory Report LA-10455-MS, Los Alamos, New Mexico. **(Dransfield and Gardner 1985, 0082)**

Environmental Protection Group, March 1992. "Environmental Surveillance at Los Alamos During 1990," Los Alamos National Laboratory Report LA-12271-ENV, Los Alamos, New Mexico. **(Environmental Protection Group 1990, 0740)**

Gardner, J. N., T. Kolbe, and S. Chang, in press. "Geology, Drilling, and Some Hydrologic Aspects of Seismic Hazards Program Coreholes, Los Alamos National Laboratory, New Mexico," Los Alamos National Laboratory Report LA-12460-MS, Los Alamos, New Mexico. **(Gardner et al. 1993, 15-16-423)**

Gardner, J. N., and L. House, October 1987. "Seismic Hazards Investigations at Los Alamos National Laboratory, 1984 to 1985," Los Alamos National Laboratory Report No. LA-11072-MS, Los Alamos, New Mexico. **(Gardner and House 1987, 0110)**

Hickmott, D., January 7, 1993. "Mapping South of S-Site," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:001 to B. Martin (CLS-DO) from D. Hickmott (EES-1), Los Alamos, New Mexico. **(Hickmott 1993, 15-16-402)**

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)**

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

Layton, D., B. Mallon, W. Mitchell, L. Hall, R. Fish, L. Perry, G. Snyder, K. Bogen, W. Mallock, C. Ham, and P. Dowd, 1987. *Conventional Weapons Demilitarization: A Health and Environmental Effects Data-Base Assessment, Explosives and Their Co-Contaminants, Final Report, Phase II.* US Army Medical Research and Development Command, Fort Detrick, Frederick, MD, P.O. 83PP3813, AD-UCRL-21109. **(Layton et al. 1987, 15-16-447)**

Nyhan, J. W., L. W. Hacker, T. E. Calhoun, and D. L. Young, June 1978. "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. **(Nyhan et al. 1978, 0161)**

Nyhan, J. W., W. V. Abeele, B. A. Perkins, and L. J. Lane, December 1984. "Development of Corrective Measures Technology for Shallow Land Burial

Facilities at Arid Sites," *Proceedings of the Sixth Annual Participants' Information Meeting, Department of Energy Low-Level Waste Management Program*, CONF-8409115, prepared by EG&G Idaho, Inc., Idaho Falls, Idaho, pp. 277-300. **(Nyhan et al. 1984, 0165)**

Nyhan, J. W., and L. J. Lane, May 1986. "Erosion Control Technology: A User's Guide to the Use of the Universal Soil Loss Equation at Waste Burial Facilities," Los Alamos National Laboratory Manual No. LA-10262-M, Los Alamos, New Mexico. **(Nyhan and Lane 1986, 0159)**

Nyhan, J. W., March 1989. "A Hydrologic Modeling Study of Water Balance Relationships at the Area P Landfill in Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-11521-MS, Los Alamos, New Mexico. **(Nyhan 1989, 0154)**

Vaniman, D., and K. Wohletz, November 14, 1990. "Results of Geological Mapping/Fracture Studies: TA-55 Area," Los Alamos National Laboratory Memorandum EES1-SH90-17, Los Alamos, New Mexico. **(Vaniman and Wohletz 1990, 0541)**

Weir, J. E., Jr., and W. D. Purtymun, 1962. "Geology and Hydrology of Technical Area 49, Frijoles Mesa, Los Alamos County, New Mexico," US Geological Survey Administrative Release, Albuquerque, New Mexico. **(Weir and Purtymun 1962, 0228)**

Executive Summary

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4.0 TECHNICAL APPROACH

This section presents the technical approach for the evaluation of potential release sites (PRSs). The technical approach described herein is applied to all PRSs in Chapter 5.

4.1 Aggregation of Potential Release Sites

Chapter 5, Evaluation of Potential Release Sites (PRSs), presents the conceptual models, data needs, data quality objectives, and sampling and analysis plans for all PRSs that will have a current RCRA facility investigation (RFI). In Chapter 5, PRSs are aggregated when it makes sense to address several of them as a unit in terms of characterization, risk assessment, and/or remediation. For example, the active firing site PRSs associated with Technical Area (TA) 11 are aggregated (Subsection 5.14) since only the potential for off-site hazards will be evaluated in this RFI and final investigations and corrective actions will be postponed until decommissioning. This may be considered to be a conditional remedy, consistent with proposed Subpart S guidance. Most aggregates considered in Addendum 1 to this work plan (Subsections 5.18 through 5.25) are grouped based on geographical proximity for use in a risk assessment. Tables 1-4 and 1-4a in Chapter 1 ~~lists~~ list the aggregates and related PRSs and the section in Chapter 5 where these aggregates are presented. A detailed discussion of the rationale for aggregating the PRSs is given in the background subsection (Subsection 5.x.1) for each aggregate.

4.2 Approaches to Site Characterization

This work plan adheres to the Environmental Restoration (ER) Program technical approach for data collection and evaluation as documented in Chapter 4 of the Installation Work Plan (IWP) (LANL 1992, 0768 1993, 1017). This technical approach adopts the philosophy of the Observational Approach (Appendix G, IWP) (LANL ~~1992, 0768~~ 1993, 1017), which bases decisions for action [e.g., collecting additional data vs moving from the facility investigation to the corrective measures study (CMS)] on definitions for acceptable uncertainties that depend on the current phase of the investigation. Investigations are phased so that decisions remain closely tied to the ultimate goal of selecting an appropriate corrective action and so that they are formulated in light of what is already known about the site. The ER Program has adopted a risk-based approach to making corrective action decisions during the RFI/CMS process. In this work plan, the Data Quality Objectives (DQO) process [Chapter 4 and Appendix ~~I~~ H of the IWP (LANL ~~1992, 0768~~ 1993, 1017)] is used to identify site-specific risk-based decisions or risk-related questions, to identify and, in some cases, quantify risk-based decision errors, and to specify sampling designs to support the risk-based decisions or risk-related questions. This RFI work plan emphasizes human risk; however, ecological risk will also be considered in the future.

Ecological risk assessment and Natural Resource Damage Assessment (NRDA) methodology is currently under development, and guidance on the measurement end points and spatial scales for determining significant ecological effects ~~will be available in the next IWP~~ is available in Appendix L of the IWP (LANL 1993, 1017). No further action (NFA) for individual PRSs will be proposed based on a comparison to human health risk-based screening action levels (SALs) or a baseline health risk assessment, but an ecological risk assessment will have to be conducted at the appropriate spatial scale to identify ecological effects. If unacceptable ecological effects are identified, then the NFA decisions will be revisited. The contribution of all PRSs, including those proposed for NFA, to the unacceptable ecological risk will be assessed so that an effective mitigation strategy can be developed.

Certain environmental criteria, as required by the National Environmental Policy Act (NEPA), Endangered Species Act, wetlands executive orders, or Historic Preservation Act will be evaluated before sampling or any other significant site activity. Section 7 of the Federal Endangered Species Act requires that all Federal agencies, including the US Fish and Wildlife Service, ensure that site activities will not jeopardize the continued existence of a Federally listed threatened or endangered species. The purpose of these evaluations is to determine the impact of sample collection on components of the environment protected by these specific regulations. These regulatory drivers may be important in future ecological risk assessments, and include:

- State or Federal sensitive, threatened, or endangered plant or animal species that potentially occur in Operable Unit (OU) 1082,
- sensitive areas (e.g., flood plains or wetlands), and
- plants and wildlife of cultural importance.

4.2.1 Decision Model

A goal of this RFI is to detect the presence of contaminants of concern (COCs). COCs are defined as hazardous constituents or radionuclides whose levels are ~~either~~ above SALs and above background levels. SALs are media-specific concentration levels for potential contaminants derived using conservative criteria. SALs are discussed in Subsection 4.2.2.

The first step in the RFI is to evaluate archival information and make field reconnaissance visits to formulate a conceptual model for the site (Fig. 4-1). A detailed flow diagram of RCRA decisions requiring environmental data is presented in Fig. 4-1 of the IWP (LANL 1993, 1017). These data help develop a list of potential contaminants of concern (PCOCs).

As shown in Fig. 4-1, NFA or deferred action (DA) may be recommended after the first step of the RFI. Criteria for NFA or DA based on archival information are discussed in Subsections 4.2.4 and 4.4.1 of ~~the IWP (LANL 1992, 0768)~~ this work plan and the details are described in Appendix I, Subsection 4.1 of ~~that document~~ the IWP (LANL 1993, 1017). The PRSs recommended for NFA or DA based on archival information are presented in Chapter 6 of this work plan and are depicted on a fold-out map in Appendix E. Some of the DA PRSs are also discussed in Chapter 5 because they will have current investigations to evaluate off-site migration; for example, TA-11 Firing Site Aggregate (Subsection 5.14).

NFA or DA is based on human health concerns, but these decisions may be revisited based on an ecological risk assessment performed at a later date.

In some cases existing site data are adequate to identify the need for a corrective action. If there is an obvious, feasible, and effective remedy, then a voluntary corrective action (VCA) (Subsection 4.2.3) will be implemented;

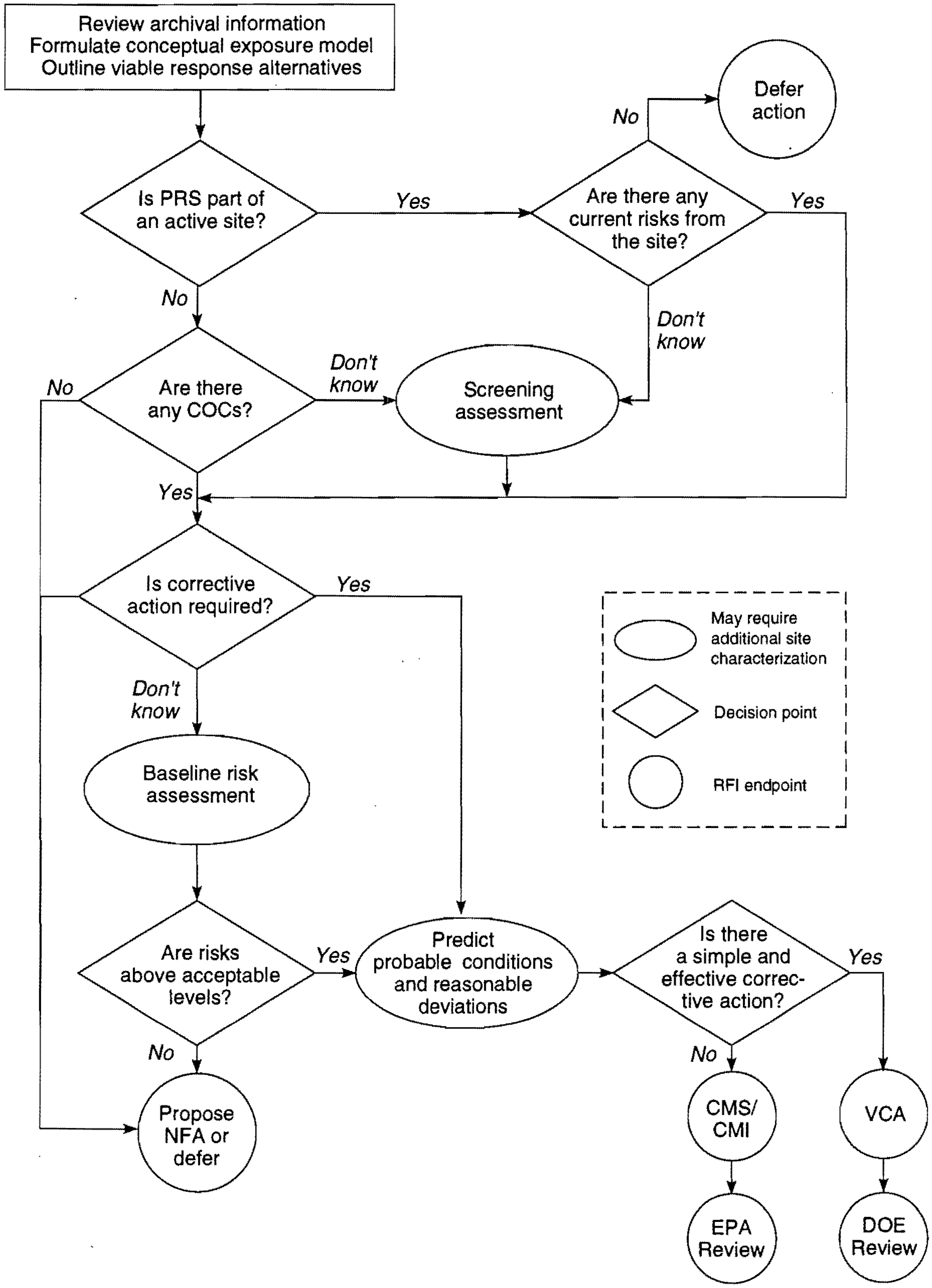

Fig. 4-1. Decision flow during the RFI.

otherwise, a corrective measures study (CMS) will be required. Some sump outfalls (Subsections 5.2, 5.3) will have VCAs.

In other cases, PRSs may have known contaminants, but the historical data are inadequate to quantify the hazard associated with a site. These sites require Phase I data to support a baseline risk assessment. These data include the nature and extent of contamination. PRSs included in this category are the sanitary waste treatment plant (Subsection 5.7), the burning ground (Subsection 5.8), Cañon de Valle (Subsection 5.9), the ponds (Subsection 5.12), and TA-13 (Subsection 5.13).

For many PRSs in OU 1082 the archival information indicates that it is highly probable there are no COCs at the site, but there are no existing data and the archival information is not sufficient to recommend NFA. For these sites, and sites where virtually no information exists, a screening assessment will be conducted to determine the presence or absence of COCs. A primary goal of screening assessments (most Phase I investigations) is to identify those PRSs that pose no hazard to human health or the environment so that they can be recommended for NFA. Eliminating non-problems through screening assessments allocates resources efficiently and effectively, and provides timely corrective actions for those PRSs that present the greatest hazard.

The generic logic flow for screening assessments is shown in Fig. 4-3 of the IWP (LANL 1993, 1017). Descriptions of sampling strategies for screening assessments are given in Subsection 4.5. There are two principal kinds of sampling strategies used in a screening assessment: reconnaissance sampling and baseline risk assessment sampling, although in some cases reconnaissance sampling may eventually be used in a baseline risk assessment. The purpose of reconnaissance sampling is to determine if there are any COCs at a PRS where there is little or no historical information. The purpose of baseline risk assessment *sampling* is to collect data to support two decisions: 1) determine if there are any COCs by comparing concentrations to SALs, and 2) perform a baseline risk assessment. Baseline risk assessment sampling is used where data suggest that some potential contaminants will exceed SALs, and a baseline risk assessment is likely.

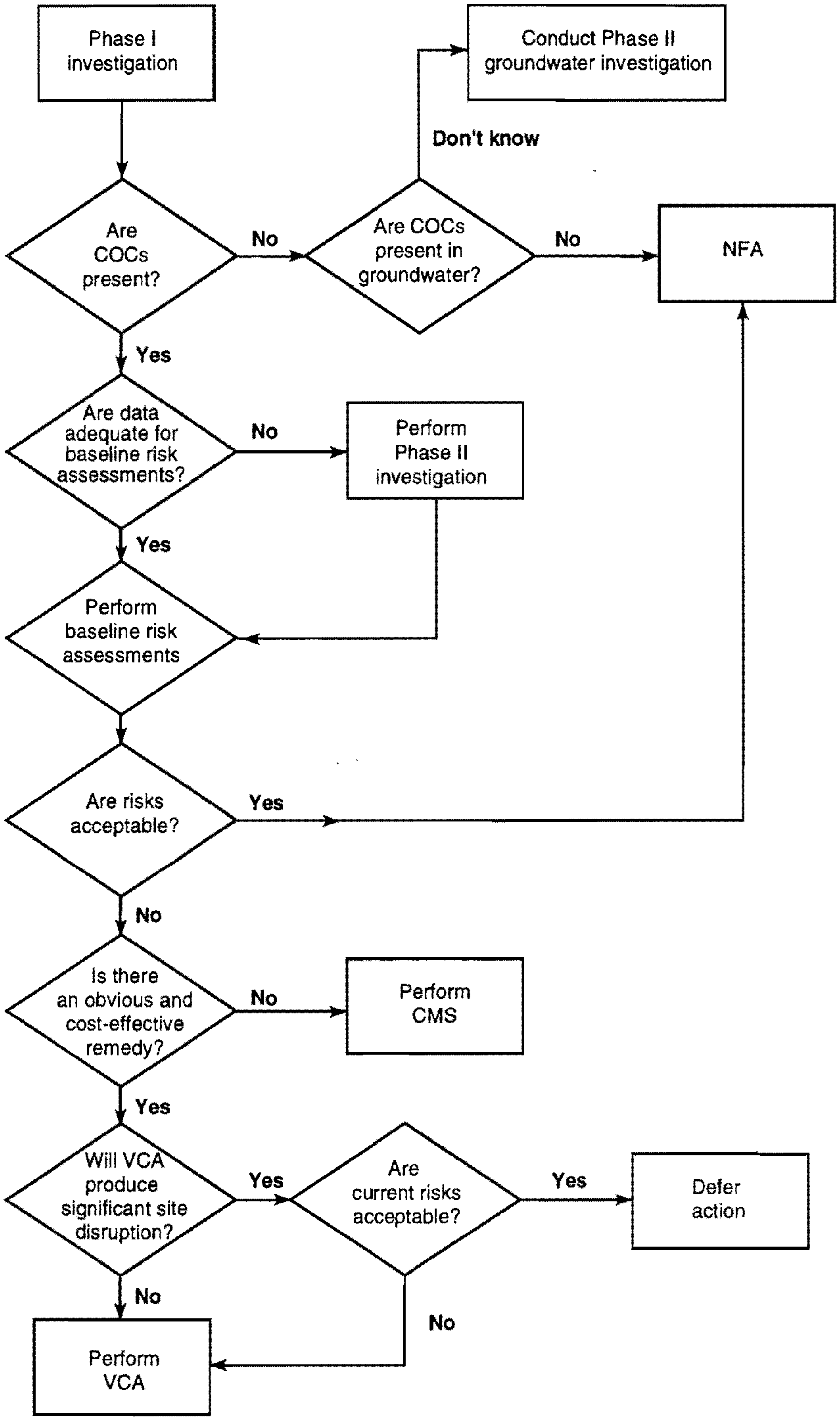

Fig. 4-2. Decision logic for actions subsequent to Phase I investigations.

If COCs are detected in the screening assessment, then a decision will be made to either implement a VCA or perform a baseline risk assessment. Figure 4-2 presents the decision logic subsequent to the screening assessment phase. This figure has been slightly modified from the figure (Fig. 4-1) presented in the IWP (LANL 1993, 1017). Additional characterization data may be required for these phases. The baseline risk assessments for OU 1082 will be performed using the ~~risk~~ exposure scenarios described in Subsection 4.3.

PRS or PRS aggregate-specific decision processes are described in the Remediation Decisions and Investigations Objectives sections of Chapter 5.

4.2.2 Screening Action Levels

SALs are media-specific concentration levels for potential contaminants derived using conservative criteria (IWP, Appendix J) (LANL ~~1992, 0768~~ 1993, 1017). In most cases, SALs for nonradiological potential contaminants are based on the methodology in Proposed Subpart S of 40 CFR 264 to calculate action levels (EPA 1990, 0432). Radiological SALs are based on a 10 mrem per year dose using a residential-use exposure scenario. However, if a regulatory standard exists ~~and is lower than the value derived by these methods~~ (e.g., maximum contaminant levels in water), then this ~~lower~~ value is used in place of the SAL. The derivation of SALs is discussed in Chapter 4 of the IWP and the values for nonradiological and radiological constituents are given in Appendix J (LANL ~~1992, 0768~~ 1993, 1017). The motivation for developing SALs is to have a tool for effective discrimination between problem and non-problem sites so that resources are used effectively. SALs are not cleanup levels; cleanup levels will be based on site-specific risk evaluations and as low as reasonably achievable (ALARA) criteria. In some cases, cleanup levels may be higher than SALs. For example, if the site will never be used for residential use, the site-specific land-use scenario (e.g., recreational use) could allow higher levels of soil contamination than the conservative residential use scenario used to calculate SALs.

SALs for the primary PCOCs at OU 1082 are given in Tables 4-1 and 4-1a. These PCOCs were identified through the evaluation of archival information, historical data, and the literature on high explosives (HE) (see Appendix D).

TABLE 4-1

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Acetone	5.1, 5.2, 5.3, 5.12	8240	100/100 ppb	GC/PID	50 ppb	PID	0.2	0	3 500	8 000
ADNT (g)								0		
Amines (a)								0		
Ammonium nitrate (d)								0		
Ammonium sulfate	5.2							0		
Anthracene	5.2	8270	10/660 ppb	GC/FID	1 ppm			0	10 000	24 000
Anthranils (i.e., 2,6 dinitroanthranil) (a)								0		
Asbestos	5.10, 5.13, 5.14							0		
Barium	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, 5.17	6010	2.0/0.2	XRF	10 ppm	LIBS	<100	125-829	2 000	5 600
Benzene	5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	0.67
Beryllium	5.2, 5.7, 5.12, 5.13, 5.14	6010	0.3/0.03			LIBS	0.1	1.0-4.4	4	0.16
BDNPA (d)								0		
BDNPF (d)								0		
Bromodichloromethane	5.2	8240	5/5 ppb	GC/PID	10 ppb			0	0.56	11
BTX (f)								0		
Butyl acetate, n-	5.2							0		
Cadmium	5.2, 5.12	6010	4.0/0.4	XRF	2 ppm			1.2-1.70	5	80
Carbon disulfide	5.7	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	3 500	7.4
Carbon tetrachloride	5.2	8420	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	0.21
Cesium-137		γ spec	20 pCi/L / 0.1 pCi/g	Gross γ	4 pCi/g			0-1.4	110 pCi/L	4 pCi/g
Chlorobenzene	5.2, 5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	100	67
Chloroethane	5.7	8240	10/10 ppb	GC/PID	10 ppb	PID	0.2	0	NA	3 300
Chloroethene	5.1							0		
Chloroform	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	100	0.21
Chloromaleic anhydride	5.2							0		
Chloromethane	5.7	8240	10/10 ppb	GC/PID	10 ppb	PID	0.2	0	27	6.4
Chlorothene	5.2							0		

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Chromium	5.1, 5.2, 5.12, 5.15	6010	7.0/0.7	XRF	8 ppm	LIBS	2	2.03-71.07	100	400 (VI)
Copper	5.7, 5.14	6010	6.0/0.6	XRF	3 ppm			2-18	1 300	3 000
Cyanide	5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.14, 5.15, 5.16	9010	0.01/5					0	200	1 600
Cyanuric acid (c)								0		
DATB (c)								0		
Decyclgallophenone (f)								0		
Di(2-ethyl) sebacate (f)								0		
2-Amino-4,6-DNT (a)								0		
4-Amino-2,6-DNT (a)								0		
Dibromochloromethane	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	4.2	83
Dichloroethane, 1,2-	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	0.2
Diethylene triamine	5.2, 5.5							0		
Dimethyldisulfide	5.7							0		
Dimethylformamide	5.2							0	3 500	8 000
1,1 Dimethylhydrazine (a)								0		
1,2 Dimethylhydrazine (a)								0		
Dimethylsulfoxide	5.1, 5.3							0		
1,3 DNB (a)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	4.0/0.25					0	3.5	8
Dinitroethylbenzene (f)								0		
Dinitroglycoluril (e)								0		
3,5 Dinitrophenol (d)								0		
2,4 DNT (a)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	5.7/0.25	GC/FID	1 ppm			0	0.05	1
2,6 DNT (a)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	9.4/0.26	GC/FID	1 ppm			0	0.05	1
Dipentaerythritol hexanitrate (a)								0		

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Dioctyl phthalate		8270	10/660 ppb	GC/FID	1 ppm			0	700	1 600
EDD (d)								0		
Ethyl acetate	5.1, 5.2							0	32 000	72 000
Ethylene glycol	5.1, 5.2							0	70 000	160 000
Formaldehyde (a)								0		
Freon-PCA solvent	5.1							0		
n-Hexane	5.2							0	2 100	4 800
HMX	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	13.0/2.2			HE spot		0	1 800	4 000
Hydrazines (a)								0		
Lead	5.2, 5.10, 5.13, 5.14	6010	42.0/4.2	XRF	10 ppm	LIBS	2	18-56	50	500
Lithium hydride	5.17							0		
MAN (e)		8270						0		
Mercury	5.2, 5.4, 5.15	7470		XRF	30 ppm			0.007-0.029	2	24
Methanol (a)								0	18 000	40 000
Methylcyclohexane	5.2							0		
Methyl ethyl ketone (2-Butanone)	5.2	8240	100/ 100 ppb	GC/PID	50 ppb	PID	0.2	0	1 700	4 000
Methylene chloride	5.2, 5.7	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	5.6
Methylnitramine (a)								0		
N-methylpicramide (a)								0		
Nickel	5.12	6010	15.0/1.5	XRF	4 ppm			1.6-19	100	1 600
Nitrate (a,f)	5.9	9200	1 mg/L / 1 ppm					0	10 000	130 000
Nitriles (i.e., 2,4,6 trinitrobenzonitrile) (a)								0		
Nitrite (a)			0.02 mg/L/NA					0	1 000	8 000
Nitrobenzene (d)		8330	NA/0.26					0	18	5.3
Nitrocellulose (d)	5.2							0		

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Nitroguanadine (c)								0		
Nitromethane (c)								0		
2 NT (a)		8330	12.0/0.25					0	350	800
3 NT (a)		8330	7.9/0.25					0	350	800
4 NT (a)		8330	8.5/0.25					0	350	800
NTO (e)								0		
Octyl	5.2							0		
PAH (h)	5.9, 5.10, 5.13, 5.14							0		
Pentaerythritol	5.2							0		
PETN (c)						HE spot	100	0	700	1 600
Picric acid (e)								0		
Plutonium-238	5.7, 5.14, 5.15, 5.16	α spec	0.04 pCi/L / 0.005 pCi/g	Gross α/β	25 pCi/g	FIDLER	>100 nCi/m2	<0.01 pCi/g	15 pCi/L	27 pCi/g
Plutonium-239,240	5.7, 5.14, 5.15, 5.16	α spec	0.04 pCi/L / 0.005 pCi/g	Gross α/β	25 pCi/g	FIDLER	100 nCi/m2	<0.052 pCi/g	15 pCi/L	24 pCi/g
Polonium-210	5.13							---		
PYX (e)								0		
RDX (b)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	14.0/1.0			HE spot	100	0	3.2	64
Silver	5.4, 5.5, 5.6, 5.7, 5.9, 5.14, 5.15, 5.16	6010	7.0/0.7	XRF	17 ppm			1.61	170	400
TAGN (f)								0		
TATB (c)						HE spot	100	0		
TCP (f)								0		
Tetryl (d)		8330	44.0/0.65					0	350	800
Thallium		6010		XRF	15 ppm			0	2	6.4
Thorium-232	5.7, 5.14			Gross α/β	25 pCi/g			---	15 pCi/L	0.88 pCi/g
1,3,5 TNB (a)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	7.3/0.25					0	1.8	4

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
2,4,6 TNT (b)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.16	8330	6.9/0.25			HE spot	100	0	12	40
Toluene diisocyanate	5.2							0		
Toluene	5.1, 5.2, 5.3, 5.7, 5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	1 000	890
Trichloroethane, 1,1,1-	5.2	8240	5/5 ppb	GC/PID	10 ppm	PID	0.2	0	200	1 000
Trichloroethylene	5.1, 5.4, 5.8, 5.12							0	5	3.2
Trimethyl phenol	5.2							0		
Trinitroethylbenzene (f)								0		
Trinitrostilbene (f)								0		
Tripentaerythritol acetonitrate (a)								0		
Tripicrylmelamine (e)								0		
Uranium (natural)	5.2, 5.3, 5.4, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16			XRF	10 ppm			1.54-6.73	NA	66 pCi/g
Uranium-235	5.14, 5.15, 5.16	α spec	0.2 pCi/L / 0.05 pCi/g	Gross α/β	25 pCi/g	Phoswich	35 pCi/g	---	21 pCi/L	18 pCi/g
Uranium-238	5.14, 5.15, 5.16	α spec	0.2 pCi/L / 0.05 pCi/g	Gross α/β	25 pCi/g	Phoswich	35 pCi/g	---	6.7 pCi/L	59 pCi/g
Zinc	5.7	6010	2.0/0.2	XRF	34 ppm			38-71	10 000	24 000

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.1 THROUGH 5.17

Additional entries will be made in this table as they become available.
Note: All MDLs are extremely case-specific because of varying sample matrices and geometries and count times.
NA Not available
(1) Potential contaminants of concern (PCOCs) include all chemicals specifically listed in Chapter 5, potentially hazardous HE components (see Appendix D), and HE co-contaminants (see Appendix D).
(2) Potential release sites in which the PCOC is of concern based on archival research.
(3) SW 846 method unless otherwise indicated.
(4) Method detection limits for EPA methods are taken directly from those listed in the appropriate SW 846 method or from the QAPjP. ICP metals detection limits in soils estimated as 100x water MDLs.
(5) Estimated by ~~EM-9~~ CST-9.
(6) Beryllium, lead, and chromium from Han and Cremers 1990 (15-16-470). PID from manufacturers' specifications. Uranium and plutonium equal ~~HS-4~~ ESH-4 estimate. TNT from Baytos 1991, 0741. HMX, RDX, TATB, and PETN estimated by ~~WX-12~~ ESA-12.
(7) ~~Local metal and radionuclide values~~ Copper, mercury, nickel, and zinc are from Ferenbaugh et al. 1990, 0099; radionuclides from Purtymun et al. 1987, 0211; and other materials from Duffy and Longmire 1993, 15-16-480.
(8) ~~SALs for TCL and TAL materials from IWP. HE SALs calculated using method described in IWP Appendix J. Water SALs are the lowest of those calculated for IWP Table J-1, and those listed in IWP Table J-2 as Safe Drinking Water Act or State of New Mexico MCLs. Radionuclide SALs calculated using RESRAD assuming a 10 mrem/yr exposure limit.~~ SALs are based on methodology presented in Subsection 4.2.2 and Appendix J of the IWP (LANL 1993, 1017).
(a) HE impurity or environmental breakdown product.
(b) HE component used at TA-16 (est. > 500 000 lbs.; all estimated for 50-year time frame 1944-1993 by L. Hatler of WX-3).
(c) HE component used at TA-16 (est. 10 000 to 100 000 lbs).
(d) HE component used at TA-16 (est. 1 000 to 10 000 lbs).
(e) HE component used at TA-16 (est. 100 to 1 000 lbs).
(f) HE component used at TA-16 (est. < 100 lbs).
(g) HE component used at TA-16 (unknown, but low quantities).
(h) HE burn products.

Abbreviations
ADNT - 3,5-dinitiro-1,2,4-triazole
BDNPA - Bis(dinitroproponyl) acetal
BDNPF - Bis(dinitroproponyl) formal
BTX - 5,7-Dinitro-1-picrylbenzotriazole
DATB - Diaminotrinitrobenzene
DNB - Dinitrobenzene
DNPA - 2,2-Dinitropropyl acrylate polymer
DNT - Dinitrotoluene
EDD - Ethylenediamine dinitrate
HMX - Cyclotetramethylenetetranitramine
MAN - Methylamine nitrate
NT - Nitrotoluene
NTO - 1,2,4-Nitro-triazole-5-one
PCB - polychlorinated biphenyl
PETN - Pentaerythritol tetranitrate
PYX - 2,6-Bis(picylamino)-3,5-dinitropyridine
RDX - Cyclotrimethylenetrinitramine
TAGN - Triaminoguanidine nitrate
TATB - Triaminoguanidine nitrate
TCP - Tricresylphosphate
TNB - Trinitrobenzene
TNT - Trinitrotoluene

TABLE 4-1A

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.18 THROUGH 5.25

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Acetone	5.18, 5.19, 5.20, 5.22, 5.23, 5.25	8240	100/100 ppb	GC/PID	50 ppb	PID	0.2	0	3 500	8 000
1-Acetylhexahydro-3,5-dinitro-1,3,5-triazine(e)										
1-Acetyloctahydro-3,5,7-trinitro-1,3,5,7 tetra-zocine(e)										
Amines (e)								0		
Amyl acetate	5.24							0		
Anthranils (i.e., 2,6 dinitroanthranil) (e)								0		
Asbestos	5.18, 5.19, 5.20, 5.21, 5.24, 5.25							0		
Barium	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	6010	2.0/0.2	XRF	10 ppm	LIBS	<100	125-829	2 000	5 600
Benzene	5.19, 5.20, 5.21, 5.22, 5.25	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	0.67
Benzo(a)pyrene (PAH)[d]	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8270							0.2	0.1
Beryllium	5.18, 5.20, 5.23, 5.24, 5.25	6010	0.3/0.03			LIBS	0.1	1-4.4	4	0.16
Cadmium	5.18, 5.20, 5.23, 5.25	6010	4.0/0.4	XRF	2 ppm			1.2-1.7	5	80
Carbon-14	5.20								2 600	4.7×10^5
Carbon tetrachloride	5.19, 5.22, 5.25	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	5	0.21
Chromium	5.19, 5.20, 5.22, 5.23, 5.24, 5.25	6010	7.0/0.7	XRF	8 ppm	LIBS	2	2.03–71.07	100	400 (CrVI)
Cobalt-60	5.19, 5.24							---	200 pCi/L	0.9 pCi/g
Copper	5.18, 5.20, 5.23	6010	6.0/0.6	XRF	3 ppm			2-18	1 300	3 000
Cyanide	5.18, 5.20, 5.23, 5.24, 5.25	9010	0.01 mg/L/ 5 mg/L					0	200	1 600

TABLE 4-1A (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.18 THROUGH 5.25

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
2-Amino-4,6-DNT (e,f)								0		
1,1 Dimethylhydrazine (e,f)								0		
1,3-DNB (e,f)	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	4.0/0.25					0	3.5	8
2,4-DNT (e,f)	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	5.7/0.25	GC/FID	1 ppm			0	0.5	1
3-5 Dinitro-cresol (e,f)										
Dioxane	5.24							0		
Dipentaerythritol hexanitrate (e)								0		
Ethylene dichloride	5.24							0	5	0.2
HMX	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	13.0/2.2			HE spot	100	0	1 800	4 000
Hydrazines (e)								0		
Lead	5.18, 5.19, 5.20, 5.23, 5.24, 5.25	6010	42.0/4.2	XRF	10 ppm	LIBS	2	18–56	50	500
Mercury	5.18, 5.20	7470		XRF	30 ppm			0.007-0.029	2	24
2 Methylaniline (e)										
Methyl ethyl ketone (2-Butanone)	5.22, 5.25	8240	100/ 100 ppb	GC/PID	50 ppb	PID	0.2	0	1 700	4 000
Methylnitramine (e)								0		
N-methylpicramide (e)								0		
Nickel	5.23, 5.25	6010	15/1.5	XRF	4 ppm			16-19	100	1 600
Nitriles (i.e., 2,4,6 trinitrobenzonitrile) (e)								0		
3 Nitroaniline (e)								0		

TABLE 4-1A (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.18 THROUGH 5.25

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
2 Nitro 4 amino toluene (e,f)								0		
2 Nitro-m-cresol (e,f)								0		
Nitrocellulose (c)	5.20					HE spot	100	0		
2-NT (e,f)		8330	12/0.25				500	0	350	800
PETN (b)	5.18, 5.19, 5.20, 5.23, 5.24					HE spot	100	0	700	1 600
Plutonium-239	5.18, 5.24, 5.25	α spec	0.04 pCi/L/ 0.005 pCi/g	Gross α/β	25 pCi/g	FIDLER	100 nCi/m^2	<0.052 pCi/g	15 pCi/L	24 pCi/g
Radium	5.19, 5.24							---	20 pCi/L	0.73 pCi/g (Ra-226)
RDX (a)	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	14.0/1.0			HE spot	100	0	3.2	64
Silver	5.18, 5.20, 5.24, 5.25	6010	7.0/0.7	XRF	17 ppm			1.61	170	400
Strontium-90	5.24							0.03–1.0 pCi/g	8 pCi/L	8.9 pCi/g
Thorium-232	5.24								15 pCi/L	0.88 pCi/g
1,3,5-TNB (e)	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	7.3/0.25					0	1.8	4
2,4,6 TNT	5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24, 5.25	8330	6.9/0.25			HE spot	100	0	12	40
Toluene	5.18, 5.20, 5.21, 5.22, 5.25	8240	5/5 ppb	GC/PID	10 ppb	PID	0.2	0	1 000	890

TABLE 4-1A (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082 FOR AGGREGATES 5.18 THROUGH 5.25

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (mg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (mg/L) (8)	SAL IN SOIL (ppm) (8)
Trimethyl phenol	5.22							0	---	
Tripentaerythritol acetonitrate (e)								0		
Uranium-235	5.18, 5.20, 5.24	γ spec	0.2 pCi/L/ 0.05 pCi/g	Gross α/β	25 pCi/g	Phoswich	35 pCi/g	---	21 pCi/L	18 pCi/g
Uranium-238	5.18, 5.20, 5.22, 5.23, 5.24, 5.25	α spec	0.2 pCi/L/ 0.05 pCi/g	Gross α/β	25 pCi/g	Phoswich	35 pCi/g	---	6.7 pCi/L	59 pCi/g
Xylene	5.21	8240		GC/PID		PID		0	10 000	160 000
Zinc	5.18, 5.20, 5.23	6010	2.0/0.2	XRF	34 ppm			38-71	10 000	24 000

Additional entries will be made in this table as they become available.
Note: All MDLs are extremely case-specific because of varying sample matrices and geometries and count times.
NA Not available
(1) Potential contaminants of concern (PCOCs) include all chemicals specifically listed in Chapter 5, potentially hazardous HE components (see Appendix D), and HE co-contaminants (see Appendix D).
(2) Potential release sites in which the PCOC is of concern based on archival research.
(3) SW 846 method unless otherwise indicated.
(4) Method detection limits for EPA methods are taken directly from those listed in the appropriate SW 846 method or from the QAPjP. ICP metals detection limits in soils estimated as 100x water MDLs.
(5) Estimated by ~~EM-9~~ CST-9.
(6) Beryllium, lead, and chromium from Han and Cremers 1990 (15-16-470). PID from manufacturers' specifications. Uranium and plutonium equal ~~HS-4~~ ESH-4 estimate. TNT from Baytos 1991, 0741. HMX, RDX, TATB, and PETN estimated by ~~WX-12~~ ESA-12.
(7) ~~Local metal and radionuclide values~~ Copper, mercury, nickel, and zinc are from Ferenbaugh et al. 1990, 0099; radionuclides from Purtymun et al. 1987, 0211; and other metals from Duffy and Longmire 1993, 15-16-480.
(8) ~~SALs for TCL and TAL materials from IWP. HE SALs calculated using method described in IWP Appendix J. Water SALs are the lowest of those calculated for IWP Table J-1, and those listed in IWP Table J-2 as Safe Drinking Water Act or State of New Mexico MCLs. Radionuclide SALs calculated using RESRAD assuming a 10 mrem/yr exposure limit.~~ SALs are based on methodology presented in Subsection 4.2.2 and Appendix J of the IWP (LANL 1993, 1017).
(a) HE component used at TA-16 (est. > 500 000 lbs.; all estimated for 50-year time frame 1944-1993 by L. Hatler of WX-3).
(b) HE component used at TA-16 (est. 10 000 to 100 000 lbs).
(c) HE component used at TA-16 (est. 1 000 to 10 000 lbs).
(d) HE burn product.
(e) HE impurity or environmental breakdown product. These are PCOCs at all PRSs in which HE is a PCOC.
(f) For these compounds other isomers are also PCOCs.

Abbreviations
ADNT - 3,5-dinitiro-1,2,4-triazole
BDNPA - Bis(dinitroproponyl) acetal
BDNPF - Bis(dinitroproponyl) formal
BTX - 5,7-Dinitro-1-picrylbenzotriazole
DATB - Diaminotrinitrobenzene
DNB - Dinitrobenzene
DNPA - 2,2-Dinitropropyl acrylate polymer
DNT - Dinitrotoluene
EDD - Ethylenediamine dinitrate
HMX - Cyclotetramethylenetetranitramine
MAN - Methylamine nitrate
NT - Nitrotoluene
NTO - 1,2,4-Nitro-triazole-5-one
PCB - polychlorinated biphenyl
PETN - Pentaerythritol tetranitrate
PYX - 2,6-Bis(picylamino)-3,5-dinitropyridine
RDX - Cyclotrimethylenetrinitramine
TAGN - Triaminoguanidine nitrate
TATB - Triaminoguanidine nitrate
TCP - Tricresylphosphate
TNB - Trinitrobenzene
TNT - Trinitrotoluene

Many of the PCOCs listed in Table 4-1 do not have SALs available in the IWP, Appendix J. This is because many of the compounds are not target compound list (TCL) or target analyte list (TAL) analytes. For those compounds for which reference dose (RfD) and/or slope factors were readily available, SALs were calculated using the methodology of the IWP. These compounds include TNT, HMX, RDX, and DNT. If PCOCs without SALs listed in Tables 4-1 and 4-1a are determined at finite concentrations in environmental samples using gas chromatography or high-pressure liquid chromatography (HPLC), then the following steps will be taken:

1. available literature sources will be screened in search of reference dose (RfD) and/or slope factors for these compounds in order to calculate SALs or perform baseline risk assessments; and,

2. if health-based SALs for these compounds cannot be calculated, cleanup levels will be negotiated with appropriate regulatory agencies.

If other PCOCs are detected, additional SALs will be provided.

4.2.3 Voluntary Corrective Actions

VCAs will be implemented at OU 1082 when a site presents unacceptable risks, or has contaminant levels greater than SALs and it is more cost-effective to implement a VCA than to perform the characterization necessary to perform a baseline risk assessment. For a VCA to be implemented the remedy must be obvious, feasible, and effective. A VCA may be proposed during any phase of the RFI. The PRSs that are likely to have VCAs include are sump outfalls in Subsections 5.2 and 5.3., and a RCRA closure of MDA P, which is described in Subsection 6.1.4.1. Implementation of a VCA requires DOE approval. Any VCAs that will produce mixed waste will be postponed until the mixed waste storage/disposal facility is available, unless the site presents an immediate health hazard or is not on DOE property. The VCA process described in the IWP will be followed (LANL 1993, 1017). VCAs will be described in technical quarterly reports to DOE, and the public will be informed of VCAs in quarterly public meetings.

4.2.4 Active Sites

Many PRSs or portions of PRSs in OU 1082 are integral components of active site operations or are buried under an active area (TA-16 sumps, Subsections 5.2, 5.3; TA-11 and TA-16 septic systems, Subsection 5.4; the materials testing outfall, Subsection 5.5; the photoprocessing outfall, Subsection 5.6; and TA-11 firing site aggregate SWMUs, Subsection 5.14). Portions of the burning ground (Subsection 5.8) are still active and operated under RCRA interim status, so only the inactive part will be sampled. Current on-site health and safety risks for active PRSs are the responsibility of the active operations and will not be addressed in this RFI. Furthermore, it is not appropriate to characterize active surface PRSs to evaluate corrective actions at this time because the active operational groups are continually changing site conditions. Subsurface PRSs at most active sites present no current health hazard and characterization of such PRSs would seriously disrupt active operations. Therefore, final investigations and permanent corrective actions for active PRSs or PRSs beneath active sites will be addressed when the site is decommissioned. However, it is appropriate to ascertain if off-site migration of contaminants from these PRSs is occurring or is likely to occur. If off-site migration of potential contaminants is occurring, then either a Phase II survey will be conducted or a VCA will be implemented. It is also prudent to evaluate subsurface contamination from active septic systems to potentially reduce costs of future remediation efforts.

More detailed discussions of the approaches for active PRSs and the methods used to evaluate off-site migration, subsurface contamination from septic systems, and public hazards are given in Subsections 5.2, 5.3, 5.4, 5.5, 5.6, 5.8, and 5.14.

4.3 Conceptual Exposure Models for OU 1082

A conceptual model was developed to identify potential contaminant migration pathways and any potential human receptors. This information helps to specify the location and magnitude of sampling and analytical methods needed to accurately characterize PRSs at OU 1082. A conceptual model includes four elements: 1) identification of PCOCs; 2) characterization of the release of COCs; 3) determination of migratory pathways; and,

4) identification of human receptors. Subsection 4.3.1 presents an overview of the selection of PCOCs at OU 1082. Subsection 4.3.2, Potential Environmental Pathways, discusses the potential contaminant release mechanisms and migration pathways for each category. Subsection 4.3.3, Potential Human Impacts, contains a detailed PRS-specific conceptual model for each PRS or PRS aggregate and describes potential current and future receptors and potential exposure to site-related chemicals.

4.3.1 Potential Contaminants of Concern

The objectives of the Phase I environmental data collection activities are to accomplish the following:

1. confirm the presence or absence of anticipated PCOCs from known past site activities (see Tables 4-1 and 4-1a),

2. use broad spectrum analytical methods that will allow for a reasonable determination that important additional PCOCs are not present (e.g., the evaluation of tentatively identified compounds from mass spectral scans),

3. select analytical methods primarily on the basis of sensitivity for anticipated PCOCs at their SALs and secondarily for broad-band-spectrum capability, and,

4. estimate if the concentration of each PCOC is greater than some method threshold.

These data will be used to determine if any site PCOC exceeds some specified, unacceptable concentration that would be considered a problem. If a site problem is determined, then these data will provide information needed to design a Phase II data collection survey that would further define the extent of the unacceptable area or volume of contaminated media and the potential risk to receptors from the site.

Tables 4-1 and 4-1a list the constituents of potential concern that have been identified through archival information as PCOCs for OU 1082. Any chemical or radiological substance considered hazardous to human health will be identified in the RFI work plan for characterization and eventual cleanup ~~however, chemicals that are essential human nutrients present at low~~

concentrations and toxic at very high levels (e.g., potassium, magnesium) will not be quantified in a baseline risk assessment.

The PCOCs in Tables 4-1 and 4-1a can be divided into three general categories: 1) substances determined to have been used in specific processes at TA-16 based on archival research, including VOCs and cyanide; 2) components used in HE formulations identified in WX Applied Theoretical Physics Engineering and Science Applications Division SOPs; and, 3) environmental breakdown products and impurities of commercial HE (see Appendix D). Several plastic components and salts (e.g., potassium nitrate) compounds used at TA-16 but deemed not to be hazardous to human health were not included in the table.

Many of the substances included in number one above are building or process specific. Aggregates in which these materials are known to have been used are listed in the second column of Tables 4-1 and 4-1a. A number of HE components are listed in Tables 4-1 and 4-1a. However, only a few of these are identified as having been used at TA-16 in quantities greater than 10 000 lbs (see Appendix D). These are barium nitrate, TNT, HMX, and RDX, all of which were used in quantities greater than 500 000 lbs over the past 50 years; nitroguanidine and TATB, which were used in quantities from 50 000 to 500 000 lbs; and cyanuric acid, DATB, nitromethane, and PETN, which were used in quantities from 10 000 to 50 000 lbs.

Similarly, a large number of compounds have been identified as environmental breakdown products, HE impurities, and other HE co-contaminants in the laboratory (see Appendix D). However, only DNT, DNB, and TNB are frequently identified in the field as contaminants at open burn/open detonation facilities.

The above discussion allows us to focus our efforts on PCOCs likely to present a significant risk. Laboratory analysis will focus on HE and HE byproducts listed above. Certain of these HE constituents (nitroguanidine, TATB, DATB, and nitromethane) are not determined in standard EPA methods for HE by high-pressure liquid chromatography (SW 846 8330) or gas chromatography (GC)/mass spectrometry (MS) (SW 846 8270). These will be determined qualitatively using these methods.

To summarize, the main classes of ~~chemicals~~ compounds potentially located at OU 1082 are radionuclides, explosive components, barium nitrate, and some volatile organic compounds (VOCs). Potentially hazardous explosive device components, by far the major PCOC group at OU 1082, include: HE, semivolatile organic compounds (SVOCs) (i.e., explosive impurities and polycyclic aromatic hydrocarbons), metals, cyanide, and asbestos.

4.3.2 Potential Environmental Pathways

The primary release mechanism of potential contaminants at OU 1082 is through operations associated with the manufacturing and testing of explosives. Potential contaminants may have been released to the environment through drains, outfalls, sumps, and landfills, as shrapnel from firing areas, through spills and spattering to surface soil, from storage areas and surface impoundments, or through burning in disposal operations.

After chemicals have been released at OU 1082 into the environment, they can potentially migrate via: 1) liquid infiltration into near-surface or subsurface soils; 2) organic volatilization into ambient air; 3) wind entrainment of contaminated dust and deposition onto surface soils or vegetation; 4) surface water overflow and then runoff resulting in the contamination of sediments in drainage channels (refer to Chapter 3); and, 5) uptake by plants and animals.

The major migration pathways and relevant environmental media through which human exposure to residual contaminants could occur are summarized in Table 4-2. ~~Pathways that may be complete but are considered less significant include: 1) U~~ Exposure to humans via uptake by animals from ingestion and inhalation of contaminated media may be complete pathways but are considered ~~; and 2) root uptake by plants from contaminated soils. The contribution of these exposure is likely~~ to be ~~minor in comparison to~~ less significant than those pathways listed in Table 4-2. Although ingestion of animals (e.g., elk, deer, livestock) is a complete pathway, the large territory over which these animals graze in semiarid climates makes the probability of significant uptake of contaminants from a single PRS small. A site-wide ecological risk assessment is being developed for LANL. If the results indicate the potential for significant contaminant uptake by animals, the animal ingestion pathway will be reexamined.

TABLE 4-2

SUMMARY OF MAJOR MIGRATION PATHWAYS, CONTACT MEDIA, AND RESULTING POTENTIAL HUMAN EXPOSURE ROUTES

MIGRATION PATHWAYS	CONTACT MEDIA	RESULTING POTENTIAL HUMAN EXPOSURE ROUTES
Primary A. Liquid infiltration into near-surface or subsurface soils	1. Chemicals in subsurface soils	1. Refer to E
B. Wind entrainment and dispersal of surface soil and atmospheric dispersion of volatiles	1. Chemicals deposited on surface soils and edible plant surfaces 2. Chemicals in air (particulate matter and volatile compounds)	1. Ingestion of soil, dermal contact with soil, and ingestion of plants 2. Inhalation of fugitive dust or volatile compounds
C. Surface water runoff carrying soil/sediment in suspension and in solution	1. Chemicals deposited in drainage sediments 2. Chemicals released to surface waters 3. Contaminated surface water infiltrating surface and subsurface soils	1. Ingestion of sediments and dermal contact with sediments 2. Ingestion of surface water and dermal contact with surface water 3. Ingestion of soil and dermal contact with soil
Secondary D. Root uptake by plants (from contaminated soils)	1. Edible portions of plants	1. Ingestion of plants
E. Soil erosion exposing subsurface contaminated soil to the surface	1. Feeds wind dispersal (B) and surface water runoff (C)	1. Refer to exposure routes for B and C

The thickness of the unsaturated zone beneath OU 1082 suggests that migration of contaminants from the surface to the main aquifer is unlikely. Refer to Subsection ~~2.6.6~~ 2.6.2.3 of the IWP for a discussion of the hydrology of the main aquifer beneath OU 1082 (LANL 1993, 1017). Groundwater transport in the main aquifer will, therefore, not be considered a viable transport pathway in this stage of the RFI. If the results of Phase I of the RFI indicate that contaminant migration has occurred, this decision will be reevaluated.

Perched water, however, may be present in OU 1082. Potential contaminant movement into perched water, and through fractures or faults in the subsurface is possible subsequent to infiltration or leaching into the vadose zone. Perched water is not likely to be a pathway of major concern.

However, this pathway may be considered during Phase II investigations if the vadose zone is shown to be contaminated during Phase I RFI investigations. Currently, there are no wells on site that are used as a source of drinking water.

4.3.3 Potential Human Receptors

This section discusses how people could potentially be exposed to site-related PCOCs in the absence of site remediation, and presents the conceptual site models. Currently, the land is used for Laboratory operations; therefore, workers at OU 1082 represent the only potentially exposed population on site. In a few places, canyon bottoms could potentially be accessed for hiking. The nearest permanent residents to OU 1082 are in the town of Los Alamos, 6 miles to the northeast. Future land use at OU 1082 could encompass continued Laboratory operations and recreational users (i.e., on-site campers and hikers)~~-both of which will be evaluated in a baseline risk assessment~~. These proposed future land use scenarios are the most reasonable and probable scenarios for this site. However, these land use scenarios have to be negotiated with the stakeholders (NMED, EPA, general public) before they can be incorporated into a risk assessment. Residential use is not considered a likely potential future land use scenario because ~~OU 1082~~ this site is located in a rural area far from existing development~~; therefore, this scenario will not be evaluated in a baseline risk assessment~~. If the stakeholders determine that future residential use be considered for this site, then that scenario will be evaluated following guidelines in Appendix K, Section 3.0 of the IWP (LANL 1993, 1017).

4.3.3.1 Conceptual Site Model

The on-site conceptual models identify historical sources of potential contamination, historical migration and conversion, potential current sources of contamination, release mechanisms, contact media, and exposure routes for each PRS or aggregate. Conceptual exposure models are used to illustrate how chemicals can move in the environment from potential release sites to human receptors. They are used to help identify appropriate media and locations for sampling and to determine if the PRS poses a threat to human health or the environment. Generally, surface soil is defined as the upper 6 in. and subsurface soil is from 6 in. to 12 ft or bedrock. At TA-16, the

A soil horizon is generally less than 6 in. thick, so this sampling domain will generally include part of both the A and B soil horizons. Infiltration on or leaching into the vadose zone is not a significant pathway unless contamination is located in subsurface soils. Elements of the conceptual models are presented in Table 4-3. These elements summarize the assumptions used to create aggregate-specific conceptual models. The aggregate-specific conceptual models are presented in Figs. 4-3 through 4-10.

The conceptual models for OU 1082 are formulated based on available PRS information only. Further refinement of the conceptual models, or development of separate models may be necessary based on data gathered through the RFI investigation.

Site specific information on PRS aggregates is presented in Chapter 5.

4.3.3.2 Potential Human Exposure

To identify the presence of COCs, sampling plans proposed for OU 1082 involve comparing analytical data from samples to SALs. As mentioned in Subsection 4.2.2, SALs are based on a conservative, residential exposure scenario. If measured concentrations exceed SALs ~~or if several chemicals come close to SALs~~, then further investigation will be conducted. ~~, even though none of the individual chemicals exceed SALs.~~ If several chemicals come close to, but remain below SALs, then it is possible that in combination they could prove harmful to human health. Section 4.0 of Appendix J in the IWP describes the methodology that will be used to address multiple constituents (LANL 1993, 1017). If contaminated media are found in Phase I or Phase II, the human exposure potential to these contaminants will be quantified in a baseline risk assessment. Human exposure is estimated through a model of the reasonable maximum exposure (RME) individual who is defined through assumptions of current and future land use (EPA 1989, 0305; EPA 1991, 0746; EPA 1992, 15-16-469). Two land use scenarios ~~will~~ may be evaluated in a baseline risk assessment~~s~~ for OU 1082: continued Laboratory operations (current and future) and recreational (current and future). These land use scenarios will have to be negotiated with stakeholders before they can be evaluated in a risk assessment. Continued Laboratory operations is a scenario that encompasses two theoretical populations of

TABLE 4-3

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

PATHWAYS/MECHANISM	CONCEPT/HYPOTHESES
HISTORICAL SOURCES	• Operations/processes that contributed to the creation of the PRS (e.g., storage area, etc.)
PRS RELEASE MECHANISM	• Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposing into the environment
MIGRATION PATHWAY/ CONVERSION MECHANISM	
Atmospheric dispersion	• Entrainment is limited to chemicals in surface soils
Particulate dispersion	• Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, as well as atmospheric conditions
Volatilization	• Volatilization occurs to volatile organic compounds in surface soils, subsurface soils, and surface water
Surface water runoff	
Surface water	• Surface runoff is directed by natural topographic features or manmade diversions and flows toward the canyons. A topographic low can cause the water to pond on the mesa top, but in most cases the water will flow into the canyon • Chemical transport by surface runoff can occur in solution, sorbed to suspended sediments, or as mass movement of heavier bed sediments • Surface runoff may carry chemicals beyond the OU boundary • Contaminated surface runoff may infiltrate the canyon-bottom alluvium
Sediments	• Surface soil erosion and sediment transport is a function of runoff intensity and soil properties • Chemicals dispersed on the soil surface can be collected by surface water runoff and concentrated in sedimentation areas in drainages • Erosion of drainage channels can extend the area of contaminant dispersal in the drainage
Alluvial aquifers	• Surface runoff discharged to the canyons may infiltrate into sediments of channel alluvium
Infiltration	• Infiltration into surface soils depends on the rate of precipitation or snowmelt, antecedent soil water status, depth of soil, and soil hydraulic properties • Infiltration into the tuff depends on the unsaturated flow properties of the tuff • Joints and fractures in the tuff may provide additional pathways for infiltration to enter the subsurface regime
POTENTIAL RELEASE MECHANISM	
Leaching	• Storm water/snowmelt can dissolve chemicals from soil or other solid media, making them available for contact • Water solubility of chemicals and their relative affinity for soil or other solid media affects the ability of leaching to cause a release • Leaching and subsequent resorption can extend the area of contamination
Soil erosion	• The erosion of surface soils is dependent on soil properties, vegetative cover, slope and aspect, exposure to the force of the wind, and precipitation intensity and frequency • Depositional areas as well as erosional areas exist, and erosive loss of soil may not occur in all locations • Storm water runoff can mobilize soils/sediments, making them available for contact • Storm intensity/frequency, physical properties of soils, topography, and ground cover determine the effectiveness of erosion as a release mechanism • Erosion may also enlarge the contaminated area

TABLE 4-3 (continued)

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

PATHWAYS/MECHANISM	CONCEPT/HYPOTHESES
POTENTIAL RELEASE MECHANISM (continued)	
Mass wasting	• The loss of rock from the canyon walls is a discontinuous, observable process • The rate of the process is extremely slow
Resuspension (wind suspension)	• Wind suspension of contaminated soil/sediment as dust makes chemicals available for contact via inhalation/ingestion • Physical properties of soil (e.g., silt content, moisture content), wind speed, and size of exposed ground surface determine effectiveness of wind suspension as a release mechanism • Wind suspension can enlarge the area of contamination and create additional exposure pathways, such as deposition on plants followed by plant consumption by humans/animals
Excavation	• Manual or mechanical movement of contaminated soil during construction, remediation, or other activities makes contaminated soil available for dermal contact, ingestion, and inhalation as dust • The method of excavation (i.e., type of equipment), physical properties of soil, weather conditions, and magnitude of excavation activity (i.e., depth and total area of excavation) influence the effectiveness of excavation as a release mechanism • Excavation can increase or decrease the size of the contaminated area, depending on how the excavated material is handled
EXPOSURE ROUTE	
Inhalation	• Vapors, aerosols, and particulates (including dust) can be inhaled and absorbed by the lungs and mucous membranes. • Physical and chemical properties of airborne chemicals influence the degree of retention in the body after being inhaled
Ingestion	• Ingestion of soil, water, food, and dust can lead to chemical intake via absorption in the gastrointestinal tract
Direct contact	• Some hazardous chemical constituents will absorb through the skin when in contact with contaminated surfaces of soil, tuff, or rubble • Physical and chemical properties of chemicals influence the degree of dermal absorption • Factors such as skin moisture and temperature affect the degree of dermal absorption
Whole body radiation	• External, or whole body radiation, can occur through exposure to gamma-ray-emitting radionuclides that may be present in soil either directly through the soil or re-entrained dusts • Exposure to penetrating radiation can also occur through inhalation or ingestion when radionuclide-contaminated soil or tuff surfaces erode and/or dusts become re-entrained

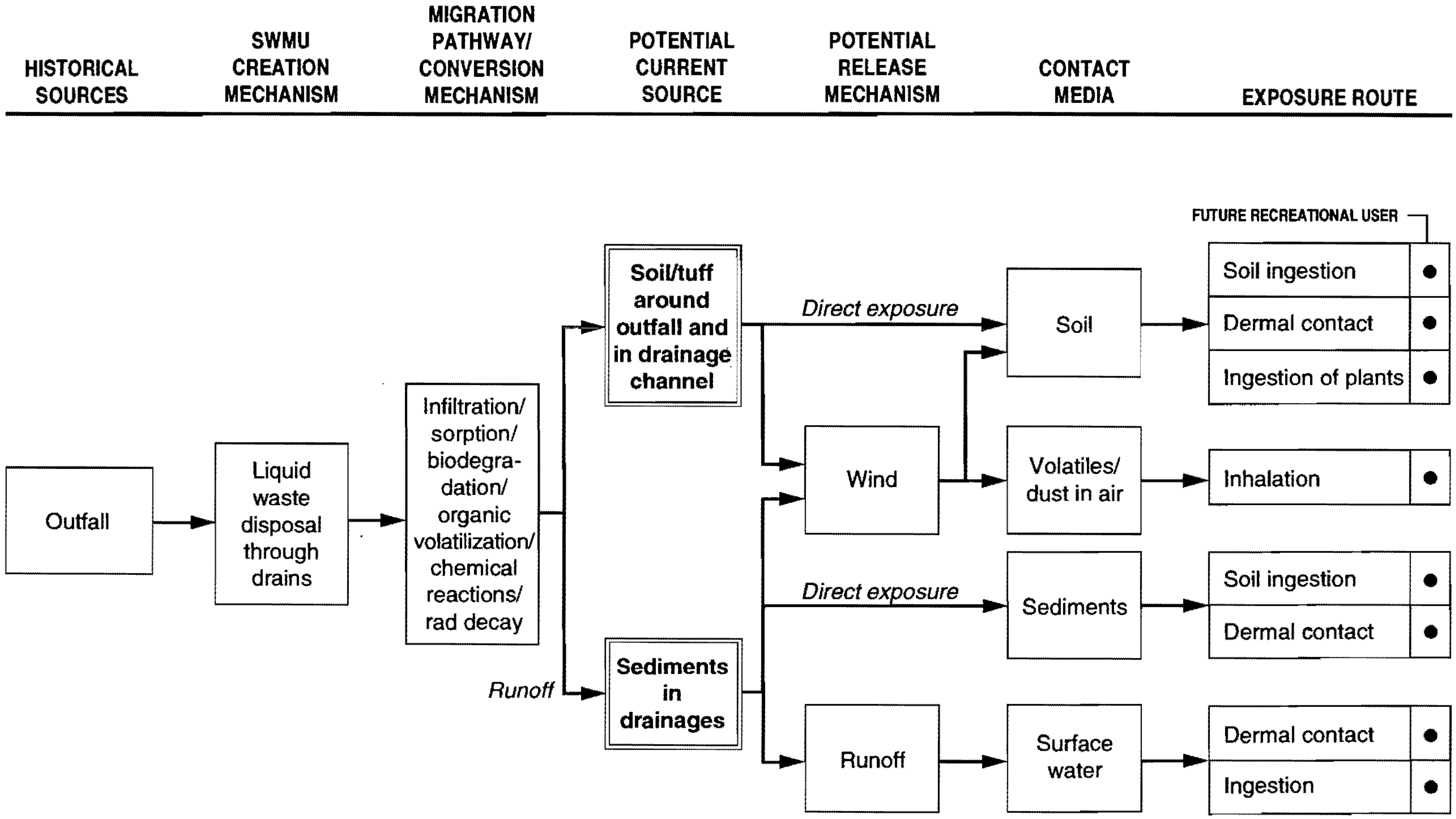

Fig. 4-3. **Conceptual exposure model for operational releases (Subsections 5.5 and 5.6); ~~and~~ K-Site Aggregate B (Subsection 5.15), and GMX-3 structures without sumps (Subsection 5.19), recreational scenario for canyon walls and/or bottoms; and continued Laboratory operations for mesa tops.**

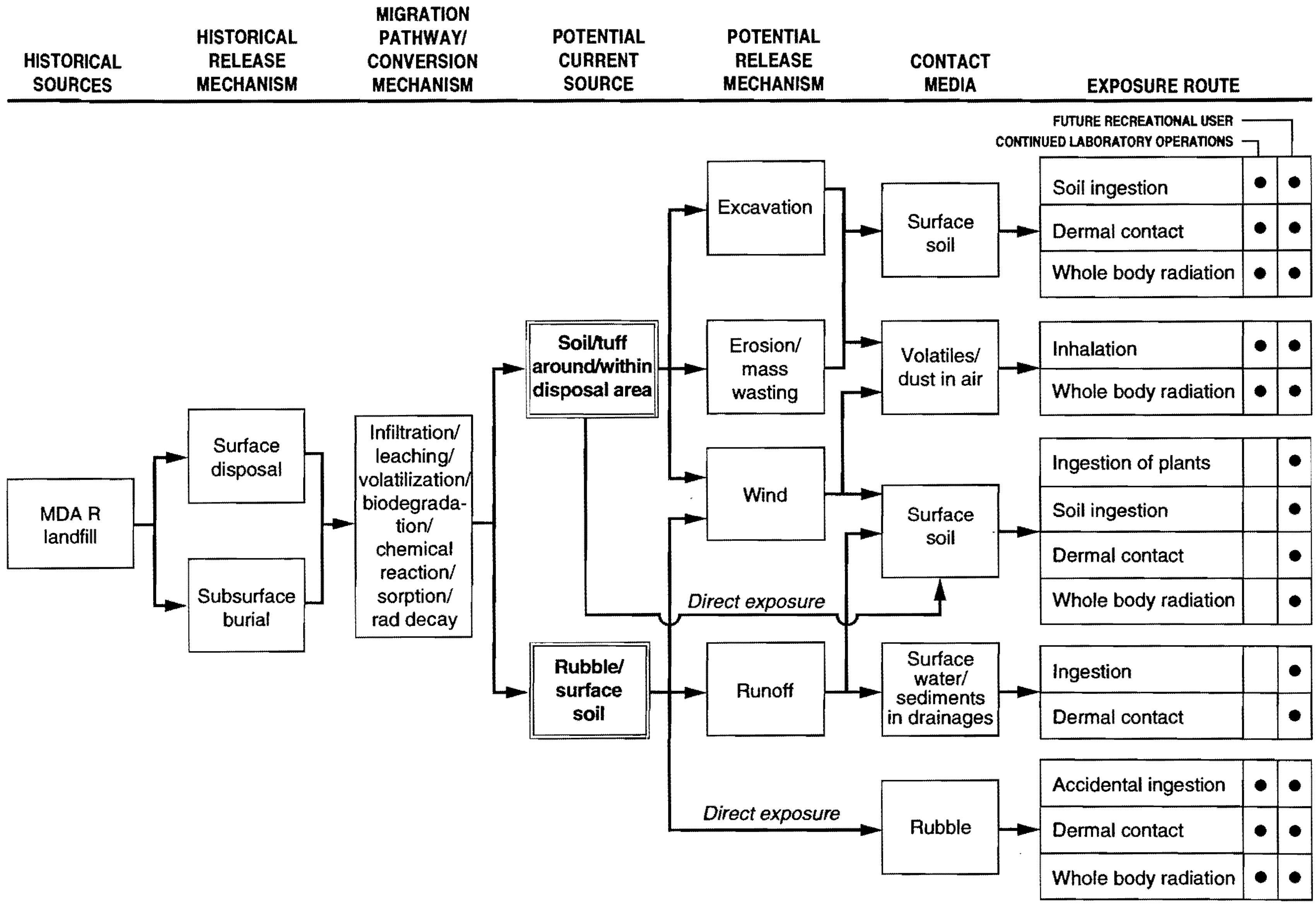

Fig. 4-4. On-site conceptual exposure model for MDA R (Subsection 5.10) landfills: continued Laboratory operations scenario for subsurface and surface soils located on the mesa top; recreational scenario for surface areas located on canyon wall and bottom (erosion of subsurface soils, surface soil, sediment, and surface water pathways).

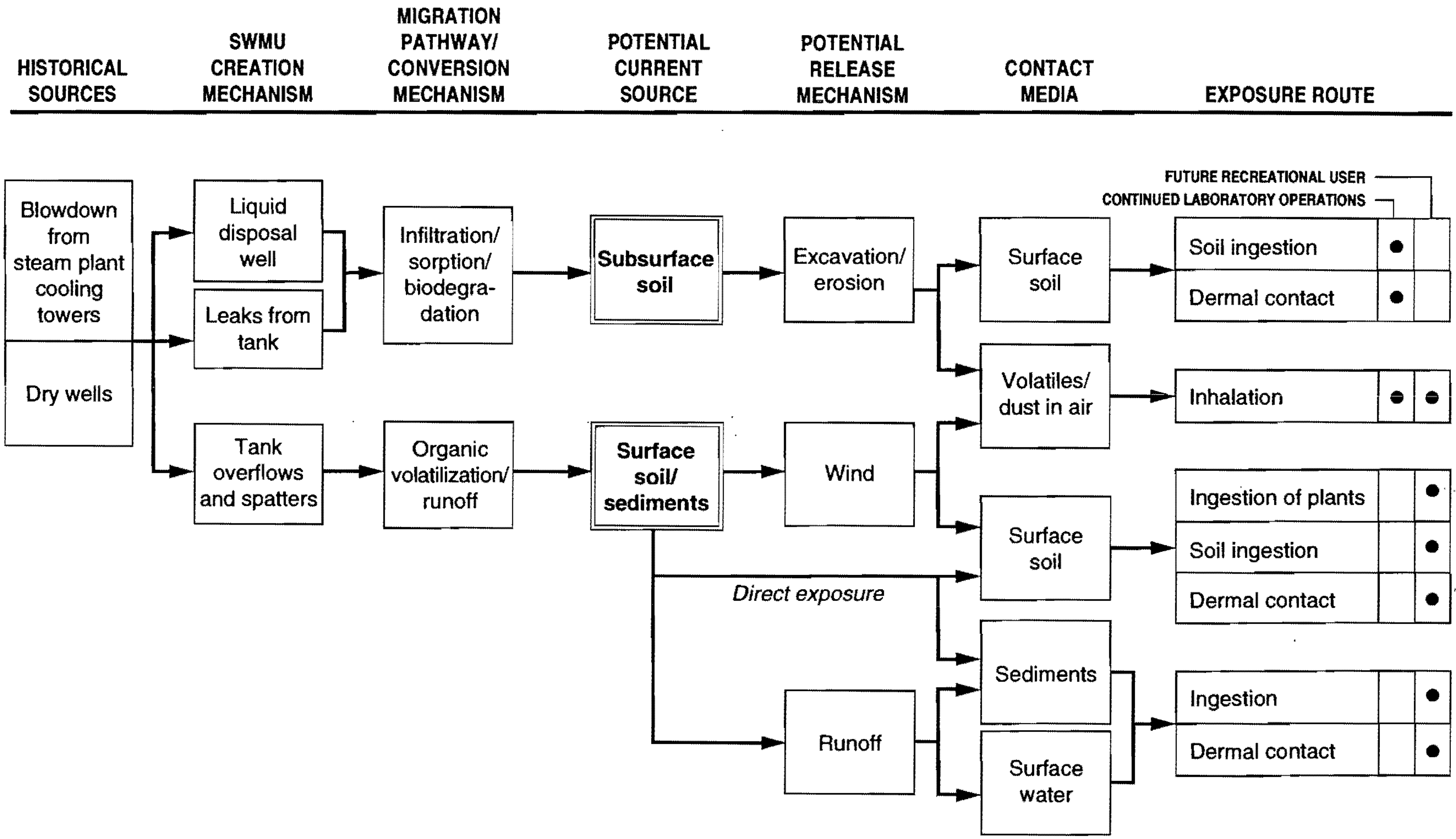

Fig. 4-5. **On-site conceptual exposure model for PRSs 16-001(a-d) (Subsection 5.1) at TA-16: continued Laboratory operations scenario for subsurface and surface soil located on mesa top; recreational scenario for surface soil located on canyon wall and bottom (sediment and surface water pathways).**

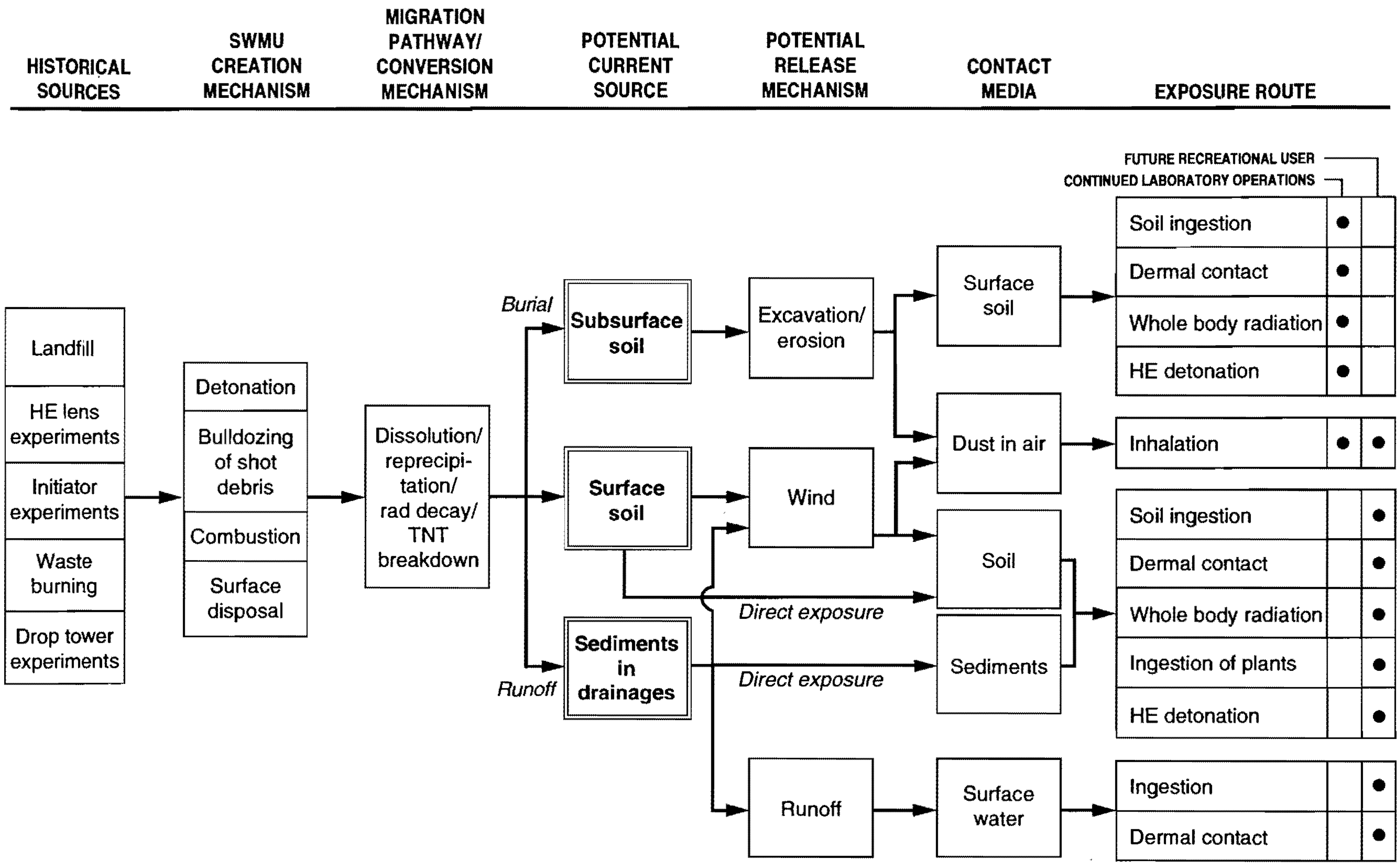

Fig. 4-6. **On-site conceptual exposure model for SWMUs at TA-13 (P-Site; Subsection 5.13) and K-Site Aggregate A (Subsection 5.14): continued Laboratory operations scenario for subsurface and surface soil located on mesa top; recreational scenario for surface areas located on canyon wall and bottom (surface soil, sediment, and surface water pathways).**

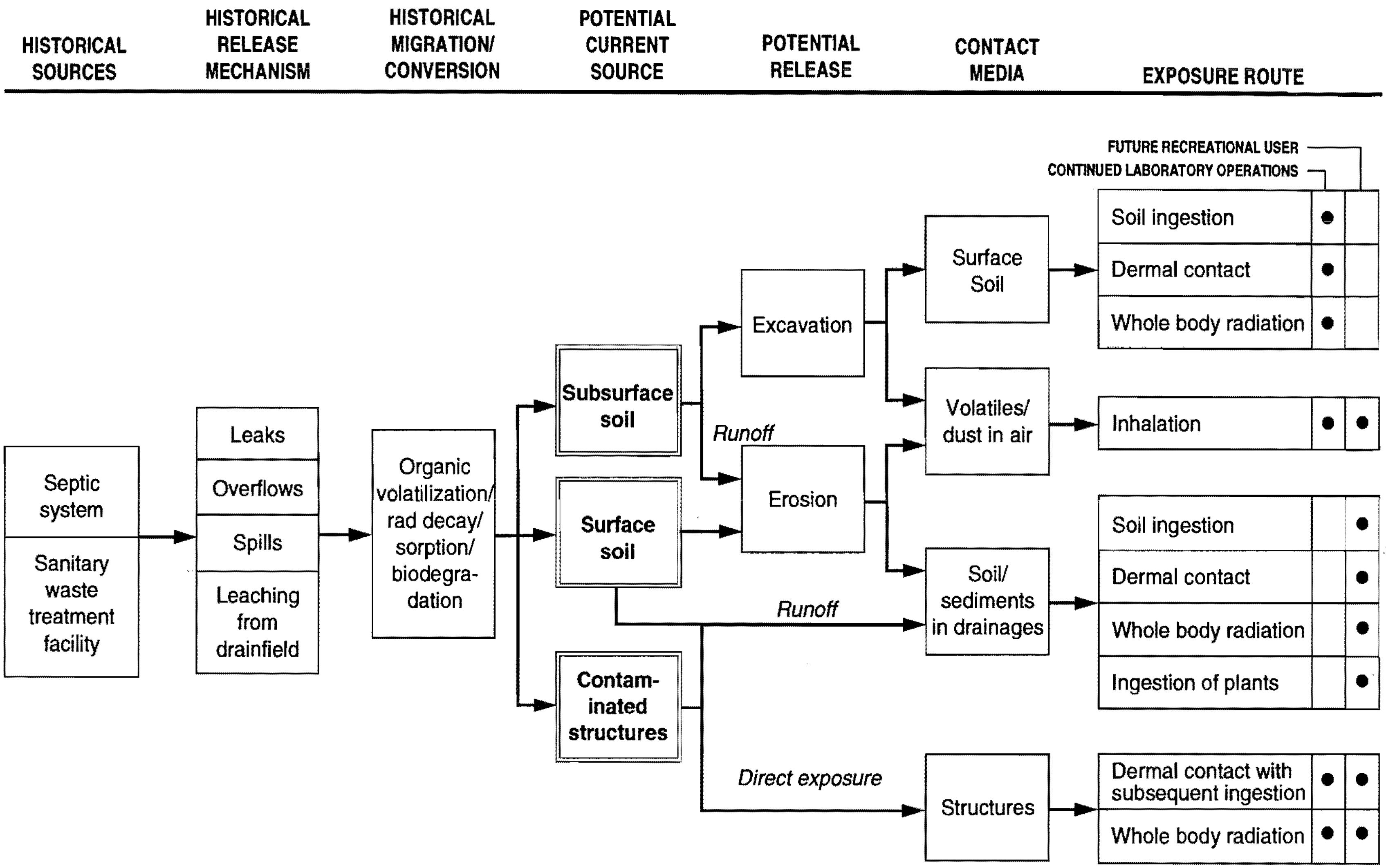

Fig. 4-7. On-site conceptual exposure model for septic systems (Subsections 5.4 and 5.22) and the sanitary waste treatment facility (Subsection 5.7): continued Laboratory operations scenario for subsurface and surface soils located on mesa top; recreational scenario for surface area on canyon wall and bottom (surface soil, sediment, and surface water pathways).

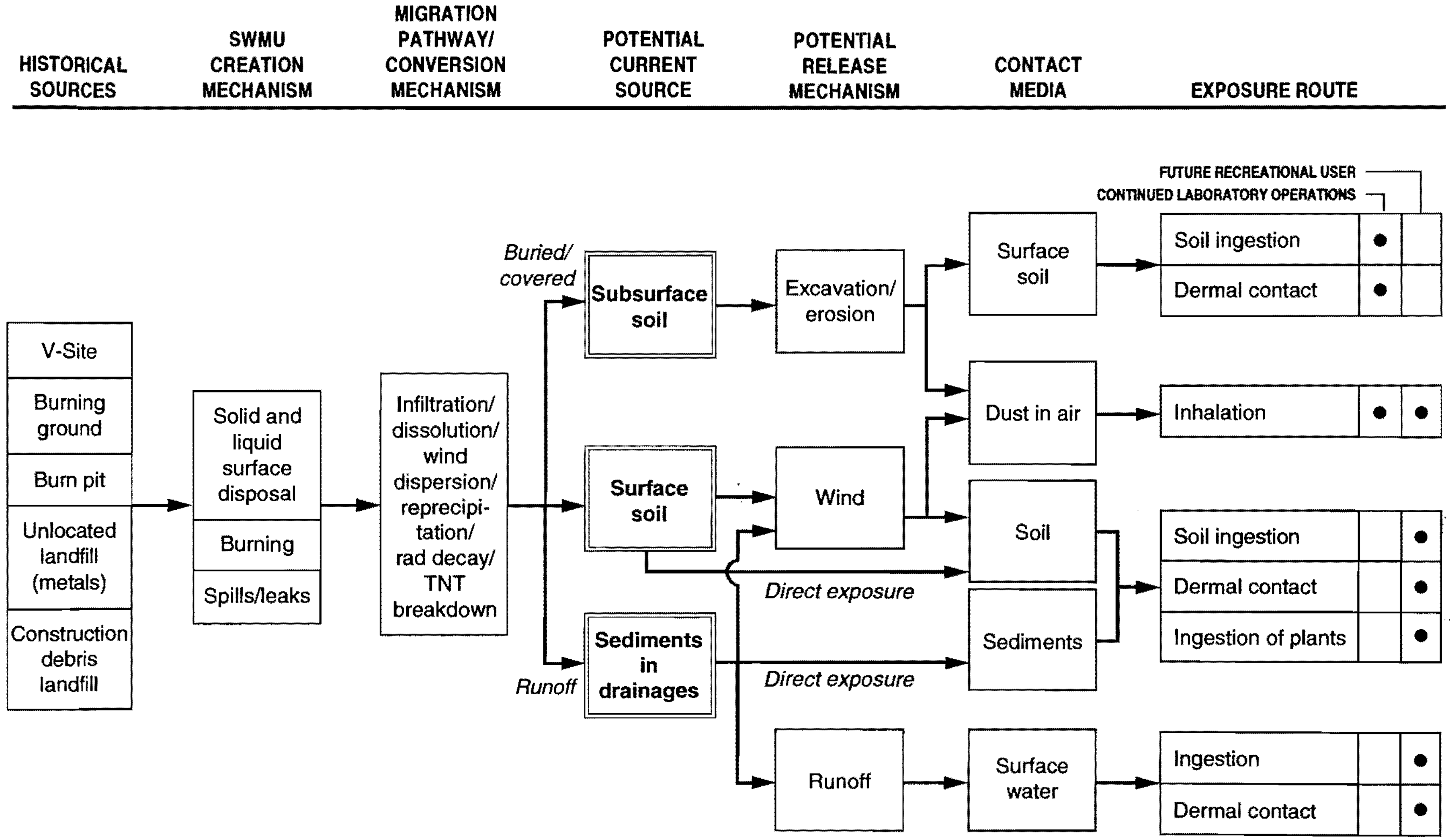

Fig. 4-8. **On-site conceptual exposure model for burning ground aggregate (Subsection 5.8), surface waste disposal areas [SWMUs 16-009, 16-016(a,b)] (Subsection 5.11), K-Site Aggregate C (Subsection 5.16), and spill (Subsection 5.17): continued Laboratory operations scenario for subsurface and surface areas located on mesa top; recreational scenario for surface areas on the canyon wall and bottom (surface soil, sediment, and surface water pathways).**

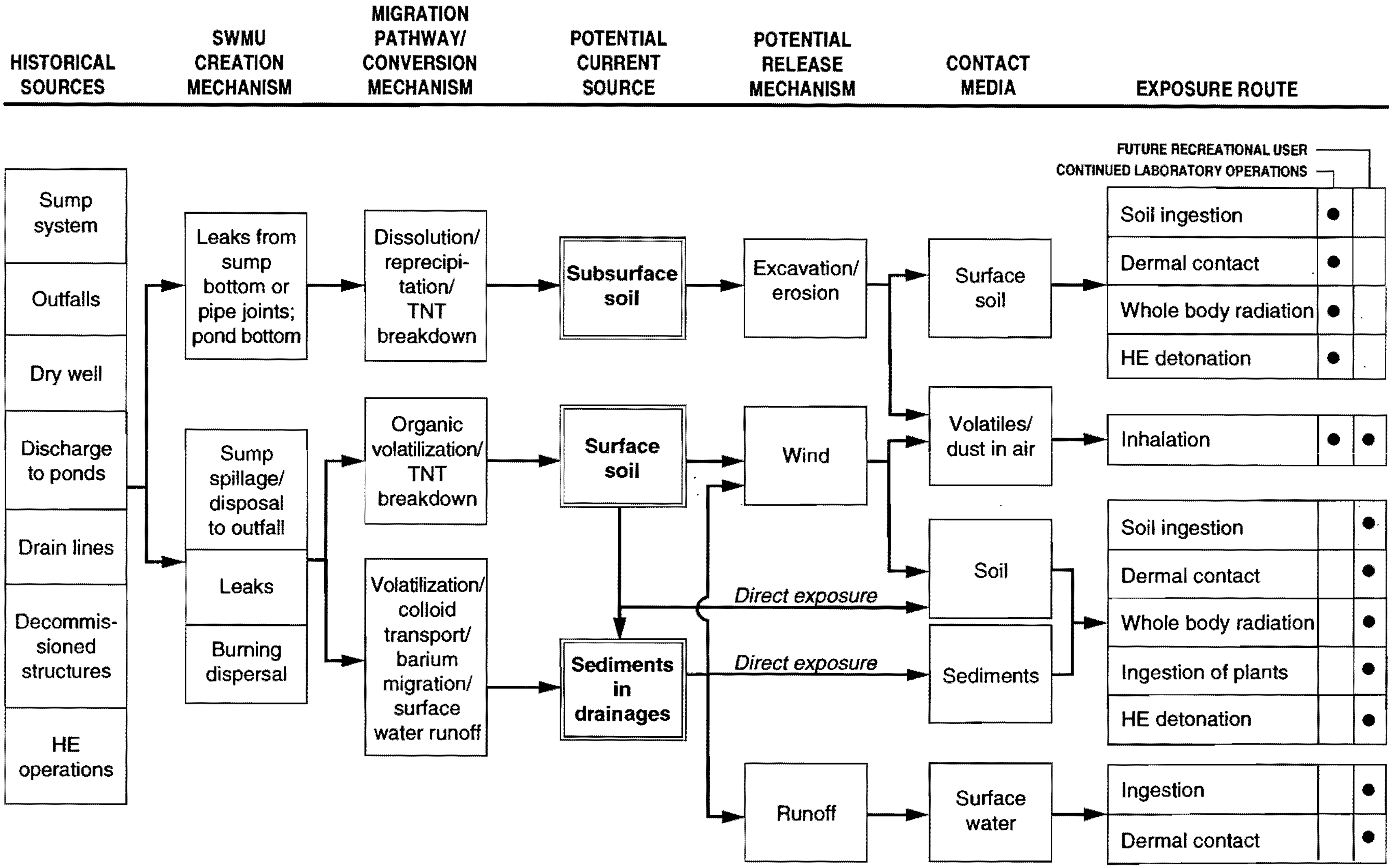

Fig. 4-9. On-site conceptual exposure model for HE sumps, decommissioned buildings, drain lines, and outfalls (Subsections 5.2, 5.3, 5.18, 5.20, 5.21, 5.23, 5.24, and 5.25) and ponds (Subsection 5.12) at TA-16: continued Laboratory operations scenario for subsurface and surface soils on mesa top; recreational scenario for surface soil areas on canyon wall and bottom (sediment and surface water pathways). Radionuclide contamination potentially present in sumps SWMUs 16-003(a-e,h-k,n,o) and associated outfalls, but not in SWMUs 16-003(f,g,l,m) or SWMUs 16-029(a-g).

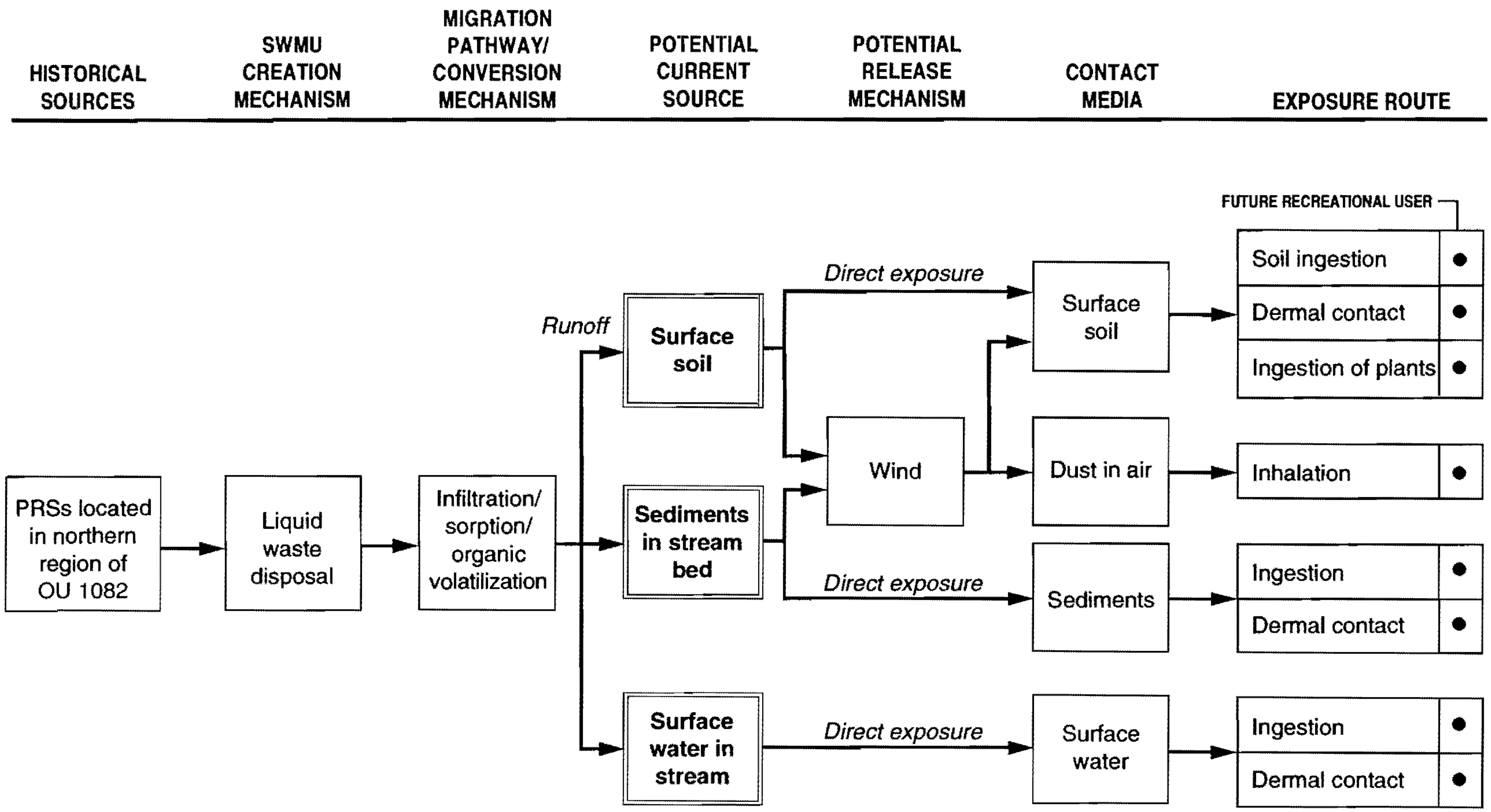

Fig. 4-10. Conceptual exposure model for Cañon de Valle (Subsection 5.9): recreational scenario.

potentially exposed individuals; on-site workers and construction workers. The continued Laboratory operations and recreational scenarios are developed below.

Refer to Subsections 4.1.5 and 4.3.3 of the ~~1992~~ 1993 IWP for ER Programmatic guidance on probable land use scenarios (LANL ~~1992, 0768~~ 1993, 1017). Depending on site-specific parameters (e.g., types of contaminants present or migration potential), the worst-case exposure scenario (i.e., the RME individual) may vary. For those PRSs where two scenarios may be applicable, ~~two~~ both scenarios will be evaluated in a baseline risk assessment~~s will be calculated~~ to determine the worst case. For any baseline risk assessment, the 95% upper confidence limit on the arithmetic average concentration of COCs in exposure areas, either surface or subsurface soils, is sufficient to determine receptor exposures. ~~The continued Laboratory operations and recreational scenarios are developed below.~~ Appendix K, Section 3.0 of the IWP contains a detailed description of the exposure scenarios, exposure pathways, and scenario-specific exposure parameters (LANL 1993, 1017).

Unlike most other operable units at the Laboratory, a contact with HE pathway is relevant for OU 1082. Under both continued Laboratory operations and recreational scenarios, detonation of residual HE in the environment could present substantial human risk. The Department of Defense has developed guidelines that describe when soil may potentially detonate, 10% HE is typical for eastern ordnance sites (US Army Corps of Engineers 1991, 15-16-471). Site-specific safety levels for HE in soils will be developed in consultation with the ~~Design Engineering Division (WX)~~ Engineering and Science Applications (ESA) Division. However, based on existing data, only two PRS aggregates contain either raw HE or soil HE at levels greater than 2 wt %; these aggregates are described in Subsection 5.3, the TA-16-260 outfall, and Subsection 5.14, K-Site Aggregate A. Thus, this pathway is likely only to be relevant for a subset of the aggregates described in Chapter 5. Rigid ~~WX~~ ESA Division operating procedures preclude site-worker contact with HE in either of these areas.

4.3.3.2.1 Continued Laboratory Operations

Land use in the foreseeable future is likely to continue to be similar to current Laboratory operations. Most areas of OU 1082 are active sites for the ~~WX~~ ESA Division of the Laboratory and construction of new buildings and other facilities in the area is possible. Populations of on-site workers (individuals who work on or near the site) and construction workers (individuals who would be exposed to near-surface and subsurface soils through various activities including excavation) are estimated to be the most likely RME individuals. They are therefore used in the exposure scenarios that will be evaluated under the land use scenario of continued Laboratory operations.

On-site workers (including maintenance and office workers) are expected to be routinely exposed to contaminated media. Therefore, this scenario is considered the most conservative exposure scenario for PRSs in OU 1082 that consist of potential surface contamination on the mesa top. If PCOCs in surface soils are above SALs, then a baseline risk assessment using the on-site worker scenario will be evaluated. The PRS aggregates that include potential surface contamination of the mesa top are: blowdown tanks (Subsection 5.1); sumps (Subsections 5.2 and 5.3); septic tanks (Subsection 5.4); operational releases (Subsection 5.5); burn and treatment area (Subsection 5.8); MDA R (Subsection 5.10); surface waste disposal areas (Subsection 5.11); firing sites (Subsections 5.13 and 5.14); potential surface contamination (Subsection 5.16); ~~and~~ waste storage areas (Subsection 5.17); GMX-3 area (Subsections 5.18, 5.19, and 5.23); GMX-2 (Subsection 5.20); administration area (Subsection 5.21); T-Site (Subsection 5.24); and, V-Site (Subsection 5.25).

The construction worker is expected to be exposed to subsurface contamination during excavation. Once subsurface soil is excavated and brought to the surface, on-site workers could also be exposed. Therefore, for PRSs in OU 1082 that consist of subsurface contamination above SALs, a baseline risk assessment using the construction worker and on-site worker scenario will be evaluated. PRS aggregates with potential subsurface contamination include dry wells (Subsection 5.1); sumps (Subsection 5.2); TA-16-260 sumps and outfall (Subsection 5.3); septic systems (Subsection 5.4); sanitary waste treatment facility (Subsection 5.7); burn and treatment area (Subsection 5.8); MDA R (Subsection 5.10); wastewater ponds (Subsection 5.12); the TA-13 firing site (Subsection 5.13); GMX-3 HE process buildings and the 90s-line (Subsections 5.18 and 5.23); GMX-2 (Subsection 5.20); administration area (Subsection 5.21); septic tanks (Subsection 5.22); T-Site (Subsection 5.24); and, V-Site (Subsection 5.25).

Exposure pathways relevant to continued Laboratory operations include: 1) inhalation of fugitive dust or volatile compounds; 2) incidental ingestion of contaminated soils; 3) direct dermal contact with contaminated soils; 4) whole body radiation; and, 5) contact with HE (see Table 4-4).

4.3.3.2.2 Recreational

OU 1082 is adjacent to Bandelier National Monument and US Forest Service lands. When this site is decommissioned in the future, OU 1082 could potentially be released for recreational use. The recreational scenario is the most probable scenario for PRSs consisting of surface contamination on the canyon walls and/or the canyon bottoms. Although in the future the recreational scenario may also apply to mesa tops, this scenario will not be evaluated because the worker scenario has been identified as the future RME for mesa tops. Workers are not expected to come into direct contact with contaminated media on walls or on canyon bottoms because of limited development in these areas. The recreational scenario excludes agriculture, but considers short-term camping, daily hiking, ~~hunting~~, and possibly limited construction.

PRSs in OU 1082 that consist of surface contamination on canyon walls and/or canyon bottoms above SALs will be evaluated in a baseline risk assessment using the recreational scenario. Those PRSs include: outfalls (Subsections 5.1, 5.2, 5.3, 5.4, 5.7, and 5.8); materials testing lab outfall (Subsection 5.5); photoprocessing facility outfall (Subsection 5.6); Cañon de Valle (Subsection 5.9); surface water runoff for MDA R (Subsection 5.10) into drainage channels; TA-11 outfalls (Subsection 5.15); drainage from GMX-2 (Subsection 5.20); and, outfall from T-Site (Subsection 5.24).

Recreational users of the area could potentially come into contact with contaminants through ambient air, surface soil, sediments in drainage, and pooled surface water. ~~Campers or hunters could also be exposed to~~

TABLE 4-4

SUMMARY OF EXPOSURE ROUTES IN THE CONTINUED LABORATORY OPERATIONS SCENARIO

EXPOSURE ROUTE	ASSUMPTIONS
1. Inhalation of ambient air (fugitive dust or volatiles)	• Fugitive dust is generated by soil disturbances (i.e., bulldozers, trucks and other earth-moving equipment) during construction activities • Construction activities may expose subsurface chemicals to the surface (i.e., excavation) • There may be volatile organic compounds in near-surface and subsurface soils that would contribute to the inhalation exposure • For dust transport indoors, it can be assumed that indoor concentrations are less than those outdoors • For vapor transport indoors, concentrations indoors and outdoors can be assumed to be equivalent, except at sites where subsurface soil gases are entering indoors; in this case, vapor concentrations inside could exceed those outdoors
2. Incidental ingestion of soil	• Incidental soil ingestion of surface or subsurface soils may occur as a result of construction activities • Office workers would be expected to contact much less soil and dust than construction workers
3. Dermal contact with soil	• Skin surface area available for contact with soil includes arms, hands, face, and head
4. Whole body radiation	• Irradiation from radionuclides on the ground surface may occur
5. Contact with HE	• This pathway in considered a "safety" effect of potential contaminants unless concentrations in soils are low. Exposure to HE is through inhalation and soil exposures (above).

~~contaminants via ingestion of game, such as elk. Game are subject to accumulation of contaminants originating from OU 1082 via ingestion of contaminants in the surface water, ingestion of contaminated plants, and inadvertently through the ingestion of contaminated surface soil~~.

Exposure pathways for the recreational scenario include: 1) inhalation of fugitive dust; 2) soil ingestion; 3) dermal contact with soil; 4) contact with high explosives; 5) whole body radiation; 6) dermal contact with surface water; 7) accidental ingestion of surface water; and 8) ~~ingestion of game; and, 9)~~ ingestion of edible plants (piñon nuts, berries, etc.) (see Table 4-5). No body of water in the immediate vicinity is large enough to produce a

TABLE 4-5

SUMMARY OF EXPOSURE ROUTES IN THE RECREATIONAL SCENARIO

EXPOSURE ROUTE	ASSUMPTIONS
1. Inhalation of ambient air (fugitive dust or volatiles)	• Fugitive dust is generated by the wind and during recreational activities (e.g., dirt biking) • There may be volatile constituents on site that would contribute to the inhalation exposure
2. Incidental ingestion of soil	• Incidental soil ingestion of surface or sediments may occur as a result of recreational activities
3. Dermal contact with soil	• Skin surface area available for contact with soil includes arms, hands, face, legs, upper body, and head (the camping event occurs in warm weather).
4. External radiation	• Irradiation from radionuclides on the ground surface may occur
5. Dermal contact with surface water	• Ephemeral streams may be present as a result of snowmelt and summer rainfall • Rainfall events result in pooled water • Standing water occurs after the rainfall event before it seeps into the ground
6. Accidental ingestion of surface water	• Ephemeral streams may be present as a result of snowmelt and summer rainfall • Rainfall events result in pooled water • Standing water occurs after the rainfall event before it seeps into the ground
7. Contact with HE	• This is mainly a safety model rather than a toxicology model; assumption are to be obtained.
8. Ingestion of edible plants	• Root uptake of chemicals by plants may result in human exposure via ingestion of plants.

consistent supply of game fish; therefore, exposure to contaminants by consuming contaminated fish is not a viable pathway for this site.

4.4 Potential Response Actions

Table 4-6 summarizes the potential response actions for each PRS aggregate. Remediation alternatives must achieve acceptable risk levels; however, choosing between alternatives that meet human health risk requirements will be based on factors such as ecological impact, cost, regulatory concerns (in addition to risk), impact on Laboratory operations, socioeconomic impacts, and public concern (~~Appendix 1~~ Chapter 4, IWP) (LANL ~~1992, 0768~~ 1993, 1017). Note that all actions refer to potential or known surface soil problems

TABLE 4-6

POTENTIAL RESPONSE ACTIONS FOR EACH PRS AGGREGATE*

SUB-SECTION	DESCRIPTION	NO FURTHER ACTION OR DEFERRED ACTION	REMOVAL/ TREATMENT		MIXED WASTE	INCIN-ERATION/ REMOVAL	DECON/ REMOVAL	CONDI-TIONAL CAP/ MONITOR	IN-STREAM BARRIERS	ACCESS RESTRIC-TION	IN SITU BIOREME-DIATION
			HAZ-ARDOUS ONLY	RADIO-ACTIVE ONLY							
5.1	Blowdown tanks/dry wells	x	x				x				
5.2	HE sumps and outfalls	x	x		x	x	x		x	x	x
5.3	260-Line HE sumps and outfall	x	x		x	x	x		x	x	x
5.4	TA-11 and TA-16 septic systems	x	x				x				
5.5	Material processing	x	x				x				
5.6	Photoprocessing	x	x				x		x	x	
5.7	Sanitary waste treatment plant	x	x		x		x				
5.8	Buming ground	x	x		x	x	x				
5.9	Cañon de Valle	x					x	x	x	x	
5.10	MDA R	x	x		x		x	x		x	x
5.11	Landfills	x	x				x				
5.12	Ponds	x	x		x		x	x			x
5.13	P-Site	x	x		x		x	x		x	
5.14	K-Site firing site	x	x	x					x		
5.15	K-Site outfalls	x	x	x			x				
5.16	K-Site potential surface contamination	x	x	x			x				
5.17	Decommissioned waste storage area	x	x				x				

TABLE 4-6 (continued)

POTENTIAL RESPONSE ACTIONS FOR EACH PRS AGGREGATE*

SUB-SECTION	DESCRIPTION	NO FURTHER ACTION OR DEFERRED ACTION	REMOVAL/ TREATMENT: HAZ-ARDOUS ONLY	REMOVAL/ TREATMENT: RADIO-ACTIVE ONLY	MIXED WASTE	INCIN-ERATION/ REMOVAL	DECON/ REMOVAL	CONDI-TIONAL CAP/ MONITOR	IN-STREAM BARRIERS	ACCESS RESTRIC-TION	IN SITU BIOREME-DIATION
5.18	GMX-3 HE process buildings	x	x		x		x				
5.19	GMX-3 without sumps	x	x		x		x				
5.20	GMX-2	x	x		x		x				
5.21	Administration area	x	x				x				
5.22	Septics	x	x				x				
5.23	GMX-3 inactive sumps and outfalls	x	x				x				
5.24	T-Site	x	x		x		x				
5.25	V-Site and TA-16-100	x	x		x		x				

* Note that this table is not meant to be all-inclusive.

that represent the contaminants of greatest concern at the site. Subsurface contaminants could require other technologies (e.g., steam injection for vadose zone contaminants).

4.4.1 Criteria for Recommending NFA

Chapter 6 presents the PRSs recommended for NFA or DA based on archival information and field visits. Figure 4-1 shows the decision logic for these recommendations. Appendix I, Subsection 4.1 of the IWP (LANL ~~1992, 0768~~ 1993, 1017) presents a detailed discussion of the rationale for NFA or DA based on archival information.

NFA recommendations based on screening assessments will include an evaluation of combined effects from multiple contaminants and ALARA criteria for radioactive contaminants.

NFA recommendations after baseline risk assessments will be based on acceptable risk-based levels ~~s, 10^{-6} to 10^{-4}~~ for carcinogens, and a hazard index less than one for noncarcinogens. These NFA recommendations will also consider ALARA criteria for radioactive contaminants.

4.4.2 Disposal and Treatment Options

Disposal and treatment options for contaminated materials at OU 1082 include: removal to a RCRA-permitted treatment, storage, and disposal (TSD) facility, removal to the Laboratory mixed waste facility when it is in operation, removal and incineration ~~and removal~~, or decontamination (burning or treatment by supercritical water), bioremediation, and recycling. This list is not all-inclusive. New technologies will be considered as they develop.

4.4.3 Conditional Remedies

Conditional remedies for PRSs at OU 1082 include: capping and monitoring of surface soil or installation, maintenance, and monitoring of in-stream barriers. Conditional remedies are most appropriate for active sites.

4.4.4 Access Restrictions

All PRSs are within a secured portion of the Laboratory, with security fences or no trespassing signs posted. Access restrictions to all PRSs will continue for the foreseeable future.

4.4.5 *In Situ* Remediation

While bioremediation of HE is the most likely *in situ* remediation option for some PRSs in OU 1082, at the time of actual field remediation all *in situ* options for all PCOCs will be evaluated for applicability.

4.5 Sampling Strategies and Sampling Methods

Three sampling strategies will be taken for the RFI Phase I surveys: reconnaissance, baseline risk assessment, and VCA. Reconnaissance sampling is biased toward collecting material that is representative of the maximum contaminant concentration in a PRS, where there is little or no historical data. Baseline risk assessment sampling collects material that reflects the most likely exposure scenario for the PRS, and is appropriate where there is a high probability that a baseline risk assessment will be performed. VCA sampling is used to guide corrective actions for PRSs where there is a known hazard. Sampling SOPs used in the RFI Phase I are summarized in Table 4-7 and are discussed below.

4.5.1 Sampling Strategies

Sampling strategies for OU 1082 aggregates are summarized in Table 4-8. Note that for some aggregates, more than one sampling strategy is planned within different parts of the same aggregate. For example, VCA sampling is proposed at the sumps (Subsection 5.2) to bound HE contamination, and reconnaissance sampling is proposed downstream from that contaminated region.

4.5.1.1 Reconnaissance Sampling

The premise of reconnaissance sampling is that samples can be taken that represent the maximum contaminant concentration in a PRS. Sample locations are biased by either knowledge of the physical process responsible for the potential contaminant distribution in space (or time) or by preliminary field screening and/or mobile laboratory methods. If field screening is used to select sample locations, then it is critical that methods are available for all potential contaminants, or that a smaller set of potential contaminants can be used as surrogates for the remaining PCOCs. In the OU 1082 RFI, the PCOCs barium and HE (HMX, RDX, and TNT) are generally used to guide the selection of biased reconnaissance samples because of the

TABLE 4-7

STANDARD OPERATING PROCEDURES (SOPs) FOR OU 1082

TITLE	NUMBER
General Instructions for Field Investigations	LANL-ER-SOP-01.01
Sample Containers and Preservation	LANL-ER-SOP-01.02
Handling, Packaging, and Shipping of Samples	LANL-ER-SOP-01.03
Sample Control and Field Documentation	LANL-ER-SOP-01.04
Field Quality Control Samples	LANL-ER-SOP-01.05
Management of RFI-Generated Waste	LANL-ER-SOP-01.06
Land Surveying Procedures	LANL-ER-SOP-03.01
Drilling Methods and Drill Site Management	LANL-ER-SOP-04.01
Sampling for Volatile Organics	LANL-ER-SOP-06.03
Soil Water Samples	LANL-ER-SOP-06.05
Spade and Scoop Method for Collection of Soil Samples	LANL-ER-SOP-06.09
Hand Auger and Thin-Wall Tube Sampler	LANL-ER-SOP-06.10
Stainless Steel Surface Soil Sampler	LANL-ER-SOP-06.11
Sediment Material Collection	LANL-ER-SOP-06.14
Coliwasa Sampler for Liquids and Slurries	LANL-ER-SOP-06.15
Collection of Sand, Packed Powder, or Granule Samples Using the Hand Auger	LANL-ER-SOP-06.18
Volatile Organic Sampling Train	LANL-ER-SOP-06.21
Canister Sampling for Organics EPA Method T0-14	LANL-ER-SOP-06.22
Screening of PCBs in Soil	LANL-ER-SOP-10.01
MCA-465/Fidler Instrument System	LANL-ER-SOP-10.04
Measurement of Bulk Density, Dry Density, Water Content, and Porosity in Soil	LANL-ER-SOP-11.01
Particle Size Distribution of Soil/Rock Samples	LANL-ER-SOP-11.02
Permeability of Granular Soils	LANL-ER-SOP-11.03
Soil and Core pH	LANL-ER-SOP-11.04
Total Organic Carbon	LANL-ER-SOP-11.05
Cation-Exchange Capacity	LANL-ER-SOP-11.06

likelihood of the presence of these compounds. These PCOCs are by far the most significant at TA-16 based on historical information and existing data.

Reconnaissance sampling data will provide an estimate of the upper bound on the concentration of PCOCs. The measured values will be compared to

TABLE 4-8

SAMPLING STRATEGIES USED IN OU 1082 AGGREGATES

SUB-SECTION	DESCRIPTION	RECON-NAISSANCE SAMPLING	BASELINE RISK ASSESSMENT SAMPLING	VOLUNTARY CORRECTIVE ACTION SAMPLING
5.1	Blowdown tanks/dry wells	x		
5.2	HE sumps/outfall	x		x
5.3	HE sumps/active outfall	x		x
5.4	Septic systems • active systems • inactive systems	 x [1]		 x
5.5	Materials testing laboratory	x		
5.6	Photoprocessing laboratory		x	
5.7	Sanitary waste treatment plant • pond • structures	 x		 x
5.8	Burning ground	x [1]		
5.9	Cañon de Valle		x	
5.10	MDA R	x		
5.11	Surface disposal	x		
5.12	Ponds		x	
5.13	P-Site	x [1]		
5.14	TA-11 firing site (active site) • drainages • Water Canyon		 x	 x
5.15	TA-11 outfalls	x [2]		
5.16	TA-11 surface contamination	x [1]		
5.17	Waste storage	x [1]		
5.18	GMX-3 HE process buildings	x		
5.19	GMX-3 without sumps	x		
5.20	GMX-2	x		
5.21	Administration area	x		
5.22	Septics	x		
5.23	GMX-3 inactive sumps and outfalls	x		
5.24	T-Site	x		
5.25	V-Site and TA-16-100	x		

1 Baseline risk assessment planned using reconnaissance samples (these may be biased).
2 Baseline risk assessment planned for aggregate.

SALs (Subsection 4.2.2), which are based on a conservative residential exposure scenario.

Reconnaissance sampling results could also be used in support of a baseline risk assessment. ~~Most reconnaissance sampling plans will have at least three full laboratory analyses, which is the minimum number required for a baseline risk assessment~~. Data from neighboring PRSs may be combined into a single baseline risk assessment, which is possible if these PRSs fall within an exposure area for the risk scenario and the list of COCs ~~are~~ is similar. It is important to note that using positively biased data creates a conservative risk assessment, but is one step closer to a representative risk assessment compared to the assumptions used to derive the SALs.

The portion of the field sample that is submitted for laboratory analysis will also be biased by field screening or mobile laboratory results. Thus, reconnaissance sampling may have two levels of biasing to increase the chance of sampling the maximum potential contaminant concentration in a PRS. Deep borings (>12 in. length) will often be field screened every 6 in. for potential contaminants (e.g., radioactivity, HE, volatile organics, metals).

For some reconnaissance surveys, the number of samples is based on quantitative statements of error tolerances (Table 4-9). These are stated as the desired probability of detecting potential contamination when a certain per cent of the site is expected to be contaminated. For example, the decision maker may state that he wants to detect contaminants above SALs at least 90% of the time, if 25% of the site is contaminated. The binomial presence-absence sampling model (also known as the "nomogram" approach in the IWP) supplies the number of independent analyses of the PRS that must be taken to meet this performance goal ~~(Table 4-9)~~ (LANL ~~1992, 0768~~ 1993, 1017). For the above example, nine independent analyses are required to meet the decision maker's uncertainty tolerances. As noted above, these samples will be biased by field screening and do not assume a grid sampling pattern. The derivation of the binomial presence-absence sampling approach is given in Appendix H of the IWP (LANL ~~1992, 0768~~ 1993, 1017). The reconnaissance sampling approach uses biasing techniques to assure that the samples sent for laboratory analysis represent the maximum for a PRS.

TABLE 4-9

SAMPLE SIZES FOR RECONNAISSANCE SAMPLING

DETECTION PROBABILITY	FRACTION OF SITE AFFECTED									
	0.50	0.45	0.40	0.35	0.30	0.25	0.20	0.15	0.10	0.05
0.51	2	2	2	2	2	3	4	5	7	14
0.54	2	2	2	2	3	3	4	5	8	16
0.57	2	2	2	2	3	3	4	6	9	17
0.60	2	2	2	3	3	4	5	6	9	18
0.63	2	2	2	3	3	4	5	7	10	20
0.66	2	2	3	3	4	4	5	7	11	22
0.69	2	2	3	3	4	5	6	8	12	23
0.72	2	3	3	3	4	5	6	8	13	25
0.75	2	3	3	4	4	5	7	9	14	28
0.78	3	3	3	4	5	6	7	10	15	30
0.81	3	3	4	4	5	6	8	11	16	33
0.84	3	4	4	5	6	7	9	12	18	36
0.87	3	4	4	5	6	8	10	13	20	40
0.90	4	4	5	6	7	9	11	15	22	45
0.93	4	5	6	7	8	10	12	17	26	52
0.96	5	6	7	8	10	12	15	20	31	63
0.99	7	8	10	11	13	17	21	29	44	90

This biasing provides a probability statement that is conservative (i.e., the probability of detecting contamination is greater than 90%).

False negative errors are controlled in reconnaissance surveys, but false positive errors are not controlled. However, the consequences of a false negative decision are more serious (propose NFA for a contaminated PRS) than are the consequences of a false positive error (collect additional data). Reconnaissance sampling is most appropriate where there is reliable historical or archival data that indicate that the PRS is not known to be a problem based on existing data (a true negative) and biased sampling is possible. For PRSs where it is likely that potential contaminants are above SALs, then baseline risk assessment sampling is more appropriate.

4.5.1.2 Baseline Risk Assessment Sampling

Baseline risk assessment sampling is recommended for PRSs where archival data or existing analytical data indicate that PCOCs are likely to be above SALs. The main difference is that in addition to providing data for a screening assessment, these data must be suitable for a baseline risk assessment. Data used in a baseline risk assessment must be representative of the heterogeneity within the exposure area and have adequate QA/QC measures. The absolute minimum number of samples that could be adequate for a baseline risk assessment is three laboratory analyses, but the actual number for any PRS is based on the heterogeneity of the PCOCs and the exposure scenario. Field screening or mobile laboratory results may help determine the spatial or temporal extent of the potential contaminants, but these data will not be used to bias sampling.

The most important difference between baseline risk assessment sampling and reconnaissance sampling is the lack of biasing, which yields a set of samples that is more representative of the exposure scenario. The likely exposure scenarios for these PRSs or PRS aggregates are a long-term worker, construction worker or recreational user scenario, but the appropriate future use scenario will be decided with stakeholder input. A construction worker excavation scenario assumes that exposure occurs from the average concentration in 5-ft-depth increments to a maximum depth of 12 ft (LANL 1993, 1017). A 5-ft interval represents the length of a core rod. Thus, the sample should be collected to represent the average concentration in ~~a~~ 5 ft soil cores down to 12 ft.

A statistically based sampling design should be developed for baseline risk assessment surveys. Key design inputs for a statistically based survey are the spatial variation of the PCOCs and the laboratory measurement performance for these PCOCs. In some cases, such information for the PCOCs and the PRS will not be available, the baseline risk assessment survey will be designed based on professional judgment. All baseline risk assessment surveys will include a sufficient amount of QA/QC so that these design inputs will be known and a *post-hoc* assessment of data sufficiency can be made.

4.5.1.3 Voluntary Corrective Action Sampling

VCA sampling results will not be used in a screening assessment. The purpose of VCA sampling is to bound the extent of contamination and to collect other information to guide site remediation. Media characteristics (e.g., organic material content) and the lists of COCs are important factors used to guide remediation. Thus, VCA sampling plans will vary based on the extent of the historical information on the PCOCs and other site characteristics. The verification sampling (post-remediation) is not considered as part of VCA sampling, and will be described in the VCA plan.

4.5.2 Sampling Methods

For a complete list of SOPs used in the RFI for OU 1082, refer to Table 4-7. Most samples taken at OU 1082 will be surface soil samples taken with hand augers. Other samples will include borings though soil and bedrock with a diamond drill. All sampling activities at OU 1082 will be conducted only after procedures are approved by the Explosives Safety Committee.

Field sample handling procedures will include collection of material for volatile organic analysis, metals, radionuclides, and semivolatiles.

Samples will be collected from defined sampling points, a sampling grid, or by stratified random sampling. To implement stratified random sampling the field survey team will be given x and y offsets from a sampling grid. Stratified random sampling is used where there is a concern about the presence of heterogeneously distributed contaminants where there is no spatial pattern to contamination.

4.6 Field Surveys

Field investigations during RFI Phase I have many common elements. While not all Phase I field surveys include all components, most surveys include: health and safety surveys, location surveys, and geophysics surveys.

4.6.1 Health and Safety Surveys

Before any site work can be started, the health and safety team must screen the site for potential worker hazards. In addition, when subsurface samples are taken, the borehole and cores are also sampled for health and safety purposes. These health and safety data may be helpful in selecting samples for laboratory analysis, or in determining the handling procedures for the samples.

4.6.1.1 Asbestos Monitoring

Over the years, many of the historical buildings at OU 1082 have been razed and, in many cases, burned. As part of this process noncombustibles, including asbestos shingles and pipe insulation, were removed for disposal.

Testing soils for asbestos is expensive and currently there is no generally accepted method for the analysis of asbestos in soil (Stenner et al. 1990, 15-16-554).

The likelihood of adverse health effects resulting from asbestos-contaminated soil is dependent on the presence of friable asbestos and human exposure via inhalation. Given these two considerations, the following guidelines to be followed during sampling are recommended to ensure protection to human health while minimizing unnecessary expenses of sampling, analysis, and possible remedial action.

1. If there are no visible signs of asbestos-containing material (ACM) and historical evidence indicates that ACM was not at the site, NFA is suggested.

2. If there are no visible signs of ACM and historical evidence indicates that ACM might have been at the site and removal procedures are uncertain or may not have adequately contained the asbestos, ambient air monitoring will be initiated to better define the presence of asbestos contamination in the soil. Since current exposure at the sites is typically occupational exposure, it would be appropriate to compare asbestos levels in the air with the OSHA standard of 0.2 fibers/cc of air (ACGIH 1993, 1102). If this value is exceeded, remedial actions may be necessary.

3. If there are visible signs of ACM and historical evidence may or may not indicate that ACM might have been at the site, it is recommended that the visible ACM be eliminated by VCA and ambient air monitoring be initiated to better define the presence of asbestos fiber contamination in the soil, especially during high winds and/or during activities that would disturb the soil. Since current exposure at the sites is typically

occupational exposure, it would be appropriate to compare asbestos levels in the air with the OSHA standard of 0.2 fibers/cc of air (ACGIH 1993, 1102). If this value is consistently exceeded, remedial actions may be necessary.

4.6.2 Land Surveys

Each PRS aggregate will be field surveyed before sample collection. This will consist of site engineering mapping (geodetic) and geomorphologic mapping. Site mapping is required to accurately record the location of PRSs and sampling points. In the field, the engineering survey will locate, stake, and document all PRS locations (that can be ascertained before sampling) and all surface engineering features and structures. These data will be recorded on a base map. If the repositioning of a sample location becomes necessary during sample collection, this new position will be resurveyed and the revised location will be indicated on the base map. The engineering survey will be performed ~~by a licensed professional working to "Minimum Standards for Land Surveying In New Mexico: (New Mexico Board of Registration for Professional Engineers and Surveyors, (1/1/89) with oversight by the field team leader~~ in accord with ER SOP 3.01, Land Surveying Procedures.

The geomorphologic survey will consist of the mapping of the first-order stream channels downslope of any identified drain outfall. This mapping will facilitate the selection of outfall sediment sample collection points. The surface drainage mapping will include the sediment catchment sites adjacent to any identified outfall.

4.6.3 Geophysics Surveys

The purpose of geophysics surveys is to locate subsurface objects. Engineering as-built diagrams locate objects, but not always with the precision needed for sampling. For example, samples taken adjacent to an active septic system drain line, must miss the line and collect the material of interest. In other cases, subsurface utility lines may be in the vicinity of the proposed soil cores.

The general location of the subsurface components will be determined from examination of dated aerial photographs and engineering drawings, land surveys, and from on-site visual inspection. Geophysical surveys will be conducted if necessary to precisely determine the boundaries of subsurface structures. The Geosciences Technical Team will provide guidance as to the appropriate geophysical methods. Once located, the sites will be surveyed in and permanently marked in the field and the data recorded on a base map.

~~4.6.4 Field Quality Assessment Samples~~

~~The purpose of field quality assessment samples to quantify the performance of a sampling technique (surface samples taken by a hand auger, boreholes taken by a diamond drill, etc.). A rule-of-thumb for a usual investment in QA is 10 to 20 % more samples (1 to 2 QA field samples for 20 field samples). There are several kinds of QA samples that can be collected. For example, for composite samples of a soil column, one may subsample the core twice or one may collect a second aliquot of the homogenized sample. Another kind of field QA sample is a collocated (or neighboring) sample. The investment in these various field QA types depends on the sources of variation in the sampling process. The largest source of variation is usually from field sample preparation (homogenizing), which indicates that the best investment in field QA is to collect additional subsamples of the homogenate.~~

4.7 Analytical Options

Use of field screening procedures and the field mobile laboratory are two analytical approaches that will ensure that the initial fixed laboratory findings capture the likely presence or indicate the absence of anticipated site PCOCs during reconnaissance sampling. These two analytical approaches allow the field team to better select samples that may reflect a site problem and to ensure that adequate samples are collected to characterize the PRS. Field screening will be particularly useful at OU 1082, where a limited number of compounds (HE, barium) present the majority of likely human risk, and field screening methods for these compounds are fast, effective, and have low detection limits. Field laboratory methods will not be needed for most OU 1082 aggregates, except for radiological constituents.

These two screening approaches are not intended to replace the need for fixed analytical laboratories during reconnaissance, baseline risk assessment, or VCA sampling, but to make decision-making more efficient through data timeliness, dollar and people resource use, and adequacy of decision data quality. During the reconnaissance phase, the objective of the screening assessment process is primarily to confirm the site COCs and to estimate the upper bound on the COC concentration. The screening approaches will help select biased samples representative of the maximum concentration in a PRS, and this material will be sent to the analytical laboratory. The selected approach and the supporting quality assessment and quality control data must always be specific to the site decision that is being made. This decision-based strategy to specify data quality helps ensure the adequacy of the analytical data generation process.

4.7.1 Field Screening Methods

Field screening methods include volatile organic methods [photoionization detector (PID), flame ionization detector (FID)], metals method (XRF, LIBS), the HE spot test for explosives, and radiation methods (beta/gamma or alpha counters, low energy spectra instruments - FIDLER, Phoswich). For instruments based on a counting technology (e.g., XRF, FIDLER) increasing counting time reduces the detection limit (a factor of $\frac{1}{\sqrt{n}}$, where n is the multiple by which counting is increased, e.g., 10 min. count has a detection limit of 71% of a 5 min. count). Typical detection limits for field screening and field laboratory methods of importance in this RFI work plan are summarized in Tables 4-1 and 4-1a.

Photoionization detector: A Model PI 101 PID, or its equivalent, will be used. It is a general survey instrument capable of detecting real-time concentrations of many complex organic compounds and some inorganic compounds in air. The instrument is usually not specific for a particular compound, unless the sample contains a limited number of volatile organics. The applicable SOP, which is currently in draft form, is Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

Flame ionization detector: A Foxboro Model OVA-128, or its equivalent, will be used. It is a flame ionization detector (FID), which can be used as a general screening instrument to detect the presence of many organic vapors. Its response to an unknown sample is relative to the flammability of the calibration gas. The applicable SOP, which is currently in draft form, is

Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

Laser-Induced Breakdown Spectroscopy (LIBS): The laser spark from a Spectra-Physics DCR-11 has been used as an excitation source for the analysis of inorganics via atomic emission spectroscopy. In this method, a powerful laser pulse is focused on or in the material to be analyzed. As a result, the material is vaporized and a plasma of high temperature and high electron density is formed, consisting of electron and excited atoms. One identifies emitting species by spectrally and temporally resolving the plasma light. Detection limits of 2 ppm for chromium and lead and 0.1 ppm for beryllium were determined (Han and Cremers 1990, 15-16-470). For measurements using 100 sparks (10 seconds), accuracies were within 80% and precision was 20% risk-specific dose (RSD) or better for chromium detection. Preliminary experiments suggest that LIBS also has good detection limits (estimated at <100 ppm) for barium in soils (Brown et al. 1992, 15-16-389).

HE Spot-Test Kit: The HE spot-test kit was developed to identify the presence of explosives as contaminants on equipment and in environmental media. Three reagents in a carrying case with a portable ultraviolet (UV) lamp can be used to detect any of the common explosives used at Los Alamos. These explosives are HMX, RDX, TNT, PETN, and TATB. After a suspect area or material is wiped with a clean filter paper, a drop of each of the three reagents placed on different parts of the sample will change color when explosives and/or other nitrogen compounds are present. A UV light (short wavelength, 254 nm) enhances color for RDX/HMX explosives. For checking soil contaminated with TNT, it was possible to detect a content as low as 0.01% (100 ppm) as determined by laboratory experiments (Baytos 1991, 0741).

The Laboratory's HE spot test kit was recently upgraded by Group DX-16 (Spontarelli 1994, 15-16-537). The current method relies on decomposition of the explosive compound to form the nitrite ion, which is then detected colorimetrically. The improved procedure indicates contamination by TNT, TATB, tetryl, HMX, RDX, PETN, nitroglycerine, and nitrocellulose. The detection limit of the method is approximately 100 ppm for all of the explosives with the exceptions of PETN and TATB. The PETN detection limit was determined to be 500 ppm and that for TATB remains unknown (Spontarelli 1994, 15-16-537). Although these detection limits do not achieve SALs for RDX (64 ppm) and TNT (40 ppm), they should be adequate for Phase I sample biasing.

Low-Energy Gamma Instruments: Two instruments are commonly used for these surveys, the FIDLER and the Phoswich. Both are optimized for the detection of low-energy photons, such as the 60 keV gamma emission from americium-241 or the x-rays that accompany the decay of most heavy radionuclides, such as uranium, thorium, plutonium, and other transuranic radionuclides. Either instrument may be used for this work plan. Discrete- or continuous-measurement recording options are available. Surveys are conducted by carrying the instrument close to the ground surface and observing the rate meter or scaler. Measurements may also be made at the ground surface to characterize material without collecting a sample.

PAH Field Immunoassay System: The Quantix portable real-time immunoassay system is designed to detect PAH in soils (Quantix 1993, 15-16-539). The system uses isopropanol to extract PAH from soil prior to analysis using an immunoassay method. Comparison of data obtained using the Quantix system and GC-MS method 8270 shows good agreement (R^2 = 0.72 - 0.98) between the two methods (Quantix 1993, 15-16-539). Detection limits for total PAH (0.7 ppm) are adequate for biasing samples.

BTEX Field Immunoassay System: The Agri-Diagnostics Associates field immunoassay system for BTEX (benzene-toluene xylene) is a quantitative field screening method that is specific for the BTEX components of gasoline. The immunoassay method has a detection range of 250 ppb to 65 ppm total BTEX in water and 3.5 to 940 ppm total BTEX in soil. The immunoassay method results compare well with SW 846 method 8020 data for both gasoline-spiked and field contaminated samples. This system should be adequate for biasing samples in PRSs in which BTEX is a significant PCOC.

TABLE 4-10

MOBILE LABORATORY METHODS THAT MAY BE USED IN OU 1082

METHOD	ANALYTE OR ANALYTE CLASS	LABORATORY REPORTING LIMIT
XRF with quick extraction via microwave	RCRA metals	e.g., Barium (Ba) - 10 ppm
GC/MS	VOC, SVOC, pesticides	e.g., Acetone - 0.05 ppm
HE colorimetic	TNT, DNT, RDX	TBD
Beryllium (Be) spot test	Be	TBD
Mercury (Hg) spot test	Hg	TBD
Gross α/β	α/β radiation	α - 55 pCi/g [1,a] β - 24 pCi/g [1,a]
Gross γ	γ radiation	4 pCi/g [1,b]
γ spectroscopy	γ radiation	< 5 pCi/g [1,2,b]

[a] 1 gm sample
[b] 100 gm sample
[c] 15 gm sample

[1] 5 minute counts
[2] Isotope dependent
TBD To be determined by ~~EM-9~~ CST-9

4.7.2 Field Laboratory

Refer to the field laboratory methods summary table (Table 4-10) for a list of all field laboratory methods that are currently available and may be used at OU 1082.

X-ray fluorescence (XRF): XRF is a technique for analyzing metals in solids. The instrument consists of a source for sample excitation, a detector or proportional counter, a sample chamber, and an energy analyzer. The XRF instrument will be used for detection of metals, particularly barium, that are heavier than sulfur, on solid surfaces. Dried soil or crushed debris samples are placed in a sample chamber, excited, and counted for finite time periods (such as 200 seconds). XRF only scans the upper layer of any material, which means that sample preparation can have a large impact on repeated measurements of a sample. There is no ER SOP for field-based XRF; calibration and field procedures recommended by the instrument manufacturer will be followed. Lower detection limits are related to the sample counting time. Thus, counting time must be selected with a knowledge of the list of PCOCs and appropriate SALs. Examples of manufacturer-reported lower detection limits are 10 ppm for uranium, 55 ppm for silver, and 15 ppm for lead. EM-9 CST-9 estimates the barium detection limit to be 10 ppm.

The XRF provides a total metals analysis. Because EPA extraction method 3050 uses an acid leaching protocol and thus provides a partial metal analysis, the XRF data should not be compared directly to SALs. If used, field-based XRF data will guide selection of samples for laboratory analysis.

4.7.3 Analytical Laboratory Methods

See the PCOC summary table for a listing of the principal analytical methods (Tables 4-1 and 4-1a). We have defined a subset of the SW 846 6010 metals as the OU 1082 metals suite. In many cases only this subset of metals will be reported. These metals include: barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, silver, thallium, and zinc.

4.8 Quality Assessment

4.8.1 Laboratory Quality Assessment Samples

Refer to Annex II for a description of the type and number of laboratory quality assessment samples. The purposes of these samples are to assess analytical precision and bias, and to help discover fraud.

4.8.2 Field Quality Assessment Samples

The purpose of field quality assessment samples is to quantify the performance of a sampling technique (surface samples taken by a hand auger, boreholes taken by a diamond drill, etc.). Thus, adequate data should be collected within OU 1082 to evaluate each sampling method. As stated in the QAPjP, one quality assessment sample will be taken for twenty field samples. Many kinds of quality assessment samples can be collected (e.g., collocated samples, homogenate subsamples, field duplicates), and the type and number of these samples depends on the major source of variation in the sample collection process. The implementation plan for OU 1082 will use guidance in the IWP and survey-specific requirements in determining the number and type of field quality assessment samples. A brief discussion of the types of field quality assessment samples proposed in reconnaissance and baseline risk assessment surveys is presented below.

Reconnaissance sampling surveys usually involve collecting discrete samples from the surface or a segment of a soil core. These samples are selected by field screening or judgment to represent the maximum concentration in the PRS. Quality assessment samples will be taken to quantify the effectiveness of the biasing by collecting additional samples at random (within the PRS or in the soil core). Another quality assessment investment is to collect collocated (or neighboring) samples. Collocated samples help determine the local variation in PCOCs, which is an important assumption in the statistical survey design. A roughly equal number of quality assessment samples for evaluating the biasing procedure and for collocated samples is expected to be allocated.

Baseline risk assessment surveys will collect material that is representative of the risk scenario. In some cases, samples will be homogenized in the field before being submitted to the analytical laboratory. The largest source of variation is usually from field sample preparation (homogenizing), which indicates that the best investment in field quality assessment for baseline risk assessment surveys is to collect additional subsamples of the homogenate. Collocated samples will also be collected, but the expected investment is three additional subsamples for every one additional collocated sample. The rationale for this investment is that field quality assessment information for collocated samples will be collected in the reconnaissance surveys, and that sample homogenization is expected to contribute an order of magnitude more variation to the sampling process than does local spatial variation of PCOCs.

4.9 Recordkeeping and Field Logs

All records generated by OU 1082 field investigations will be processed and archived in accordance with the Records Management Plan presented in Annex IV of the IWP (LANL ~~1992, 0768~~ 1993, 1017). Records generated during field activities will be documented in the field log. Records documenting activities occurring after samples are shipped from the field to the analytical laboratory, including laboratory analyses, laboratory analytical results, data validation, data analysis, and preparation of the RFI Report will be archived in accordance with the Records Management Plan.

A field log will be maintained during the sampling program. The log will document all field activities, including the sampling activity; record the information obtained from the field screening instrumentation; identify the procedures used in sampling and sample site selection; identify the personnel involved; and, record any other information pertinent to the sampling process and to the quality of the results. Field logs maintained by individual field team members will be consolidated into a master log at the end of each major sampling activity.

The completed field log will document the implementation of this work plan. Most importantly, it will document the site-specific decisions of the field team leader required under the phased approach presented in this plan, as well as any modifications to the plan required to address unanticipated site conditions. Because sampling and site characterization are essentially processes of discovery, minor modifications to the sampling plan and to its implementing procedures may occur. As a vehicle for documentation, the field log will be written to provide sufficiently comprehensive descriptions of the sampling activities and their rationale so that modifications to the work plan are not expected to be needed.

REFERENCES

ACGIH (American Conference of Governmental Industrial Hygienists, 1993). "1993-1994 Threshold Limit Values For Chemical Substances and Physical Agents and Biological Exposure Indices," ISBN: 1:882417-03-8, Cincinnati, Ohio. **(ACGIH 1993, 1102)**

Baytos, J. F., July 1991. "Field Spot-Test Kit for Explosives," Los Alamos National Laboratory Report LA-12071-MS, Los Alamos, New Mexico. **(Baytos 1991, 0741)**

Brown, R., B. Martin, and D. Hickmott, August 1992. "Barium Transport at S-Site and Laser-Induced Breakdown Spectroscopy (LIBS): Its Application to Field Screening of Barium in Soils," Los Alamos National Laboratory, Los Alamos, New Mexico. **(Brown et al. 1992, 15-16-389)**

Duffy, C. and P. Longmire, 1993. "Preliminary Background Elemental Concentrations in Bandelier Tuff and Selected Soil Series, 1993," Los Alamos National Laboratory, Los Alamos, New Mexico. **(Duffy and Longmire 1993, 15-16-480)**

EPA (US Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)," Interim Final, EPA 540/1-89/002, Office of Emergency and Remedial Response, Washington, DC. **(EPA 1989, 0305)**

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55., pp. 30798-30884. **(EPA 1990, 0432)**

EPA (US Environmental Protection Agency), March 25, 1991. 'Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance "Standard Default Exposure Factors," Interim Final,' OSWER Directive 9285.6-03, Office of Emergency and Remedial Response, Toxics Integration Branch, Washington, DC. **(EPA 1991, 0746)**

EPA (US Environmental Protection Agency), May 29, 1992. "Guidelines for Exposure Assessment," Federal Register Vol. 57, No. 104, pp. 22888-22983. **(EPA 1992, 15-16-469)**

Ferenbaugh, R. W., E. S. Gladney, and G. H. Brooks, Jr., October 1990. "Sigma Mesa: Background Elemental Concentrations in Soil and Vegetation, 1979," Los Alamos National Laboratory Report LA-11941-MS, Los Alamos, New Mexico. **(Ferenbaugh et al. 1990, 0099)**

Han, M. Y. and D. Cremers, 1990. "Rapid determination of metal contaminants in soils using the laser spark," (submitted to J. Environmental Analytical Chemistry). **(Han and Cremers 1990, 15-16-470)**

~~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)**~~

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

Quantix Systems, June 7, 1993. Preliminary Product Performance Characteristics of the Quantix Portable Workstation, New Jersey. **(Quantix 1993, 15-16-539)**

Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987. "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory Report LA-11134-MS, Los Alamos, New Mexico. **(Purtymun et al. 1987, 0211)**

Spontarelli, T., 1994. "Explosives Spot Test," Los Alamos National Laboratory Group DX-16 Report, Los Alamos, New Mexico. **(Spontarelli 1994, 15-16-537)**

Stenner, R.D., J.G. Droppo, R.A. Peloquin, R. W. Bienert, N.C. VanHouten, April 1990. "Guidance Manual on the Estimation of Airborne Asbestos Concentrations as a Function of Distance From a Contaminated Surface

Area For Area Suspension Evaluations," Pacific Northwest Laboratory Report No. PNL-7311, Richland, Washington. **(Stenner et al. 1990, 15-16-554)**

US Army Corps of Engineers Toxic and Hazardous Materials Agency, 1991. "Feasibility Study for the Explosives Washout Lagoons (Site 4) Soils Operable Unit," Final Report, Umatilla Depot Activity (UMDA), Germston, Oregon. **(US Army Corps of Engineers 1991, 15-16-471)**

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- HE Sumps and Outfalls
- HE Sumps and Active Outfall at TA-16-260
- TA-11 and TA-16 Septic Systems
- Materials Testing Laboratory
- Photoprocessing Facility
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- GMX-3—With Sumps
- GMX-3—Without Sumps
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- World War II Administration Area
- Septic Systems
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Addendum 2

(To be completed in 1995)

5.0 EVALUATION OF POTENTIAL RELEASE SITE AGGREGATES

Chapter 5 describes the history, data quality objectives, and sampling plans for the Operable Unit (OU) 1082 potential release sites (PRSs) for which sampling is deemed appropriate at this time. The solid waste management units (SWMUs) that are covered ~~here~~ in aggregates 5.1 through 5.17 are from Tables A and B of the Hazardous and Solid Waste Amendments (HSWA) Module and other PRSs that fit systematically into this work plan activity. The remaining OU 1082 PRSs ~~will be~~ are addressed in subsequent Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan addenda. Subsections 5.18 through 5.25 are in Chapter 5 of Addendum 1.

The framework for sample collection strategies and use of data as applied in Chapter 5 is found in Chapter 4, Subsections 4.5.1.1 and 4.5.1.2. Annex II, Quality Assurance Project Plan, describes the quality control issues pertinent to this work plan. Occupational Safety and Health Administration (OSHA) requirements for current site workers are the responsibility of the operating groups and are not addressed in this work plan.

5.0.1 Index to PRSs Described in Chapter 5

The OU 1082 RFI work plan describes potential release site (PRS) histories, potential contaminants of concern (PCOCs), data quality objectives (DQOs), and sampling plans for a large number of PRSs (87 in 1993 and 164 in 1994). In order to locate information for individual PRSs, an index table (Table 5-0-1) and index maps [Figs. 5-0-1(a), 5-0-1(b), and 5-0-2] for all PRSs and PRS sampling maps in the work plan and Addendum 1 are provided below. PRSs not listed in this table either will be described in the 1995 addendum to the OU 1082 RFI work plan or are proposed for no further action (NFA) or deferred action (DA) in Chapter 6.

5.0.2 DQOs for Reconnaissance Sampling - Generic Logic

Sampling designs in the RFI work plan for OU 1082 follow the general guidelines described in the IWP. In particular, the streamlined approach and DQO process for sample design, as described in Subsections 4.1.2 and Appendix H of the IWP, were used to guide the development of sampling (LANL 1993, 1017). The aggregates described in Subsections 5.1 through

TABLE 5-0-1

INDEX TO PRSs

PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
11-001(a)	14/DA	5.14.1.1	5-245	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-001(b)	14/DA	5.14.1.1	5-245	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-001(c)	16	5.16.1.1	5-274	5-73	5-272	5-75	5-279	5.16.4.2	5-280
11-002	14/DA	5.14.1.1	5-248	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-003(a)	NFA	6.2.3.1	6-24	NA	NA	NA	NA	NA	NA
11-003(b)	14/DA	5.14.1.1	5-246	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(a)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(b)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(c)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(d)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(e)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-004(f)	14/DA	5.14.1.1	5-247	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-005(a)	4	5.4.1.1	5-97	5-28	5-102	5-30	5-108	5.4.4.3	5-110
11-005(b)	4	5.4.1.1	5-98	5-28	5-102	5-30	5-108	5.4.4.3	5-110
11-005(c)	15	5.15.1.1	5-260	5-70	5-261	5-72	5-267	5.15.4.2	5-268
11-006(a)	14/DA	5.14.1.1	5-248	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-006(b)	14/DA	5.14.1.1	5-248	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-006(c)	14/DA	5.14.1.1	5-248	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-006(d)	14/DA	5.14.1.1	5-248	5-67	5-244	5-69	5-257	5.14.4.2	5-258
11-007	NFA	6.1.5.1	6-13	NA	NA	NA	NA	NA	NA
11-008	NFA	6.2.3.2	6-25	NA	NA	NA	NA	NA	NA
11-009	NFA	6.1.5.2	6-14	NA	NA	NA	NA	NA	NA
11-010(a)	NFA	6.1.5.7	6-22	NA	NA	NA	NA	NA	NA
11-010(b)	DA	6.2.1.1	6-22	NA	NA	NA	NA	NA	NA
11-011(a)	15	5.15.1.1	5-260	5-70	5-261	5-72	5-267	5.15.4.2	5-268
11-011(b)	15	5.15.1.1	5-263	5-70	5-261	5-72	5-267	5.15.4.2	5-268
11-011(c)	DA	6.2.1.2	6-23	NA	NA	NA	NA	NA	NA
11-011(d)	15	5.15.1.1	5-263	5-70	5-261	5-72	5-267	5.15.4.2	5-268
11-012(a)	16	5.16.1.1	5-271	5-73	5-272	5-75	5-279	5.16.4.2	5-280
11-012(b)	16	5.16.1.1	5-271	5-73	5-272	5-75	5-279	5.16.4.2	5-280
11-012(c)	16	5.16.1.1	5-271	5-73	5-272	5-75	5-279	5.16.4.2	5-280
11-012(d)	16	5.16.1.1	5-271	5-73	5-272	5-75	5-279	5.16.4.2	5-280
13-001	13	5.13.1.1	5-226	5-64	5-227	5-66	5-236	5.13.4.3	5-239
13-002	13	5.13.1.1	5-226	5-64	5-227	5-66	5-236	5.13.4.3	5-239
13-003(a)	4	5.4.1.1	5-98	5-28	5-102	5-30	5-108	5.4.4.3	5-109
13-003(b)	4	5.4.1.1	5-98	5-28	5-102	5-30	5-108	5.4.4.3	5-109
13-004	13	5.13.1.1	5-226	5-64	5-227	5-66	5-236	5.13.4.3	5-240
16-001(a)	1	5.1.1.1	5-4	5-1	5-2	5-3	5-12	5.1.4.3	5-13
16-001(b)	1	5.1.1.1	5-4	5-1	5-2	5-3	5-12	5.1.4.3	5-13
16-001(c)	1	5.1.1.1	5-4	5-1	5-2	5-3	5-12	5.1.4.3	5-13
16-001(d)	1	5.1.1.1	5-4	5-1	5-2	5-3	5-12	5.1.4.3	5-13
16-001(e)	2	5.2.1.1	5-26	5-7	5-40	5-20	5-65	5.2.4.2	5-80
16-003(a)	2	5.2.1.1	5-19	5-7	5-40	5-20	5-65	5.2.4.2	5-80
16-003(b)	2	5.2.1.1	5-20	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(c)	2	5.2.1.1	5-32	5-7	5-40	5-20	5-66	5.2.4.2	5-79
16-003(d)	2	5.2.1.1	5-24	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(e)	2	5.2.1.1	5-25	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(f)	2	5.2.1.1	5-25	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(g)	2	5.2.1.1	5-26	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(h)	2	5.2.1.1	5-28	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(i)	2	5.2.1.1	5-31	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-003(j)	2	5.2.1.1	5-31	5-7	5-40	5-20	5-65	5.2.4.2	5-79

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PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
16-003(k)	3	5.3.1.1	5-81	5-21	5-82	5-27	5-93	5.3.4.2	5-94
16-003(l)	2	5.2.1.1	5-31	5-7	5-40	5-20	5-65	5.2.4.2	5-72
16-003(m)	2	5.2.1.1	5-32	5-7	5-40	5-20	5-65	5.2.4.2	5-73
16-003(n)	2	5.2.1.1	5-35	5-7	5-40	5-20	5-66	5.2.4.2	5-79
16-003(o)	2	5.2.1.1	5-37	5-7	5-40	5-20	5-66	5.2.4.2	5-79
16-004(a)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-004(b)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-004(c)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-004(d)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-004(e)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-004(f)	7	5.7.1.1	5-133	5-38	5-136	5-42	5-144	5.7.4.2	5-145
16-005(a)	22	5.22.1.1	5-439	5-110	5-445	5-114	5-451	5.22.4.2	5-452
16-005(b)	NFA	6.4.3.1	6-36	NA	NA	NA	NA	NA	NA
16-005(c)	18	5.18.1.1	5-313	5-80	5-325	5-87	5-339	5.18.4.2	5-346
16-005(d)	18	5.18.1.1	5-313	5-80	5-325	5-87	5-339	5.18.4.2	5-346
16-005(e)	20	5.20.1.1	5-387	5-95	5-398	5-102	5-409	5.20.4.2	5-418
16-005(f)	NFA	6.4.3.4	6-39	NA	NA	NA	NA	NA	NA
16-005(g)	DA	6.1.1.1	6-5	NA	NA	NA	NA	NA	NA
16-005(h)	22	5.22.1.1	5-442	5-110	5-445	5-114	5-451	5.22.4.2	5-456
16-005(i)	NFA	6.4.2.5	6-35	NA	NA	NA	NA	NA	NA
16-005(j)	24	5.24.1.1	5-481	5-124	5-486	5-128	5-493	5.24.4.2	5-497
16-005(k)	22	5.22.1.1	5-442	5-110	5-445	5-114	5-451	5.22.4.2	5-456
16-005(l)	22	5.22.1.1	5-444	5-110	5-445	5-114	5-451	5.22.4.2	5-456
16-005(m)	24	5.24.1.1	5-481	5-124	5-486	5-128	5-493	5.24.4.2	5-498
16-005(n)	NFA	6.1.5.3	6-16	NA	NA	NA	NA	NA	NA
16-005(o)	NFA	6.1.5.4	6-17	NA	NA	NA	NA	NA	NA
16-006(a)	4	5.4.1.1	5-99	5-28	5-102	5-30	5-108	5.4.4.3	5-109
16-006(b)	NFA	6.1.5.5	6-18	NA	NA	NA	NA	NA	NA
16-006(c)	4	5.4.1.1	5-99	5-28	5-102	5-30	5-108	5.4.4.3	5-110
16-006(d)	4	5.4.1.1	5-100	5-28	5-102	5-30	5-108	5.4.4.3	5-110
16-006(e)	4	5.4.1.1	5-100	5-28	5-102	5-30	5-108	5.4.4.3	5-110
16-006(f)	NFA	6.1.5.6	6-18	NA	NA	NA	NA	NA	NA
16-006(g)	25	5.25.1.1	5-503	5-130	5-508	5-134	5-515	5.25.4.2	5-519
16-006(h)	DA	6.4.1.1	6-31	NA	NA	NA	NA	NA	NA
16-006(i)	NFA	6.4.2.1	6-33	NA	NA	NA	NA	NA	NA
16-007(a)	12	5.12.1.1	5-214	5-59	5-215	5-63	5-223	5.12.4.2	5-222
16-007(b)	NFA	6.2.2.1	6-23	NA	NA	NA	NA	NA	NA
16-008(a)	12	5.12.1.1	5-214	5-59	5-217	5-63	5-223	5.12.4.2	5-224
16-008(b)	NFA	6.1.2.1	6-6	NA	NA	NA	NA	NA	NA
16-009	11	5.11.1.1	5-200	5-56	5-203	5-58	5-209	5.11.4.3	5-210
16-010(a)	8	5.8.1.1	5-152	5-44	5-155	5-46	5-166	5.8.4.2	5-167
16-010(b)	DA	6.1.1.1	6-4	NA	NA	NA	NA	NA	NA
16-010(c)	DA	6.1.1.1	6-4	NA	NA	NA	NA	NA	NA
16-010(d)	DA	6.1.1.1	6-4	NA	NA	NA	NA	NA	NA
16-010(e)	DA	6.1.1.1	6-4	NA	NA	NA	NA	NA	NA
16-010(f)	DA	6.1.1.1	6-5	NA	NA	NA	NA	NA	NA
16-010(g)	DA	6.1.3.1	6-7	NA	NA	NA	NA	NA	NA
16-010(h)	8	5.8.1.1	5-152	5-44	5-155	5-46	5-166	5.8.4.2	5-168
16-010(i)	8	5.8.1.1	5-152	5-44	5-155	5-46	5-166	5.8.4.2	5-168
16-010(j)	DA	6.1.1.1	6-5	NA	NA	NA	NA	NA	NA
16-010(k)	8	5.8.1.1	5-152	5-44	5-155	5-46	5-166	5.8.4.2	5-170
16-010(l)	8	5.8.1.1	5-153	5-44	5-155	5-46	5-166	5.8.4.2	5-170

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PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
16-010(m)	8	5.8.1.1	5-153	5-44	5-155	5-46	5-166	5.8.4.2	5-170
16-010(n)	8	5.8.1.1	5-153	5-44	5-155	5-46	5-166	5.8.4.2	5-170
16-011	19	5.19.1.1	5-354	5-89	5-365	5-93	5-371	5.19.4.2	5-373
16-012(a)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(a2)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(b)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(c)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(d)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(e)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(f)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(g)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(h)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(i)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(j)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(k)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(l)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(m)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(n)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(o)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(p)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(q)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(r)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(s)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(t)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(u)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(v)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(w)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(x)	NFA	6.1.3.2	6-8	NA	NA	NA	NA	NA	NA
16-012(y)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-012(z)	NFA	6.1.5.7	6-19	NA	NA	NA	NA	NA	NA
16-013	17	5.17.1.1	5-283	5-76	5-285	5-78	5-290	5.17.4.2	5-289
16-015(a)	21	5.21.1.1	5-423	5-104	5-426	5-108	5-432	5.21.4.2	5-434
16-015(b)	21	5.21.1.1	5-424	5-104	5-426	5-108	5-432	5.21.4.2	5-434
16-015(c)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-015(d)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-016(a)	11	5.11.1.1	5-200	5-56	5-203	5-58	5-209	5.11.4.3	5-213
16-016(b)	11	5.11.1.1	5-200	5-56	5-203	5-58	5-209	5.11.4.3	5-213
16-016(c)	8	5.8.1.1	5-153	5-44	5-155	5-46	5-166	5.8.4.2	5-167
16-017	DA	6.4.1.1	6-31	NA	NA	NA	NA	NA	NA
16-018	DA	6.1.4.1	6-9	NA	NA	NA	NA	NA	NA
16-019	10	5.10.1.1	5-186	5-53	5-188	5-55	5-195	5.10.4.2	5-197
16-020	6	5.6.1.1	5-119	5-34	5-121	5-36	5-129	5.6.4.2	5-130
16-021(a)	5	5.5.1.1	5-111	5-31	5-113	5-33	5-116	5.5.4.2	5-117
16-021(c)	3	5.3.1.1	5-81	5-21	5-82	5-27	5-93	5.3.4.2	5-94
16-023(a)	NFA	6.5.1.1	6-42	NA	NA	NA	NA	NA	NA
16-023(b)	19	5.19.1.1	5-354	5-89	5-365	5-93	5-371	5.19.4.2	5-377
16-024(b)	19	5.19.1.1	5-356	5-89	5-365	5-93	5-371	5.19.4.2	5-377
16-024(c)	19	5.19.1.1	5-356	5-89	5-365	5-93	5-371	5.19.4.2	5-377
16-024(d)	19	5.19.1.1	5-356	5-89	5-365	5-93	5-371	5.19.4.2	5-377
16-024(e)	18	5.18.1.1	5-318	5-80	5-325	5-87	5-339	5.18.4.2	5-348
16-024(f)	24	5.24.1.1	5-481	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-024(g)	24	5.24.1.1	5-481	5-124	5-486	5-128	5-493	5.24.4.2	5-496

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PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
16-024(h)	24	5.24.1.1	5-482	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-024(k)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(l)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(m)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(n)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(o)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(p)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(q)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-024(r)	20	5.20.1.1	5-388	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-025(a)	19	5.19.1.1	5-358	5-89	5-365	5-93	5-371	5.19.4.2	5-373
16-025(a2)	20	5.20.1.1	5-392	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-025(b)	19	5.19.1.1	5-358	5-89	5-365	5-93	5-371	5.19.4.2	5-373
16-025(b2)	20	5.20.1.1	5-393	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-025(c)	NFA	6.4.3.2	6-37	NA	NA	NA	NA	NA	NA
16-025(c2)	20	5.20.1.1	5-394	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-025(d)	19	5.19.1.1	5-360	5-89	5-365	5-93	5-371	5.19.4.2	5-377
16-025(e)	18	5.18.1.1	5-318	5-80	5-325	5-87	5-339	5.18.4.2	5-348
16-025(f)	18	5.18.1.1	5-318	5-80	5-325	5-87	5-339	5.18.4.2	5-348
16-025(g)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(g2)	NFA	6.4.3.5	6-40	NA	NA	NA	NA	NA	NA
16-025(h)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(i)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(j)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(k)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(l)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-345
16-025(m)	24	5.24.1.1	5-482	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-025(n)	24	5.24.1.1	5-482	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-025(o)	24	5.24.1.1	5-482	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-025(p)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(q)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-025(r)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-346
16-025(s)	19	5.19.1.1	5-358	5-89	5-365	5-93	5-371	5.19.4.2	5-373
16-025(t)	20	5.20.1.1	5-389	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-025(u)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-345
16-025(v)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-345
16-025(w)	20	5.20.1.1	5-390	5-95	5-398	5-102	5-409	5.20.4.2	5-419
16-025(x)	25	5.25.1.1	5-504	5-130	5-508	5-134	5-515	5.25.4.2	5-516
16-025(y)	20	5.20.1.1	5-390	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-025(z)	20	5.20.1.1	5-391	5-95	5-398	5-102	5-409	5.20.4.2	5-412
16-026(b)	2	5.2.1.1	5-27	5-7	5-40	5-20	5-65	5.2.4.2	5-75
16-026(c)	2	5.2.1.1	5-27	5-7	5-41	5-20	5-65	5.2.4.2	5-75
16-026(d)	2	5.2.1.1	5-28	5-7	5-41	5-20	5-65	5.2.4.2	5-75
16-026(e)	2	5.2.1.1	5-28	5-7	5-41	5-20	5-65	5.2.4.2	5-75
16-026(h2)	2	5.2.1.1	5-32	5-7	5-41	5-20	5-65	5.2.4.2	5-76
16-026(i2)	NFA	6.4.2.3	6-34	NA	NA	NA	NA	NA	NA
16-026(j2)	2	5.2.1.1	5-38	5-7	5-41	5-20	5-65	5.2.4.2	5-77
16-026(m)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-026(n)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-026(o)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-026(p)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-026(q)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-350
16-026(s)	21	5.21.1.1	5-424	5-104	5-426	5-108	5-432	5.21.4.2	5-436
16-026(v)	2	5.2.1.1	5-32	5-7	5-40	5-20	5-66	5.2.4.2	5-69

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PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
16-026(w)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	347
16-028(a)	NFA	6.4.2.6	6-36	NA	NA	NA	NA	NA	NA
16-029(a)	2	5.2.1.1	5-29	5-7	5-40	5-20	5-66	5.2.4.2	5-69
16-029(a2)	20	5.20.1.1	5-390	5-95	5-398	5-102	5-409	5.20.4.2	5-418
16-029(b)	2	5.2.1.1	5-27	5-7	5-41	5-20	5-65	5.2.4.2	5-75
16-029(b2)	20	5.20.1.1	5-395	5-95	5-398	5-102	5-409	5.20.4.2	5-417
16-029(c)	2	5.2.1.1	5-28	5-7	5-41	5-20	5-65	5.2.4.2	5-75
16-029(c2)	20	5.20.1.1	5-391	5-95	5-398	5-102	5-409	5.20.4.2	5-417
16-029(d)	2	5.2.1.1	5-28	5-7	5-41	5.20	5-65	5.2.4.2	5-75
16-029(d2)	20	5.20.1.1	5-392	5-95	5-398	5-102	5-409	5.2.4.2	5-417
16-029(e)	2	5.2.1.1	5-32	5-7	5-41	5-20	5-65	5.2.4.2	5-76
16-029(e2)	20	5.20.1.1	5-393	5-95	5-398	5-102	5-409	5.20.4.2	5-417
16-029(f)	2	5.2.1.1	5-38	5-7	5-41	5-20	5-65	5.2.4.2	5-77
16-029(f2)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(g)	2	5.2.1.1	5-38	5-7	5-41	5-20	5-66	5.2.4.2	5-78
16-029(g2)	NFA	6.4.1.1	6-31	NA	NA	NA	NA	NA	NA
16-029(h2)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-348
16-029(k)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(l)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(m)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(n)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(o)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(p)	18	5.18.1.1	5-322	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(q)	23	5.23.1.1	5-463	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(r)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-347
16-029(s)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(t)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(u)	23	5.23.1.1	5-462	5-117	5-464	5-122	5-472	5.23.4.2	5-475
16-029(v)	20	5.20.1.1	5-394	5-95	5-398	5-102	5-409	5.20.4.2	5-417
16-029(w)	25	5.25.1.1	5-504	5-130	5-508	5-134	5-515	5.25.4.2	5-519
16-029(x)	25	5.25.1.1	5-504	5-130	5-508	5-134	5-515	5.25.4.2	5-518
16-029(y)	20	5.20.1.1	5-389	5-95	5-398	5-102	5-409	5.20.4.2	5-417
16-029(z)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-349
16-030(d)	2	5.2.1.1	5-28	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-030(g)	2	5.2.1.1	5-32	5-7	5-40	5-20	5-65	5.2.4.2	5-73
16-030(h)	2	5.2.1.1	5-31	5-7	5-40	5-20	5-65	5.2.4.2	5-79
16-031(c)	25	5.25.1.1	5-505	5-130	5-508	5-134	5-515	5.25.4.2	5-518
16-031(d)	19	5.19.1.1	5-359	5-89	5-365	5-93	5-371	5.19.4.2	5-378
16-031(g)	NFA	6.4.3.3	6-38	NA	NA	NA	NA	NA	NA
16-032(a)	18	5.18.1.1	5-320	5-80	5-325	5-87	5-339	5.18.4.2	5-350
16-032(b)	NFA	6.5.1.3	6-43	NA	NA	NA	NA	NA	NA
16-032(c)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-349
16-032(d)	NFA	6.4.2.4	6-35	NA	NA	NA	NA	NA	NA
16-032(e)	NFA	6.4.3.6	6-41	NA	NA	NA	NA	NA	NA
16-034(a)	18	5.18.1.1	5-314	5-80	5-325	5-87	5-339	5.18.4.2	5-341
16-034(b)	24	5.24.1.1	5-483	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-034(c)	24	5.24.1.1	5-483	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-034(d)	24	5.24.1.1	5-484	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-034(e)	24	5.24.1.1	5-484	5-124	5-486	5-128	5-493	5.24.4.2	5-496
16-034(f)	24	5.24.1.1	5-484	5-124	5-486	5-128	5-493	5.24.4.2	5-497
16-034(g)	NFA	6.4.2.2	6-34	NA	NA	NA	NA	NA	NA
16-034(l)	19	5.19.1.1	5-362	5-89	5-365	5-93	5-371	5.19.4.2	5-377

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PRS	AGGRE-GATE	HISTORY SUBSECTION	(PAGE)	PCOC TABLE NUMBER	(PAGE)	SAMPLING TABLE NUMBER	(PAGE)	SAMPLING SUBSECTION	(PAGE)
16-034(m)	20	5.20.1.1	5-396	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-034(n)	20	5.20.1.1	5-396	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-034(o)	20	5.20.1.1	5-394	5-95	5-398	5-102	5-409	5.20.4.2	5-416
16-034(p)	19	5.19.1.1	5-354	5-89	5-365	5-93	5-371	5.19.4.2	5-373
16-035	13	5.13.1.1	5-226	5-64	5-227	5-66	5-236	5.13.4.3	5-241
16-036	13	5.13.1.1	5-226	5-64	5-227	5-66	5-236	5.13.4.3	5-241
25-001	NFA	6.5.1.2	6-42	NA	NA	NA	NA	NA	NA
37-001	NFA	6.2.3.3	6-26	NA	NA	NA	NA	NA	NA
C-11-001	14/DA	5.14.1.1	5-246	5-67	5-244	5-69	5-257	5.14.4.2	5-258
C-11-002	16	5.16.1.1	5-271	5-73	5-272	5-75	5-279	5.16.4.2	5-280
C-11-003	NFA	6.2.3.4	6-27	NA	NA	NA	NA	NA	NA
C-16-003	NFA	6.5.2.5	6-48	NA	NA	NA	NA	NA	NA
C-16-004	NFA	6.5.2.1	6-44	NA	NA	NA	NA	NA	NA
C-16-005	20	5.20.1.1	5-395	5-95	5-398	5-102	5-409	5.20.4.2	5-412
C-16-006	19	5.19.1.1	5-360	5-89	5-365	5-93	5-371	5.19.4.2	5-378
C-16-007	NFA	6.5.2.6	6-49	NA	NA	NA	NA	NA	NA
C-16-017	24	5.24.1.1	5-484	5-124	5-486	5-128	5-493	5.24.4.2	5-497
C-16-021	NFA	6.5.2.2	6-45	NA	NA	NA	NA	NA	NA
C-16-022	NFA	6.5.2.2	6-45	NA	NA	NA	NA	NA	NA
C-16-023	NFA	6.5.2.4	6-47	NA	NA	NA	NA	NA	NA
C-16-024	NFA	6.5.2.2	6-45	NA	NA	NA	NA	NA	NA
C-16-025	NFA	6.5.2.3	6-45	NA	NA	NA	NA	NA	NA
C-16-026	NFA	6.5.2.3	6-45	NA	NA	NA	NA	NA	NA
C-16-027	NFA	6.5.2.3	6-45	NA	NA	NA	NA	NA	NA
C-16-028	21	5.21.1.1	5-425	5-104	5-426	5-108	5-432	5.21.4.2	5-436
C-16-029	NFA	6.5.2.3	6-45	NA	NA	NA	NA	NA	NA
C-16-030	21	5.21.1.1	5-425	5-104	5-426	5-108	5-432	5.21.4.2	5-436
C-16-031	21	5.21.1.1	5-425	5-104	5-426	5-108	5-432	5.21.4.2	5-436
C-16-032	NFA	6.5.2.1	6-44	NA	NA	NA	NA	NA	NA
C-16-033	NFA	6.5.2.4	6-47	NA	NA	NA	NA	NA	NA
C-16-037	NFA	6.5.2.4	6-47	NA	NA	NA	NA	NA	NA
C-16-038	NFA	6.5.2.4	6-47	NA	NA	NA	NA	NA	NA
C-16-039	NFA	6.5.2.1	6-44	NA	NA	NA	NA	NA	NA
C-16-040	NFA	6.5.2.1	6-44	NA	NA	NA	NA	NA	NA
C-16-042	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-043	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-045	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-048	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-052	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-053	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-054	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-055	NFA	6.5.2.6	6-49	NA	NA	NA	NA	NA	NA
C-16-056	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-057	NFA	6.5.2.8	6-50	NA	NA	NA	NA	NA	NA
C-16-059	NFA	6.5.2.7	6-50	NA	NA	NA	NA	NA	NA
C-16-064	19	5.19.1.1	5-362	5-89	5-365	5-93	5-371	5.19.4.2	5-378
C-16-065	19	5.19.1.1	5-362	5-89	5-365	5-93	5-371	5.19.4.2	5-378
C-16-066	NFA	6.5.2.4	6-47	NA	NA	NA	NA	NA	NA
C-16-067	19	5.19.1.1	5-362	5-89	5-365	5-93	5-371	5.19.4.2	5-378
C-16-068	25	5.25.1.1	5-506	5-130	5-508	5-134	5-515	5.25.4.2	5-518
C-16-069	20	5.20.1.1	5-389	5-95	5-398	5-102	5-409	5.20.4.2	5-417
C-16-074	25	5.25.1.1	5-506	5-130	5-508	5-134	5-515	5.25.4.2	5-518
C-25-001	NFA	6.5.1.2	6-42	NA	NA	NA	NA	NA	NA
Cañon de Valle	9	5.9.1.1	5-172	5-47	5-175	5-52	5-183	5.9.4.2	5-184

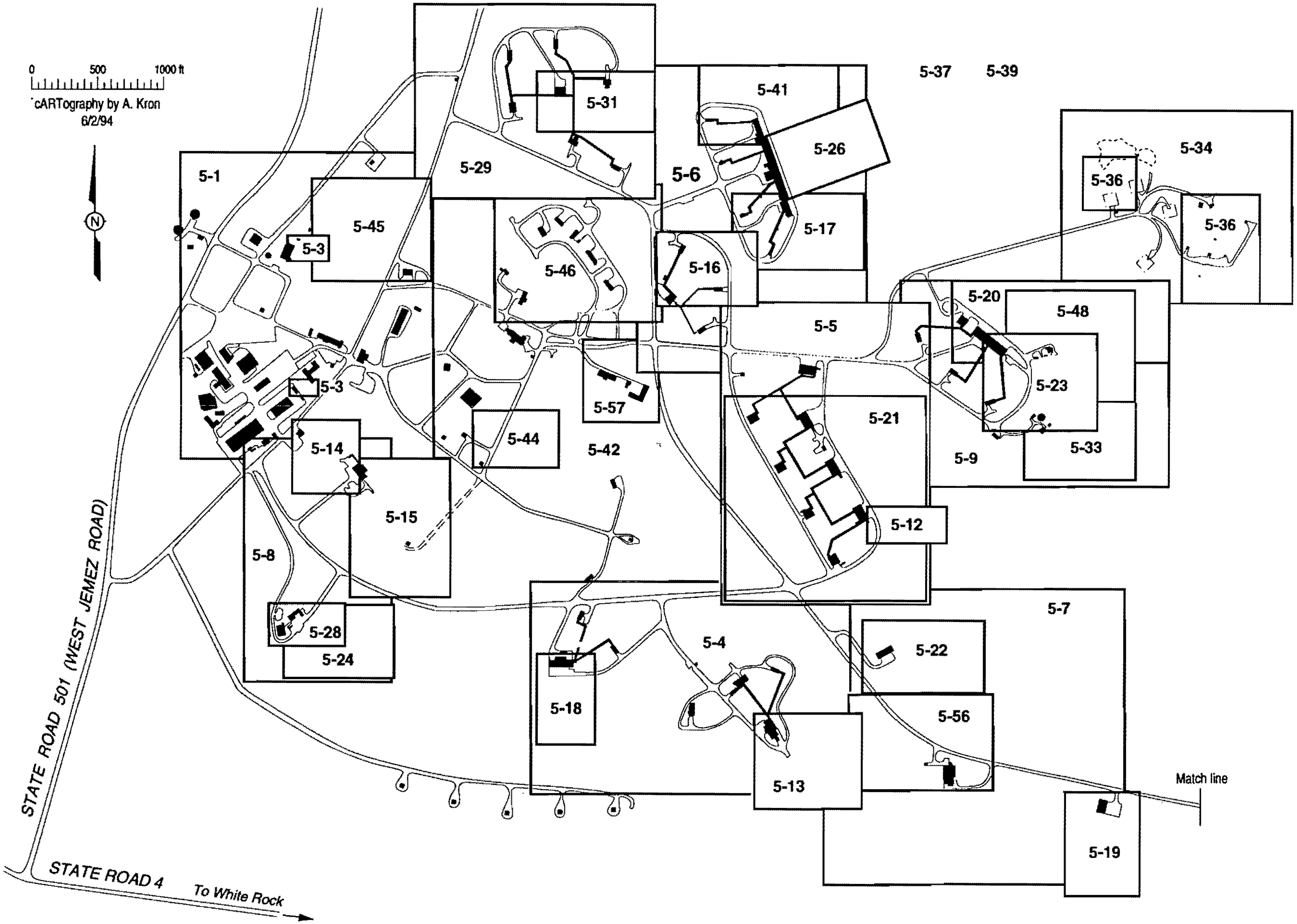

Fig. 5-0-1(a). Index to PRS location and sampling maps for OU 1082 (1993 RFI Work Plan).

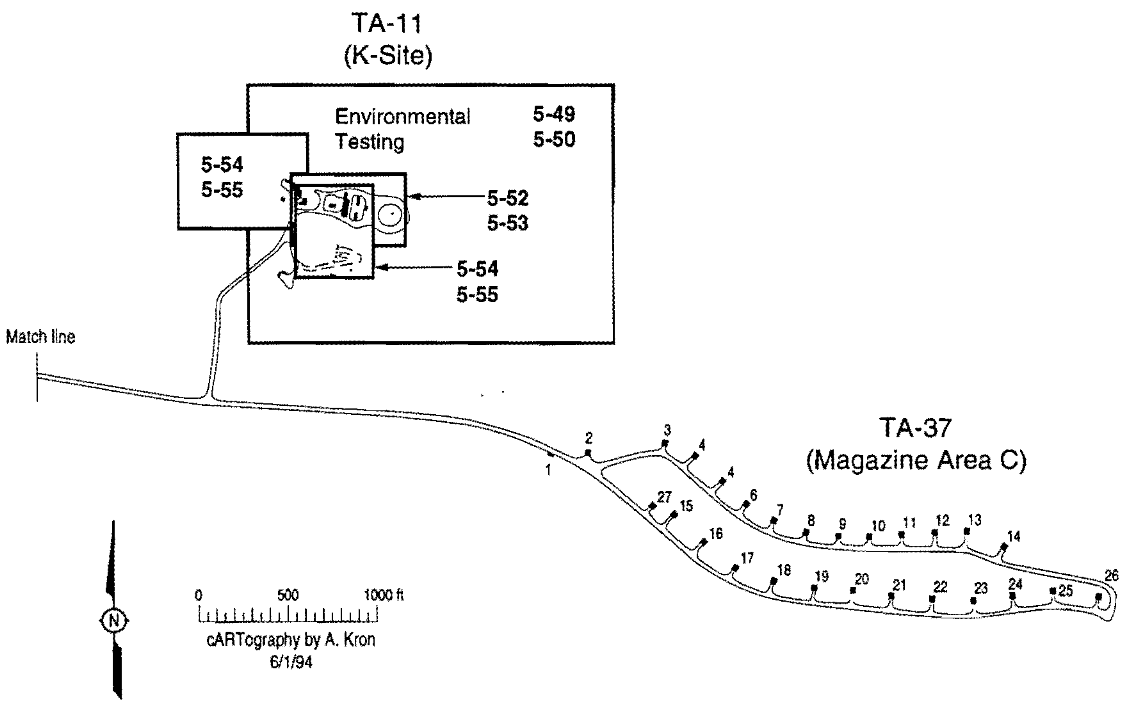

Fig. 5-0-1(b). Index to PRS location and sampling maps for OU 1082 (1993 RFI Work Plan).

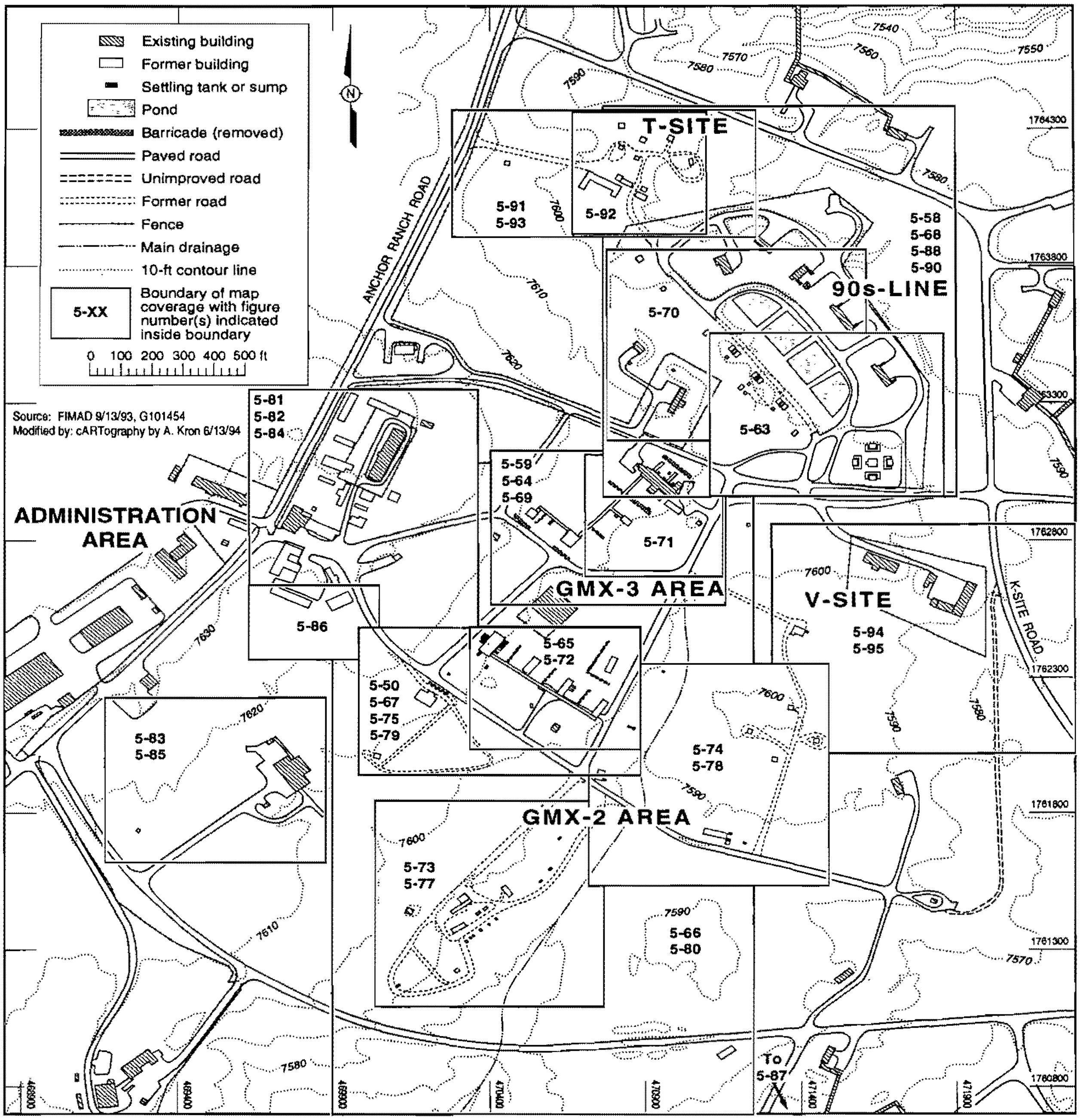

Fig. 5-0-2. Index to detailed sampling and PRS location figures for Subsections 5.18 through 5.25.

5.17 are a diverse group of PRS aggregates, with correspondingly diverse DQOs.

In contrast, because all of the aggregates in the 1994 work plan addendum address potential contamination associated with decommissioned World War II era S-Site structures, Subsections 5.18 through 5.25 are all reconnaissance sampling with similar DQOs (Throughout this document the term "World War II era" is used to refer to the period from roughly 1944 to 1950). In particular, portions of DQO Steps 1, Problem Statement; 2, Decision Process; 3, Decision Inputs; 4, Investigation Boundary; 5, Decision Logic; and 6, Design Criteria, are virtually identical for these aggregates. DQO Steps 1, 4, and 6 typically also include aggregate-specific information that is included in Subsections 5.X.2 and 5.X.3 where X extends from 18 to 25. Because of the similarities of the DQOs across aggregates 5.18 through 5.25, generic DQOs appropriate for reconnaissance sampling of the World War II era buildings are presented below. These generic DQOs are then cited in Subsections 5.18 through 5.25 in the interest of minimizing the repetitiveness of the aggregate descriptions.

5.0.2.1 Problem Statement (DQO Step 1)

For aggregates 5.18 through 5.25 the primary Phase I problem is typically to determine if contaminants are at levels of concern in any PRS in each aggregate. Virtually every aggregate contains both surface contamination due to combustion of World War II era buildings and subsurface contamination due to leakage from sumps and drain lines. Typically, the indicator PCOC of concern is HE. The term HE refers to a broad range of compounds (see Appendix D) of varying toxicity. The two principal HE of concern in the World War II S-Site area are TNT (soil SAL = 40 ppm) and RDX (soil SAL = 64 ppm). The probability of contamination in PRSs within each aggregate varies, depending on the specific activities that occurred in the individual PRS in the aggregate.

5.0.2.2 Decision Process (DQO Step 2)

The objective of the Phase I investigations for aggregates 5.18 through 5.25 is reconnaissance sampling to determine if PCOC concentrations are above SALs in surface and subsurface soils. For each PRS if PCOC concentrations are below SALs, then a no further action (NFA) decision will be proposed for that PRS. If PCOC concentrations are greater than SALs and background values, then a Phase II study will be initiated to determine the spatial extent and concentrations of contaminants of concern relative to an acceptable risk level.

For each aggregate, potential remediation options for PRSs that pose an unacceptable health and environmental risk include removal of contaminated surface or subsurface soils with treatment and disposal.

5.0.2.3 Decision Inputs (DQO Step 3)

For PRSs in each of aggregates 5.18 through 5.25 the primary data needs are the confirmation of likely PCOCs, identification of additional PCOCs, and determination of the concentrations of all PCOCs in surface and subsurface soils. If SALs are not available for one or more PCOCs detected in a PRS, then these must be determined. Further, in order to locate the potentially contaminated areas of these PRSs for efficient and effective laboratory sampling, site information on facilities from visual indications, engineering drawings, field screening, and particularly ortho-corrected aerial photographs* are needed to determine the location of former structures, subsurface plumbing, and drainages.

5.0.2.4 Investigation Boundary (DQO Step 4)

Boundaries are defined in each aggregate; 5.18 through 5.25. However, the PRS boundaries are typically used as investigation boundaries.

The depth boundary for undisturbed surface samples is 0 to 6 in. For HE process building footprints, where bulldozing of soil has occurred and HE is likely to have infiltrated into the subsurface, the depth boundary is extended to 0 to 12 in. The depth boundary for subsurface samples, such as sumps, drain lines, and septic tanks, is typically 0 in. to the soil-tuff interface.

5.0.2.5 Decision Logic (DQO Step 5)

For aggregates 5.18 through 5.25, if the maximum observed PCOC concentrations in surface or subsurface soils for a PRS are above their

*Orthocorrected aerial photographs are corrected for local topography and the height and position of the airplane from which the photographs were taken.

SALs and above any constituent background level, then a Phase II study will be performed. A baseline risk assessment will be completed at any time that adequate data exist for an exposure unit of interest. If SALs or background levels are not exceeded, then an NFA decision will be proposed for the PRS.

Some adjustments are made to this decision rule to account for PCOCs for which SALs are less than the normal range of background (e.g., beryllium), or if several PCOCs exhibit concentrations that are close to SALs without actually exceeding them. Chapter 4, Subsection 4.1.4 and Appendix J of the IWP (LANL 1993, 1017) provide details of the effect of these adjustments on the decision rule.

5.0.2.6 Design Criteria (DQO Step 6)

For aggregates 5.18 through 5.25 a reconnaissance sampling approach (IWP, Appendix H) is proposed for all PRSs in each aggregate (LANL 1992, 0768). Reconnaissance sampling is based on the assumption that biased samples can be taken at the likely points of highest PCOC concentration. Biased laboratory sampling locations are chosen based on knowledge of process, geomorphologic mapping, and field screening. The term laboratory sample refers to samples selected for analysis in a fixed-base laboratory.

Each sampling design contains both field screening samples and laboratory samples. The field screening samples are used to increase the likelihood that laboratory samples are collected in regions of potential contamination. Positive field screening results will also be used to focus any Phase II investigations to exposure units known to contain contamination. The laboratory samples are designed to investigate the nature of PCOCS and to determine if the PCOCs are present at concentrations above SALs.

In order to design both the number and location of field screening and laboratory samples, each PRS was categorized into its likely heterogeneity and seriousness. These determinations were based on process knowledge, archival information, engineering drawings, and field visits. Rough definitions of the seriousness categories are: a very serious PRS is considered to have a 50% or better chance of containing PCOCs at a level an order of magnitude greater than SALs and background; a serious PRS is considered to have a greater than 10% chance of containing PCOCs at a level an order of magnitude greater than SALs and background; a not very serious PRS is considered to have a greater than 1% chance of containing PCOCs above SALs and background; and, a negligible PRS is considered to have much less than a 1% chance of containing PCOCs above SALs and background.

An indicator constituent or class of constituents was also designated for each PRS. Indicator constituents are PCOCs that: 1) are deemed to be likely to present the most serious health risks at a PRS, and 2) can easily be measured using field screening methods. It is important that the indicator constituents not have radically different initial dispersal mechanisms or environmental transport parameters from other potential constituents of serious concern. HE (TNT and RDX) are the indicator constituents for most PRSs considered in Subsections 5.18 through 5.25. HE and HE byproducts, including barium, are by far the most serious PCOCs based on both amounts used and toxicity at most PRSs in these aggregates. Large amounts (> 100 000 lb) of TNT and RDX were processed through the World War II era S-Site complex, and both TNT and RDX have low SALs in soil (40 ppm for the former and 64 ppm for the latter). The HE spot test, which is described in Chapter 4, has 100 ppm detection limits for TNT, RDX, HMX, tetryl, and nitrocellulose. HE and HE byproducts are differentially mobilized in arid soil environments (for example DNT is typically mobilized deeper into the subsurface than TNT and RDX). However, modeling of the relative transport of TNT, RDX, HMX, DNT, TNB, and DNB suggests that screening for TNT, RDX, and HMX would also identify regions in which DNB, DNT or TNB were PCOCs (Layton et al. 1987, 15-16-447). In World War II era S-Site, barium was discharged to the environment mixed with TNT (baratol), so screening for TNT should generally indicate the location of barium contamination. In addition, because of the high SAL for barium (5 600 ppm) it is of significantly lower concern than HE and organic HE byproducts.

The number of field screening samples for each PRS is determined using the binary presence-absence diagram (Table 4-9) in concert with the designations in the seriousness/heterogeneity tables. Knowledge of processes occurring in the facilities associated with the PRSs allowed identification of those PRSs most likely to contain hazardous constituents. Table 5-0-2 shows the ranges of field screening samples for PRSs in each of these categories. Heterogeneity categories are based on the relative area within a PRS that is likely to be contaminated. If it is assumed that a

TABLE 5-0-2

FIELD SCREENING SAMPLING NUMBERS*

AMOUNT OF CONTAMINATION	VERY HETEROGENEOUS	NOT VERY HETEROGENEOUS	HOMOGENEOUS
Very serious	12 - 25	6 - 16	4-8
Serious	8 - 24	4 - 8	3 - 5
Not very serious	5 - 10	3 - 7	2 - 5
Negligible	3 - 6	1 - 5	1 - 4

* Note that the wide ranges in these categories reflect the significant differences within categories. For example, very heterogeneous sumps and drain lines can include up to nine decommissioned sumps.

homogeneous PRS is affected over 50% of its area if it is affected at all, a not very heterogeneous PRS is affected over 30% of its area if it is affected at all, and a very heterogeneous PRS is affected over 15% of its area if it is affected at all, then these sample numbers provide greater than an 84% chance of detecting the indicator constituents for very serious PRSs, greater than a 72% chance of detecting the indicator constituents for the serious PRSs, and greater than a 54% chance of detecting the indicator constituents in the not very serious PRSs. It is important to note that although the HE spot test has detection limits for TNT (100 ppm) and RDX (100 ppm) that are larger than the SALs for these constituents, the likely mode of dispersal of HE in the World War II era S-Site (primarily through sump and drain line leaks and through cracks in building floors and doors) would lead to small, highly concentrated zones of HE contamination. These hot spots are unlikely to be missed by the HE spot test.

The number of laboratory samples for each PRS is designated based on professional judgment using guidance provided by a preliminary application of a Bayesian approach to sampling design (IWP, Appendix H) (LANL 1993, 1017). Based on knowledge of process, engineering drawings, and understanding of the 1960s World War II era S-Site cleanup, a Bayesian prior probability that a single sample taken in a stratified location would be below SALs for each PRS was estimated. This information is summarized for each PRS in Subsections 5.x.3.4. It also is estimated that the cost of a false negative result (HE chunk explosion) is two times greater than the cost of a false positive result (unneeded initiation of a Phase II study) for an HE-contaminated PRS.

Laboratory sample numbers derived using this approach are superimposed on Table 5-0-3, a seriousness/heterogeneity table. Typically within any category in this table, sump and drain line PRSs received more samples than building footprint PRSs. The PRSs deemed to be heterogeneous and seriously contaminated received the most samples (up to seven) because they had the largest degree of uncertainty concerning their likelihood of contamination and, thus, there was a large value in collecting additional data. Those PRSs deemed likely to be very seriously contaminated received up to four samples, because fewer samples are needed to locate samples with PCOCs above SALs in these PRSs than in PRSs with a larger degree of uncertainty. Other less serious and more homogeneous PRSs are assigned fewer samples (Table 5-0-3).

TABLE 5-0-3

LABORATORY SAMPLING NUMBERS

AMOUNT OF CONTAMINATION	VERY HETEROGENEOUS	NOT VERY HETEROGENEOUS	HOMOGENEOUS
Very serious	3 - 4	3 - 4	1 - 2
Serious	3 - 7	2 - 4	2 - 4
Not very serious	2 - 4	2 - 3	1 - 2
Negligible	0 - 3	0 - 2	0 - 1

Hypothetical Example of Application of Design Criteria to Typical PRSs

A simple example illustrates the application of these methods to typical World War II era S-Site PRSs.

Figure 5-0-3 shows PRSs associated with the site of a decommissioned HE processing building and its decommissioned sump and drain line. The soil beneath the decommissioned process building is estimated to be potentially heterogeneously contaminated because any HE within its footprint is likely to be derived from localized wastewater discharge through cracks in the

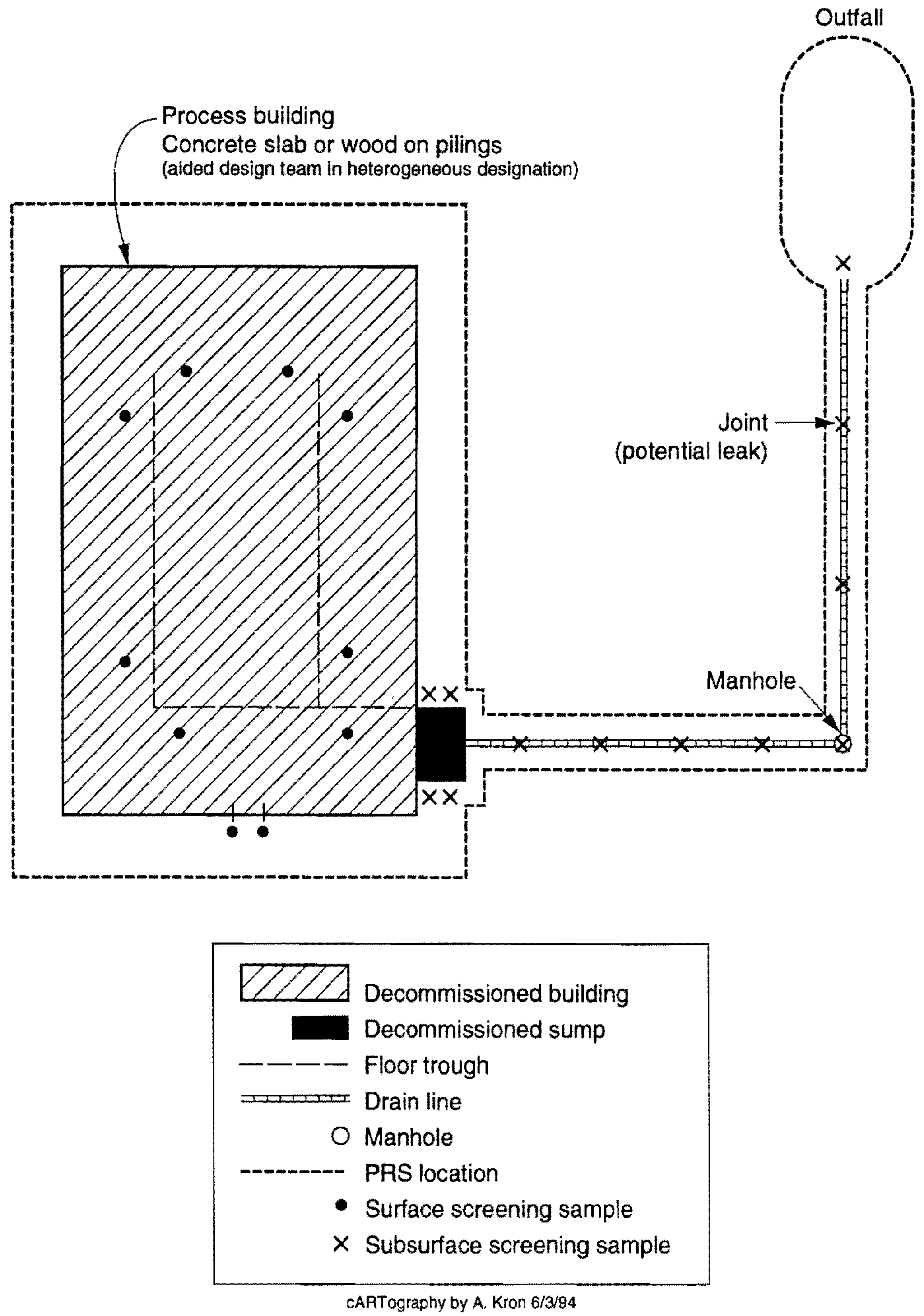

Fig. 5-0-3 Schematic diagram showing typical groups of SWMUs covered in Subsections 5.18 through 5.25.

building's floor and door. The building footprint is estimated to have serious potential for contamination because thousands of pounds of HE were processed in the building and the building was steam cleaned daily for ten years. The soil associated with the sump and drain line is likely to be heterogeneously contaminated because HE waste is likely to have leaked from drain line joints, particularly the joint between the sump and drain line (Martin and Hickmott 1993, 15-16-497). Any contamination of the sump and drain line is likely to be serious, because the 1960s World War II era S-Site cleanup only remediated HE in soils above a level of 3 wt %, which is nearly three orders of magnitude larger than the SALs for TNT and RDX.

Based on consideration of the seriousness/heterogeneity table (Table 5-0-2), ten field screening samples were designated in the process building PRS and twelve are designated in the sump/drain line PRS. Eight of those ten samples for the process building PRS are distributed randomly within the building footprint because the location of any floor leaks is unknown; hence, any soil contamination is likely to be heterogeneous and at a fairly high level (perhaps 1 wt %). Two samples are biased to the doorway area because steam washing likely would wash HE-rich wastewater through the doorway. For the sump/drain line PRS four biased screening samples will be taken in the sump area, as determined from orthocorrected 1965 aerial photographs; site workers report that the majority of HE found in soils during the 1960s cleanup was located within twenty feet of the sumps. The remaining eight samples are distributed at irregular intervals along the former location of the drain line; any leaks from the drain lines are likely to have been located near pipe joints and hence, heterogeneous and at a moderate level (perhaps 1 wt %).

For this hypothetical example, the OU 1082 Team estimates a 90% chance that a single stratified sample in either the footprint or sump/drain line would be below SALs for TNT or RDX. After consideration of a Bayesian statistical design based on this 90% prior probability, professional judgment is used to select five laboratory samples for the sump and drain line and three laboratory samples within the building footprint.

This simple example illustrates the processes used to arrive at the number of field and laboratory samples for each PRS considered in Subsections 5.18 through 5.25.

Pages 5-1 through 5-304 describe aggregates 5.1 through 5.17 found in the 1993 RFI Work Plan for OU 1082.

5.18 Decommissioned Sumps, Outfalls, and Associated Buildings in the GMX-3 Area

5.18.1 Background

This aggregate consists of all PRSs associated with activities in World War II era S-Site buildings that were equipped with high explosives (HE) sumps and were operated by Group GMX-3, High Explosives and Implosion Systems (see Table 5-79). In this document the terms S-Site and World War II era S-Site are both used to refer to the portion of TA-16 used for HE processing from 1944 to the early 1950s. These PRSs are an aggregate because they are geographically contiguous and they have a similar suite of PCOCs. Data from sampling of these PRSs may eventually be combined in baseline risk assessments. In addition, drainage sampling in the area may provide information on off-site migration of PCOCs from all of the PRSs.

These structures were primarily occupied by the production explosives groups such as GMX-3 and its predecessor Groups X-3, Explosives Development and Production, and E-10, Ordnance Division, S-Site plant. HE was subjected to disruptive processes, such as casting or machining, in most of these structures; therefore, the potential for contamination is relatively high. All of the buildings had HE sumps and associated drain lines and outfalls; therefore, subsurface contamination is a potential problem. HE sump operations are described in Subsection 5.2 of the 1993 OU 1082 Work Plan (LANL 1993, 1094). Most buildings were decommissioned, destroyed by intentional burning, and removed to the Area P landfill; as a result, surface contamination is limited to burn residuals. Sumps and drain lines were removed, and associated HE-contaminated soil was cleaned up to a residual level of 3% HE (Martin and Hickmott 1993, 15-16-497). Inasmuch as the SALs for the principal HE of concern, TNT and RDX, are more than an order of magnitude lower than this cleanup level, residual subsurface HE is likely.

5.18.1.1 Description and History

The decommissioned GMX-3 area is located in the central portion of the current S-Site complex (Fig. 5-0-2). The area considered in this aggregate is bounded on the north by TA-16-89, TA-16-90, TA-16-91, TA-16-92, and

TABLE 5-79

PRSs FOR DECOMMISSIONED GMX-3 STRUCTURES WITH SUMPS AND OUTFALLS

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION (ALL ARE DECOMMISSIONED)	DIMENSIONS (FT)
16-005(c)	TA-16-176		Septic tank for TA-16-41	8 x 6 x 4
16-005(d)	TA-16-177		Septic tank for TA-16-27	10 x 6 x 4.5
16-024(e)	TA-16-33	S-26D	HE machining (four chambers)	13 x 13 x 9 13 x 13 x 9 7 x 23 x 8 8 x 10 x 9
16-025(e)	TA-16-31	S-26B	HE machining (four chambers)	13 x 13 x 9 13 x 13 x 9 7 x 13 x 8 8 x 10 x 9
16-025(f)	TA-16-32	S-26C	HE machining (four chambers)	13 x 13 x 9 13 x 13 x 9 7 x 13 x 8 8 x 10 x 9
16-025(g)	TA-16-95	S-106-N	HE machining	20 x 12 x 13
16-025(h)	TA-16-96	S-106-E	HE machining	20 x 12 x 13
16-025(i)	TA-16-97	S-106-S	HE machining	20 x 12 x 13
16-025(j)	TA-16-98	S-106-W	HE machining	20 x 12 x 13
16-025(k)	TA-16-25	S-23, S-3	Powder inspection (room with addition)	20 x 30 x 15 6 x 12 x 7
16-025(l)	TA-16-26	S-24, S-4	HE casting	40 x 45 x 18
16-025(p)	TA-16-44	S-33	Raw HE inspection (room with two additions)	20 x 60 x 14 6 x 10 x 9 6 x 10 x 14
16-025(q)	TA-16-45	S-34	X-ray examination (room with two additions)	20 x 60 x 14 6 x 10 x 9 7 x 10 x 14
16-025(r)	TA-16-46	S-35	HE rest house (room with vestibule)	20 x 60 x 14 6 x 10 x 10
16-025(u)	TA-16-42	S-31	HE casting (room with addition)	40 x 95 x 18 6 x 10 x 8
16-025(v)	TA-16-43	S-32	HE casting and machining (room with two additions)	20 x 60 x 14 5 x 20 x 10 5 x 16 x 10
16-026(q)	TA-16-27*	S-25, 25E*	Sumps and outfall for TA-16-27, HE casting	**

TABLE 5-79 (continued)

PRSs FOR DECOMMISSIONED GMX-3 STRUCTURES WITH SUMPS AND OUTFALLS

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION (ALL ARE DECOMMISSIONED)	DIMENSIONS (FT)
16-026(w)	TA-16-45*	S-34*	Outfall for TA-16-45 photography laboratory	NA
16-029(m)	TA-16-95*	S-106-N*	TA-16-95 sump and drain	**
16-029(n)	TA-16-96*	S-106-E*	TA-16-96 sump and drain	**
16-029(o)	TA-16-97*	S-106-S*	TA-16-97 sump and drain	**
16-029(p)	TA-16-98*	S-106-W*	TA-16-98 sump and drain	**
16-029(r)	TA-16-25*	S-23, 53*	TA-16-25 drain	
16-029(z)	TA-16-42 TA-16-43 TA-16-44 TA-16-45*	S-31 to 34*	TA-16-42, TA-16-43, TA-16-44, and TA-16-45 sumps and drain	**
16-029(f2)	TA-16-24*	S-20*	TA-16-24 outfall	NA
16-029(h2)	TA-16-801		TA-16-95, TA-16-96, TA-16-97, and TA-16-98 drain line and outfall	NA
16-032(a)	TA-16-42 TA-16-43 TA-16-44 TA-16-45*	S-31 to 34*	TA-16-42, TA-16-43, TA-16-44, and TA-16-45 secondary sumps, drain, and outfall	**
16-032(c)	TA-16-26*	S-24, 54*	TA-16-26 sump, drain, and outfall	**
16-034(a)	TA-16-24*	S-20*	Chemical analysis laboratory	20 x 36 x 11

* These structures are not numbered, so associated buildings are given.
** Sumps are typically 6 to 12 ft long x 4 ft wide x 5 ft deep.

TA-16-93 (the 90s-Line, see Subsection 5.23) (Fig. 5-58), on the east by a northeast-southwest road east of TA-16-27 (Fig. 5-59), on the west by the administration area (see Subsection 5.21), and on the south by the east-west road separating the GMX-2 and GMX-3 areas (Fig. 5-60). The area is relatively level sloping less than 10 ft from north to south and roughly 20 ft from west to east. The primary drainage in this region is eastward to a north-south ditch that empties into Water Canyon roughly 0.25 miles south of the World War II era S-Site complex.

Operations within the GMX-3 area were devoted to developing techniques for production of HE lenses, the explosives component of a nuclear weapon, with high chemical purity and with accurate shapes. Specific operations

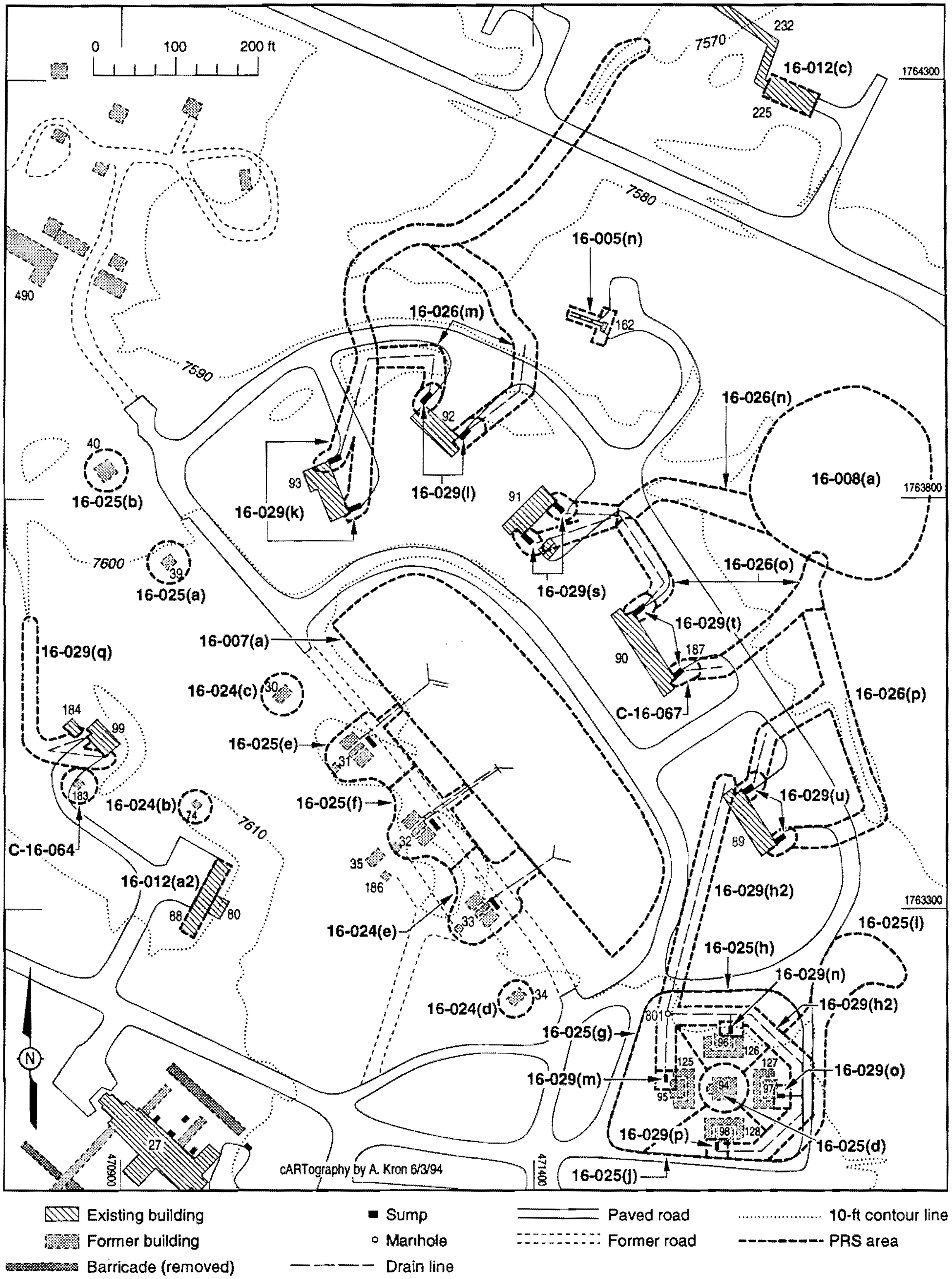

Fig. 5-58. Locations of PRSs at GMX-3.

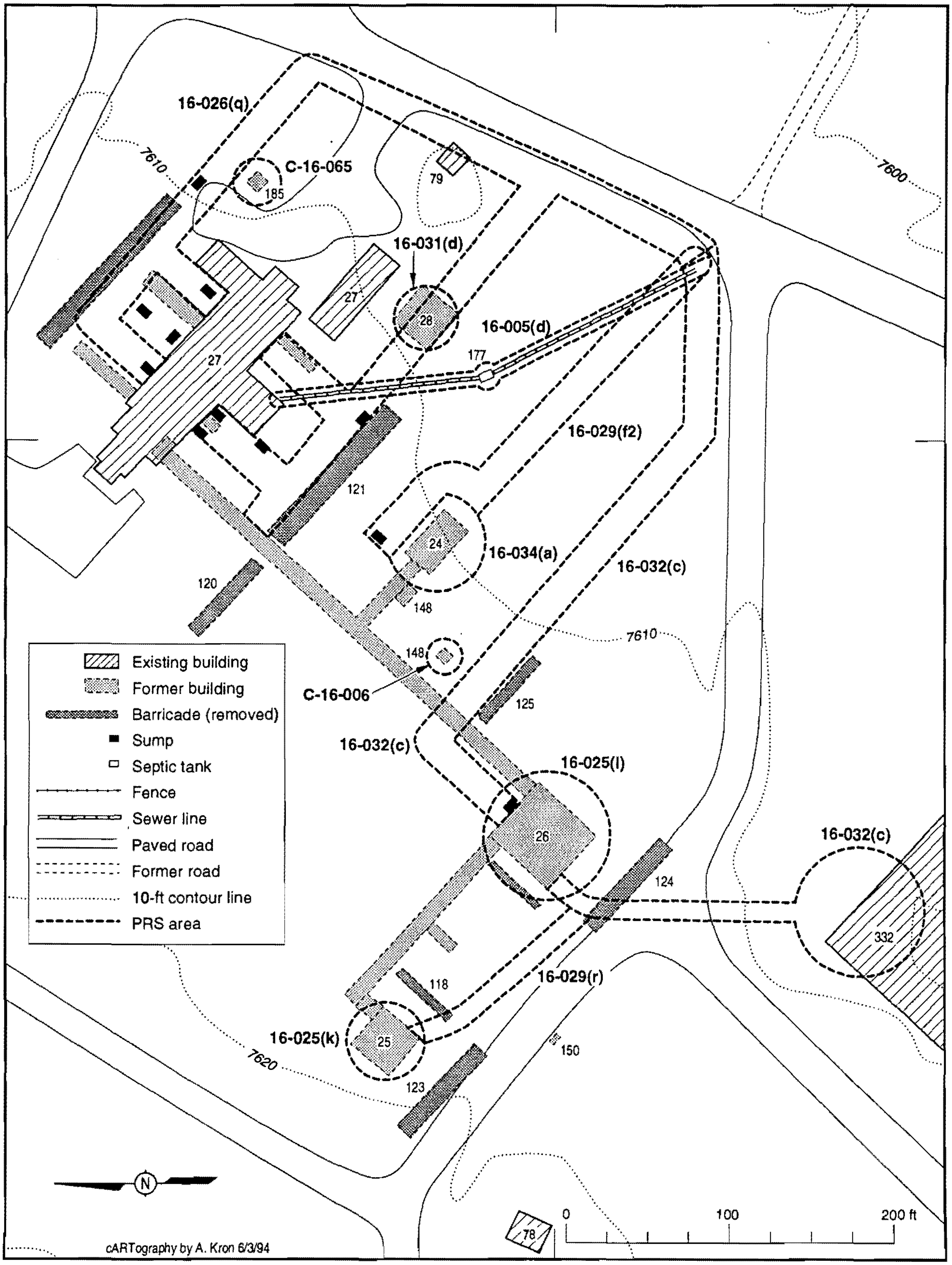

Fig. 5-59. Locations of PRSs at GMX-3 central.

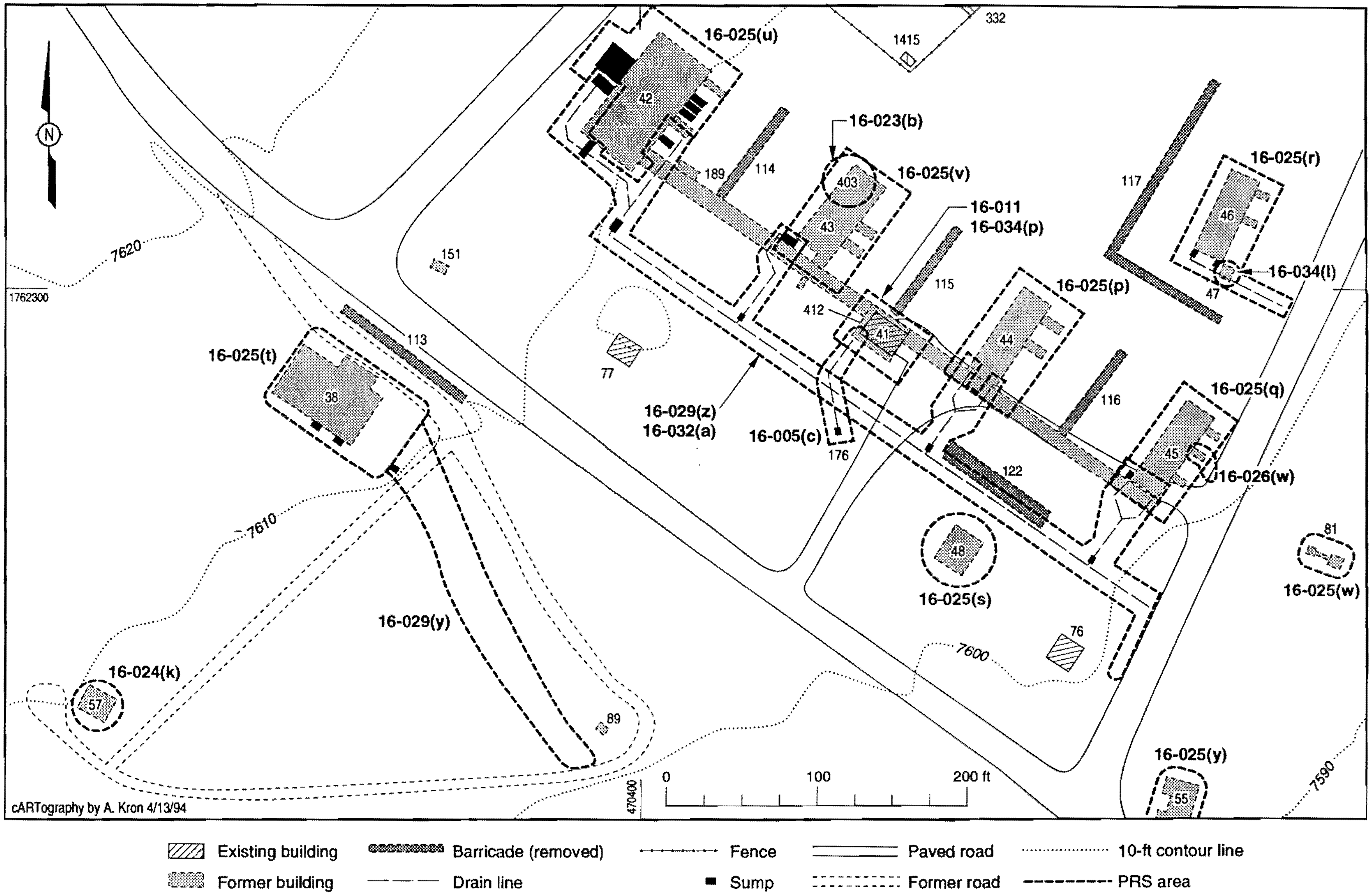

Fig. 5-60. Locations of PRSs at GMX-3 south.

performed in individual buildings changed between 1944, when S-Site was first fitted for HE operations, and the early 1950s, when these operations were transferred into the modern S-Site complex. At any time an individual building was likely to be devoted to a single type of operation. The sequence of HE processing operations; powder sorting, followed by casting, followed by machining, followed by x-ray examination, remained fairly constant throughout this time period. Large quantities, up to 100 000 lb of HE per month, were processed through the area during the waning stages of World War II (Hawkins 1946, 0663). The two principal HE used in World War II era HE lenses were Composition-B and baratol; the former contained the primary explosives TNT and RDX, and the latter contained TNT and the inert material barium nitrate.

Casting and machining were the operations most likely to produce contamination of both buildings and their sumps and drain lines. Casting operations consisted of melting powdered HE and pouring the melts into shaped molds. Cooling protocols were carefully controlled during the casting stage because this was how most imperfections (especially bubbles) in the HE lenses were segregated to ridge regions in the molds (called risers). To control cooling, casting buildings were generally equipped with piping arrays that provided water and steam at various temperatures and pressures to cooling jackets surrounding the molds. HE vapor, produced during melting of cast HE, tended to coat the interiors of casting buildings, particularly their ductwork. This widely dispersed HE was removed daily using high pressure steam/hot water mixtures. The wash water was drained through troughs in floors into sumps or leaked out through cracks in the building floors and walls, potentially contaminating both the sumps with their drainage systems and the ground around the casting buildings. Following casting, risers were sawed off, then the HE charges were machined under a stream of water using lathes, drill presses, and other machine tools to remove imperfect surface material and establish a final shape. Fine HE powder in machining buildings, produced during riser sawing and machining, also was washed into sump systems and may have collected or passed through cracks in the buildings' floors.

Other HE operations in the GMX-3 area, such as powder inspection, x-ray radiography, and HE product storage are likely to have produced smaller amounts of HE contamination of buildings and sumps than HE machining or casting. HE powders were inspected prior to casting to remove contaminants such as bobby pins (these were frequently dropped accidentally into the HE by the female workers in the World War II era ordnance plants). X-ray radiography did not involve disruption of HE, but small chips from the charges were occasionally produced in the x-ray buildings. HE was normally held in magazines and rest houses between operations. Spillage of HE occasionally occurred in these magazines and rest houses. Buildings associated with these operations were also hosed down on a periodic basis to remove HE contamination, with wash water discharged to sumps and drainage systems.

HE collected in sumps was regularly shoveled out and taken to the burning ground. However, some HE washed through the sumps and in many cases this runoff water flowed into a secondary sump before it discharged into a surface outfall or a subsurface French drain. Although the sump systems were designed to collect all of the waste HE, they functioned inefficiently. HE contamination frequently occurred adjacent to sumps due to spillage during sump cleaning, beneath the bottom of sumps due to leaks, at leaks or clogged points in the drain lines or French drains, or in the sump outfalls. During the cleanup of the GMX-3 area during the 1960s, the highest levels of HE contamination in soils were invariably located within 20 ft of the sumps (Martin and Hickmott 1993, 15-16-497).

The first two process buildings at S-Site, TA-16-25, the casting building, and TA-16-24, an inspection building, were completed during the spring of 1944. At this time, HE machining was done in TA-16-38, which is discussed in Subsection 5.20. S-Site was first administered by Group E-5, Implosion Experimentation, through June 1944, then Group E-10, S-Site plant, from June though August 1944 (Hawkins 1946, 0663).

As needs for HE lenses increased in late 1944 and early 1945, two major expansions of S-Site occurred. The S-2 expansion, completed in February 1945, included construction of TA-16-41 (control building), TA-16-42 (casting), TA-16-43 (machining), TA-16-44 (inspection), TA-16-45 (x-ray), and TA-16-46 (storage). The S-3 expansion, completed in June 1945, included construction of TA-16-27 (casting) and TA-16-31, TA-16-32, and TA-16-33 (machining). From August 1944 through the end of World War II, the GMX-3 area was administered by Group X-3, Explosives Development and Production, in particular by Section X-3C, Production.

After World War II, HE processing activities decreased markedly. Sections X-3C, X-3D, and X-3E were consolidated into Group X-3, Explosives Production, in 1946. In 1948, this group was renamed GMX-3. Machining buildings TA-16-95, TA-16-96, TA-16-97, TA-16-98, and TA-16-99 were constructed in 1948. HE processing continued until the early 1950s, when casting and machining activities were transferred to TA-16-300 and TA-16-302 (the 300-Line) and TA-16-260 respectively. Most of the structures at the GMX-3 area were destroyed by burning in February 1960. The buildings in the 20s-Line, such as TA-16-24, TA-16-25, and TA-16-26, were not burned until 1968. The residual debris from burning and the subsurface structures such as sumps and drain lines was cleaned up in 1967.

The following PRSs resulted from operations in the GMX-3 buildings that have attached sumps. All of the decommissioned structures in this area were surveyed for radiation, HE, and toxic chemicals prior to being burned. Unless otherwise noted, the results of these surveys were negative. Currently, most of the building footprints are overgrown by scrub grasses. In a few cases, some chunks of concrete, asbestos shingling, or broken vitrified clay pipe mark the locations of the buildings. The locations of the buildings were determined by digitizing a 1947 aerial photograph onto a FIMAD base map. Generally, these locations correlated well with locations of residual pebble driveways and the highest concentrations of debris. Sump locations were accurately determined from a 1965 aerial photograph, on which most of the sumps are clearly visible.

SWMUs 16-005(c,d) are areas that contained septic tanks (TA-16-176 and TA-16-177) and their drain lines. TA-16-176 served TA-16-41 and TA-16-177 served TA-16-27 (Figs. 5-59 and 5-60). Both tanks served lavatories, but the two buildings they served varied drastically in potential HE levels. Both tanks were of reinforced concrete construction and had wooden covers. TA-16-176 discharged to a 4-in. vitreous clay pipe that fed a leach field (ENG-C 5600) and TA-16-177 discharged to a 6-in. vitreous clay pipe that discharged to the southeast of the tank in the roadside drainage that received effluent from the 20s-Line buildings (ENG-R 289).

TA-16-41 [SWMU 16-034(p) in Subsection 5.19] contained an office as well as two lavatories, but was physically separate from the HE processing buildings of the 40s-Line that it served. A former site worker regarded TA-16-176 as not contaminated, but could not recall its removal (Martin 1993, 15-16-477). The Facilities Engineering Structure location maps list TA-16-176 as removed but do not specify a removal date. Engineering drawings do not agree concerning its exact location but its drain line was excavated through shallow or exposed tuff so it is likely a trough can be located by hand excavation.

TA-16-27 and its operation are described below. The building is highly contaminated; thus, it is likely that the septic tank, TA-16-177, also was contaminated.

5.18.1.1.1 20s-Line PRSs

SWMUs 16-025(k,l), 16-026(q), 16-029(r,f2), 16-032(c), and 16-034(a) represent building footprints and adjacent soil, and sumps, drain lines, outfalls, and adjacent soil associated with TA-16-24, TA-16-25, TA-16-26, and TA-16-27 (Fig. 5-59). These buildings compose the 20s-Line. All are located in the central portion of the World War II era S-Site complex on level ground (Fig. 5-59). During much of the operational history of the GMX-3 area, HE powder was inspected in TA-16-25, experimental casting occurred in TA-16-26, production casting was done in TA-16-27, and laboratory analysis was completed in TA-16-24. Casting products from the 20s-Line were allowed to cool in TA-16-88, followed by riser removal in TA-16-99, and machining in TA-16-31, TA-16-32, TA-16-33 or TA-16-95, TA-16-96, TA-16-97, and TA-16-98 (Fig. 5-58). These buildings were built at different times, did not have similar histories or designs, and had individual sumps and drain lines.

SWMUs 16-025(k) and 16-029(r) contain potentially contaminated surface and subsurface soil associated with the building footprint and drainage system for TA-16-25 (Fig. 5-59). TA-16-25 was a wooden-frame building (20 ft long x 30 ft wide x 15 ft high) with a concrete foundation and floor. It was constructed in February 1944 and did not have a sump. It has been placed in this aggregate because it is believed to have had an outfall. TA-16-25 initially served as a HE powder inspection room (Ackerman 1945, 15-16-509; Martin 1993, 15-16-477). A former site worker suggested that such HE inspection activities would have produced fairly significant amounts of HE wastes. HE powder was spread on tables for the removal of foreign objects such as nails in preparation for casting (Martin 1993, 15-16-477). This building had no lavatory. Contrary to the information contained in the SWMU Report (LANL 1990, 0145), this building was apparently never used for casting or electroplating. TA-16-25 was destroyed by intentional burning in March 1968.

SWMU 16-029(r) is soil associated with the drainage system for TA-16-25. A very early S-Site utility drawing (ENG-C 5708) suggests that a drain line exited TA-16-25 from its southeast corner and emptied into a pond located southeast of TA-16-26. Later drawings do not show this pond, but many aerial photographs (Koogle and Pouls Engineering, Inc. 1965, 15-16-516) show a circular patch of vegetation roughly where the pond is inferred to have been located. A drainage ditch that heads eastward in a straight line from the circle and then turns south to service the sumps of TA-16-55 is also visible on many aerial photographs (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). TA-16-25 was shown to be HE contaminated during the surveys preceding its destruction by burning (Engineering Department 1959, 15-16-256). In 1970, the drainage in the roadside ditch near TA-16-25 was stated to be contaminated with HE (Thrap 1970, 15-16-001).

SWMUs 16-025(l) and 16-032(c) contain potentially contaminated surface and subsurface soil associated with the footprint of TA-16-26 and with its sump and drainage systems (Fig. 5-59). TA-16-26 was the first S-Site casting building (Martin 1993, 15-16-477). It was a medium-sized building (40 ft long x 45 ft wide) built early in 1944. This building had a basement under roughly one-third of its area (12 ft wide x 40 ft long) that served as a utility room. This basement was not quite a full story in height, and had a wooden ceiling that formed an elevated floor behind the casting kettles. This elevated platform provided access to the kettles. Contaminants generated before the burning of the building could have become buried below ground level in the former location of the basement when the building was removed. This basement had a small sump (4 ft deep) in the floor, which could have collected HE-contaminated wash water. The rest of the main floor was concrete slab slightly elevated from surrounding ground level. This slab contained a lead-lined drainage trough near the permanent floor mounts of the casting kettles. This trough led to a sump that is described below.

TA-16-26 was first used for casting during the summer of 1944, and continued to be the principal S-Site production casting facility through early 1945. A former site worker's earliest recollections of S-Site were watching HE castings being worked in TA-16-26 with hand tools such as files, rasps, and hand saws (Truslow 1973, 15-16-264). After the construction of TA-16-27, TA-16-26 was used for raw HE inspection (Ackerman 1945, 15-16-509). TA-16-26 was destroyed by intentional burning in March 1968. Industrial drains and sumps were disposed of at TA-54 and noncombustible material was flashed and disposed of at the Area P landfill.

SWMU 16-032(c) is the sumps, drain lines, and outfall drainages for TA-16-26 (Fig. 5-59). A 1944 drawing shows a drain line exiting the southwest side of TA-16-26. This line fed a pond (described in the discussion of TA-16-25) located south of TA-16-26. During the 1945 renovation of TA-16-26, an HE sump was installed on the northeast side of the building. Later drawings and a 1965 aerial photograph show only a single sump on the northeast wall of the building (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). This sump drained to a secondary sump, which fed a drain line that flowed eastward beneath a corner of the road east of TA-16-26. The rock-lined ditch associated with this drainage is still present. This ditch drained into the main drainage of the World War II era S-Site (Fig. 5-0-1). This sump and an attached drain area are shown on Engineering Drawing ENG-R 869 (also see drawing ENG-C 5521 for design of this sump).

SWMU 16-026(q) contains surface and subsurface soil associated with the sumps, drain lines, and inactive outfalls for TA-16-27 (Fig. 5-59). This building has not been decommissioned. The structure itself is treated as part of SWMU 16-017 in Chapter 6. TA-16-27 is a large (roughly 150 ft long x 50 ft wide) wooden-frame building with a concrete foundation, concrete floor, and a large basement that contains vacuum pumps and other equipment. The building consists of a 39 ft x 89 ft central casting room, and several smaller rooms that were used as laboratories and offices. An associated equipment building to the south of the main building is also considered to be part of TA-16-27. The main casting room was fitted with over twenty casting stations, each of which had temperature-controlled water outlets. Overhead ductwork provided ventilation to the casting room. Some of this ductwork remains and contains recrystallized HE (Martin 1993, 15-16-477; Martin and Hickmott 1993, 15-16-497). There appear to have been five 600-lb casting kettles in the building based on examination of World War II era photographs (LASL photo circa 1946, 3083).

TA-16-27 was originally constructed with four sumps. Both the north and south sides of the building each had one primary sump adjacent to the building. These sumps were connected to secondary sumps located a few feet from the building (Fig. 5-59). In the early 1950s these four sumps were removed and five new primary sumps were constructed; two on the north side of the building and three on the south side of the building. Both the north set of sumps and the south set of sumps fed secondary sumps located more than 50 ft from TA-16-27 (Fig. 5-59). The drain lines from both secondary sumps flowed eastward in rock-lined ditches to a ditch that flowed south along the roadway, under the road corner, and into the main drainage of the World War II era S-Site (Fig. 5-59).

Construction of TA-16-27 was completed in May 1945. The building was the main production casting facility for S-Site through 1953, when TA-16-300 and TA-16-302 were completed, although casting was stopped temporarily in 1946 due to deterioration of the building. Full-scale lenses for nuclear devices were cast in this building (Ackerman 1945, 15-16-509). During July 1945 casting occurred in three shifts, going on around-the-clock. After casting operations were moved into the 300-Line in the early 1950s, TA-16-27 was used as a warehouse (Thrap 1970, 15-16-001). In 1970 the building was abandoned. It is currently empty, and in a severe state of disrepair.

The sumps and drain lines for this building were removed in 1968. These materials were disposed of in Area L at TA-54. In 1970 the building was surveyed for radioactive contamination (Buckland 1970, 15-16-005; Kennedy 1970, 15-16-006), chemical contamination (Mitchell 1970, 15-16-007), and HE contamination (Courtright, 1970, 15-16-004). One piece of equipment was mildly contaminated with radioactivity, presumably from depleted uranium, and the building was extensively HE contaminated.

SWMUs 16-029(f2) and 16-034(a) contain surface and subsurface soils associated with the building footprint and sump system for TA-16-24 (Fig. 5-59). TA-16-24, completed May 1946, was a wooden-frame building 20 ft long x 36 ft wide x 11 ft high with a concrete floor. It served as an analytical laboratory for the 20s-Line (Ackerman 1945, 15-16-162), where properties of production castings, including HE density, composition, and particle size were determined (Martin 1993, 15-16-477). These activities might have resulted in both HE contamination and contamination by solvents used in the HE analysis. The building had lead-lined ducts and a lead-lined trough in the floor. This trough surrounded a hood located in the northwest corner of the building. This building was destroyed by intentional burning in March 1968. It had a sump and outfall which are discussed below.

SWMU 16-029(f2) contains surface and subsurface soil associated with the decommissioned sump and outfall of analytical laboratory, TA-16-24. Effluent exited TA-16-24 from the southwest end of the building, flowed into a sump located about 15 ft northwest of the building's west corner, and drained into a rock-lined ditch that flowed east under the road corner and into the main drainage from the site (Fig. 5-0-1). A former site worker suggested that the lack of formal waste-disposal procedures during World War II may have resulted in solvents being disposed into the sump system (Martin 1993, 15-16-477). This sump and drain line were removed to TA-54 and other noncombustible debris was disposed of at the Area P landfill.

5.18.1.1.2 30s-Line PRSs

SWMUs 16-024(e), 16-025(e), and 16-025(f) include both surface and subsurface soil associated with three identical HE machining buildings TA-16-31, TA-16-32, and TA-16-33 (Fig. 5-58). These were part of a row of buildings referred to as the 30s-Line, which also included magazines, radiographic facilities, and utility buildings. TA-16-33 was mistakenly designated as a magazine within the SWMU Report (LANL 1990, 0145). The 30s-Line is located in the north-central portion of the World War II era S-Site complex on extremely level ground (Fig. 5-58). No drainage exits the location of the SWMUs.

These buildings each consisted of two chambers (13 ft^2) for machining and a separate control room (8 ft^2). Pipes connected the control rooms to the machining chambers. These three wooden structures with concrete slab floors had fill dirt around and between them. Each was almost entirely buried and had a door to the control room exposed on the southwest side and doors to the machining chambers in blowout walls on the northeast side. There was also an air conditioning system mounted on top of each mound surrounding a machining building. Each chamber side faced a road and each earthen mound on that side was flush with the plane of the doors. Originally, each machining chamber had a lead-lined drainage channel to wash out HE. In August 1945 the lead-lined troughs were replaced with concrete troughs with spark-proof mastic covering. In the 1950s these buildings were converted from machining buildings to other purposes. In a 1950s list of structures TA-16-31 is listed as a hot-cold chamber, TA-16-32 is listed as an x-ray building, and TA-16-33 is listed as an additive storage building (Engineering Department 1959, 15-16-256).

A sump that received effluent from the troughs of two machining chambers was located between each building and the road to the northeast of the 30s-Line (Fig. 5-58). Each sump had a drain line that passed beneath the adjacent road, under an earthen barricade that lined the far side of the road, and into the settling ponds to the northeast [SWMU 16-007(a), a row of four ponds]. There were no secondary settling tanks, and each of the three drain lines daylighted at one of the boundaries between two of the four ponds, feeding the two with a Y-shaped end pipe. These sumps and drains were not assigned SWMU numbers, so they will be treated as part of the SWMUs associated with the buildings. Drain line locations are shown on the Utility Location Plan [R-861, 869, 870]. The sumps are clearly visible in an aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516).

Because of the small size of these buildings and the large amounts of soil contained in the barricades around them, it is likely that any contamination of the building footprints was diluted during bulldozing of the barricades. Photographs taken during cleanup of these structures suggest the soil removal and dispersal operation did not penetrate significantly below the original level of the land (LASL photographs 67-5070, 67-6022).

These buildings were listed as having HE contamination in 1959 (Engineering Department 1959,15-16-256).

5.18.1.1.3 40s-Line PRSs

SWMUs 16-025(p,q,r,u,v), 16-026(w), 16-029(z), and 16-032(a) contain potentially contaminated surface and subsurface soil associated with TA-16-42, TA-16-43, TA-16-44, TA-16-45, and TA-16-46 and their sump and drain line systems (Fig. 5-60). These buildings compose part of the 40s-Line, which was located on eastward sloping ground in the south-central portion of the World War II era S-Site complex (Fig. 5-60). The 40s-Line contained several HE production facilities in a single line of buildings that were connected by enclosed walkways, with casting in TA-16-42, experimental casting and/or machining in TA-16-43, physical inspection (of raw materials) in TA-16-44, and x-ray examination in TA-16-45. Temporary storage in TA-16-46 was separate from the other four buildings. There were several other buildings associated with the 40s-Line that did not have sumps and these are treated in Subsection 5.19. TA-16-43, TA-16-44, TA-16-45, and TA-16-46 were wooden buildings, 20 ft wide x 60 ft long with wooden floors on pillars. The soil beneath them was leveled from its gentle slope to the east. TA-16-42 had a concrete floor on pillars and slightly larger dimensions of 40 ft wide x 90 ft long. All these buildings had floor troughs along their longer walls that discharged into sumps and, except for TA-16-46, these fed a common outfall. Details of this outfall system are discussed below. There were barricades between the buildings, but they are not within the SWMU boundaries and were encased in wood on both sides, limiting their volume. The level ground between these buildings drained slightly to the north, then east by ditches and culverts along the road that flanked the backs of the buildings (ENG-C 5599). Decommissioning of these structures may have resulted in a thin layer of clean dirt over contaminated regions within the SWMUs.

TA-16-42 processed high volumes of HE and is the structure within the 40s-Line most likely to have associated contamination (Huselton 1945, 15-16-152). This building had a lead-lined trough across the south of the building in addition to those along the sides. It also had a partial basement for utility service (ENG-C 5732) that could have collected HE. Because the floor was concrete, HE that leaked to the ground could have been protected from burning during decommissioning. Fuel was placed in the basement when the building was burned, but not between the concrete floor and the ground in the pillar-supported region (Martin and Hickmott 1993, 15-16-497). Wings were added to TA-16-42 in 1949 as a control room on the east side and to service a new casting kettle on the west side.

TA-16-43 was also heavily HE contaminated during its years of operation. It contained a cement partition in its north corner that was used as a blast shield for machine tools in the building. This building was used for cutting risers from HE castings (Martin 1993, 15-16-477). According to a former site worker an extra drain line oriented southward and passing near TA-16-41 was added from the building's single sump.

TA-16-44 was used for sifting incoming HE powder and removing metallic contaminants; therefore, it may have had significant contamination. It was also used for inspecting completed charges, including density determinations by the water displacement method. The sumps for this building are not visible on the aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516); these sumps were removed prior to the 1966 cleanup in order to pave the area adjacent to the incinerators at TA-16-43 and TA-16-41. This paving and drain line pipes were removed in the 1966 cleanup (Martin 1993, 15-16-477). Because the sumps at TA-16-44 are not in the 1965 photograph, it is questionable whether they can be exactly located. The sump locations are depicted on drawing ENG-R 876.

TA-16-45 was used for x-ray examination of HE lenses. It contained lead shielding and a darkroom. A pair of HE sumps [SWMU 16-029(z)] connected TA-16-45 into the 40s-Line drainage line [SWMU 16-032(a)], but this line did not receive significant amounts of HE (Martin 1993, 15-16-477). More significantly, the darkroom had two sinks and one floor drain which discharged through a separate line from the HE sumps. This floor drain is discussed with SWMU 16-026(w).

TA-16-46 was a rest house for HE products awaiting radiography in TA-16-45. Because it was built with sumps, it is in this aggregate, but its likely relatively low level HE contamination justifies treating it much like the buildings in Subsection 5.19. TA-16-46 was offset from the rest of the 40s-Line, and had an outfall that is not a SWMU but that is included within the boundary of SWMU 16-025(n). The exact location of the outfall is not known, but it probably drained into a ditch along the road that was used for the main

40s-Line drainage 200 ft south of TA-16-46 (Martin 1993, 15-16-477). This ditch can be seen in the aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516), but is rather obscure in the vicinity of TA-16-46.

SWMUs 16-029(z), 16-032(a), and 16-026(w) represent the soil associated with the principal HE drainage system for the 40s-Line. All parts of the drain system are decommissioned.

SWMU 16-029(z) includes the sumps attached to TA-16-42, TA-16-43, TA-16-44, and TA-16-45 of the 40s-Line and the drain lines extending to the secondary sumps. The drainage ditch that a former site worker claimed was used for discharge of the 40s-Line can be seen on the aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). SWMU 16-032(a) includes secondary sumps for these buildings, located about 60 ft from the building structures, and a common drain line linking them all. The sumps are shown in the Engineering drawing ENG-R 876, but not with enough accuracy to locate them. The TA-16-44 secondary sump is not in any of these photos and may be difficult to locate.

SWMU 16-026(w) consists of the drain line from the darkroom of TA-16-45. The drain line exited the building from its eastern wall. A detailed engineering drawing of TA-16-45 (Engineering drawing ENG-C 5645) shows the pipe only as a line from the building, listing a few specifications such as a filter at the end and instructions to "spill on the ground." Thus, the location of the discharge point for this line is uncertain. The photoprocessing laboratory probably drained directly into the ditch east of TA-16-45. The ditch no longer exists. All of these buildings were designated as HE contaminated in the 1959 survey (Engineering Department 1959, 15-16-256).

5.18.1.1.4 Machining Line - North/South/East/West

SWMUs 16-025(g), 16-025(h), 16-025(i), 16-025(j), 16-029(m), 16-029(n), 16-029(o), 16-029(p), and 16-029(h2) contain surface and subsurface soil associated with HE machining buildings TA-16-95, TA-16-96, TA-16-97, and TA-16-98 (often called West, North, East, and South) and their sumps and drain lines (Fig. 5-58). The buildings were located east of the 30s-Line on flat terrain with a slight drop in elevation to the northeast. Some drainage probably flowed into a culvert under the northern end of the easternmost road into a gully. These buildings were all small (20 ft long x 12 ft wide with 20 ft x 6 ft porches), and of wooden-frame construction on concrete floors. They were surrounded by access roads that roughly formed a square border. Each building had a U-shaped and wooden-walled earthen barricade separating it from a central utility building, TA-16-94.

One of these buildings (either TA-16-96 or TA-16-98) was more automated than the rest, with equipment observable with a periscope from TA-16-94. Another, TA-16-98, was decommissioned as a machining building and converted into a coffee and smoking room.

These buildings all had platforms with garbage cans to collect pieces of HE for disposal at the burning ground. These buildings were destroyed by intentional burning in 1960, explosive residues were removed to TA-54, and noncombustibles were disposed of at the Area P landfill.

SWMUs 16-029(m), 16-029(n), 16-029(o), 16-029(p), and 16-029(h2) contain potential soil contamination associated with the decommissioned sumps and drains of TA-16-95, TA-16-96, TA-16-97, and TA-16-98. There were no secondary sumps.

A drain line flowed from the sump for TA-16-98 to the sump for TA-16-97, then to the sump for TA-16-96, and finally to the manhole TA-16-801. A second drain line exits the sump for TA-16-95 and flows into this manhole. Another drain line exits TA-16-801 and trends north beneath the 90s-Line. This large drain system will be designated 16-029(h2), which was associated with manhole TA-16-801 in the SWMU Report. Most of the structures associated with these SWMUs were removed in 1967 (see LASL photos 67-5065, 67-5066, 67-5067, and 67-5068). It appears that the drain line segment beneath the barricade for TA-16-89 was never dug up, and it is unclear whether this drain line ever daylighted.

All of these buildings were designated as HE contaminated in the 1959 HE survey (Engineering Department 1959, 15-16-256).

5.18.1.2 Conceptual Exposure Model

The conceptual exposure model for the HE process buildings is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.18.1.2.1 Nature and Extent of Contamination

The principal PCOCs for PRSs within this aggregate are HE (principally TNT and RDX), HE byproducts (i.e., DNT, DNB, TNB), volatile and semivolatile organics, and metals, particularly barium and silver. Additional minor PCOCs include depleted uranium in PRSs associated with TA-16-27, which contained radioactively contaminated equipment and cyanide in PRSs associated with x-ray and photoprocessing building TA-16-45. Table 5-80 summarizes the PCOCs on a SWMU-specific basis.

For many years there have been concerns with HE contamination at S-Site buildings. In 1945, ten samples were taken beneath casting buildings TA-16-42 and TA-16-27, five under each building (Fig. 5-61). They were subjected to a blowtorch flame to determine if the soils were explosive. The five samples under TA-16-42 were biased to areas with visible HE contamination, those under TA-16-27 were taken at random. The samples from TA-16-42 ignited, but explosions did not propagate. Those from TA-16-27 did not ignite. It was concluded that HE levels under TA-16-42 were less than 1% and that the levels at TA-16-27 were negligible (Huselton 1945, 15-16-152).

A limited number of analytical samples exist within the GMX-3 operational area. These were reported in a previous investigation (LANL 1989, 0425). Eighteen individual 0 to 3 ft samples located approximately on a grid were composited into six laboratory samples; all were taken in the general area of TA-16-41 (over the decommissioned 40s-Line). Three individual grab samples were analyzed for volatile organics. Sampling locations are shown in Fig. 5-62 and results are shown in Table 5-81. All composite samples were analyzed for radionuclides, metals, and HE in the laboratory. Field screening results for HE were negative, a few field screening results for organic vapors yielded values to 100 ppm. Surprisingly, no HE was found in the grab samples analyzed in the laboratory. No biasing toward sump or building locations was involved in this sampling. It is interesting to note that

TABLE 5-80

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, DECOMMISSIONED SUMPS, OUTFALLS, AND ASSOCIATED BUILDINGS IN THE GMX-3 AREA

				HE			RAD	METALS				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-005(c)	Septic tank,TA-16-176, served TA-16-41	HE processing	N	X	X			X	X	X	X	
16-005(d)	Septic tank,TA-16-177, served TA-16-27	HE casting, laboratories	N	X	X		X	X	X	X	X	
16-024(e)	TA-16-33 and associated sump	HE machining	N	X	X	X		X	X			
16-025(e)	TA-16-31 and associated sump	HE machining	N	X	X	X		X	X			
16-025(f)	TA-16-32 and associated sump	HE machining	N	X	X	X		X	X			
16-025(g)	TA-16-95	HE machining	N	X	X	X		X	X			
16-025(h)	TA-16-96	HE machining	N	X	X	X		X	X			
16-025(i)	TA-16-97	HE machining	N	X	X	X		X	X			
16-025(j)	TA-16-98	HE machining	N	X	X	X		X	X			
16-025(k)	TA-16-25	HE powder inspection	N	X	X	X			X			
16-025(l)	TA-16-26	HE casting, raw HE inspection	N	X	X	X		X	X			
16-025(p)	TA-16-44	Raw HE inspection	N	X	X	X			X			
16-025(q)	TA-16-45	X-ray examination	N	X	X	X		X	X			X
16-025(r)	TA-16-46 and associated sump	HE rest house	N	X	X	X		X	X			
16-025(u)	TA-16-42	HE casting	N	X	X	X		X	X			
16-025(v)	TA-16-43	HE casting and machining	N	X	X	X		X	X			
16-026(q)	Sumps and outfall from TA-16-27	HE casting, laboratories	N	X	X		X	X	X	X	X	
16-026(w)	Outfall from TA-16-45	X-ray examination	N	X	X			X	X	X	X	X
16-029(m)	Sump & drain associated with TA-16-95	HE machining	N	X	X			X	X			
16-029(n)	Sump & drain associated with TA-16-96	HE machining	N	X	X			X	X			
16-029(o)	Sump & drain associated with TA-16-97	HE machining	N	X	X			X	X			
16-029(p)	Sump & drain associated with TA-16-98	HE machining	N	X	X			X	X			
16-029(r)	Sump & drain associated with TA-16-25	HE powder inspection	N	X	X				X			

TABLE 5-80 (continued)

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, DECOMMISSIONED SUMPS, OUTFALLS, AND ASSOCIATED BUILDINGS IN THE GMX-3 AREA

				HE			RAD	METALS				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-029(z)	Sumps & drain associated with TA-16-42, -43, -44, -45	HE casting, machining, x-ray examination, and inspection	N	X	X			X	X	X	X	X
16-029(f2)	Sump associated with TA-16-24	Analytical laboratory	N	X	X			X	X	X	X	
16-029(h2)	Merger and outfall for SWMUs 16-029(m) to 16-029(p)	HE machining	N	X	X			X	X			
16-032(a)	Secondary sumps, drains, and outfalls associated with TA-16-42, -43, -44, -45	HE casting, machining, x-ray examination, and inspection	N	X	X			X	X	X	X	X
16-032(c)	Sump, drain, and outfall associated with TA-16-26	HE casting, raw HE inspection	N	X	X			X	X			
16-034(a)	TA-16-24	Analytical laboratory	N	X	X	X		X	X		X	

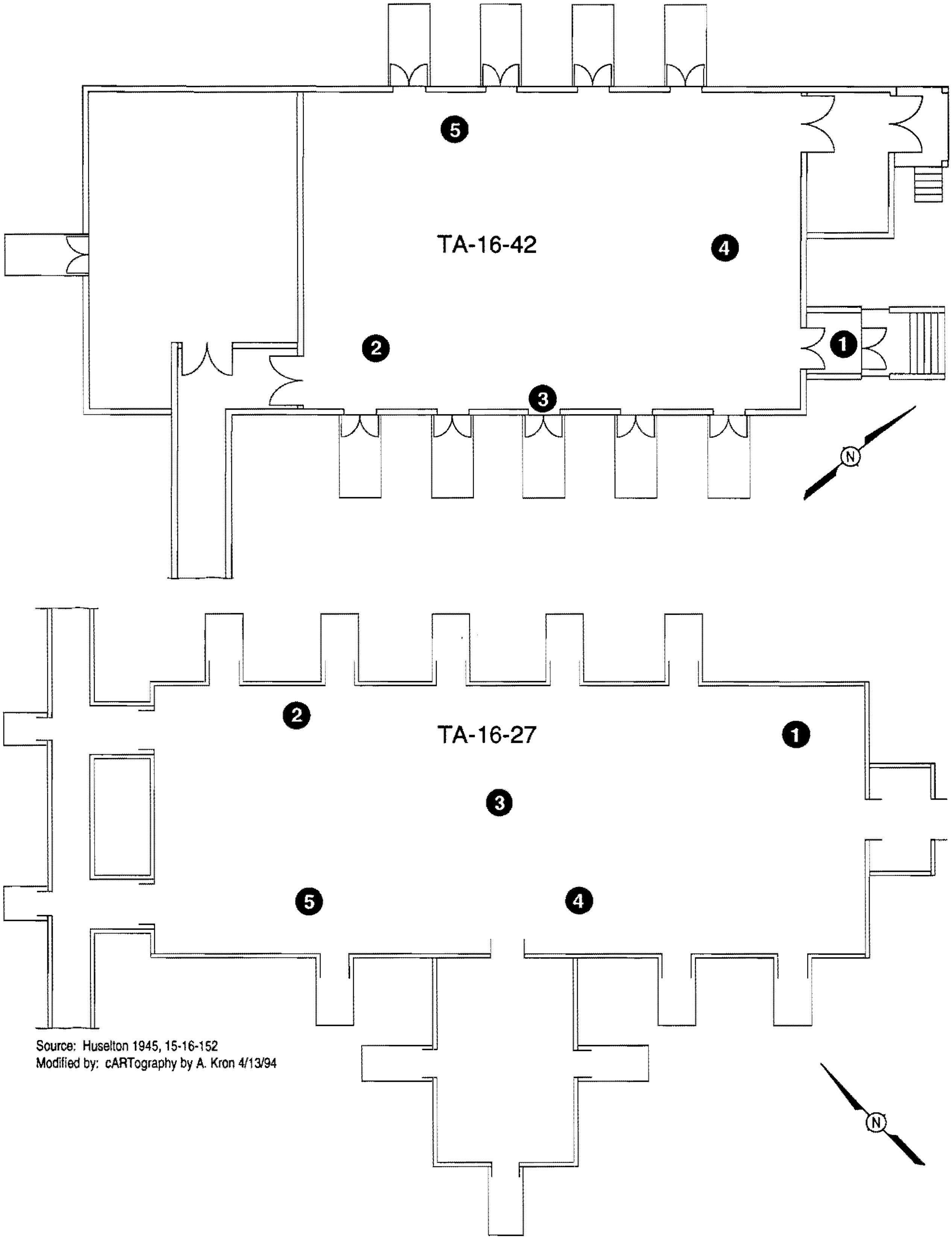

Fig. 5-61. Sampling locations in World War II blowtorch HE study.

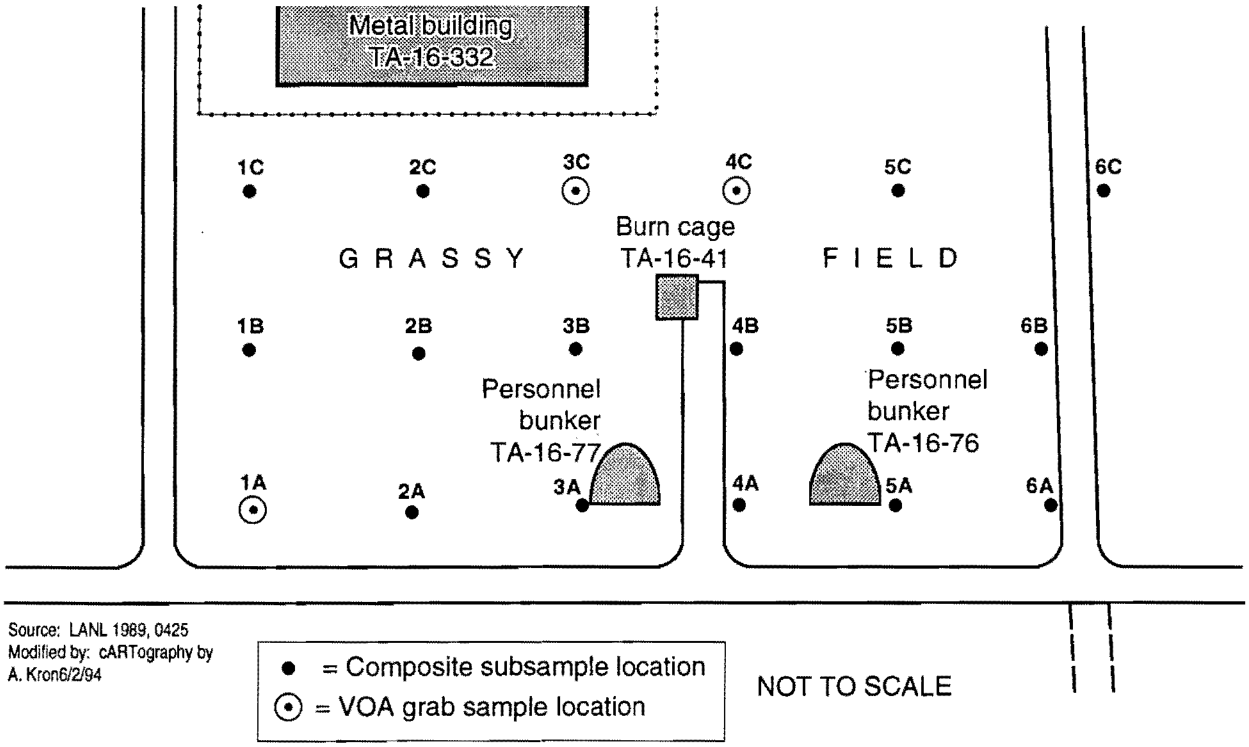

Fig. 5-62. Sampling locations for 1989 Environmental Study at GMX-3.

silver and cobalt-56 were only found in samples taken near TA-16-45 and TA-16-48. None of the analyses for suspected PCOCs was above SALs, except for beryllium, which was in its background range.

5.18.1.2.2 Potential Pathways and Exposure Routes

Potential release of contaminants from the septic tanks, the basement in decommissioned TA-16-26, sumps, drain lines, and outfalls could have occurred as the result of leaks from structures or pipe joints into subsurface soils. Potential surface contamination could have occurred through spillage from the sumps and liquid disposal to the outfall. Surface soil underneath and around the decommissioned buildings may be contaminated as a result of leaks and spills during routine operations. Infiltration of surface water could have transported contaminants into subsurface soils beneath the footprints of the former structures. Although solvents from the analytical laboratory [SWMU 16-034(a)] could have volatilized into the atmosphere, there is some possibility that releases may have reached the subsurface environment.

Once these contaminants have been released into the environment, the major migration pathway for potential surface contamination is through surface water runoff that may carry contaminants beyond the original release site to accumulate in sedimentation areas in drainages. The PRSs associated with the 30s-Line discharged directly into the decommissioned wastewater ponds. The PRSs associated with the TA-16-95, TA-16-96, TA-16-97, and TA-16-98 HE machining buildings eventually discharged into the pond located north of the site. For the remaining PRSs, drainage is toward the southeast into the large drainage ditch that runs from north to south. Wind dispersion is not a significant migration pathway because the area has been revegetated with grasses and weeds. Potential subsurface contamination does not pose a current public health risk until the subsurface soil is exposed to the surface either through excavation or erosion. Chapter 4 of this RFI work plan contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

This site is currently inactive and infrequently used by on-site workers. In addition, institutional controls do not permit public access to this area.

TABLE 5-81

ANALYSES OF 40s-LINE SOIL SAMPLES
ENVIRONMENTAL PROBLEM #27 (LANL 1989, 0425)

SAMPLE	840-1	840-2	840-3	840-4	840-5	840-6	SALs
Medium	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Units (ppm)	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]
VOCs [a]							
Acetone	35	NA	13	23	NA	NA	8 000
Toluene		NA	2		NA	NA	890
Terpene (possible)		NA		6	NA	NA	
Metals							
Barium	277	165	87.5	174	192	240	5 600
Beryllium [c]	1.4	1.1		1.1	1.5	1.8	0.16
Cadmium	3.8			2.9	4.1	3.9	80
Chromium	16.2	8.8	6.6	10.6	12.7	13.0	400
Copper [c]	8.4	9.6		52.8	7.4	8.8	3 000
Silver [c]						20.8	400
Zinc	36.6	24.9	24.2	47.5	32.7	35.4	24 000
Radionuclides							
Thorium-232	<13 800	<11 600	<9 900	NA	<13 400	<13 400	880
Uranium-235				NA		150	18 000
Uranium-238	<13 100	<11 800	<10 800	NA	<13 400	<12 500	59 000
Cobalt-56 [d]				NA		<150	
Cesium-137				NA	190		4 000

A blank cell indicates the analyte was not detected
na indicates that the sample was not analyzed for the analyte
a All VOCs were analyzed in one grab sample from within the three composited samples
b All radionuclides in pCi/kgW
c Beryllium, copper, and silver were found in QC blanks and may be biased high
d Original reference states that cobalt-56 was found. Because of short half-life of cobalt-56, it is likely that cobalt-60 was the actual analyte.

5.18.2 Remediation Decisions and Investigation Objectives

5.18.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. This aggregate consists of decommissioned sumps, septic tanks, outfalls, and buildings in the GMX-3 area of S-Site. The probability of HE contamination is moderate to high for most PRSs, since most buildings involved HE processing. However, HE in excess of 3 wt % was removed during the 1960s cleanup (Martin and Hickmott 1993, 15-16-497).

There is one PRS where the problem is not based on potential HE contamination. PCOCs for the photoprocessing laboratory outfall [SWMU 16-026(w)] include silver and developing chemicals.

5.18.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.18.3 Data Needs and Data Quality Objectives

5.18.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in generic DQO Step 3 in Subsection 5.0.2.

5.18.3.2 Investigation Boundary (DQO Step 4)

The spatial boundaries of potential contamination for the PRS are contained by the PRS boundaries for the sumps, septic tanks, outfalls, drainages, drain fields, ponds, and decommissioned buildings. It is expected that sumps and drain lines are excavated into the tuff since the soil is shallow at S-Site, usually less than three feet deep. The depth boundary for the sumps, septic tanks, drain fields, and outfalls is from the surface to the soil-tuff interface. Although the original location of the PCOCs at the building footprints, drainages, ponds, or outfalls was the soil surface (less than 6 in.), the decommissioning activities such as bulldozing most likely redistributed or covered the PCOCs to a shallow depth. Surface HE is also likely to have been redistributed from the surface to a shallow depth by fifty years of water infiltration and resultant transport through the soil column. Given the shallow soil at S-Site, the depth boundaries for surface soil at disturbed sites will be the top 12 in. of soil or the depth to tuff, whichever is less.

The main drainage to the east of the GMX-3 area will be considered from the discharge point of the culvert that drains the 20s-Line to the road due south of TA-16-37. The drainage will be considered in a 1-ft wide swath to a depth of 6 in. This shallow depth was chosen because the drainage was not disturbed by the cleanup activities during the 1960s.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.18.3.3 Decision Logic (DQO Step 5)

This aggregate follows generic DQO Step 5, presented in Subsection 5.0.2.

5.18.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Tables 5-82 and 5-83). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, a PCOC that both can easily be screened and that represents the major likely health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. However, HE and its associated constituents make up the vast majority of material processed through the S-Site buildings. In addition, site-wide drainage sampling is designed to provide non-biased insights into the transport of any PCOCs off site. For all but one PRS in the GMX-3 decommissioned structures aggregate, HE was selected to be the indicator PCOC. The indicator PCOC for the photoprocessing laboratory outfall was silver.

This aggregate mainly consists of sumps and footprints of HE processing buildings. The amount of residual contamination was judged to be related to

TABLE 5-82

GROUPING OF GMX-3 SUMP, SEPTIC SYSTEM, AND OUTFALL PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious	16-026(q) 16-032(a)	TA-16-27 HE casting, sumps/outfall TA-16-42 to TA-16-45 Secondary sumps, drain and outfall	16-029(z)	TA-16-42 to TA-16-45 HE casting sump and drain		
Serious	16-032(c) 16-024(e) 16-025(e) 16-025(f) 16-029(h2)	TA-16-26 HE casting sump and drainage TA-16-33 TA-16-31 TA-16-32 HE machining sumps and footprints TA-16-801 Merger and outfall for 16-029(m) to 16-029(p)				
Not very serious	16-029(r) 16-029(f2) 16-005(d)	TA-16-25 HE powder inspection outfall TA-16-24 Analytical laboratory sump TA-16-177 for TA-16-27 Septic tank	16-029 (m) 16-029 (n) 16-029 (o) 16-029 (p)	TA-16-95 TA-16-96 TA-16-97 TA-16-98 HE sump and drain	16-026(w)	TA-16-45 Photoprocessing laboratory outfall
Negligible			16-005(c) 16-025(r)	TA-16-176 for TA-16-41 Septic tank TA-16-46 HE rest house footprint and sump		

TABLE 5-83

GROUPING OF GMX-3 BUILDING FOOTPRINT PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious	16-025(v) 16-025(u) 16-025(l)	TA-16-43 HE casting and machining (wooden floor on pilings) TA-16-42 HE casting (concrete floor on piling- known cracks) TA-16-26 HE casting (slab floor with basement)				
Not very serious			16-025(g) 16-025(h) 16-025(i)	TA-16-95 TA-16-96 TA-16-97		
Negligible	16-025(p) 16-025(q)	TA-16-44 Raw HE inspection TA-16-45 X-ray examination (both have wooden floors on pilings)	16-025(k) 16-025(j) 16-034(a)	TA-16-25 HE powder inspection room HE machining TA-16-98 TA-16-24 HE analytical laboratory (concrete slab floor)		

the process conducted in the building and length of the time that the building was actively used. HE casting operations were judged to produce the greatest contamination, followed by HE machining; powder inspection and HE rest houses were judged to yield minimal residual contamination. The septic tanks were judged to present either a not very serious or negligible problem because the septic tanks served lavatories. The photoprocessing laboratory outfall was ranked as serious because the indicator PCOC is silver, which was not a target compound during the decommissioning of World War II era S-Site.

The ranking of sump-outfall PRSs into heterogeneity categories was made based on the length of the drain lines associated with a sump or outfall and the HE processing operations associated with each sump or outfall. Small drain line systems or individual sumps were judged to be relatively homogeneous, whereas large drain line systems associated with more destructive operations were judged likely to be heterogeneous. The most important factors for selecting the heterogeneity of the building footprints were the type of floor present and the existence of known structural flaws (cracks) or basements where PCOCs could collect. Buildings with wooden floors, likely cracks in the concrete slab, or basements were judged to be heterogeneous. Other building footprints were judged to be not very heterogeneous, because it was estimated that decommissioning activities such as soil grading would have homogenized potential contaminants somewhat.

The information on the severity and heterogeneity of PCOCs was used to estimate the probability of observing a concentration less than the SAL of PCOCs in each PRS (Tables 5-84 and 5-85). These probabilities were consistent with the severity categories, where PRSs in the greater severity categories were ranked within these categories.

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Mapping from orthocorrected aerial photographs will allow accurate (+/- 2 ft) location of building footprints and many of the sumps. However, field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas.

Field screening points were selected for each PRS to provide adequate coverage of each PRS, again considering both the likely heterogeneity of

TABLE 5-84

SAMPLING PARAMETERS FOR GMX-3 SUMP, SEPTIC TANK, AND OUTFALL PRSs

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-026(q) 16-032(a)	HE	50%	4
16-029(z)	HE	50	4
16-032(c)	HE	70	7
16-024(e) 16-025(e) 16-025(f) 16-029(h2)	HE	50	3
16-029(m) 16-029(n) 16-029(o) 16-029(p)	HE (400 ppm)	90	2
16-026(w)	Silver	80	2
16-029(r) 16-029(f2)	HE	95	3
16-005(d)	HE	95	3
16-005(c)	HE	99	1
16-025(r)	HE	99	1

the PRS and the potential severity of contamination in the PRS.

The sampling plan in the main S-Site drainage will be based on qualitative criteria. The design is based on sampling every 200 ft down the drainage starting at the point southeast of the road corner where the 20s-Line PRS drainages discharge and ending 800 ft downstream, north of the first road encountered along the drainage.

5.18.4 Sampling and Analysis Plans

SOPs that control field activities in this sampling plan are listed in Table 5-86. Appropriate health and safety precautions will be undertaken according to

TABLE 5-85

SAMPLING PARAMETERS FOR GMX-3 BUILDING FOOTPRINT PRSs

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-025(u)	HE	70%	3
16-025(l)	HE	70	3
16-025(v)	HE	90	3
16-025(g) 16-025(h) 16-025(i)	HE	95	2
16-025(p)	HE	99	1
16-025(q)	HE	99	1
16-025(k) 16-025(j)	HE	99	1
16-034(a)	HE	99	1

the site-specific Health and Safety Plan. Sampling numbers and required analyses are shown in Table 5-87.

5.18.4.1 Engineering Surveys

The PRSs composing this aggregate will be field surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all building locations will be accurately located (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. Subsurface structures will be located based on period engineering drawings when their locations cannot be inferred from site mapping and aerial photographs. In the field, the engineering survey will locate, stake, and document the location of each PRS and each point for field screening and sampling. Geomorphic sediment mapping will be completed in the drainage. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.18.4.2 Sampling

All samples will be field screened for HE by spot test and radionuclides by gross beta-gamma. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

TABLE 5-86

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

Unless otherwise indicated, laboratory samples will be selected using the following prioritized biasing scheme: 1) samples with positive HE spot test readings; 2) samples with above-background radiation readings (two times background or more); and, 3) samples biased as described below on a PRS-specific basis. In cases where more field-screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to an individual PRS source to better limit the PCOC list. In the absence of positive field screening readings, the sample submitted for laboratory analysis will represent the soil-tuff interface from any individual core.

Surface samples will be to a 12 in. maximum depth unless otherwise indicated, and at least 300 ml of soil will be collected. Each subsurface core

TABLE 5-87

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR GMX-3 BUILDINGS WITH SUMPS AND OUTFALLS

PRS	PRS TYPE	SAMPLED MEDIA	LABORATORY: STRUCTURE	LABORATORY: STRUCTURE FIELD DUP	LABORATORY: SURFACE	LABORATORY: SURFACE FIELD DUP	LABORATORY: SUBSURFACE	LABORATORY: SUBSURFACE FIELD DUP	FIELD SCREENING #: GROSS ALPHA	FIELD SCREENING #: GROSS GAMMA/BETA	FIELD SCREENING #: ORGANIC VAPOR	FIELD SCREENING #: HE SPOT TEST	FIELD SCREENING #: GEOPHYSICS SURFACE	FIELD SCREENING #: BARIUM - LIBS	FIELD SCREENING #: A GEOLOGICAL CHARACTERIZATION	FIELD: GROSS ALPHA	FIELD: GROSS GAMMA/BETA	FIELD: TRITIUM	FIELD: VOLATILE ORGANICS	FIELD: B XRF	FIELD: SOIL MOISTURE	LABORATORY ANALYSES: ALPHA SPECTROSCOPY	LABORATORY ANALYSES: GAMMA SPECTROSCOPY	LABORATORY ANALYSES: C BETA SPECTROSCOPY	LABORATORY ANALYSES: TOTAL URANIUM	LABORATORY ANALYSES: ISOTOPIC PLUTONIUM	LABORATORY ANALYSES: ISOTOPIC URANIUM	LABORATORY ANALYSES: D VOA (SW 8240)	LABORATORY ANALYSES: E SEMIVOLATILES (SW 8270)	LABORATORY ANALYSES: F METALS (SW 6010)	LABORATORY ANALYSES: G ASBESTOS	LABORATORY ANALYSES: H HIGH EXPLOSIVES (SW 8330)	LABORATORY ANALYSES: CYANIDE
16-005(c)	Septic tank	Soil					1			4		4																1	1	1		1	
16-005(d)	Septic tank	Soil					3			5		5													3			3	3	3		3	
16-024(e)*	Burned building/sump	Soil			2		1			8		8																	3	3		3	
16-025(e)*	Burned building/sump	Soil			2		1			8		8																	3	3		3	
16-025(f)*	Burned building/sump	Soil			2		1			8		8																	3	3		3	
16-025(g)	Burned building	Soil			2					6		6																	2	2		2	
16-025(h)	Burned building	Soil			2					6		6																	2	2		2	
16-025(i)	Burned building	Soil			2	1				6		6																	2	2		2	
16-025(j)	Burned building	Soil			1					5		5																	1	1		1	
16-025(k)	Burned building	Soil			1					5		5																	1	1		1	
16-025(l)	Burned building	Soil			3					12		12																	3	3		3	
16-025(p)	Burned building	Soil			1					5		5																	1	1		1	
16-025(q)	Burned building	Soil			1					5		5																	1	1		1	1
16-025(r)*	Burned building/sump	Soil			1		1			4		4																	2	2		2	
16-025(u)	Burned building	Soil			3					22		22																	3	3		3	
16-025(v)	Burned building	Soil			3	1				12		12																	3	3		3	
16-026(q)	Sump	Soil					4			25		25													4			4	4	4		4	
16-026(w)	Outfall	Soil					2			2		2																2	2	2		2	2
16-029(m)	Sump	Soil					2			3		3																	2	2		2	
16-029(n)	Sump	Soil					2			3		3																	2	2		2	

TABLE 5-87 (continued)

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR GMX-3 BUILDINGS WITH SUMPS AND OUTFALLS

			LABORATORY						FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
															A					B				C				D	E	F	G	H	
PRS	PRS TYPE	SAMPLED MEDIA	STRUCTURE	FIELD DUP	SURFACE	FIELD DUP	SUBSURFACE	FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	GEOPHYSICS SURFACE	BARIUM - LIBS	GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	METALS (SW 6010)	ASBESTOS	HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-029(o)	Sump	Soil					2			3		3																	2	2		2	
16-029(p)	Sump	Soil					2			3		3																	2	2		2	
16-029(r)	Sump TA-16-25	Soil					3			8		8																	3	3		3	
16-029(z)	Sump TA-16-42	Soil					4			16		16																4	4	4		4	4
16-029(f2)	Sump TA-16-24	Soil					3			8		8																3	3	3		3	
16-029(h2)	Sump	Soil					3			10		10																	3	3		3	
16-032(a)	Sump	Soil					4			12		12											4					4	4	4		4	4
16-032(c)	Sump	Soil					7			20		20																7	7	7		7	
16-034(a)	Burned building	Soil			1					5		5																	1	1		1	

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
= The actual number of samples will depend on the depth of the cores.
A, B, C, E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, and zinc); H = full suite.
* These PRSs include both a process building footprint and one or more sumps.

will be augered to the soil-tuff interface. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-87. Field screening locations are shown in Figs. 5-63, 5-64, and 5-65.

5.18.4.2.1 Surface Sampling

SWMUs 16-025(j), 16-025(k), 16-025(p), 16-025(q), and 16-034(a). The sampling for these five building footprint SWMUs is designed to detect surface HE contamination of nonhomogeneous soil at the site of building footprints with minimal severity of potential contamination. Therefore, five field screening samples will be taken in each building footprint to choose one laboratory sample for analysis. The field screening samples will be taken in the four quarters of each building, and adjacent to the known location of a door of each structure (Figs. 5-63, 5-64, and 5-65). In the absence of screening indicators, each SWMU will be sampled for laboratory analysis near a door. In cases where more than one sample yields positive HE spot test results, choose the laboratory sample randomly from positive samples, and use data from the other positive field samples to help design any necessary Phase II sampling plan.

SWMUs 16-025(g), 16-025(h), 16-025(i). The sampling of these three building footprint SWMUs is designed to detect surface HE contamination of nonhomogeneous soil at the former site of building footprints where the likelihood of contamination is low. Therefore, six field screening samples will be taken in each building footprint to choose two laboratory samples for analysis. The field screening samples will be taken in the four quarters of each footprint, in the building center, and adjacent to a former location of the buildings' doors (Fig. 5-63). In the absence of positive field screening results, or in a case where less than two positive values occur, the additional laboratory samples will be chosen using the following ranking: 1) near a door of the HE processing area; and, 2) near the center of the building. If

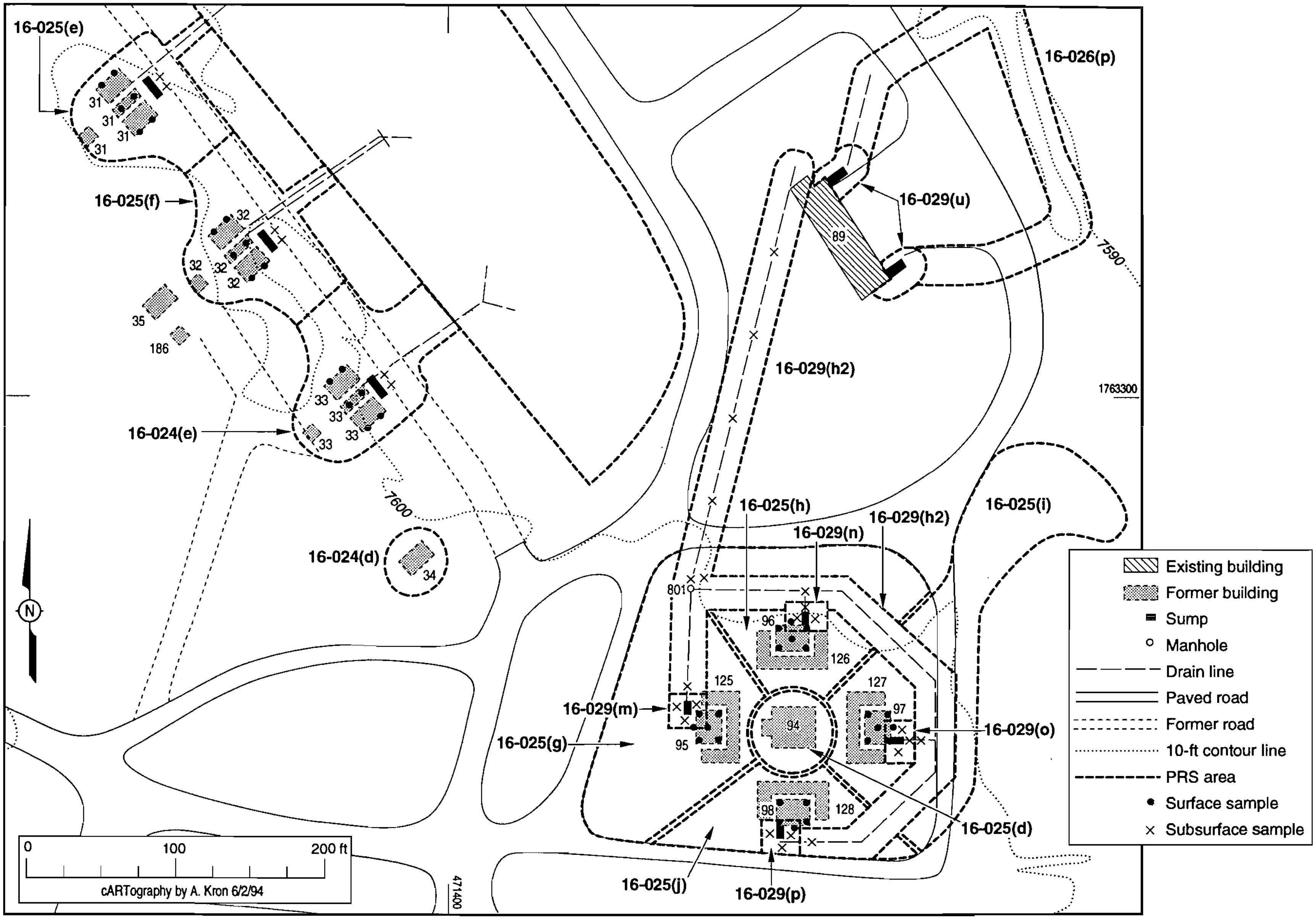

Fig. 5-63. Sampling locations at GMX-3 north.

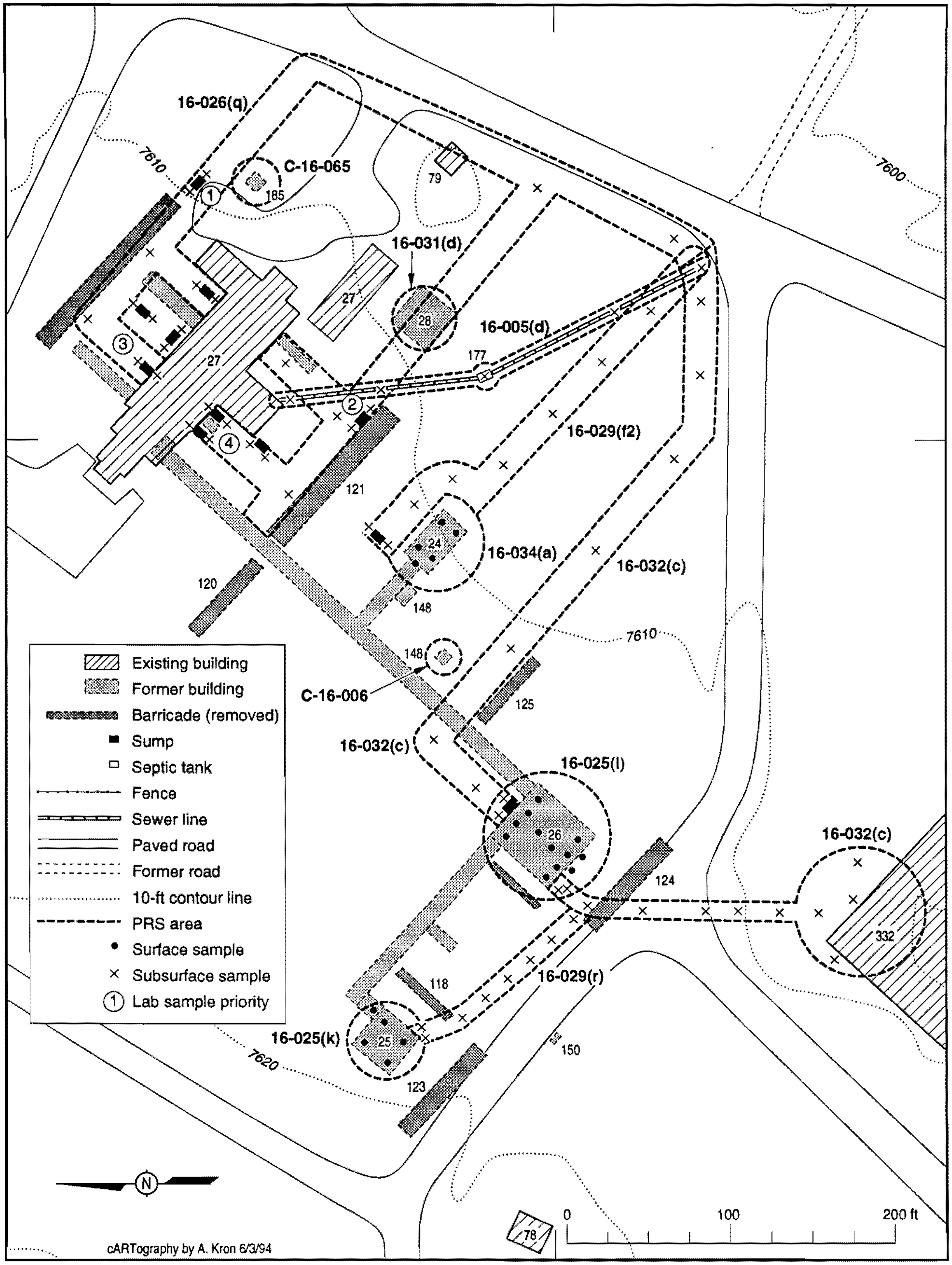

Fig. 5-64. Sampling locations at GMX-3 central.

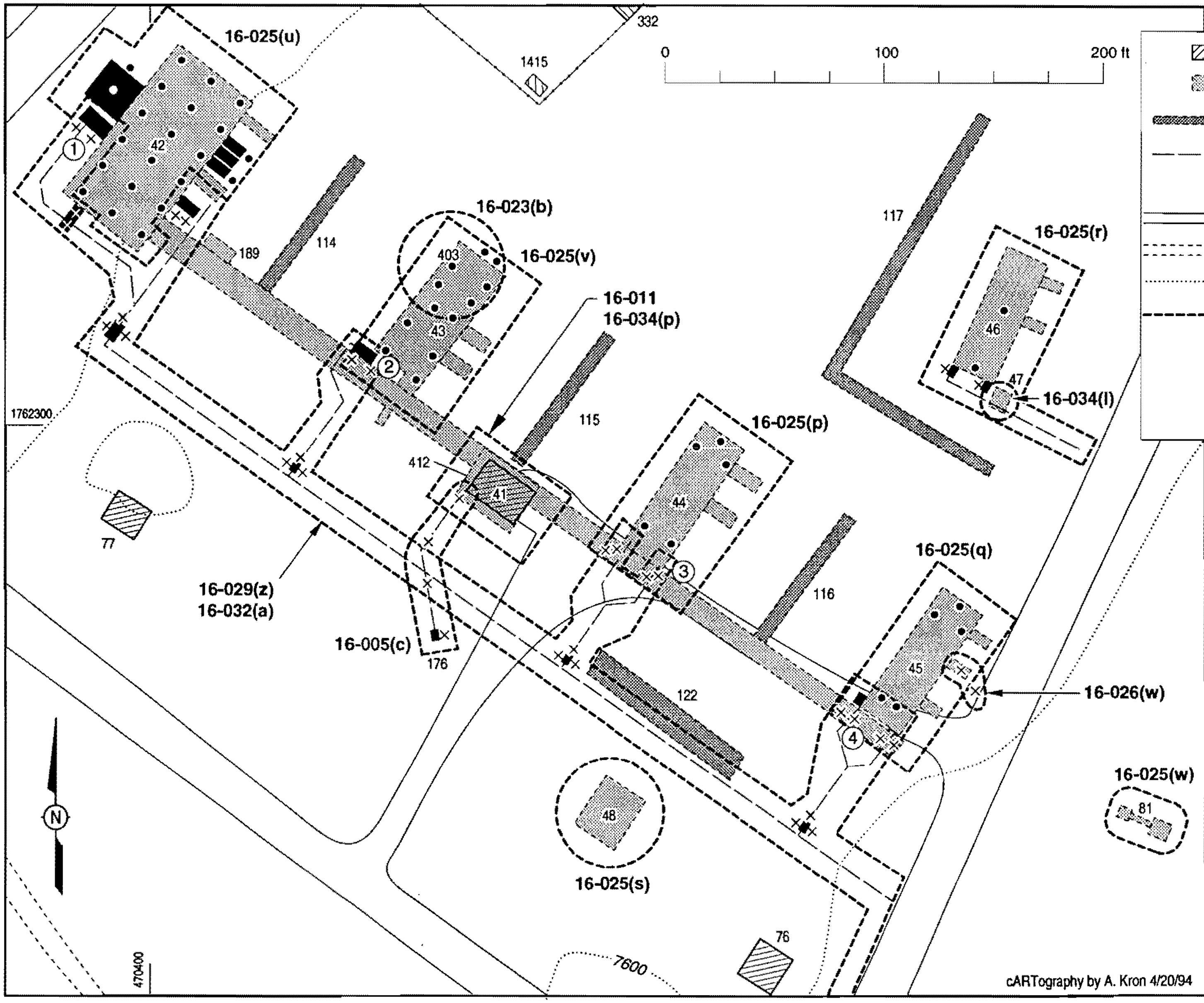

Fig. 5-65. Sampling locations at GMX-3 south.

more than two field screening samples yield positive values, select the laboratory samples at random from within the positive screening samples and use the other positive samples to help design Phase II sampling plans.

SWMU 16-025(v). The sampling of the footprint of former machining building TA-16-43 is designed to detect surface HE contamination in a region of presumed heterogeneous soil contamination of likely moderate level. Twelve field screening samples will be taken within the building footprint (10) and adjacent to its north door (2), as shown on Fig. 5-65, in order to choose three samples for laboratory analysis. These field screening points are disposed with two each in each of the four quarters of the building footprint, two near a door, and two in the center of the building footprint (Fig. 5-65). In the absence of field screening indicators, or if less than three samples show field indications of contamination, the additional samples will be taken in the following order: 1) one near the door of the building; 2) one in the east quadrant; and, 3) one in the south quadrant. If more than three samples yield positive screening values, select the laboratory samples randomly from within the positive samples and use the additional ones in the design of the Phase II sampling.

SWMU 16-025(l). The sampling of the footprint of former casting building TA-16-26 is designed to detect surface contamination in a region of presumed serious heterogeneous soil contamination. Twelve field screening samples will be taken within the building footprint (10) and adjacent to its southwest door (2) in order to choose three samples for laboratory analysis (Fig. 5-64). These field screening samples will be disposed with two in each quadrant of the SWMU, two in the center of the SWMU, and two near the southwest door. In the absence of field screening indicators, or in a case of a limited number of samples showing field indicators, the following ranking will be used to select the samples: 1) a sample near the door; 2) a sample in the southern quadrant; and, 3) a sample in the western quadrant.

SWMU 16-025(u). The sampling of the footprint of the former casting building TA-16-42 is designed to detect surface contamination in a region of presumed very serious heterogeneous soil contamination. Twenty-two field screening samples will be taken within the SWMU boundaries on the pattern shown in Fig. 5-65. Three laboratory samples will be taken based on positive field screening results. If more than one sample shows positive results, use the HE spot test to qualitatively evaluate which samples have the most severe contamination, and take those samples as the laboratory samples. In the unlikely absence of positive HE screening results, or if less than three samples yield positive results, the laboratory samples will be taken in the following order: 1) near the former north door where HE contamination was found in the blowtorch study (see Fig. 5-61); 2) near the center of the footprint; and, 3) near the south door.

5.18.4.2.2 Subsurface Sampling

SWMU 16-025(r). This SWMU includes both sumps and the building footprint of TA-16-46, but is considered with subsurface sampling. The sampling of the sump is designed to detect the presence of subsurface HE. Two subsurface cores to bedrock will be screened to select one sample for laboratory analysis in the sumps. One core will be located near the former locations of each of the two decommissioned sumps (Fig. 5-65). In the absence of a positive field screening reading or if both screening samples yield positive readings, select a sample from one of the two sumps randomly for laboratory analysis. Two field screening samples will be collected in the building footprint in order to select one surface sample for laboratory analysis. The locations of these field screening points are shown on Fig. 5-65; one is in the center of the building footprint, the other is near the known location of its primary entrance. In the absence of field screening indicators a single surface sample will be taken near the former location of the door of the building.

SWMU 16-005(c). The sampling of this decommissioned septic tank is designed to detect the presence of subsurface HE. Four subsurface cores to bedrock will be field screened within the surveyed SWMU boundaries in order to select one laboratory sample. These cores will be located at evenly spaced intervals along the SWMU (Fig. 5-65). In the absence of positive field screening indications of HE or radionuclides, the laboratory sample will be chosen at the location of the tank itself.

SWMU 16-005(d). The sampling of this decommissioned septic tank is also designed to detect the presence of subsurface HE; more samples are being taken than at the previous tank because of the presumed more serious nature of this SWMU. Five subsurface cores to bedrock will be field screened at locations along the septic line to select the three samples for analysis. The screening locations are shown on Fig. 5-64. In the absence of positive readings the samples will be taken in the proximal and distal ends of the line, and in the tank region (Fig. 5-64). If more than three cores yield positive indicators, select the positive samples nearest the septic tank itself to identify additional PCOCs, and use the additional positive results in a Phase II design.

SWMUs 16-029(r) and 16-029(f2). The sampling of the decommissioned sumps and drain lines for TA-16-24 and TA-16-25 is designed to detect the presence of subsurface HE at the sumps for these two process buildings that were minimally used for activities that disrupted HE. In each case, eight field screening cores to bedrock will be used to select three samples for laboratory analysis. Two of these cores for field screening will be located near the sump location or former building site, the other six will be located along the inferred location of the drain lines as shown on Fig. 5-64. In the absence of field screening indicators, or if fewer than three samples show positive field indicators, use the following hierarchy to select the remaining laboratory samples: 1) the two samples near the sump and 2) the nearest sample downstream along the drain line. In the unlikely scenario that more than three samples show positive field screening indicators, choose the samples nearest to each building to identify additional PCOCs.

SWMU 16-026(w). The objective of sampling the outfall for the decommissioned photography lab is to detect residual silver in the subsurface in the outfall and drainage associated with this SWMU. Because this PRS is considered relatively homogeneous, select two laboratory samples within the SWMU boundaries as shown on Fig. 5-65.

SWMUs 16-029(m), 16-029(n), 16-029(o), 16-029(p). The objective of sampling the sumps for the decommissioned machining buildings TA-16-95, TA-16-96, TA-16-97, and TA-16-98 is to locate residual HE in the subsurface for these SWMUs. Because these small SWMUs are deemed to be moderately heterogeneous because of their small size and moderately serious in potential contamination, take three screening samples from within each SWMU boundary, as shown on Fig. 5-63 in order to select two samples for laboratory analysis. If less than two samples for each SWMU yield positive screening indicators, select any needed laboratory samples at random from within the negative screening samples. If all three samples yield positive indicators in a SWMU, select the two laboratory samples at random from the positive samples.

SWMUs 16-024(e), 16-025(e), and 16-025(f). These SWMUs include both sumps and building footprints, but are considered with subsurface sampling because the sumps are more likely to be contaminated than are the building footprints. The objective of sampling the sumps for machining line buildings TA-16-31, TA-16-32, and TA-16-33 is to locate residual HE in the subsurface portions of these SWMUs. The subsurface portion of each of these SWMUs may be relatively homogeneous, so two field-screened subsurface cores will be taken in each sump to select one sample for laboratory analysis in each SWMU (Fig. 5-63). In the absence of screening indicators or if both cores from an individual sump show a positive HE reading, take the laboratory sample randomly.

In addition, six field screening samples will be taken to choose two laboratory samples in each building footprint (Fig. 5-63). In the absence of positive field screening results, or in a case where less than two positive values occur, the additional laboratory samples will be chosen using the following ranking: 1) near the north door of each machining area; and, 2) near the center of each building. If more than two samples yield positive values, select the lab samples at random from within the positive screening samples.

SWMU 16-029(h2). The objective of sampling the manhole and drain line associated with operations in TA-16-95, TA-16-96, TA-16-97, and TA-16-98 is again detection of subsurface residual HE in the boundaries of the SWMU. Ten field screening samples will be used to select three laboratory samples for analysis. The disposition of those samples is shown on Fig. 5-63. In summary, one field screening sample will be taken in front of each machining building (TA-16-95, TA-16-96, TA-16-97, and TA-16-98), two will be taken at the former site of the manhole, and the remaining four will be taken along the long drain line north of the manhole (Fig. 5-63). In the absence of positive field screening results, one laboratory sample will be taken at the former site of the manhole and the others will be taken at random from the negative screened samples. In the case of multiple positive field screening results, select the samples farthest upstream along the drain line, and use the other positive results to help design Phase II investigations.

SWMU 16-032(c). The objective of sampling the former locations of the sumps, drain lines, and pond associated with TA-16-26 is to detect subsurface and surface residual HE within the boundaries of the SWMU. Twenty field screening samples will be used to select seven laboratory samples for analysis. Two field screening samples will be located directly adjacent to the former location of each of two TA-16-26 sumps, seven field screening samples will be located in the north drainage of TA-16-26, five field screening samples will be taken from the south drainage of TA-16-26, and four screening samples will be located in the inferred location of the pond south of TA-16-26 (see Fig. 5-64). In the absence of positive indications, or if less than seven samples yield any positive indications, select the additional laboratory samples from the following locations: 1st) a sample near the north sump; 2nd) a sample near the south sump; 3rd) a sample within 20 ft of the north sump; 4th) a sample within 20 ft of the south sump; 5th) a sample at the distal end of the north drainage; 6th) a sample at the distal end of the south drainage; and, 7th) a sample in the north of the pond. If more than seven samples yield positive readings, select those nearest the former location of the building in order to investigate additional PCOCs and use the rest to help design the Phase II investigations.

SWMU 16-029(z). The objective of sampling the primary sumps and adjacent drain lines for TA-16-42, TA-16-43, TA-16-44, and TA-16-45 is to detect residual subsurface HE within the boundaries of the SWMU. Sixteen field screening subsurface samples will be used to select four samples for laboratory analysis (Fig. 5-65). Two field screening samples will be taken adjacent to each sump associated with the 40s-Line: three sumps at TA-16-42, one at TA-16-43, two at TA-16-44, and two at TA-16-45. In the absence of positive field screening samples, or if less than four samples provide positive indicators, take one laboratory sample at a sump associated with each of TA-16-42 through TA-16-45. These sumps are labeled 1 through 4 on Fig. 5-65, with highest priority being given to TA-16-42 and lowest to TA-16-45. In the likely case that more than four samples yield positive readings, take the westernmost positive samples, because TA-16-42 has processed by far the most HE of any building on the 40s-Line.

SWMU 16-032(a). The objective of sampling the secondary sumps and adjacent drain lines for TA-16-42, TA-16-43, TA-16-44, and TA-16-45 is to detect residual subsurface HE within the boundaries of the SWMU. Twelve field screening subsurface samples will be used to select four samples for laboratory analysis. Three field screening samples will be taken adjacent to each secondary sump associated with the 40s-Line (Fig. 5-65). In the absence of positive field screening results, or if less than four samples yield positive screening results, take one laboratory sample at random at the location of each secondary sump including one positive sample from each sump. In the likely case that more than four samples yield positive readings, take the westernmost positive samples because more HE was processed in TA-16-42 than in the other structures on this sump line, and use the additional results in the design of Phase II sampling.

SWMU 16-026(q). The objective of sampling the nine removed sumps and adjacent drain lines for TA-16-27 is to detect residual subsurface HE within the boundaries of the SWMU. Twenty-five field screening subsurface samples will be used to select four samples for laboratory analysis. Two field screening samples will be taken adjacent to each sump (Fig. 5-64). Two samples will be taken in the north drainage for TA-16-27 and five will be taken in the south drainage. In the absence of positive field screening results, or if less than four samples yield positive results, take the additional samples in this order: 1) at the northern secondary sump; 2) at the southern secondary sump; 3) at the northernmost sump; and, 4) at the westernmost sump on the south side of TA-16-27. These sumps are labeled one through four on Fig. 5-64. These sumps were selected to provide information on wastes discharged from different portions of TA-16-27. In the likely case that more than four samples yield positive readings, take the laboratory samples randomly from within those showing positive readings, and use the additional results in the design of Phase II sampling.

5.18.4.2.3 Drainage Sampling

The main drainage for the GMX-3 region will be sampled five times for laboratory analysis. Depth of samples will be 6 in. because the drainages are undisturbed. These surface sampling points are distributed at roughly 200 ft intervals south of the discharge point of the 20s-Line SWMUs southeast of the road corner (Fig. 5-66). Sampling will be focused in well-defined sediment traps, particularly ones that appear to contain large amounts of clay-rich sediments.

5.18.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal radionuclide of concern is uranium. The principal HEs of concern are TNT and RDX. The principal HE byproducts of concern are DNT, TNB, and DNB, and the principal metals of concern are barium and silver.

5.18.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-87.

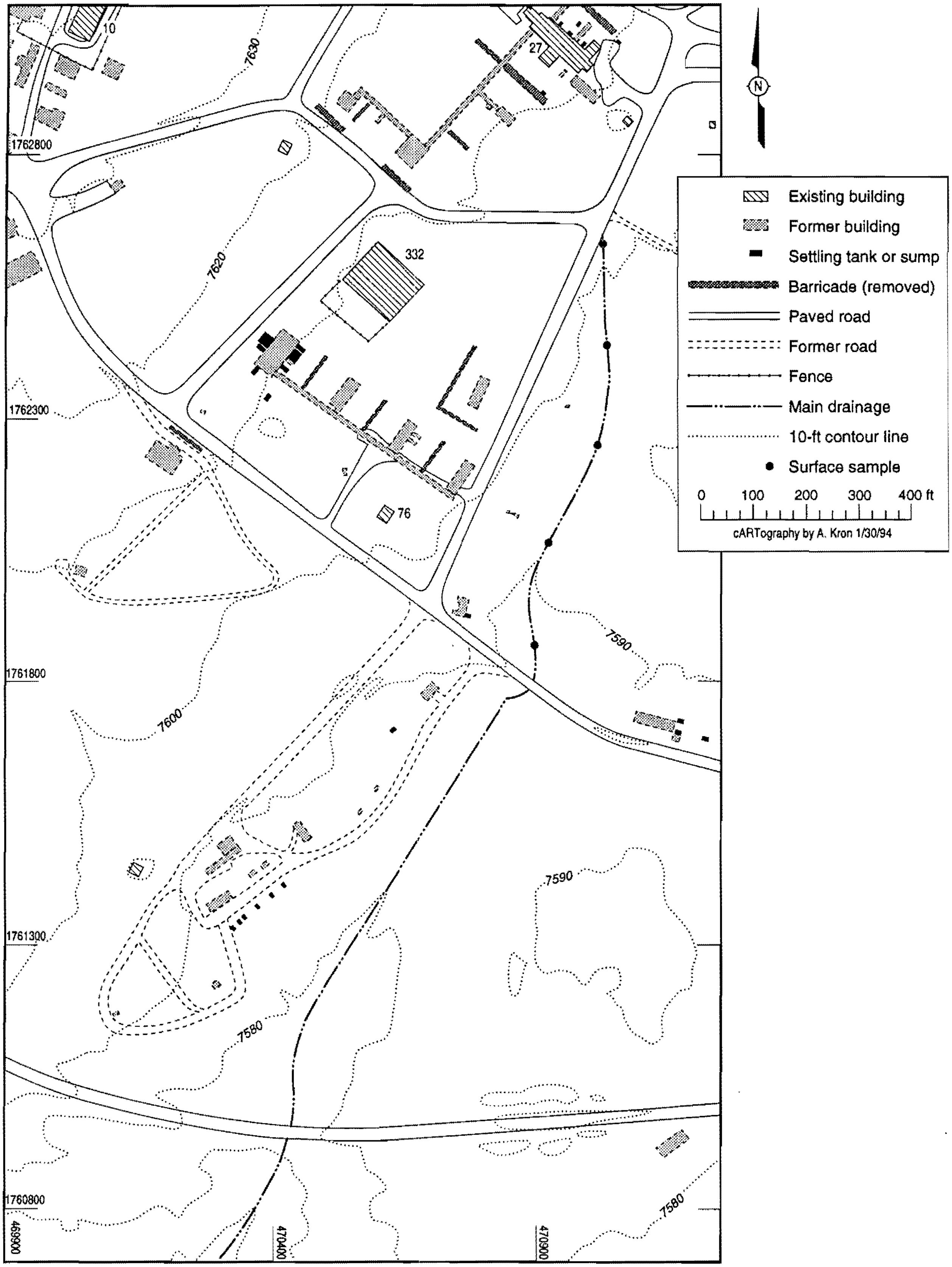

Fig. 5-66. Sampling locations for the main drainage, north.

5.19 Structures in the GMX-3 Area Without Sumps

5.19.1 Background

This aggregate consists of a variety of structures that were used by the HE production groups, such as GMX-3, to assist in operations described in Subsection 5.18. These PRSs are defined as an aggregate because they are geographically contiguous, most do not have potential subsurface contamination, and none are expected to be contaminated at levels above SALs. None of them have attached HE sumps or HE drain lines. Some structures were not used for HE operations, and others were used only for non-disruptive HE handling, such as storage, radiography, or physical measurements. Table 5-88 lists the PRSs in this aggregate.

TABLE 5-88

PRSs IN THE GMX-3 AREA WITHOUT SUMPS AGGREGATE

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION	DIMENSIONS (FT)
16-011	TA-16-412		Incinerator	14.5 x 18 x 18
16-023(b)	TA-16-403		Incinerator	9 x 10 x 17
16-024(b)	TA-16-74	S-78	Magazine	9 x 11 x 7
16-024(c)	TA-16-30	S-26A	Magazine	12 x 17.5 x 8
16-024(d)	TA-16-34	S-26E	Magazine	12 x 17.5 x 8
16-025(a)	TA-16-39	S-29	Radiography	16 x 16 x 9
16-025(b)	TA-16-40	S-29B	Radiography	16 x 16 x 9
16-025(d)	TA-16-94	S-106	Equipment and control	unknown
16-025(s)	TA-16-48	S-36	Radium building	20 x 20 x 14
16-031(d)	TA-16-28	S-25T	Cooling tower	28 x 28 x 46
16-034(l)	TA-16-47	S-35E	Equipment storage	11 x 11 x 8.5
16-034(p)	TA-16-41	S-30	Process laboratory	17 x 30 x 14
C-16-006	TA-16-148		Solvent storage	6.25 x 12.5 x 6
C-16-064	TA-16-183		Drum storage	8 x 8
C-16-065	TA-16-185		Drum storage	13.5 x 8.66 x 4.5
C-16-067	TA-16-187		Drum storage	8.33 x 8.33 x 4.5

5.19.1.1 Description and History

A detailed description and history of operations in the GMX-3 area are provided in Subsection 5.18. The structures discussed in this subsection were subsidiary to the primary casting and machining operations in the GMX-3 area. Most of these structures were built in the mid- to late-1940s, were used through the mid-1950s, and were destroyed by burning in 1960 with many other World War II era buildings (Wingfield 1960, 15-16-117). The incinerators are an exception, as detailed below.

The following PRSs resulted from operations in the GMX-3 area in structures that did not have attached sumps or drain lines. Some of the decommissioned structures discussed in this subsection were surveyed for radiation, HE, and toxic chemicals prior to being destroyed by intentional burning. Unless otherwise noted, the results of these surveys were negative. Most of the former locations of these buildings are overgrown by scrub grasses. In some cases debris, such as asbestos shingles or wood fragments, mark the locations of the decommissioned buildings.

5.19.1.1.1 Incinerators and Associated Structures

SWMUs 16-011, 16-023(b), and 16-034(p) contain potentially contaminated soil associated with trash incinerators located in the World War II era S-Site. The first two of these SWMUs were the locations of incinerators TA-16-412 and TA-16-403, respectively (Fig. 5-67). The third PRS represents the same media as SWMU 16-011, because that incinerator was built over the basement of SWMU 16-034(p) (TA-16-41). SWMU 16-034(p) will be sampled with SWMU 16-011. The SWMU Report exhibits some confusion regarding TA-16-403. It incorrectly cites the release site database as claiming that TA-16-199, not TA-16-403, was attached to TA-16-43. TA-16-412 is still present but abandoned. The incinerators are located within the 40s-Line on level terrain. These incinerators were used for burning items of paper and cloth that may have been contaminated with low levels of HE. Burning these materials on the S-Site grounds insured that HE would not be disseminated off site. No significant amount of HE could be expected to remain after burning, but measurable traces might be found in cracks when the incinerator remains or adjacent to the incinerators' locations if material was spilled during loading. The burning of HE chunks and sump effluent was done at the

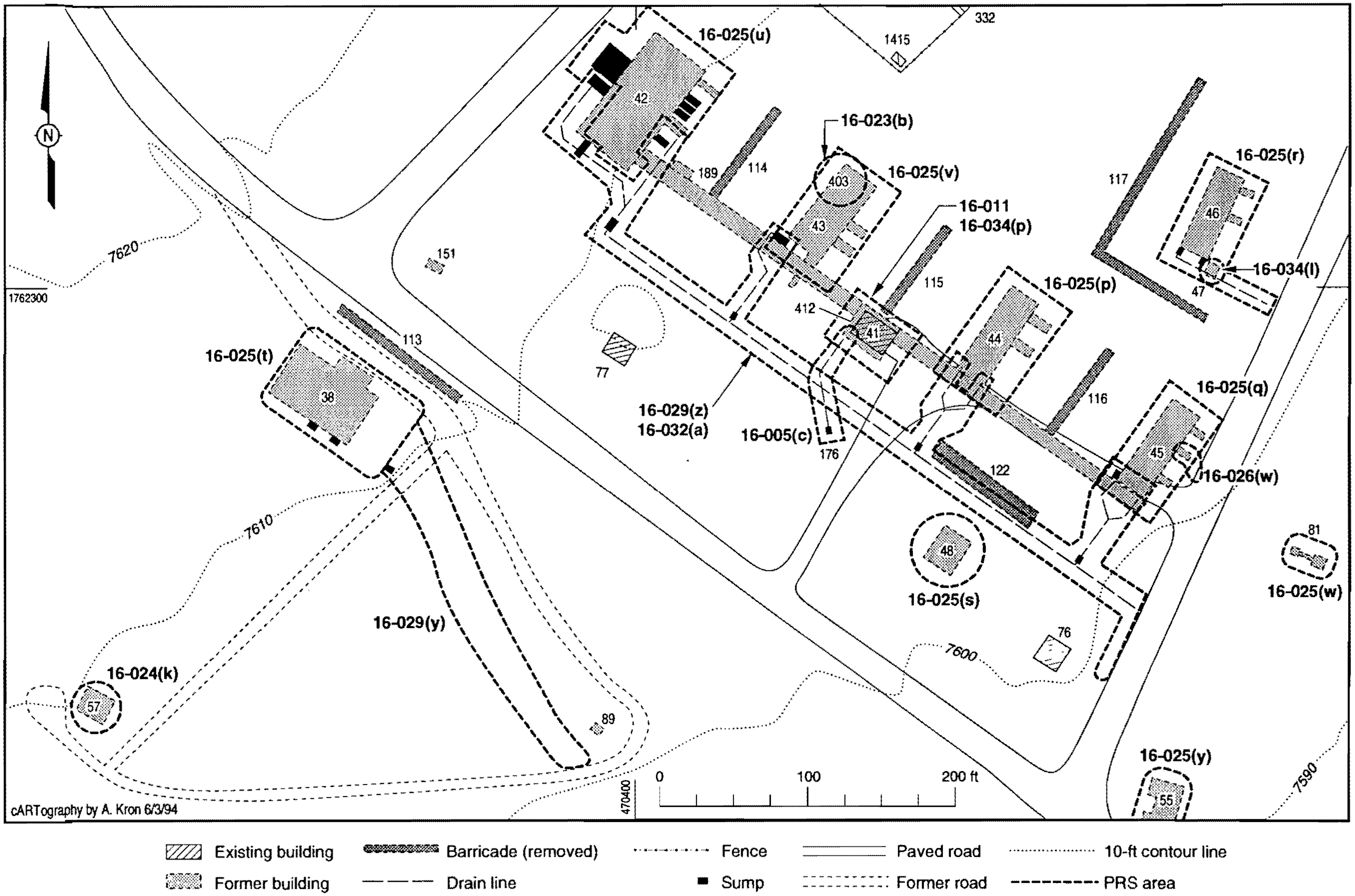

Fig. 5-67. Locations of PRSs at GMX-3, south.

TA-16 burning grounds (see Subsections 5.8 and 5.10 of the 1993 OU 1082 work plan). Two concrete structures of the 40s-Line that remained after S-Site buildings were burned in 1960 were modified to form the incinerators.

TA-16-412 incinerator was built in 1962 within the utility basement of TA-16-41. A heavy steel mesh cage was built over it. A region of the former 40s-Line (off the south end of TA-16-44) was cleared in advance of the 1966 cleanup to provide paved road access to the incinerator. The original building, TA-16-41, contained lavatories and office space on the ground floor with utilities in the basement, all to service the 40s-Line. TA-16-41 is listed as a control laboratory in the Facilities Engineering Structure List. A former site worker (Martin 1993, 14-15-477) recalls that the building contained a bathroom and compressors for motors associated with operations in the 40s-Line. Air-driven motors were used in the 40s-Line, so the utility room would not have contained hydraulic pumps.

TA-16-403 incinerator, built in 1961, was located within the partially enclosed portion of the F-shaped concrete blast shield that was originally part of TA-16-43. The conversion to an incinerator involved placing a steel mesh cage over the open top and wall. This incinerator was apparently used for approximately one year, as the Facilities Engineering Structure List indicates that incinerator TA-16-412 was built in 1962 as its replacement. Nonetheless, it was not removed until 1966 or 1967 (it is not visible in the 1967 LASL photograph 67-6026).

5.19.1.1.2 HE Magazines

SWMUs 16-024(b,c,d) contain potentially contaminated surface soil associated with HE magazines TA-16-74, TA-16-30, and TA-16-34 (Fig. 5-68). HE magazines are typically small buildings without plumbing in which either raw HE or finished HE product are stored during processing. Generally, magazines are bermed on three sides and on top for safety purposes. Each magazine was small (12 ft wide x 17.5 ft long x 8 ft high for the second two magazines and 9 ft wide x 11 ft long x 7 ft high for the first) and of wooden-frame construction with a concrete floor. TA-16-30 and TA-16-35 were located within the 30s-Line and TA-16-74 was located due north of TA-16-88 (Fig. 5-68); all were on level terrain. According to a former site worker (Martin 1993, 15-16-477), TA-16-30 stored castings to be machined in

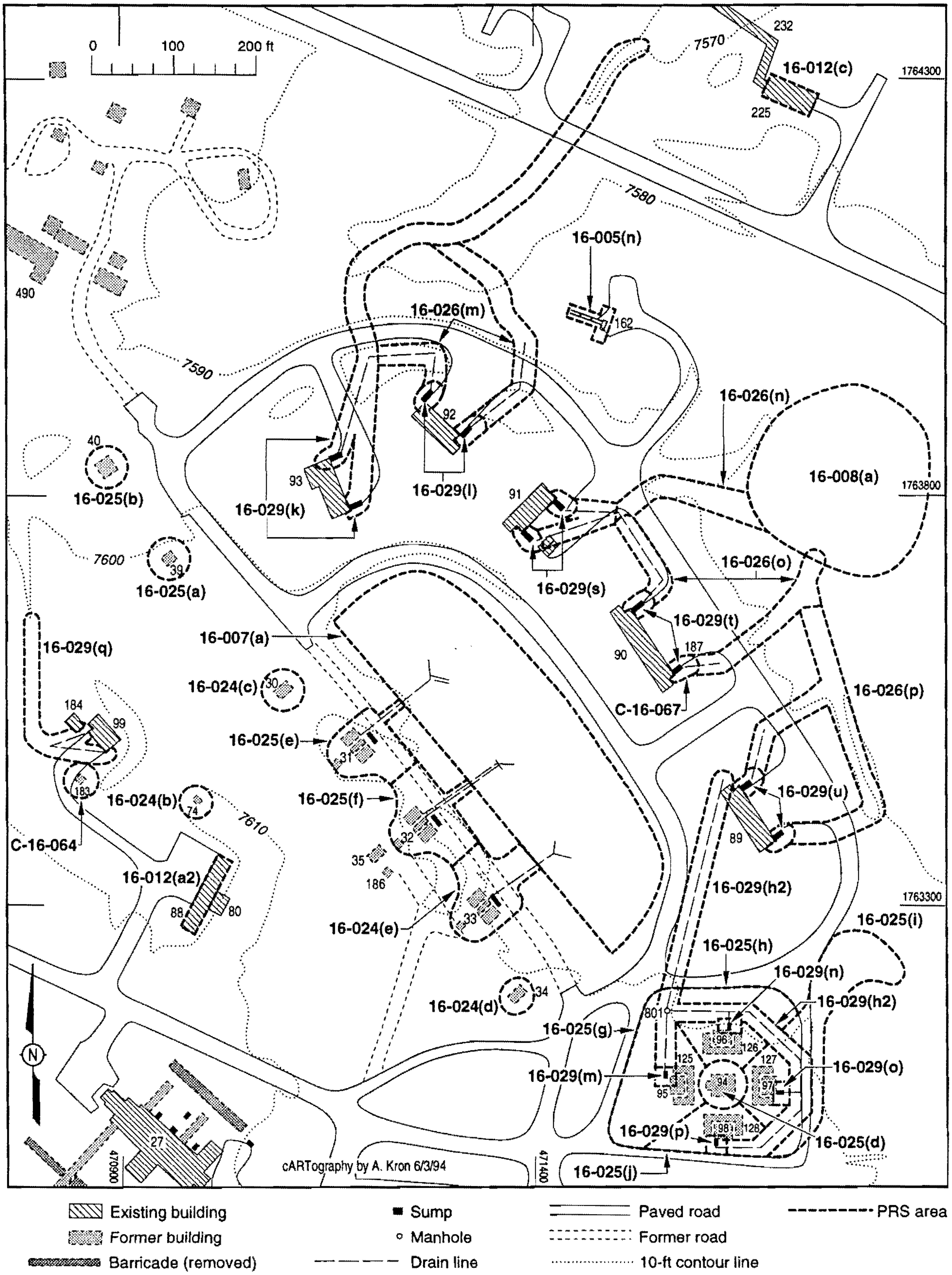

Fig. 5-68. Locations of PRSs at GMX-3, north.

TA-16-31, TA-16-32, and TA-16-33, and TA-16-34 stored machined product for physical and x-ray examination. TA-16-30 was burned in 1960 but TA-16-34 had caved in and was not burned at that time, nor does it have a known destruction date [Wingfield 1960, 15-16-111]. A rough measurement (from a photograph) of the earthen mounds over these magazines suggests each was covered by roughly 5 000 ft^3 of soil. TA-16-74 [SWMU 16-024(d)] was built in 1946 for storing HE in transit to the machining buildings TA-16-31, TA-16-32, and TA-16-33 but it was later used with the 20s-Line casting operation and held the cast HE after (and perhaps before) sawing of risers. TA-16-74 was removed in 1949 and the earthen barricade for TA-16-88 was built over its former location. This barricade is still present. The magazines were regarded as HE contaminated when they were surveyed in the late 1950s (Engineering Department 1959, 15-16-256) prior to burning in March 1960 [Wingfield 1960, 15-16-117]. There is no information about their removal.

5.19.1.1.3 Radiography Buildings

SWMUs 16-025(a,b,s) contain potentially contaminated surface soil associated with radiography buildings TA-16-39, TA-16-40, and TA-16-48, respectively (Figs. 5-67 and 5-68). All were relatively small (TA-16-39, 16 ft long x 16 ft wide x 9 ft high; TA-16-40, 20 ft long x 20 ft wide x 14 ft high with a 8.5 ft wide x 12 ft long x 11 ft high lean-to; TA-16-48, 20 ft long x 20 ft wide x 14 ft high) wooden-frame buildings with concrete floors. TA-16-40 and TA-16-48 both had source pits in their floors. All lie on level ground with no obvious drainages.

TA-16-39 [SWMU 16-025(a)] was built in early 1945, lay west of the 30s-Line machining buildings, and served as a film loading building for HE radiography at T-Site (Martin 1993, 15-16-477). The Facilities Engineering Structure List suggests that it was a radiographic building and claims it had a lead-lined pit. This claim is contradicted by an engineering drawing (Engineering drawing ENG-C 5675) that shows it to have shelf-lined walls and a concrete slab floor with no pit. Also, it was reported that TA-16-39 had cobalt-60 contamination at 10 mr/h on a source cartridge carrier and 1 mr/h on a spot on the floor prior to destruction by burning (Russo 1957, 15-16-443).

Thus, it is likely either that radiography or the storage of sources occurred in TA-16-39.

TA-16-40 [SWMU 16-025(b)] was constructed west of TA-16-39 in 1950 to provide gamma radiography within the GMX-3 area. It was fairly small, about 20 ft^2 and had earthen barricades on two sides. TA-16-40 contained a lead-lined pit in the floor for radioactive sources (Engineering drawing ENG-C 5935). When the building was examined in 1957 by H-1, it was found to be contaminated by cobalt-60 at a spot on the floor (12 mr/h) and on a source plug (0.1 mr/h) (Buckland 1957, 15-16-243). In the same memo, H-1 recommended that Zia Company remove the radiation-contaminated materials. In 1966 the debris of this building and TA-16-39 were checked for radioactivity before cleanup, but no radioactivity was found (Buckland 1966, 15-16-136).

TA-16-48 [SWMU 16-025(s)] was a part of the 40s-Line. It is listed as a smoking room in the Facilities Engineering Structures List but elsewhere (Engineering drawing ENG-R 132) as a radium building. According to a former site worker (Truslow 1973, 15-16-264), "It housed a radium source used in gamma-graphing large or high density objects." A former site worker believed that this was a radium facility and noted that during a small earthquake the radium source was crushed by a lead pig; contamination associated with this spill was cleaned up thoroughly (Martin 1993, 15-16-477).

All three of these source hutments were shown to be contaminated with HE during the late 1950s surveys (Engineering Department 1959, 15-16-256). A former site worker (Blackwell 1983, 15-16-076) suggested that TA-16-39 and TA-16-40 were contaminated with cobalt-60, radium-226, and uranium-238 and that TA-16-48 was contaminated with uranium-238.

5.19.1.1.4 Cooling Tower

SWMU 16-031(d) contains potentially contaminated soil associated with decommissioned cooling tower TA-16-28, located roughly 70 ft east of TA-16-27 (Fig. 5-69). Currently the site of the tower is level. The former location of TA-16-28 drains into the same drainage ditch as the rest of the 20s-Line. The cooling tower was of wooden-frame construction, 28 ft long x 28 ft wide x 46 ft high. This tower was used to store water used in cooling jackets for the casting operations in TA-16-27. It is not known if chromates were used at the cooling tower. TA-16-28 was constructed concurrently with TA-16-27, being completed in May 1945, and was demolished by intentional burning in 1968. The SWMU Report suggests that TA-16-28 had a sump, but no Engineering drawings of this structure have been located. The location of the sump is unknown. No record of pre-burning HE, radiation, or toxics survey is available.

5.19.1.1.5 Assorted Structures

SWMU 16-025(d) contains potentially contaminated surface soil associated with the location of decommissioned TA-16-94, an equipment and control building. TA-16-94 was located in the center of the N-S-E-W machining buildings (Fig. 5-68). The former footprint of TA-16-94 is relatively level, with a slight slope out to the roadway. TA-16-94 was built in 1948 as a control building for machining buildings TA-16-95, TA-16-96, TA-16-97, and TA-16-98. TA-16-94 was of wooden-frame construction on a concrete platform. It is possible that some HE was used in the building. The building was destroyed by intentional burning in 1960. Surveys completed prior to destruction suggest that it was clean (Engineering Department 1956, 15-16-256) but a former site worker (Blackwell 1983, 15-16-076) considered it HE contaminated.

C-16-006 was described in the SWMU Report (LANL 1990, 0145) as the former location of an equipment building constructed in 1950 and removed in 1968 (Fig. 5-69). The designation TA-16-148 was used for two different buildings at different times, so defining the potential site of contamination for this SWMU is difficult. One of the two buildings designated as TA-16-148 was a solvent storage building located west of TA-16-24 (Engineering drawing ENG-R 132, 1950). The other was a 6 ft long by 12 ft wide by 6 ft high equipment storage room adjacent to the passage to TA-16-24. The latter structure is listed in the Engineering Structure list. The potentially contaminated soil associated with the solvent storage building is assumed to be C-16-006, and the storage building is assumed to be SWMU 16-032(b), which is treated in Chapter 6.

TA-16-148, the solvent storage building, can be seen in 1946 photos taken by Sandia Laboratory. It was extremely small (less than 6 ft x 6 ft), but its

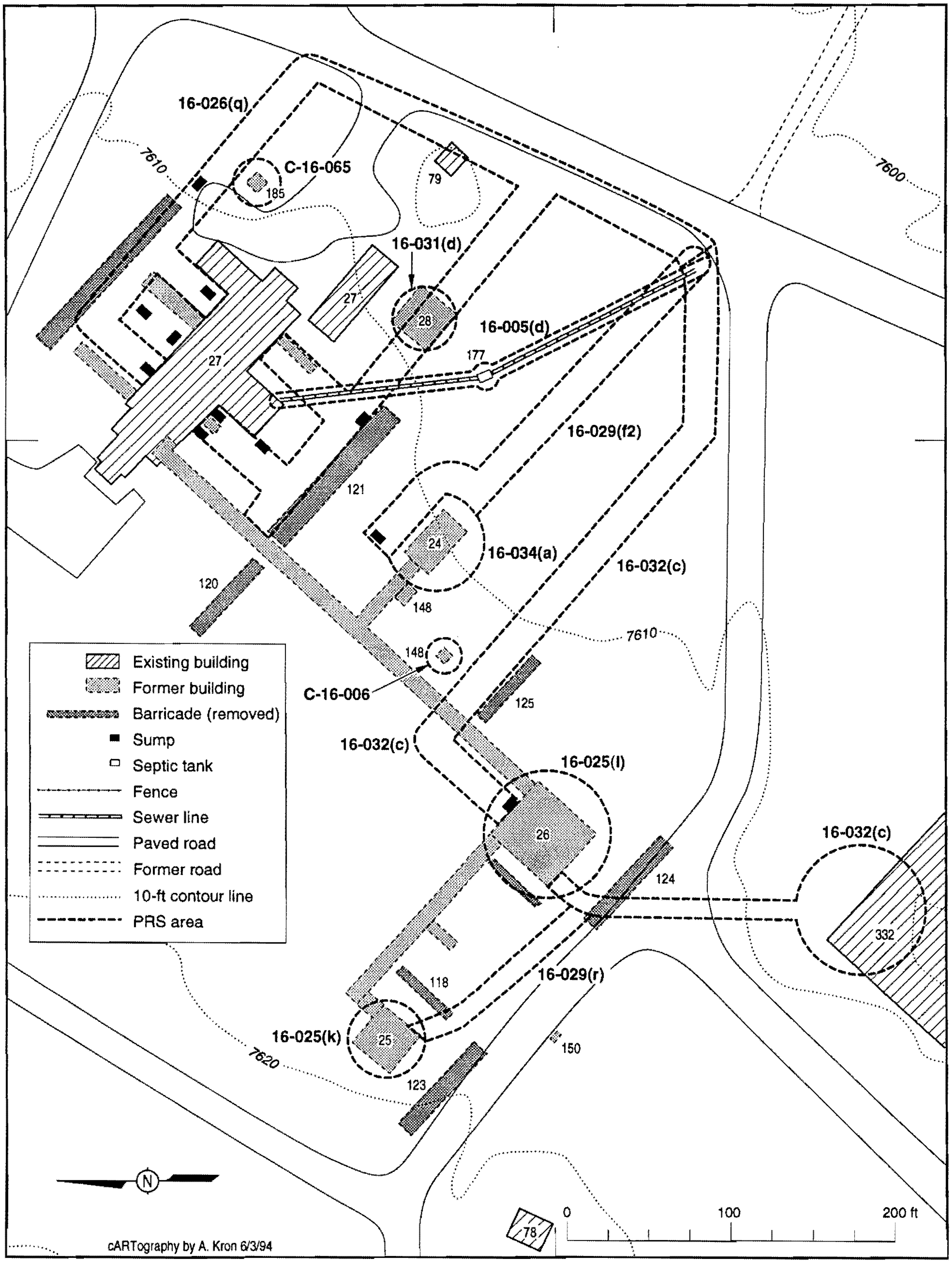

Fig. 5-69. Locations of PRSs at GMX-3, central.

exact dimensions are unknown. The solvent storage building is not mentioned in the Engineering Structure List. It was removed at some time prior to 1950, when the second building designated TA-16-148 was constructed.

SWMU 16-034(l) contains potentially contaminated surface soil associated with the former location of TA-16-47, an equipment building. TA-16-47 was located roughly 10 ft south of TA-16-46, a rest house (Fig. 5-67). Currently this site is level, with no well-defined drainage. TA-16-47 was completed in 1945 and destroyed by intentional burning in February 1960. The structure was of wooden-frame construction (11 ft long x 11 ft wide x 8.5 ft high) with a concrete foundation and floor. It is unknown what items were stored in this building, but it is possible that HE or HE-contaminated materials were included. Surveys completed prior to combustion suggested that the structure was clean (Engineering Department 1959, 15-16-256) but a former site worker (Blackwell 1983, 15-16-076) believed it to be HE contaminated.

C-16-064, C-16-065, and C-16-067 contain potentially contaminated surface soil associated with drum storage platforms designated TA-16-183, TA-16-185, and TA-16-187, respectively (Figs. 5-68 and 5-69). TA-16-183 and TA-16-187 consisted of wooden storage areas a few feet off the ground on steel legs. TA-16-183 was 8 ft long x 8 ft wide and TA-16-187 was 8.33 ft wide x 8.33 ft long x 4.5 ft high. TA-16-185 was a concrete bandstand 13.5 ft long x 8.66 ft wide x 4.5 ft high. Each was located on flat terrain with little potential for mobilization of PCOCs from the areas of the PRSs.

The first AOC, C-16-064 (TA-16-183), was located roughly 50 ft southwest of TA-16-99, which was a riser cutting building (Fig. 5-68). According to the Facilities Engineering Structure List, TA-16-183 was constructed in April 1945. TA-16-99 was not constructed until 1949. TA-16-183 is not present on pre-1950s aerial photographs, so the Engineering Structure List is incorrect. According to a former site worker, this platform was used for storage of garbage cans that contained HE scrap from the riser cutting building (Martin 1993, 15-16-477). The platform was decommissioned and flashed at the burning ground in 1968.

The second AOC, C-16-065, (TA-16-185) was a drum storage platform located 50 ft east of TA-16-27, the large casting building (Fig. 5-69). The structure was completed in 1948 and abandoned in place in 1960. The platform was still present in 1965 (Koogle and Pouls Engineering, Inc. 1965, 15-16-516) and it is likely the platform was removed in 1968, concurrently with the decommissioning of the 20s-Line. The platform was used for storage of drums of waste generated within the 20s-Line.

The third AOC, C-16-067, (TA-16-187) was a drum storage platform east of machining building TA-16-90 (Engineering drawing ENG-R 861) (Fig. 5-68). The Facilities Engineering Structure List suggests it was built in 1945; however, it is not present on mid-1940s aerial photographs. It was likely constructed concurrently with the 90s-Line in 1950. The platform is decommissioned, but the decommissioning date is not known. This platform was used for storage of barrels of oils and solvents that were laid on their sides (Martin 1993, 15-16-477). The drums were equipped with spigots, which are likely to have allowed material within the drums to spill on the ground. Aerial photographs of the area show small items, possibly individual barrels, at the location of TA-16-187 (Koogle and Pouls Engineering, Inc. 1965, 15-16-516).

5.19.1.2 Conceptual Exposure Model

The conceptual exposure model for the GMX-3 PRSs without sumps is presented in Fig. 4-3. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.19.1.2.1 Nature and Extent of Contamination

The PCOCs indicated by historical archives and interviews with site personnel include: 1) residual contamination as the result of incineration, including semivolatile organics, metals, traces of HE (RDX, TNT), and polycyclic aromatic hydrocarbons; 2) HE (RDX, TNT) and HE byproducts [i.e., DNT, TNB, DNB, and barium (baratol)] due to storage in magazines and drum storage platforms; 3) cobalt-60, lead, and radium-226 used in the radiography and film preparation buildings; 4) lead which may have been contained in the radium examination building; 5) various solvents such as carbon tetrachloride, benzene, and acetone; 6) oils and solvents from the drum storage platforms; 7) uranium that may have been examined using gamma radiography; and, 8) other metals such as chromium in cooling towers and lead in unusual HE formulations (Table 5-89).

Quantitative analytical data are not available for any of the PRSs located in this aggregate. Quantitative data for the southern GMX-3 area is presented in Subsection 5.18. Screening data from the 1960s are available for a few of the PRSs and are included in the PRS description and history sections.

5.19.1.2.2 Potential Pathways and Exposure Routes

PRSs in this aggregate consist of potential surface contamination due to leaks and spills from former structures and due to combustion and grading of decommissioned buildings. Even though solvents associated with SWMU 16-032(b) could have volatilized, it is suspected that a portion of the chemicals could have infiltrated soils beneath the former structure.

The major migration pathway is via surface water runoff that may carry contaminants beyond the original release site to accumulate in sedimentation areas in drainages. The land in this area gently slopes to the south, and surface water eventually drains into the large drainage ditch that runs from north to south. Generation of fugitive dust is not a pathway of concern at this site because the area is covered with grasses and weeds. A detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes is in Chapter 4.

This site is inactive and removed from current operations. In addition, institutional controls do not permit public access to this area.

5.19.2 Remediation Decisions and Investigation Objectives

5.19.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. This aggregate consists of inactive incinerators and decommissioned structures without sumps in the GMX-3 area of S-Site. These buildings included a storage building (solvent or oil), magazines for finished HE components, refuse incinerators, and radiography buildings. There is potential for near-surface contamination (upper 12 in. of soil) at most PRSs in this aggregate. Two radiography buildings [SWMU 16-025(b), SWMU 16-025(s)] had known releases of radionuclides from the

TABLE 5-89

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, STRUCTURES IN THE GMX-3 AREA WITHOUT SUMPS

				HE			RAD			METALS			
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	RADIUM - 226	COBALT-60	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES
16-011	Incinerator TA-16-412	Incineration of paper and cloth	N	X	X	X				X	X		X
16-023(b)	Incinerator TA-16-403	Incineration of paper and cloth	N	X	X	X				X	X		X
16-024(b)	TA-16-74	Magazine	N	X	X	X				X	X		
16-024(c)	TA-16-30	Magazine	N	X	X	X				X	X		
16-024(d)	TA-16-34	Magazine	N	X	X	X				X	X		
16-025(a)	TA-16-39	Radiography	N	X	X	X	X	X	X	X	X		
16-025(b)	TA-16-40	Gamma radiography	N	X	X	X	X	X	X	X	X		
16-025(d)	TA-16-94	Control building	N	X	X	X				X	X		X
16-025(s)	TA-16-48	Radium examination building	N	X	X	X	X	X	X	X	X		
16-031(d)	TA-16-28	Cooling tower	N	X	X	X				X	X		
16-034(l)	TA-16-47	Storage	N	X	X	X				X	X		
16-034(p)	TA-16-41	Lavatory, compressors	N	X	X	X				X	X		X
C-16-006	TA-16-148	Solvent storage	N									X	X
C-16-064	TA-16-183	Drum storage platform	N	X	X	X				X	X		
C-16-065	TA-16-185	Drug storage platform	N	X	X	X				X	X		
C-16-067	TA-16-187	Drum storage platform	N									X	X

breakage of a cobalt or radium source, and these were cleaned at the time of the accident with the best available technology. Because radiation measurement technology has improved since the cleanup, it is possible that the cleanup left some residual contamination. In conclusion, the probability of contamination is low to moderate, since all buildings were used for storage of finished products, HE scrap, or chemical supplies.

There are nine PRSs where the problem is not based primarily on the potential HE contamination. PCOCs for the incinerators [SWMU 16-011, SWMU 16-023(b)] include PAHs. PCOCs for the radiography buildings [SWMUs 16-025(a), 16-025(b), 16-025(s)] include cobalt-60 and radium-226. PCOCs for the drum storage areas (C-16-067) include semivolatile organics (e.g., total petroleum hydrocarbons). PCOCs for the solvent storage area [SWMU 16-032(b)] include volatile organic compounds (e.g., carbon tetrachloride).

5.19.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.19.3 Data Needs and Data Quality Objectives

5.19.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in the generic DQO Step 3 in Subsection 5.0.2.

5.19.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination for the SWMUs include the PRS boundaries for the decommissioned structures or the inactive incinerators. Although the original location of the PCOCs at the building footprints was the soil surface (less than 6 in.), the decommissioning activities most likely redistributed or covered the PCOCs. Given the shallow soil at S-Site, the depth boundaries for surface soil will be the top 12 in. of soil, or the depth to tuff, whichever is less. The depth boundary for subsurface sampling is the soil-tuff interface.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys. Some radiography buildings were built with lead-lined pits in the center of the structures, and these pits are likely collection points for PCOCs.

5.19.3.3 Decision Logic (DQO Step 5)

The decision logic for this aggregate follows generic DQO Step 5, presented in Subsection 5.0.2.

5.19.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-90). Relative ranks were assigned based on severity of contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that can easily be detected using field screening and represents the constituents most likely to present a health risk at a PRS. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than the indicator PCOC. To address issues associated with this potential problem, site-wide drainage sampling is designed to provide non-biased insights into the transport of any PCOCs off site. This sampling is presented in Subsection 5.18. For some PRSs in the GMX-3 structures without sumps aggregate, HE was selected to be the indicator PCOC. Several other indicator PCOCs were selected in the GMX-3 structures without sumps aggregate: gross beta gamma, PAH, BTEX, and chromium.

No PRS was judged to present a very serious or serious problem. Five PRSs were judged to present a not very serious problem; the inactive incinerator [SWMUs 16-011 and 16-034(p)] and the radiography buildings [SWMUs 16-025(a), 16-025(b), 16-025(s)]. The inactive incinerator could pose a small hazard since it has not been decommissioned, but it is unlikely to pose

TABLE 5-90

GROUPING OF GMX-3 BUILDINGS WITHOUT SUMPS INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very Serious						
Serious						
Not Very Serious	16-025(b) 16-025(s) 16-011 16-034(p)	TA-16-40 TA-16-48 Radiography TA-16-412 Incinerator and TA-16-41	16-025(a)	TA-16-39		
Negligible	16-025(d) 16-031(d) C-16-006 C-16-064 C-16-065 C-16-067	TA-16-94 Equipment and control building TA-16-28, Cooling tower TA-16-148 Solvent storage TA-16-183 TA-16-185 TA-16-187 Drum storage	16-023(b) 16-024(b) 16-024(c) 16-024(d) 16-034(l)	TA-16-403 Incinerator TA-16-74 Magazine TA-16-30 TA-16-34 Magazine TA-16-47 Storage		

a great hazard since it was used primarily for office trash. The radiography buildings were decontaminated when the radioactive sources were ruptured and should not pose a large risk either. The remainder of the PRSs posed a negligible risk of contamination due to a small original source term, the size of the PRSs, and the likely effectiveness of the cleanup during decommissioning.

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of the PCOCs within the PRS, and the subsequent redistribution of the PCOCs by the decommissioning activities and weathering of the soil. All PRSs were judged to be heterogeneous, or very heterogeneous.

The information on the severity and heterogeneity of the indicator PCOC was used to estimate the probability of observing a concentration less than SALs of PCOCs (Table 5-91).

TABLE 5-91

SAMPLING PARAMETERS FOR GMX-3 BUILDINGS WITHOUT SUMPS

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-011	PAH	85%	4
16-025(a)	Gross $\beta\gamma$	95	2
16-025(b)	Gross $\beta\gamma$	95	2
16-025(s)	Gross $\beta\gamma$	95	2
16-023(b)	PAH	99	1
16-024(b)	HE	99	0-1
16-024(c)	HE	99	0-1
16-024(d)	HE	99	0-1
16-025(d)	HE	99	0-1
16-031(d)	Chromium	99	1
16-034(l)	HE	99	0-1
16-034(p)*	PAH	85	4
C-16-006	Volatiles - PID	99	1
C-16-064	HE	99	1
C-16-065	BTEX	99	1
C-16-067	BTEX	99	1

* Note that PRS 16-034(p) sampling is identical to that for PRS 16-011.

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Mapping from orthocorrected aerial photographs will allow accurate (+/- 2 ft) location of building footprints and other structures. However, field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas. Field screening points were selected for each PRS to provide adequate coverage of each PRS, again considering both the likely heterogeneity of the PRS and the potential severity of contamination in the PRS.

5.19.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-92. Appropriate health and safety precautions will be undertaken according to the site-specific Health and Safety Plan. Sampling numbers and required analyses are shown in Table 5-93.

TABLE 5-92

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

TABLE 5-93

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR GMX-3 BUILDINGS WITHOUT SUMPS

PRS	PRS TYPE	SAMPLED MEDIA	LABORATORY SAMPLES: STRUCTURE	LABORATORY SAMPLES: STRUCTURE FIELD DUP	LABORATORY SAMPLES: SURFACE	LABORATORY SAMPLES: SURFACE FIELD DUP	LABORATORY SAMPLES: SUBSURFACE	LABORATORY SAMPLES: SUBSURFACE FIELD DUP	FIELD SCREENING #: GROSS ALPHA	FIELD SCREENING #: GROSS GAMMA/BETA	FIELD SCREENING #: ORGANIC VAPOR	FIELD SCREENING #: HE SPOT TEST	FIELD SCREENING #: POLYCYCLIC AROMATIC HYDROCARBON	FIELD SCREENING #: BTEX	FIELD SCREENING #: CHROMIUM LIBS (A)	FIELD: GROSS ALPHA	FIELD: GROSS GAMMA/BETA	FIELD: TRITIUM	FIELD: VOLATILE ORGANICS	FIELD: XRF (B)	FIELD: SOIL MOISTURE	LABORATORY ANALYSES: ALPHA SPECTROSCOPY	LABORATORY ANALYSES: GAMMA SPECTROSCOPY	LABORATORY ANALYSES: BETA SPECTROSCOPY (C)	LABORATORY ANALYSES: TOTAL URANIUM	LABORATORY ANALYSES: ISOTOPIC PLUTONIUM	LABORATORY ANALYSES: ISOTOPIC URANIUM	LABORATORY ANALYSES: VOA (SW 8240) (D)	LABORATORY ANALYSES: SEMIVOLATILES (SW 8270) (E)	LABORATORY ANALYSES: METALS (SW 6010) (F)	LABORATORY ANALYSES: ASBESTOS (G)	LABORATORY ANALYSES: HIGH EXPLOSIVES (SW 8330) (H)	LABORATORY ANALYSES: CYANIDE
16-011	Incinerator	Soil			4					9		9	9																4	4		4	
16-023(b)	Incinerator	Soil			1					5		5	5																1	1		1	
16-024(b)	Burned magazine	Soil			1**					4		4																	0-1	0-1		0-1	
16-024(c)	Burned magazine	Soil			1**					4		4																	0-1	0-1		0-1	
16-024(d)	Burned magazine	Soil			1**					4		4																	0-1	0-1		0-1	
16-025(a)	Burned building	Soil			2	1				4		4										2	2		2				2	2		2	
16-025(b)	Burned building	Soil			2					5		5										2	2		2				2	2		2	
16-025(d)	Burned building	Soil			1**					4		4																	0-1	0-1		0-1	
16-025(s)	Burned building	Soil			2					5		5										2	2		2				2	2		2	
16-031(d)	Cooling tower	Soil			1					5					5															1			
16-034(l)	Burned building	Soil			1**					4		4																	0-1	0-1		0-1	
16-034(p)*	Decom building	Soil																															
C-16-006	Decom building	Soil					1			5	5																	1	1				
C-16-064	Drum storage	Soil			1					5		5																	1	1		1	
C-16-065	Drum storage	Soil					1			5				5														1	1				
C-16-067	Drum storage	Soil					1			5		5		5														1	1	1		1	

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.

= The actual number of samples will depend on the depth of the cores.

A, B, C = not applicable; D = full suite VOA samples will be taken from the bottom half of each augered core; E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc); H = full suite.

* PRS 16-034(p) sampling is covered by PRS 16-011. These PRSs represent the same media.

** Laboratory samples for these PRSs are contingent on field screening. If spot test is negative, no samples will be taken.

5.19.4.1 Engineering Surveys

The PRSs composing this aggregate will be field-surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all structure locations will be accurately delineated (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. In the field, the engineering survey will locate, stake, and document the location of each PRS and each point for field screening and sampling. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.19.4.2 Sampling

Most samples will be field-screened for HE by spot test and radionuclides by gross beta-gamma. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using the following hierarchical biasing scheme: 1st) samples with positive HE spot test readings; 2nd) samples with above-background radiation readings (two times background or more); and, 3rd) samples biased, as described below, on a PRS-specific basis. In cases where more field-screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to an individual PRS's contaminant source to better limit the PCOC list for a PRS. In the absence of positive field screening readings or PRS-specific biased sampling points, the sample submitted for laboratory analysis will be selected at random. All surface samples will be taken to a 12 in. maximum depth. At least 300 ml of soil will be collected from each surface sample. Each subsurface core will be augered to the soil-tuff interface. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-93. Field-screening locations are shown in Figs. 5-70, 5-71, and 5-72.

5.19.4.2.1 Surface Sampling

SWMUs 16-011 and 16-034(p). The objective of sampling the decommissioned incinerator and associated decommissioned process building is to determine levels of PAHs or metals present within the debris at the bottom of the incinerator. The incinerator will be field screened for PAHs at nine points and four laboratory samples will be selected based on the field screening. The maximum screening values will be selected. The nine screening locations will be located on the nodes of the grid shown in Fig. 5-72. In the absence of positive field screening indicators or if less than four samples yield positive screening indicators, select the remaining samples randomly. If more than four samples yield positive screening indicators, select four samples randomly from the positive samples.

SWMU 16-025(a). The sampling of this source hutment is designed to detect residual radionuclides on the disturbed surfaces of this SWMU. Four surface samples will be field screened for HE and radionuclides, as described above, in order to select two 12-in. surface samples for laboratory analysis. The positions of these field-screening samples are shown on Fig. 5-70 with one sample in each of the four quadrants. However, unlike most other SWMUs in this aggregate, the hierarchy of biasing samples submitted for laboratory analysis for this SWMU will be: 1) an above-background (two times) radionuclide reading; and, 2) positive HE readings. In the absence of positive field screening results or if fewer than two samples yield positive results, remaining samples submitted to the laboratory will be selected at random. If more than two samples are positive, select randomly from within those samples showing positive readings and use the additional information to design Phase II sampling.

SWMUs 16-025(b) and 16-025(s). The sampling of these two source hutments is designed to detect residual radionuclides on the disturbed

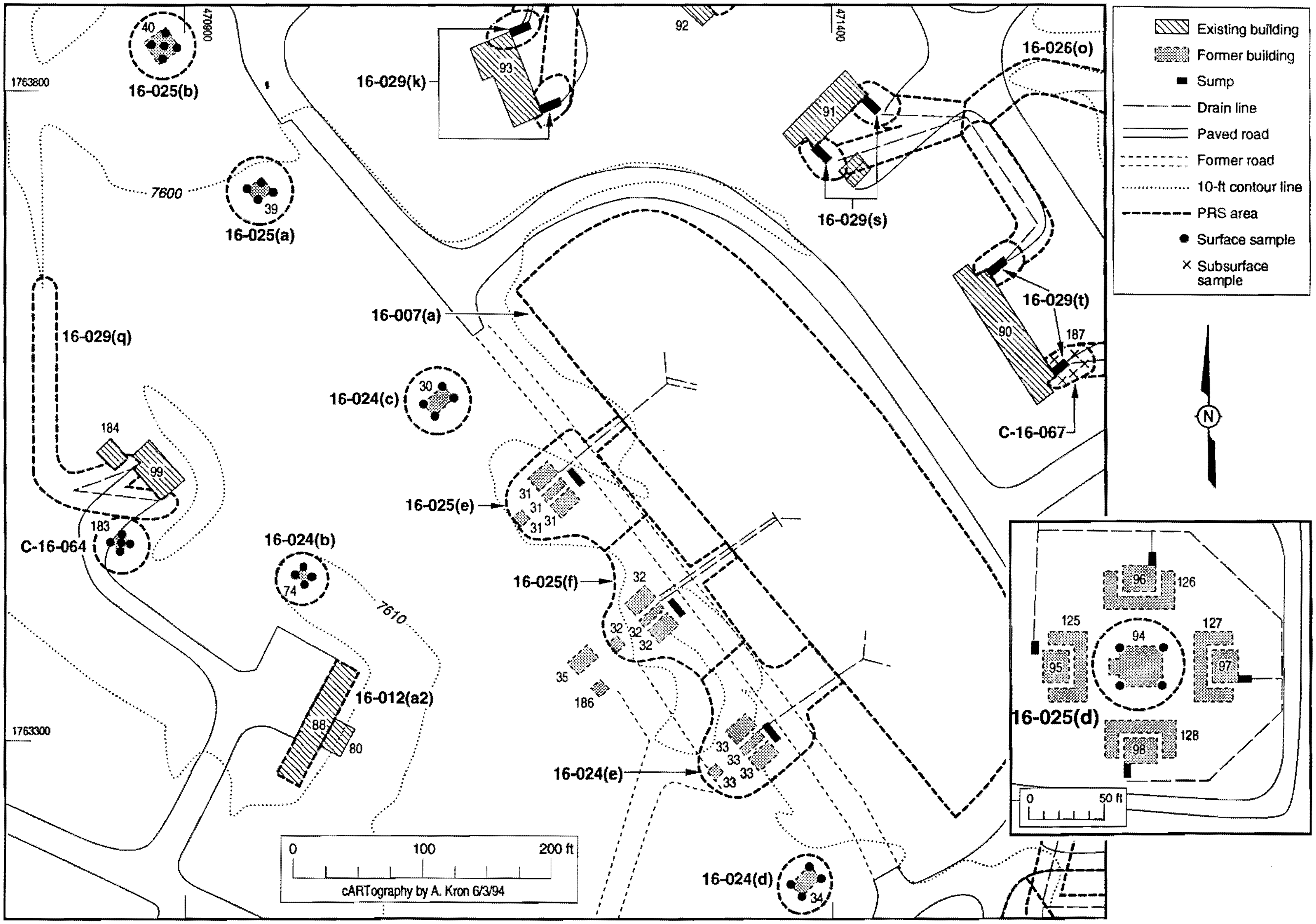

Fig. 5-70. **Sampling locations at GMX-3 without sumps, north.**

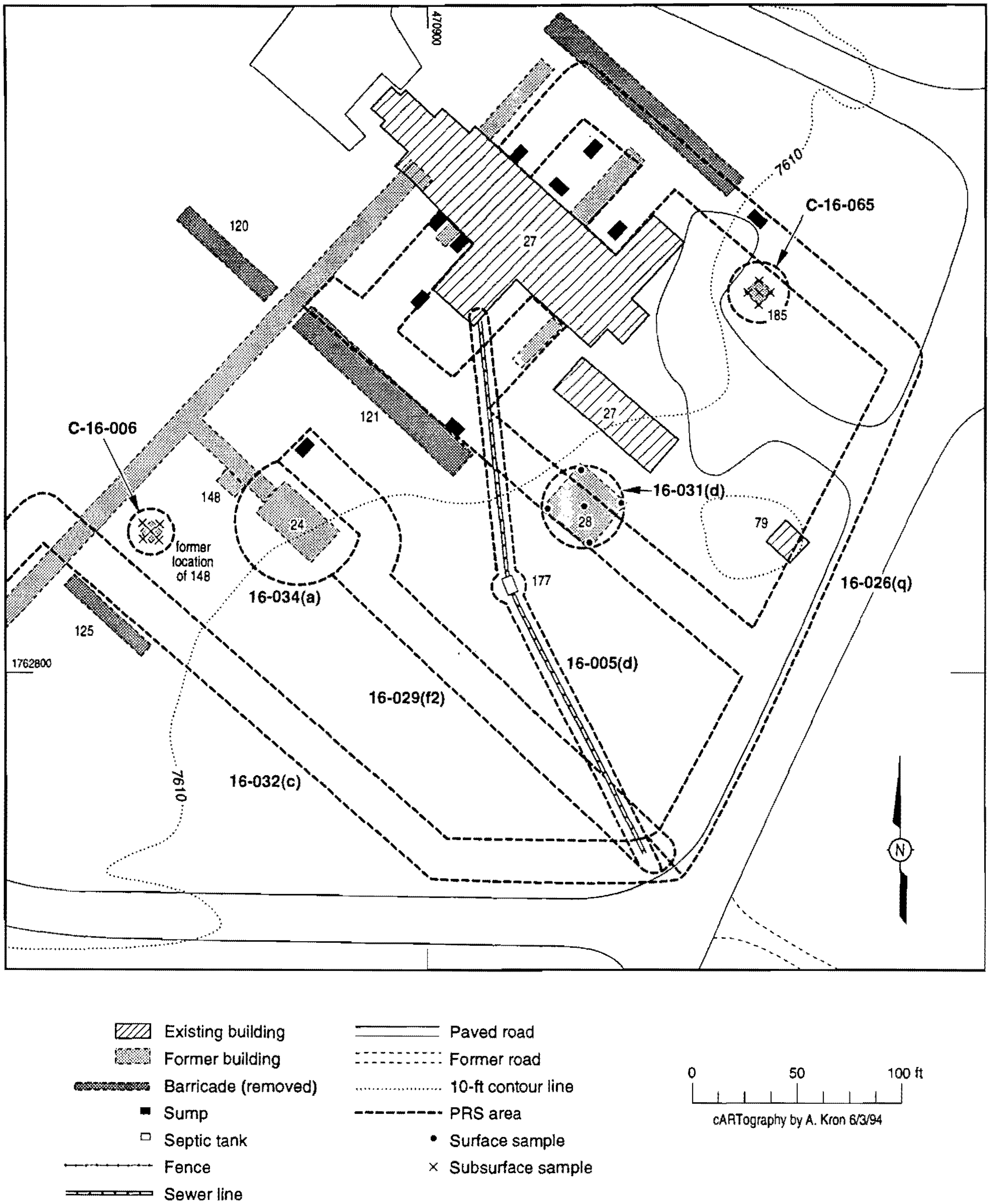

Fig. 5-71. Sampling locations at GMX-3 without sumps, central.

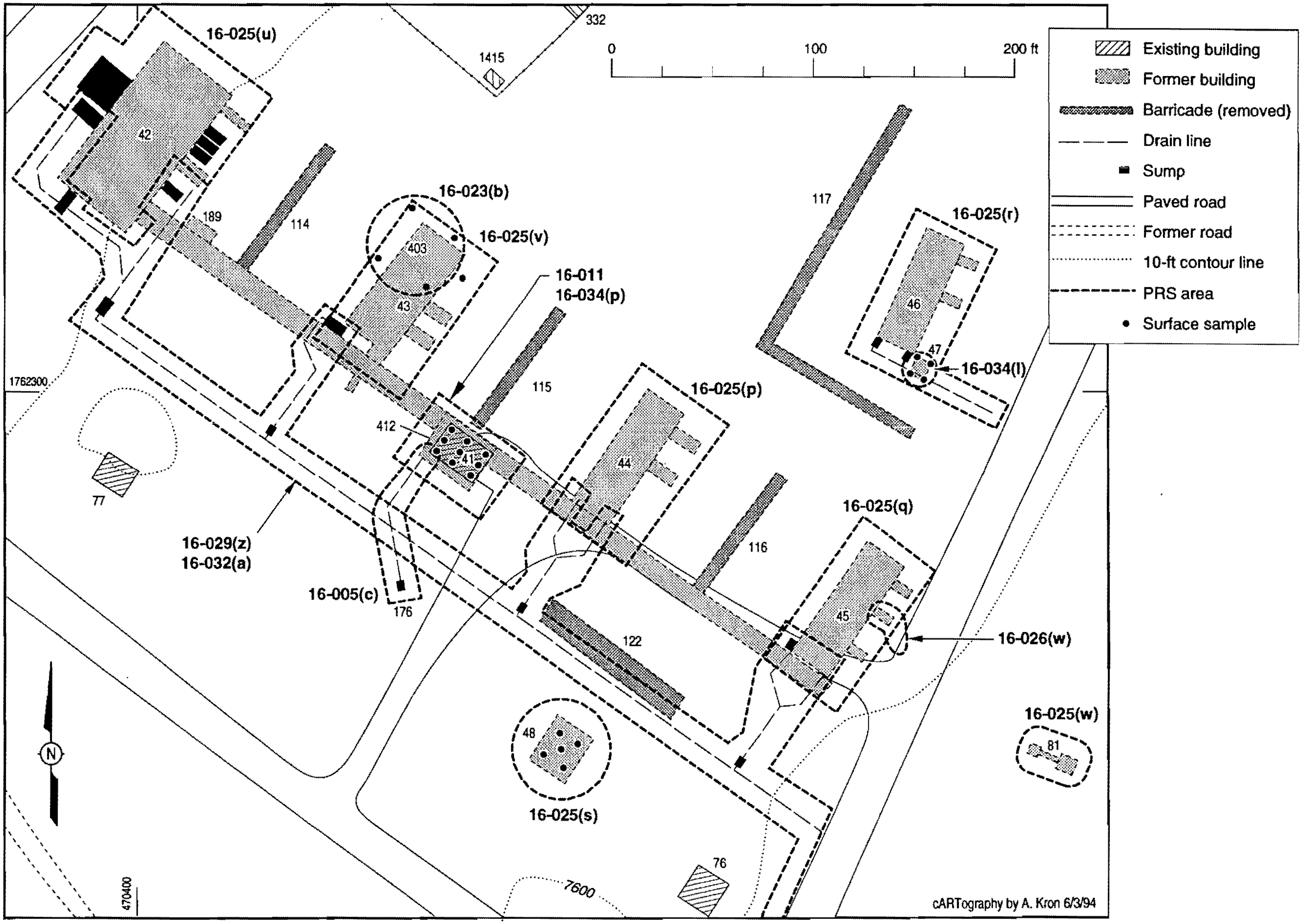

Fig. 5-72. Sampling locations at GMX-3 without sumps, south.

surfaces of these SWMUs. For each SWMU, five surface samples will be field screened for HE and radionuclides, as described above, in order to select two surface samples for laboratory analysis. The positions of these field-screening samples are shown on Figs. 5-70 and 5-72 with one sample in each of the four quadrants and one in the center of each building. However, unlike most other SWMUs in this aggregate, the hierarchy of biasing samples submitted for laboratory analysis for these SWMUs will be: 1) an above-background (two times) radionuclide reading; 2) positive HE readings; and, 3) a sample from the position of the lead-lined pit in the center of each decommissioned building. In the absence of positive field screening results or if fewer than two samples yield positive screening results, the remaining samples submitted to the laboratory will include: the sample from the center of the SWMU and one other sample selected at random from the remaining samples. If more than two samples yield positive screening values, include the center screening sample (if positive) and randomly select the remaining laboratory sample from within the set of samples yielding positive screening results. Additional positive screening results will be used in designing the Phase II sampling plan.

SWMUs 16-024(b), 16-024(c), 16-024(d), 16-025(d), and 16-034(l). The sampling of these three decommissioned magazines, one control building, and one storage building is designed to detect residual HE and HE byproducts on the disturbed surfaces of these SWMUs. For each SWMU, four surface samples will be field screened, as described above, in order to select at most a single 12 in. sample for laboratory analysis. The four field screening samples will be located in each of the four quadrants of each building (Figs. 5-70 and 5-72). SWMU 16-025(d) will be excavated to expose its former footprint prior to sampling. A laboratory sample will be taken if a positive field screening reading is found. If no positive readings occur, zero laboratory samples will be taken. If more than one sample yields a positive reading, choose a laboratory sample at random from within the positive samples.

SWMU 16-023(b). The sampling of this decommissioned incinerator is designed to detect residual burn products (i.e., benzo(a)pyrene and metals) in surface soil. Five surface samples will be field screened for PAHs, HE, and radionuclides in order to select a single surface sample for laboratory analysis. Four of the five field screening samples will be located in the four quadrants of the incinerator, and one sample will be taken 5 ft outside of the incinerator boundary in the driveway leading to the incinerator (Fig. 5-72). In the absence of positive field-screening readings, the laboratory sample will be taken in the driveway for the incinerator.

SWMU 16-031(d). The sampling of this decommissioned cooling tower is designed to detect residual chromium within the surface soils of this PRS. Five surface samples will be field-screened within the PRS for chromium by LIBS or XRF (Fig. 5-71). The screening locations are in each of the four quadrants of the structure and in the center of the SWMU. The sample with the highest chromium reading will be sent for laboratory analysis.

C-16-064. The sampling of this HE drum storage area is designed to detect residual HE associated with disposal of risers at TA-16-99. Five points within C-16-064 will be field screened for HE in order to select a single sample for laboratory analysis (Fig. 5-70). These five screening samples will be collected in the four quadrants of the AOC and in the center of the AOC. In the absence of positive screening indicators, select the laboratory sample at random from within the suite of field-screened samples. If more than one sample yields a positive HE spot test, choose the laboratory sample randomly from those samples showing positive HE readings.

5.19.4.2.2 Subsurface Sampling

C-16-006. The sampling of this PRS is designed to detect residual subsurface solvents, possibly associated with the footprint of structure TA-16-148. Five points within the SWMU boundaries will be cored and screened by PID to select one laboratory sample. The screening locations are in each of the four quadrants of the structure and in the center of the SWMU (Fig. 5-68). In the absence of positive readings on the PID, select the sample at random from within the screened samples. If more than one sample yields a positive volatile reading, select the sample with the highest reading.

C-16-065 and C-16-067. The sampling of these drum storage areas is designed to detect residual petroleum hydrocarbons associated with oil and solvent storage. Five subsurface samples within each AOC will be field screened for BTEX in order to select a single sample for laboratory analysis (Figs. 5-70 and 5-71). These five screening samples will be located in the four quadrants and in the center of each AOC. In the absence of positive screening indicators, select the laboratory sample at random from within the suite of field-screened samples. Similarly, if more than one sample yields a positive BTEX spot test, choose the sample with the highest BTEX reading as the laboratory sample.

5.19.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal radionuclides of concern are uranium, cobalt-60, and radium-226. The principal HE of concern are TNT and RDX, and the principal HE byproducts of concern are DNT, TNB, and DNB. The principal metals of concern are chromium, barium, and lead.

5.19.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-93.

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5.20 GMX-2 Area

5.20.1 Background

This aggregate consists of all the PRSs associated with HE processing activities in the southern and eastern buildings of the World War II era S-Site complex. These PRSs are an aggregate because they are geographically contiguous and they have a similar suite of PCOCs. Structures were primarily occupied by the experimental explosives groups, such as GMX-2 and its predecessors. Drainage sampling in the region may provide information on off-site migration of PCOCs from all of the PRSs, and data from this sampling may potentially be combined in future baseline risk assessments. The PRSs in the GMX-2 aggregate are listed in Table 5-94.

5.20.1.1 Description and History

The decommissioned GMX-2 area lies in the south-central and eastern portions of the World War II era S-Site (Figs. 5-0-2, 5-73, 5-74, and 5-75). There are few structures at the site; coniferous trees have overgrown the eastern portion of the GMX-2 area. The GMX-2 area is fairly level with a change in elevation of less than 30 ft sloping approximately from west to east over a distance of 2 000 ft. Site drainage is primarily to a large drainage ditch that runs north-south and is located to the east of the southern GMX-2 processing line (Fig. 5-73).

The structures in the GMX-2 area were used primarily for experimental HE research and development activities. No production-scale HE operations were conducted in the GMX-2 area; HE volumes processed were generally smaller than those processed in the GMX-3 facilities to the north. However, a wider variety of experimental explosives were used in the GMX-2 area than in the GMX-3 area.

The first structures built in the GMX-2 area were buildings TA-16-36, TA-16-37 (Fig. 5-74), and TA-16-38 (Fig. 5-75). These structures were completed during the initial construction phase at S-Site in early 1944, with all three buildings completed by March 1944. At this time, both production and experimental HE operations were done in these buildings. Group E-5, Implosion Experimentation, was the operating group in charge of these facilities through June 1944 (Hawkins 1946, 0663). Group E-10, which was

TABLE 5-94

POTENTIAL RELEASE SITES IN GMX-2 AREA

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION	DIMENSIONS LENGTH X WIDTH X HEIGHT (FT)
16-005(e)	TA-16-179		Septic system	
16-015(c)	TA-16-36	S-27E	Steam cleaning	8 x 8 x 10
16-015(d)	TA-16-51	S-42A	Steam cleaning	7 x 7 x 7
16-024(k)	TA-16-57	S-56	Decommissioned magazine	6 x 6 x 7
16-024(l)	TA-16-72	S-76	Decommissioned magazine	6 x 6 x 7
16-024(m)	TA-16-66	S-70	Decommissioned magazine	6 x 6 x 7
16-024(n)	TA-16-84	S-93	Decommissioned magazine	16 x 16 x 9
16-024(o)	TA-16-67	S -71	Decommissioned magazine	6 x 6 x 7
16-024(p)	TA-16-70	S-74	Decommissioned magazine	6 x 6 x 7
16-024(q)	TA-16-71	S-75	Decommissioned magazine	6 x 6 x 7
16-024(r)	TA-16-68	S-72	Decommissioned magazine	6 x 6 x 7
16-025(t)	TA-16-38	S-28, S-5	Soil contamination - casting	30 x 32 x 12, 10 x 24 x 9 10 x 15 x 10 10 x 15 x 12
16-025(w)	TA-16-81	S-90	Soil contamination - nitrocellulose drying	8.5 x 8.5 x 8
16-025(y)	TA-16-55	S-45A	Soil contamination - nitrate grinding	20 x 40 x 12
16-025(z)	TA-16-37	S-27	Soil contamination - casting	20 x 75 x 13
16-025(a2)	TA-16-50	S-42	Soil contamination - casting	(2) 21 x 13 x 9
16-025(b2)	TA-16-52	S-43	Soil contamination - casting	49 x 15 x 9
16-025(c2)	TA-16-56	S-46	Soil contamination - physical testing lab	16 x 16 x 9
16-029(v)	TA-16-49	S-41	Inactive HE sump - laboratory	**
16-029(y)	TA-16-38	S-28	Inactive HE sump - casting	**
16-029(a2)	TA-16-55	S-45A	Inactive HE sump - nitrate grinding	**
16-029(b2)	TA-16-53	S-44	Inactive HE sump - machining	**
16-029(c2)	TA-16-37	S-27	Inactive HE sump - casting	**
16-029(d2)	TA-16-50	S-42	Inactive HE sump - casting	**
16-029(e2)	TA-16-52	S-43	Inactive HE sump - casting	**
16-034(m)	TA-16-86	S-95	Soil contamination - laboratory	10 x 16 x 10
16-034(n)	TA-16-83	S-92	Soil contamination - laboratory	16 x 16 x 9
16-034(o)	TA-16-49	S-41	Soil contamination - laboratory	30 x 33 x 12 40 x 20 x 12
C-16-005	TA-16-53	S-44	Soil contamination - machining	unknown
C-16-069	TA-16-87	S-95A	Soil contamination - machine shop	8 x 13 x 7

** Sumps are typically 6 to 12 ft long x 4 ft wide x 5 ft deep.

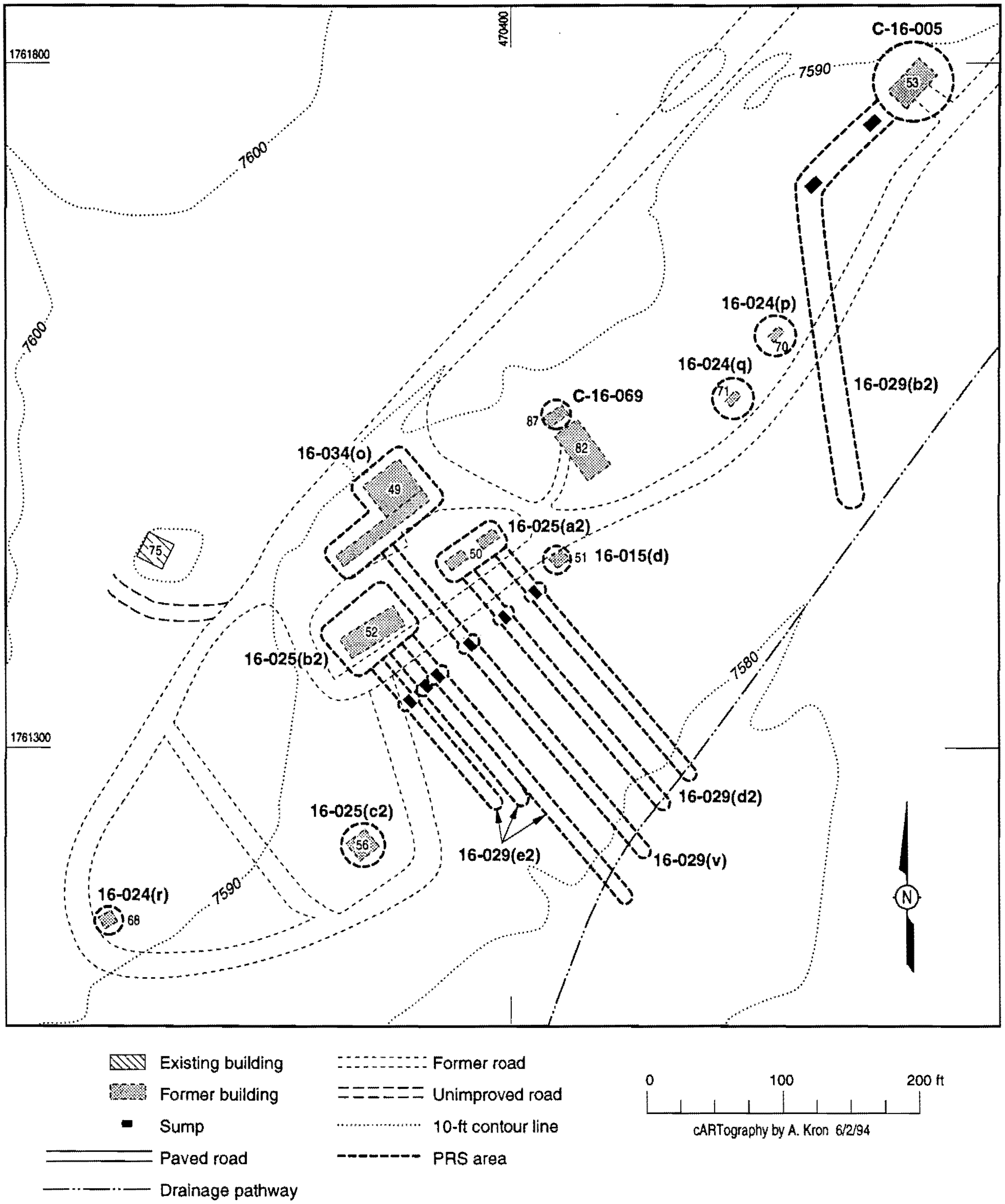


Fig. 5-73. Locations of PRSs at GMX-2 south.

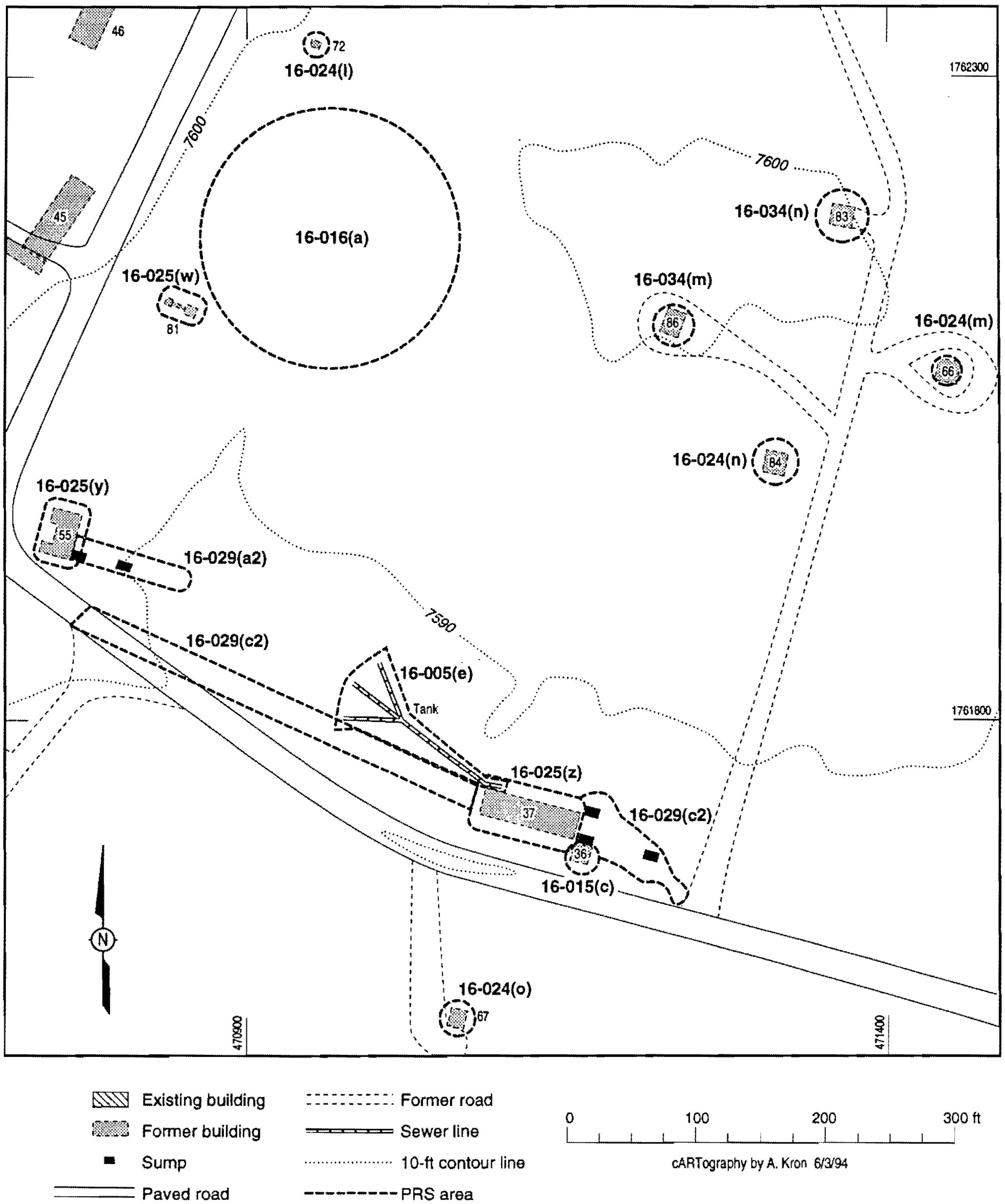


Fig. 5-74. Locations of PRSs at GMX-2 east.

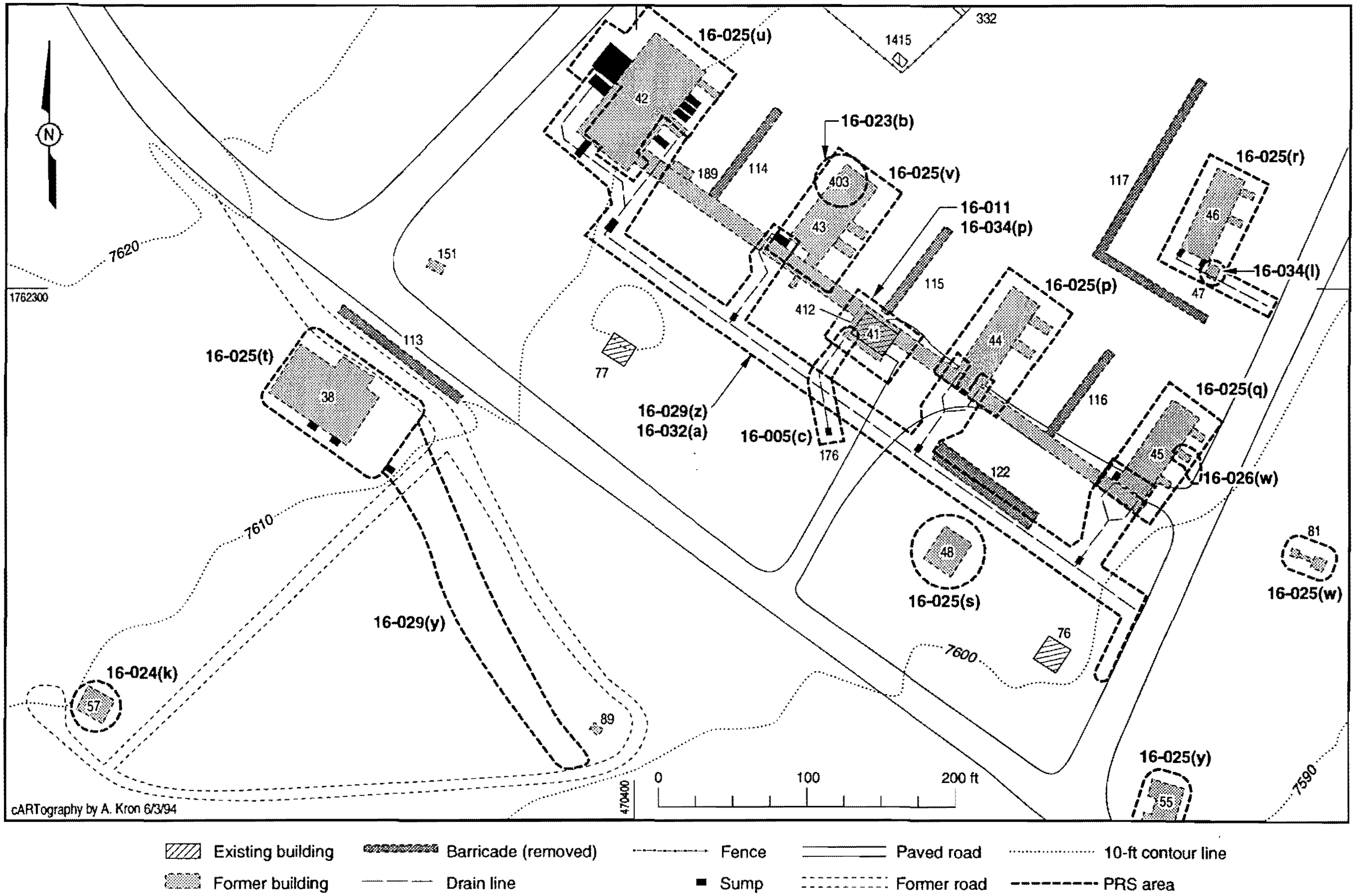


Fig. 5-75. Locations of PRSs at GMX-3 south.

formed specifically to supervise the new S-Site Plant, was created from a subsection of E-5 in July 1944. In August 1944 the Laboratory was reorganized and the GMX-2 area was placed under Group X-3, Explosives Development and Production (Hawkins 1946, 0663). Group X-3 was in charge of all of S-Site. After the completion of the 40s-Line, Section X-3A, the experimental section, operated in structures TA-16-38 (S-5) and TA-16-37 (S-6).

Buildings TA-16-49, TA-16-50, TA-16-51, TA-16-52 (Fig. 5-73), and TA-16-81 (Fig. 5-74) were completed by the fall of 1944 (Engineering Structure List). They expanded the experimental HE casting capabilities of S-Site. As S-Site operations increased during this time, the experimental research efforts were divided between two sections, Section X-3A, and Section X-3B, special research problems. Section X-3A was involved in development and control work such as lens development, refinement of casting methods, chemical analysis of HE, HE density determination, viscosity and settling rate tests, and measurements of the thermal expansion of different HE formulations (Ackerman 1945, 15-16-512; Hopper 1945, 15-16-504). This work on experimental HE formulations included investigations of mixtures of TNT with compounds such as PbO (plumbatol), $Cd(IO_3)_2$, $Pb(IO_3)_2$, $Pb(NO_3)_2$, and gelatin (no author 1944, 15-16-507; Martin and Hickmott 1993, 15-16-498). Some density determinations for barium nitrate-bearing explosives were done in mercury because of concerns that barium nitrate in that explosive would dissolve in water. Section X-3B emphasized research in areas such as vacuum overcasting, which was designed to minimize the flaws in HE charges (Ackerman 1945, 15-16-512; Gurinsky 1945, 15-16-505).

During early 1945 several new facilities were completed in the GMX-2 area, and further additions and upgrades were made to TA-16-37 and TA-16-38. TA-16-37 was turned over to Section X-3B in spring 1945 for development of the vacuum overcasting method (Gurinsky 1945, 15-16-505; Martin and Hickmott 1993, 15-16-498). Buildings TA-16-53, TA-16-55, and TA-16-56 (Fig. 5-73) were all completed during this S-2 expansion (Engineering Structure List). Not all of these buildings were controlled by Sections X-3A and X-3B. TA-16-81, the nitrocellulose drying facility and TA-16-55, the barium nitrate grinding facility, were operated by Section X-3C. Several magazines, including TA-16-84 (Fig. 5-74), were also completed during this period. The machine-shop trailer (C-16-069) (Fig. 5-73) was moved to the GMX-2 area during June 1945. After World War II, the level of operations in the GMX-2 area decreased markedly. This slowdown was due to the decreased level of HE development at S-Site. Sections X-3A and X-3B were consolidated into Group X-2 in 1946 (Hawkins 1946, 0663). Group X-2 was later renamed Group GMX-2. Although operations slowed somewhat, additional structures and additions were added to the GMX-2 area between 1946 and 1950. Building TA-16-87 (Fig. 5-73) and magazines TA-16-57, TA-16-72, TA-16-66, TA-16-70, TA-16-71 and TA-16-68 (Figs. 5-73, 5-74, and 5-75) were all completed in 1946 (Engineering Structure List). In 1950, experimental research on thallium azide detonators was conducted in the GMX-2 area at S-Site (Smith 1950, 15-16-189).

The GMX-2 area ceased to be used as an active site in the early 1950s. Many HE development activities were transferred to TA-9, the Anchor Ranch West Site. Most of the structures remaining within the GMX area were destroyed by burning in February 1960 (Engineering Department 1959, 15-16-256). The residual debris from burning and the remaining subsurface structures were cleaned up in 1966.

The following SWMUs and AOCs resulted from operations at the GMX-2 area. Almost all of the decommissioned structures within the GMX-2 area were surveyed for radiation, HE, and toxic chemicals prior to being burned in February 1960. Unless otherwise noted, the results of these surveys were negative (Engineering Department 1959, 15-16-256). Currently, most of the sites are overgrown by scrub grasses. In some cases, a few chunks of concrete, asbestos shingles, and broken vitrified clay pipe mark the locations of the buildings. In many cases, the graveled roadbeds surrounding the buildings are still visible, and allow accurate placement of the buildings. The sumps within this aggregate can be accurately located on a 1965 aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516).

SWMU 16-005(e) was the septic tank (TA-16-179) that served the lavatories and darkrooms in TA-16-37 (Fig. 5-74). It was located about 110 ft northwest of that building on level ground and was connected to it by a 6-in. vitrified clay pipe. A description of operations in TA-16-37 is provided below.

SWMU 16-015(c) contains potentially contaminated surface soil associated with decommissioned steam cleaning building (TA-16-36) located 10 ft southeast of TA-16-37 (Fig. 5-74). It was of wooden-frame construction on a concrete foundation. The surface is level in its former location. Its effluent drained to the primary sump located on the southeast corner of TA-16-37. Steam cleaning HE processing equipment is likely to have produced large amounts of HE contamination. Prior to its removal in 1960, this structure was shown to be contaminated with HE (Engineering Department 1959, 15-16-256).

SWMU 16-015(d) contains potentially contaminated surface soil associated with another decommissioned steam cleaning building (TA-16-51), which was located approximately 100 ft east of TA-16-49 (Fig. 5-73). It was of wooden-frame construction on a concrete foundation. Currently, the site of this SWMU is level. Steam cleaning machinery is likely to have produced large amounts of HE contamination. Prior to its removal in 1960, this structure was shown to be contaminated with HE (Blackwell 1983, 15-16-076; Engineering Department 1959, 15-16-256).

SWMUs 16-024(k), 16-024(l), 16-024(m), 16-024(n), 16-024(o), 16-024(p), 16-024(q), and 16-024(r) contain potentially contaminated surface soil associated with HE magazines that were located in the GMX-2 area. TA-16-57 [SWMU 16-024(k)] was located south of TA-16-38 (Fig. 5-75); TA-16-72 [SWMU 16-024(l)] was located north of TA-16-81 (Fig. 5-74); TA-16-66 and TA-16-84 [SWMUs 16-024(m) and 16-024(n)] were located northeast of TA-16-37 (Fig. 5-74); TA-16-024(o) was located south of TA-16-37 (Fig. 5-74); TA-16-70, and TA-16-71 [SWMUs 16-024(p)] and 16-024(q)] were located northeast of TA-16-49 (Fig, 5-73); and TA-16-68 [SWMU 16-024(r)] was located southwest of TA-16-56 (Fig. 5-73). The building dimensions are provided in Table 5-94. They were all of wooden-frame construction with earthen barricades on three sides and on top. All were located on flat terrain, none have nearby well-defined drainages. Little specific information concerning any of these magazines is available; however, a former site worker (Martin 1993, 15-16-477) suggests that TA-16-57 [SWMU 16-024(k)] was not extensively utilized, and also states that operations in magazines are likely to have spilled HE within the magazines. Prior to their being burned in 1960, it was determined that all of these structures were contaminated with HE (Engineering Department 1959, 15-16-256).

C-16-069 represents potentially contaminated media associated with structure TA-16-87. This building was a standard Signal Corps trailer that was used as a machine shop for metallic parts. It was located in the southern part of the GMX-2 area, northeast of TA-16-49 (Fig. 5-73). The structure was located on flat terrain. TA-16-87 contained no hazardous materials, including HE, when it was surveyed in the late 1950s (Engineering Department 1959, 15-16-256). It was removed and returned to the Atomic Energy Commission in 1957.

SWMUs 16-025(t) and 16-029(y) contain potentially contaminated surface and subsurface soil associate with decommissioned TA-16-38 and its associated sump and drain line system. TA-16-38 was located southwest of TA-16-42 (Fig. 5-75). The area containing the building's footprint is flat with a slight slope to the east. The drain line from the sump system went beneath the road to magazine TA-16-57, under the road to TA-16-49, and emptied into the main drainage ditch for World War II era S-Site south of TA-16-53.

TA-16-38 was a large rectangular building, divided into four sections. These were 30 ft long x 32 ft wide x 12 ft high, 10 x 24 x 9, 10 x 15 x 10, and 10 x 15 x 12. A massive concrete two-bay partition was located in the south corner of the building. The building was of wooden-frame construction with a concrete foundation and a concrete floor. Two outlets fed two sumps located on the southeast side of the building (Fig. 5-75). These sumps fed a secondary sump (over 15 ft deep) located approximately 50 ft southeast of TA-16-38. A drain line from this sump led southeast, apparently daylighting beyond the road to TA-16-57. A former site worker claims that this sump had a French drain system, which has not been removed, downstream from the HE sump (Martin 1993, 15-16-477).

This building was initially designed to be a milling building where risers were sawed off castings produced in TA-16-26 (Martin 1993, 15-16-477). However, because of a lack of facilities for casting, it was used for experimental casting through September 1944 (Hawkins 1946, 0663). In July 1945 the building was altered for producing pentolite HE castings that previously had been cast at Anchor Ranch Site. After World War II this building was used for machining and casting. A former site worker suggested that a wide-range of unusual HE such as plumbatol and boracitol were processed in this building (Martin and Hickmott 1993, 15-16-498).

This building was contaminated with HE when it was surveyed in the late 1950s (Engineering Department 1959, 15-16-256). A single survey (Wingfield 1960, 15-16-111) suggests that it was contaminated with radioactive materials, whereas later surveys suggest it was free of radioactive contamination. A former site worker reports that over 700 lb of HE were removed from sump TA-16-38 when it was decommissioned in the mid-1960s (Martin 1993, 15-16-477).

SWMU 16-025(w) contains potentially contaminated surface soil associated with TA-16-81, the nitrocellulose drying building. It is located southeast of TA-16-45 on ground that slopes slightly to the east (Fig. 5-74). TA-16-81 consisted of a primary building and a smaller fan room connected to the main structure by a 17 ft air duct.

Nitrocellulose was used as an ingredient of several HE formulations, including Composition B and baratol. By varying the amount of nitrocellulose in a cast explosive, its viscosity could be accurately controlled. Nitrocellulose was shipped in alcohol to avoid spontaneous combustion but the alcohol evaporated prior to use in HE castings. A former site worker reports that workers in this facility emerged 'drunk as skunks' after a day's work in the facility (Martin 1993, 15-16-477).

A former site worker also reports that solvents other than alcohol may have been associated with the nitrocellulose (Martin 1993, 15-16-477). The building was shown to be contaminated with HE prior to its decommissioning by burning (Engineering Department 1959, 15-16-256).

SWMUs 16-025(y) and SWMU 16-029(a2) contain areas of potentially contaminated surface and subsurface soil associated with TA-16-55 and its associated drain line and sumps. TA-16-55 was located south of TA-16-45 on a relatively flat site (Fig. 5-74). The sumps were east of the building and exited to a drain line that presumably flowed into the main drainage of World War II era S-Site, less than 100 ft from TA-16-55.

TA-16-55 consisted of three structures, a large process building connected to a smaller equipment room and a small storage room. The structure was wooden-frame with a concrete floor. The building had a sump on its east side, which drained to a secondary sump and then to an outfall.

TA-16-55, the first barium nitrate grinding facility at S-Site, contained a micropulverizer that was used for grinding barium nitrate. It served this function from September 1944 until TA-16-54 was constructed in early 1945 (Truslow 1973, 15-16-264). A former site worker states that this building was later used for a number of purposes, including lead storage (Martin 1993, 15-16-477). The engineering structure list suggests that it was an instrument calibration building. When the building was surveyed in 1959 it was noted as being a storage building containing "blocks of paraffin, jars of toluene, and unlabeled cans" (Schulte 1959, 15-16-263).

Prior to burning, it was determined that TA-16-55 was contaminated with HE (Engineering Department 1959, 15-16-256).

SWMUs 16-025(z) and 16-029(c2) contain areas of potentially contaminated surface and subsurface soil associated with decommissioned TA-16-37 and its associated sumps and drain lines. There is some confusion regarding which building was TA-16-37 (Martin and Hickmott 1993, 15-16-498); this RFI work plan will follow the SWMU Report and designate the larger building TA-16-37 and the associated steam cleaning building TA-16-36 (LANL 1990, 0145). TA-16-37 was located in the eastern portion of the GMX-2 area (Fig. 5-74). The area that contained the building's footprint has a slight eastward slope. The drain lines and sumps visible on aerial photographs and engineering drawings were on the east side of the building, with an older primary sump on the southeast corner of the building and a later primary sump on its northeast corner. Both primary sumps drained southeast into a secondary sump located 75 ft from the building; this drained another 250 ft to the southeast. A rock-lined ditch, not present on any engineering drawing yet examined, trends westward from TA-16-37 into the main drainage for the World War II era S-Site complex (Fig. 5-74).

TA-16-37 was a large building of wooden-frame construction with concrete floors. It was initially a fairly simple building but it was upgraded during early 1945 with an elaborate plumbing system that included an acid waste line, a propane tank and line, and a lavatory. Little information exists regarding the nature and use of the acid line. The building eventually contained a utility room, a general purpose area, and three identical laboratories with a sink and a hood.

TA-16-37 was initially designated as an explosives testing facility. Small castings were made in the facility during the spring of 1945 (Ackerman 1945, 15-16-166). During spring 1945 it was turned over to Section X-3B for investigations of problems associated with cavitation in the inner charges for the implosion device. Casting operations to address this problem were conducted at this time (Martin and Hickmott 1993, 15-16-498). The elaborate plumbing system was probably designed to facilitate HE development and vacuum overcasting operations. Vacuum overcasting was a method of cooling HE castings designed to minimize bubbles by putting a vacuum on the casting riser during charge cooling.

The building was contaminated with HE prior to its demolition by burning in 1960 (Engineering Department 1959, 15-16-256). One memo indicates that it was contaminated with carbon-14 (Engineering Department 1957, 15-16-479).

SWMUs 16-025(a2) and 16-029(d2) contain areas of potentially contaminated surface and subsurface soil associated with TA-16-50 and its associated sumps and drain lines. This building was located southeast of TA-16-49 in the southern portion of the GMX-2 area (Fig. 5-73). The footprint of the building is level; the sump and drain line area slope slightly to the east.

TA-16-50 consisted of two rooms, each 21 ft long x 13 wide x 9 ft high separated by an earthen bunker. The building was of wooden-frame construction with a concrete floor. The entire structure was surrounded by a large earthen barricade on the west, north, and south sides. The building had no sump adjacent to the building, only two sumps located approximately 75 ft southeast of the building. The locations of these sumps are currently depressed sinkholes. The drain lines from these tanks exited to the main drainage to the east of the GMX-2 area (Fig. 5-73).

The building was designed in the fall of 1944 as an experimental casting building. It served this function throughout its active lifetime. Casting buildings are likely to be contaminated from daily washing of the facilities with high-pressure steam/hot water mixtures. Most of this material went to the sumps, but some may have gone through cracks in the floor or through door seams (Martin and Hickmott 1993, 15-16-498).

The building was considered to be contaminated with HE prior to its decommissioning by burning in 1960 (Engineering Department 1959, 15-16-256).

SWMUs 16-025(b2) and 16-029(e2) contain potentially contaminated surface and subsurface soil associated with TA-16-52 and its associated sumps and drain lines. TA-16-52 was located south of TA-16-49 in the southern portion of the GMX-2 area (Fig. 5-73). The footprint of the building is level; the sump and drain line area slope slightly to the east.

TA-16-52 consisted of three sections, 15 ft long x 15 ft wide x 9 ft high, 11 ft x 15 ft x 9 ft, and 23 ft x 15 ft x 9 ft. It also contained a reinforced concrete divider in its southern portion. This portion of the building was separated from the rest of the structure by an earthen barricade. The building was of wooden-frame construction with a concrete floor. The entire structure was surrounded by a large earthen barricade on the west, north, and south sides. The structure had no sump adjacent to the building, only three sumps located approximately 75 ft southeast of the building. The locations of these sumps are currently depressed sinkholes. The drain lines from these tanks exited into the main drainage to the east of the GMX-2 area (Fig. 5-73).

The building was designed in the fall of 1944 as an experimental casting building, and apparently served this function throughout its active lifetime (Martin 1993, 15-16-477). A vertical mill for HE machining was located in the building, probably behind the concrete divider.

The building was considered to be contaminated with HE prior to its decommissioning by burning in 1960 (Engineering Department 1959, 15-16-256).

SWMU 16-025(c2) contains potentially contaminated surface soil associated with TA-16-56. This building was located almost due south of TA-16-52, in the southern portion of the GMX-2 area (Fig. 5-73). The area of the building's footprint is flat. A few cables mark the former location of the building.

TA-16-56 was a small wooden-frame building with a concrete floor. It had an earthen barricade on three sides. The building contained a soapstone sink that drained into the southernmost sump associated with TA-16-52.

The facility is listed as a testing laboratory, and a former site worker confirmed that the building was used for mechanical testing of HE charges (Martin and Hickmott 1993, 15-16-498).

The building was considered to be HE contaminated prior to burning in 1960 (Engineering Department 1959, 15-16-256).

SWMUs 16-034(o) and 16-029(v) contain areas of potentially contaminated surface and subsurface soil associated with TA-16-49 and its associated sump and drain line. TA-16-49 was located in the central portion of the GMX-2 southern area (Fig. 5-73). The footprint of the building is level, the drain line and sump area slope slightly to the east. A well-defined sinkhole marks the former location of the sump.

This building was L-shaped with the two wings of the L being 30 ft long x 33 ft wide x 12 ft high and 40 ft x 20 ft x 12 ft. It was of wooden-frame construction with a concrete foundation and floor. It had a single sump located to the southeast of the building, and it appears that a pipeline ran along the south and east sides of the building to the sump. There also was a second drain line, with no sump, that exited the building from the northeast corner. Examination of a 1966 photograph (LASL 66-4325) of the demolition of this building suggests that the second line served a rest room. Unlike many of the other buildings at World War II era S-Site, this one had no troughs in its floor. Rather, it had lead-lined troughs along several laboratory benches in the facility. These drained into the sump. The drain line from the sump eventually flowed into the main drainage located to the east of the southern GMX-2 area (Fig. 5-73).

TA-16-49 was designed to be an experimental laboratory in which physical properties of HE produced in the experimental casting facilities could be measured. These measurements included analyses of HE viscosity, wetting angles, densities, and compositions. The major purpose of these analyses was to confirm that homogeneous HE charges were being produced by the experimental casting facilities. HE mixtures for casting were also blended in this facility. A wide range of chemicals, including toluene, acetone, n-hexane, and benzene, were used in these measurements. A former site worker recalled that all HE-contaminated materials were cleaned each day and that HE wash water went into the sump. Optical analysis of HE was done in this facility (Martin and Hickmott 1993, 15-16-498). TA-16-49 remained an analytical laboratory during its entire time as an active facility.

This building was listed as HE contaminated prior to demolition in 1960 (Engineering Department 1959, 15-16-256).

C-16-005 and SWMU 16-029(b2) contain potentially contaminated surface and subsurface soil associated with TA-16-53 and its sumps and drain lines. TA-16-53 was located northeast of TA-16-49 in the southern GMX-2 area (Fig. 5-73). The former location of the building is flat, the drainage area slopes slightly to the east.

The building was 39 ft long x 16 ft wide x 14 ft high with a 6 ft long x 17 ft wide x 8 ft high addition. It was of wooden-frame construction with a concrete foundation and floor. It was surrounded on three sides by an earthen barricade. The building had a primary sump on the south side of the southern barricade and a secondary sump 100 ft to the southwest of the building, which had a drain line that exited to the south, eventually flowing into the main drainage ditch for the GMX-2 area.

When TA-16-53 was constructed in the spring of 1945, it contained a hydraulic press for HE processing. A former site worker claimed to have machined the inner charges for the Trinity device in TA-16-53 (Martin and Hickmott 1993, 15-16-498). Another former site worker claimed that both HE machining and casting were done in this building (Martin 1993, 15-16-477). The TA-16 structure list shows this building as an optical equipment storage facility.

A former site worker removed a 'desk sized' chunk of HE from around the sump of this building when the sump became clogged (Martin 1993, 15-16-477). The building was contaminated with HE prior to its demolition by burning in 1960 (Engineering Department 1959, 15-16-256).

SWMUs 16-034(m) and 16-034(n) contain areas of potentially contaminated surface soil associated with two small laboratory buildings (TA-16-83 and TA-16-86) located in the eastern portion of the GMX-2 area (Fig. 5-74). Both were located on flat ground, so neither exhibits a visible drainage. These two buildings are considered together, because interviews with S-Site personnel revealed no differentiation of activities between the two buildings.

TA-16-83 was 16 ft long x 16 ft wide x 9 ft high and TA-16-86 was 10 ft long x 16 ft wide x 10 ft high. Each structure was of wooden-frame construction. There is currently more debris associated with these buildings than with many of the other demolished structures.

Both buildings are listed as laboratories; neither had any plumbing fixtures or sumps. They contained temperature-controlled curing ovens in which a former site worker recalls drying plumbatol charges. In at least one case, such a charge caught on fire (Martin and Hickmott 1993, 15-16-498). In contrast, another former site worker recalls that these buildings were used as magazines (Martin 1993, 15-16-477).

Both TA-16-83 and TA-16-86 are listed as being HE contaminated prior to their destruction by burning in 1960 (Engineering Department 1959, 15-16-256).

5.20.1.2 Conceptual Exposure Model

The conceptual model for the GMX-2 area is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.20.1.2.1 Nature and Extent of Contamination

The PCOCs that may be present at the GMX-2 PRSs include: 1) HE, particularly TNT, RDX, and PETN, contained in the charges; 2) HE burn and byproducts such as barium (from baratol), PAH, DNT, TNB, and DNB; 3) other materials such as lead and chromium that were used in experimental high explosives; 4) chemicals used in the analytical laboratory such as acetone and benzene; 5) materials associated with photoprocessing such as silver and cyanide; 6) carbon-14, which was reported in TA-16-37; 7) uranium, which was reported in TA-16-38; and, 8) materials used in construction of the buildings such as lead and asbestos (Table 5-95).

A limited number of analytical samples exist within the GMX-2 operational area. Eighteen individual 0 to 3 ft samples located approximately on a grid were composited into six laboratory samples; all were taken in the general area east of decommissioned TA-16-38. Three individual grab samples were analyzed for volatile organics. Sampling locations from this study are shown in Fig. 5-76 and results are shown in Table 5-96. All composite samples were analyzed for radionuclides, metals, and high explosives. Field screening results for HE were negative, a few field screening results for organic vapors yielded values to 100 ppm. Surprisingly, no HE were found in these grab samples. No biasing toward sump or building locations was involved in this sampling. None of the analytes was above SALs, except for beryllium, which was in its background range.

5.20.1.2.2 Potential Pathways and Exposure Routes

The GMX-2 area contains septic tanks, decommissioned sumps, drain lines, outfalls, decommissioned buildings, and associated debris. Leaks from joints and cracks in the structures could have resulted in the release of PCOCs to surface and subsurface soils. Discharge from outfalls could have transported potential contaminants down the main drainage east of the GMX-2 area and these PCOCs may be concentrated in sedimentation areas. The release of potential contamination could have also occurred through overflow and spillage from the sumps and leaks from the former buildings into surrounding surface soils. Potential surface soil contamination can migrate through infiltration or surface water runoff into the main drainage ditch. Solvents used in HE analysis may still be present in near-surface soils. The entire area is well vegetated with grasses, weeds, and shrubs; therefore, fugitive dust generation is a pathway of minimal concern. Chapter 4 of this RFI work plan contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes appropriate for consideration in this aggregate.

TABLE 5-95

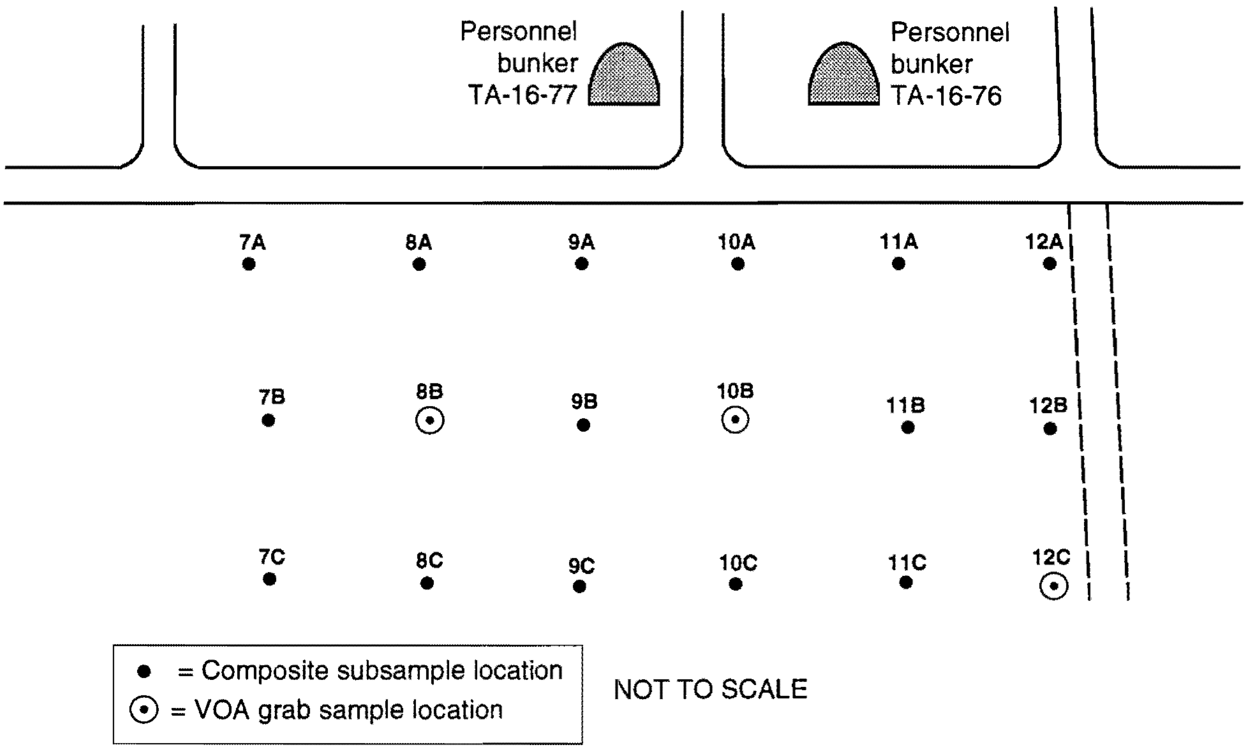
POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, GMX-2 AREA

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE			RAD		METALS				
				UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	CARBON-14	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-005(e)	Septic system, TA-16-179	Served lavatories and darkrooms in TA-16-37	N	X	X	X		X	X	X	X	X	X
16-015(c)	TA-16-36	Steam cleaning	N	X	X	X			X	X		X	
16-015(d)	TA-16-51	Steam cleaning	N	X	X	X			X	X		X	
16-024(k)	TA-16-57	Decommissioned magazine	N	X	X	X			X	X			
16-024(l)	TA-16-72	Decommissioned magazine	N	X	X	X			X	X			
16-024(m)	TA-16-66	Decommissioned magazine	N	X	X	X			X	X			
16-024(n)	TA-16-84	Decommissioned magazine	N	X	X	X			X	X			
16-024(o)	TA-16-87	Decommissioned magazine	N	X	X	X			X	X			
16-024(p)	TA-16-70	Decommissioned magazine	N	X	X	X			X	X			
16-024(q)	TA-16-71	Decommissioned magazine	N	X	X	X			X	X			
16-024(r)	TA-16-68	Decommissioned magazine	N	X	X	X			X	X			
16-025(t)	TA-16-38	HE casting and machining	N	X	X	X	X		X	X			
16-025(w)	TA-16-81	Nitrocellulose drying	N								X	X	
16-025(y)	TA-16-55	Barium nitrate grinding	N	X	X	X			X	X			
16-025(z)	TA-16-37	HE casting	N	X	X	X		X	X	X		X	
16-025(a2)	TA-16-50	HE casting	N	X	X	X			X	X			
16-025(b2)	TA-16-52	HE casting	N	X	X	X			X	X			
16-025(c2)	TA-16-56	Physical testing lab	N	X	X	X			X	X			
16-029(v)	Sump associated with TA-16-49	HE analytical laboratory	N	X	X				X	X	X	X	
16-029(y)	Sump associated with TA-16-38	HE casting	N	X	X		X		X	X			
16-029(a2)	Sump associated with TA-16-55	Barium nitrate grinding	N	X	X				X	X	X		
16-029(b2)	Sump associated with TA-16-53	HE machining	N	X	X					X			
16-029(c2)	Sump associated with TA-16-37	HE casting	N	X	X			X	X	X	X	X	X
16-029(d2)	Sump associated with TA-16-50	HE casting	N	X	X				X	X			

TABLE 5-95 (continued)

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, GMX-2 AREA

				HE			RAD		METALS				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	CARBON-14	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-029(e2)	Sump associated with TA-16-52	HE casting	N	X	X				X	X			
16-034(m)	TA-16-86	Laboratory	N	X	X	X			X	X			
16-034(n)	TA-16-83	Laboratory	N	X	X	X			X	X			
16-034(o)	TA-16-49	Laboratory	N	X	X	X			X	X		X	
C-16-005	TA-16-53	HE machining	N	X	X	X			X	X			
C-16-069	TA-16-87	Metal machine shop	N						X			X	



Source: LANL 1989, 0425
Modified by: cARTography by A. Kron 6/3/94

Fig. 5-76. Sampling locations for the 1989 study at GMX-2.

TABLE 5-96

ANALYSES OF GMX-2 SOIL SAMPLES[a]

SAMPLE	840-7	840-8	840-9	840-10	840-11	840-12	SALs
Medium	Soil	Soil	Soil	Soil	Soil	Soil	
Units (ppm)	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]	mg/kg [b]
VOCs [a]							
Acetone	NA	12	NA	12	NA	15	8 000
Metals							
Barium	242	216	129	112	97.2	188	5 600
Beryllium [b]	1.5	1.4	1.0			1.4	0.16
Cadmium	4.5	3.7	2.9			3.2	80
Chromium	13.0	11.7	8.7	6.9	7.3	12.2	400
Copper [b]		7.9					3 000
Zinc	28.8	27.8	20.1	18.0	18.0	23.3	24 000
Radionuclides							
Thorium-232	<14 400	<12 800	<11 500	<11 300	<12 500	<14 400	880
Uranium-235	130	175		96		110	18 000
Uranium-238	<13 600	<11 200	<8 200	<11 300	<10 800	<13 100	59 000
Cobalt-56		<90					

A blank cell indicates the analyte was not detected
NA indicates that the sample was not analyzed for the analyte
[a] LANL 1989, 0425
[b] All VOCs were analyzed in one grab sample from within the three composited samples
[c] Beryllium and copper were detected in QC blanks and may be biased high
[d] All radionuclides in pCi/KgW

This aggregate is removed from the ongoing operations of the current facility; therefore, current use of the old GMX-2 area is limited.

5.20.2 Remediation Decisions and Investigation Objectives

5.20.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. The probability of contamination is low to moderate for most PRSs, since most buildings involved experimental HE work. HE in excess of 3 wt % was removed during the 1960s cleanup (Martin and Hickmott 1993, 15-16-497).

There are six PRSs where the most significant problem is not based on the potential HE contamination. Significant PCOCs for the septic system [SWMU 16-005(e)] include TNT, silver, and developing chemicals. The most significant PCOCs for the nitrocellulose drying building [SWMU 16-025(w)] are probably volatiles. The most significant PCOC for the barium nitrate grinding building and sump [SWMU 16-025(y) and SWMU 16-029(a2)] is barium. The PCOCs for the metal shop (C-16-069) include machining oils and metals.

The main drainage from S-Site flows southward in a shallow ditch located east of the GMX-2 aggregate. This drainage would integrate potential contamination from all of S-Site, and if any measurements above SALs are observed within S-Site PRSs, then sampling in the main S-Site drainage would be needed to evaluate contaminant migration. Thus, samples in the S-Site drainage would need to be collected in a Phase II survey, and Phase II is judged to be likely for some S-Site PRSs. Samples taken in the S-Site drainage would also provide a QA check of the list of PCOCs, where a detection of two times above background of a PCOC in the drainage could be used as an indicator that a PCOC is present at greater concentrations upstream of the drainage.

5.20.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.20.3 Data Needs and Data Quality Objectives

5.20.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in generic DQO Step 3 in Subsection 5.0.2.

5.20.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination are the PRS boundaries for the sumps, septic tanks, outfalls, and decommissioned buildings. It is expected that sumps and drain lines are excavated into the tuff, since the soil is shallow at S-Site, usually less than three feet deep. The depth boundary for the sumps and septic tanks is from the surface to the soil/tuff interface. Although the original location of the PCOCs at the building footprints was the soil surface (less than 6 in.), the decommissioning activities most likely redistributed or covered the PCOCs. Given the shallow soil at S-Site, the depth boundaries for surface soil will be the top 12 in. of soil, or the depth to tuff, whichever is less.

The depth boundary for samples taken in the main S-Site drainage will include the top 6 in. of soil, since materials deposited from sediment transport are of interest.

For each PRS, sampling points will be biased to areas believed most likely to contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.20.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, is applied to all PRSs in this aggregate.

5.20.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Tables 5-97 and 5-98). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Site-wide drainage sampling is designed to provide non-biased insights into the transport of any PCOCs off site. For most PRSs in GMX-2, HE was selected

TABLE 5-97

GROUPING OF GMX-2 BUILDING FOOTPRINT PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very Serious						
Serious	16-025(t) 16-025(z)	TA-16-38 TA-16-37 Casting buildings				
Not Very Serious	16-015(c) 16-015(d) 16-025(a2) 16-025(b2) C-16-005	TA-16-36 TA-16-51 Steam cleaning buildings TA-16-50 TA-16-52 Casting buildings TA-16-53 HE machining building	16-025(c2) 16-034(m) 16-034(n) 16-034(o)	TA-16-56 Physical testing laboratory TA-16-86 TA-16-83 TA-16-49 Laboratories		
Negligible	C-16-005	TA-16-55 Barium nitrate grinding	16-024(k) 16-024(l) 16-024(m) 16-024(n) 16-024(o) 16-024(p) 16-024(q) 16-024(r) 16-025(w) C16-069	TA-16-57 TA-16-72 TA-16-66 TA-16-84 TA-16-67 TA-16-70 TA-16-71 TA-16-68 Magazines TA-16-81 Nitrocellulose drying TA-16-87 Metal shop		

TABLE 5-98

GROUPING OF GMX-2 SUMP AND SEPTIC PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious	16-029(y)	TA-16-38 Sump, HE casting				
Serious	16-029(v)	TA-16-49 Sump, laboratory	16-029(a2)	TA-16-55 Sump, barium nitrate grinding		
	16-029(b2)	TA-16-53 Sump, HE machining				
	16-029(c2) 16-029(d2) 16-029(e2)	TA-16-37 TA-16-50 TA-16-52 Sump, HE casting				
Not very serious						
Negligible			16-005(e)	TA-16-179 Septic system		

to be the indicator PCOC. Three other indicator PCOCs were selected in GMX-2 PRSs: barium, BTEX, and volatiles by PID. The sump for TA-16-38 was judged to present a very serious problem, based on the report that a 700 lb chunk of HE was removed during decommissioning. Eight PRSs were judged to present a serious problem: all other sumps [SWMUs 16-029(v), 16-029(b2), 16-029(c2), 16-029(d2), 16-029(e2), 16-029(a2)], and two casting buildings [SWMUs 16-025(t), 16-025(z). The problem at these PRSs was serious due to the large original HE source and the likely residual HE remaining after decommissioning. The footprints of SWMUs 16-015(c), 16-015(d), 16-025(a2), 16-025(b2), and C-16-005 were judged to be not very serious because these buildings were laboratory-scale rather than production-scale facilities. The physical testing laboratory [SWMU 16-025(c2)], and the laboratories [SWMUs 16-034(m), 16-034(n), 16-034(o)] were PRSs judged to pose a not very serious problem due to a small original HE source term. The remainder of the PRSs posed a negligible risk of contamination due to a small original source term, the size of the PRSs, and the likely effectiveness of the cleanup during decommissioning.

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of the indicator PCOC within the PRS, and the subsequent redistribution of the indicator PCOC by the decommissioning activities and weathering of the soil. All sumps, except for the barium nitrate grinding facility sump [PRS 16-029(a2)] were considered to be heterogeneous due to the variation likely to be present along the vitrified clay drain lines associated with the sumps. The barium nitrate grinding facility sump was judged to be not very heterogeneous. Any contamination at footprint SWMUs 16-015(c), 16-015(d), 16-025(a2), 16-025(b), and C-16-005 is likely to be due to leaks and, hence, be very heterogeneous. The mixing of PCOCs during decommissioning activities and the intermediate size of the remaining footprint PRS lead to the conclusion that PCOCs would be distributed not very heterogeneously, with the exception of two casting buildings [PRS 16-025(t), PRS 16-025(z)], and the barium nitrate building (C-16-005). The large casting buildings were assumed to be very heterogeneous.

The information on the severity and heterogeneity of the indicator PCOC was used to estimate the probability of observing a concentration less than SALs (Tables 5-99 and 5-100).

TABLE 5-99

SAMPLING PARAMETERS FOR GMX-3 BUILDING FOOTPRINTS PRSs

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-025(t) 16-025(z)	HE	80%	3
16-015(c) 16-015(d) 16-025(a2) 16-025(b2) C-16-005	HE	95	2
16-025(c2) 16-034(m) 16-034(n) 16-034(o)	HE	98	1
16-025(y)	Barium	99	1
16-024(k) 16-024(l) 16-024(m) 16-024(n) 16-024(o) 16-024(p) 16-024(q) 16-024(r)	HE	99	0-1
16-025(w)	Volatiles - PID	99	1
C16-069	BTEX	99	1

TABLE 5-100

SAMPLING PARAMETERS FOR SUMP, SEPTIC TANK, AND OUTFALL PRSs

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-029(y)	HE	50%	4
16-029(v) 16-029(b2) 16-029(c2) 16-029(d2) 16-029(e2)	HE	90	5
16-029(a2)	Barium	90	3
16-005(e)	HE	99	1

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Mapping from orthocorrected aerial photographs will allow accurate (+/- 2 ft) location of building footprints and many of the sumps. However, field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas. Field screening points were selected for each PRS to provide adequate coverage of each PRS, again considering both the likely heterogeneity of the PRS and the potential severity of contamination in the PRS.

The sampling plan in the main S-Site drainage will be based on qualitative criteria. The design is based on sampling every 200 ft down the drainage starting at the road north of the GMX-2 area and ending 1 200 ft downstream.

5.20.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-101. Appropriate health and safety precautions will be undertaken according to the site-specific Health and Safety Plan. Sampling numbers and required analyses are shown in Table 5-102.

TABLE 5-101

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for the Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

TABLE 5-102

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR GMX-2

		LABORATORY SAMPLES							FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
PRS	PRS TYPE	SAMPLED MEDIA	STRUCTURE	FIELD DUP	SURFACE	FIELD DUP	SUBSURFACE	FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	BTEX	BARIUM - LIBS	A GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	B XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	C BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	D VOA (SW 8240)	E SEMIVOLATILES (SW 8270)	F METALS (SW 6010)	G ASBESTOS	H HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-005(e)	Septic system	Soil					1			4		4												1				1	1	1		1	1
16-015(c)	Steam cleaning	Soil			2					6		6																	2	2		2	
16-015(d)	Steam cleaning	Soil			2					6		6																	2	2		2	
16-024(k)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(l)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(m)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(n)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(o)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(p)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(q)	Burned magazine	Soil			1*					4		4																	0-1	0-1		0-1	
16-024(r)	Burned building	Soil			1*					4		4																	0-1	0-1		0-1	
16-025(t)	Burned building	Soil			3	1				12		12													3				3	3		3	
16-025(w)	Burned building	Soil					1			4	4																	1	1				
16-025(y)	Burned building	Soil			1					5		5		5															1	1		1	
16-025(z)	Burned building	Soil			3					12		12												3					3	3		3	3
16-025(a2)	Burned building	Soil			2					6		6																	2	2		2	
16-025(b2)	Burned building	Soil			2					6		6																	2	2		2	
16-025(c2)	Burned building	Soil			1	1				5		5																	1	1		1	
16-029(v)	Sump	Soil					5			8		8																5	5	5		5	
16-029(y)	Sump	Soil					4	1		12		12													4				4	4		4	
16-029(a2)	Sump	Soil					3			7		7		7														3	3	3		3	

TABLE 5-102 (continued)

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR GMX-2

PRS	PRS TYPE	SAMPLED MEDIA	LABORATORY SAMPLES: STRUCTURE	FIELD DUP	SURFACE	FIELD DUP	SUBSURFACE	FIELD DUP	FIELD SCREENING #: GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	BTEX	BARIUM - LIBS	GEOLOGICAL CHARACTERIZATION (A)	FIELD: GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF (B)	SOIL MOISTURE	LABORATORY ANALYSES: ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY (C)	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240) (D)	SEMIVOLATILES (SW 8270) (E)	METALS (SW 6010) (F)	ASBESTOS (G)	HIGH EXPLOSIVES (SW 8330) (H)	CYANIDE
16-029(b2)	Sump	Soil					5			10		10																	5	5		5	
16-029(c2)	Sump	Soil					5			18		18												5				5	5	5		5	
16-029(d2)	Sump	Soil					5	1		16		16																	5	5		5	
16-029(e2)	Sump	Soil					5			24		24																	5	5		5	
16-034(m)	Soil contamination	Soil			1					5		5																	1	1		1	
16-034(n)	Soil contamination	Soil			1					5		5																	1	1		1	
16-034(o)	Soil contamination	Soil			1	1				5		5																	1	1		1	
C-16-005	Soil contamination	Soil			2					6		6																	2	2		2	
C-16-069	Trailer site	Soil			1					4		4	4																1	1			
Drainage					6					6		6											6	6	6	6			6	6		6	6

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
= The actual number of samples will depend on the depth of the cores.
A, B, C = not applicable; D = full suite VOA samples will be analyzed from the bottom half of surface cores; E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc); H = full suite.
* Laboratory samples are contingent on positive field screening samples.

5.20.4.1 Engineering Surveys

The PRSs composing this aggregate will be field-surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all building locations will be accurately located (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. Subsurface structures will be located using period engineering drawing and field observations when indications of such structures are not visible on aerial photographs. In the field, the engineering survey will locate, stake, and document the location of each PRS, each point for field screening and sampling, and the main drainages exiting S-Site. Geomorphic sediment mapping will be completed in the drainage. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.20.4.2 Sampling

All samples will be field-screened for HE by spot test and radionuclides by gross beta-gamma. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using the following prioritized biasing scheme: 1) samples with positive HE spot test readings, 2) samples with above-background radiation readings (two times background or more), and 3) samples biased as described below on a PRS-specific basis. In cases where more field-screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to the potential source of contamination in an individual PRS to better limit the PCOC list for a PRS. In the absence of positive field screening readings, the subsurface sample submitted for laboratory analysis will represent the soil-tuff interface for any individual core.

All surface samples will be taken to a 12 in. maximum depth unless otherwise indicated. At least 300 ml of soil will be collected from each surface sample. Each subsurface core will be augered to the soil-tuff interface. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-102. Field-screening locations are shown in Figs. 5-77, 5-78, and 5-79.

5.20.4.2.1 Surface Sampling

SWMUs 16-025(t), 16-025(z). The sampling of footprints of former casting buildings TA-16-38 and TA-16-37 is designed to detect surface HE contamination in a region of presumed heterogeneous soil contamination of likely moderate to high level. Twelve field screening samples within each building footprint will be taken as shown on Figs. 5-78 and 5-79, in order to choose three samples for laboratory analysis. In the absence of field screening indicators, or if fewer than three samples show field indications of contamination, the three samples will be taken in the following order: 1) one near the former primary door of each building; 2) one near the center of the footprint; and, 3) one chosen at random from within the screened samples. If more than three samples yield positive indicators, select the laboratory samples at random from within the positive samples.

SWMUs 16-015(c), 16-015(d), 16-025(a2), 16-025(b2), C-16-005. The sampling of these two steam cleaning building footprint SWMUs, two casting building footprint SWMUs, and one machining building footprint SWMU is designed to detect surface HE contamination of heterogeneous soil at the former sites of these buildings, where the likelihood of contamination is moderate. Therefore, six field screening samples will be taken in each building footprint to choose two laboratory samples for analysis for each SWMU. The field screening samples will be taken as shown on Figs. 5-77, 5-78, and 5-79. In the absence of positive field-screening results, or in a case where fewer than two positive values occur, the additional laboratory samples will be chosen using the following order: 1) near the door of the HE processing area; and 2) near the center of the

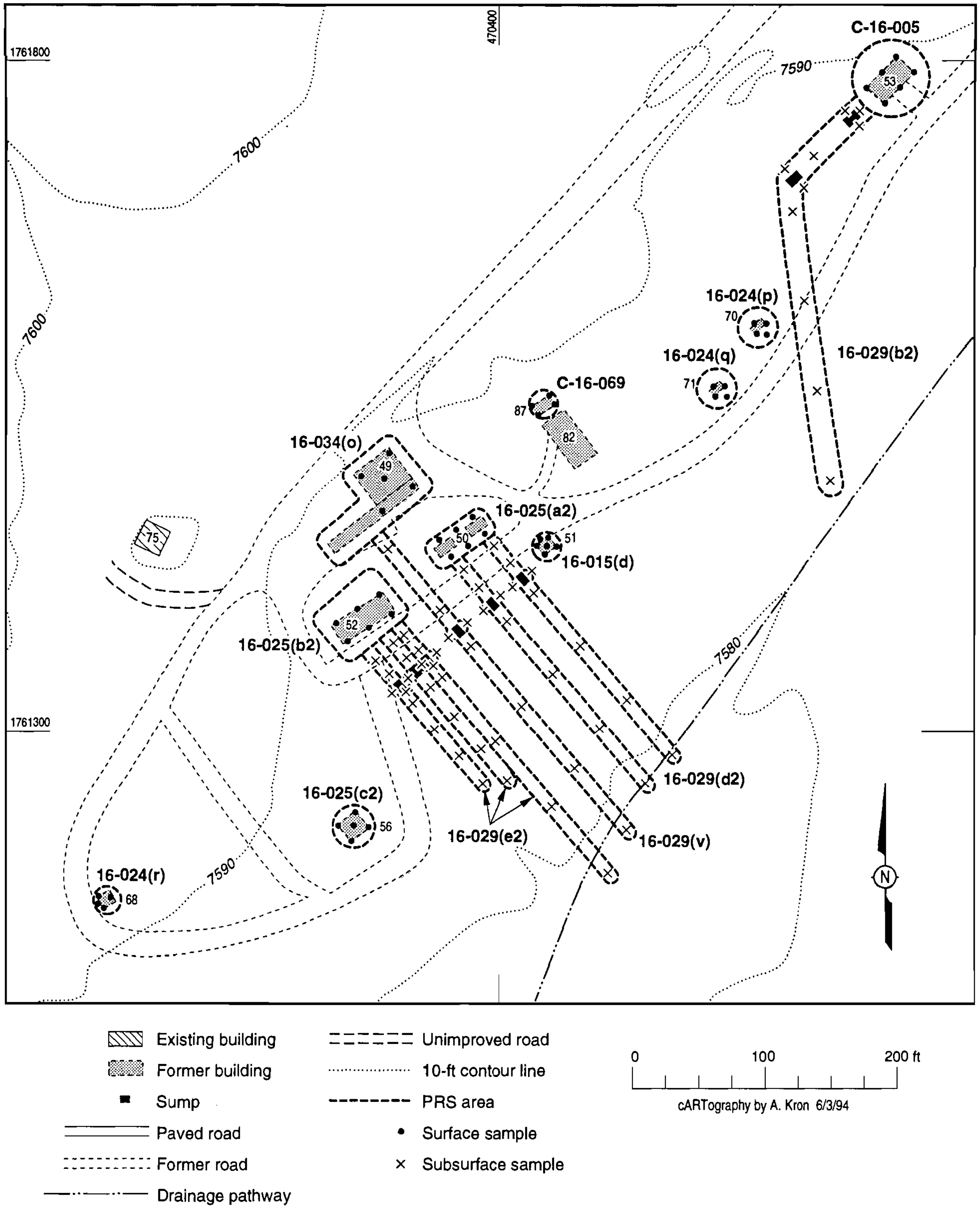


Fig. 5-77. Sampling locations at GMX-2 south.

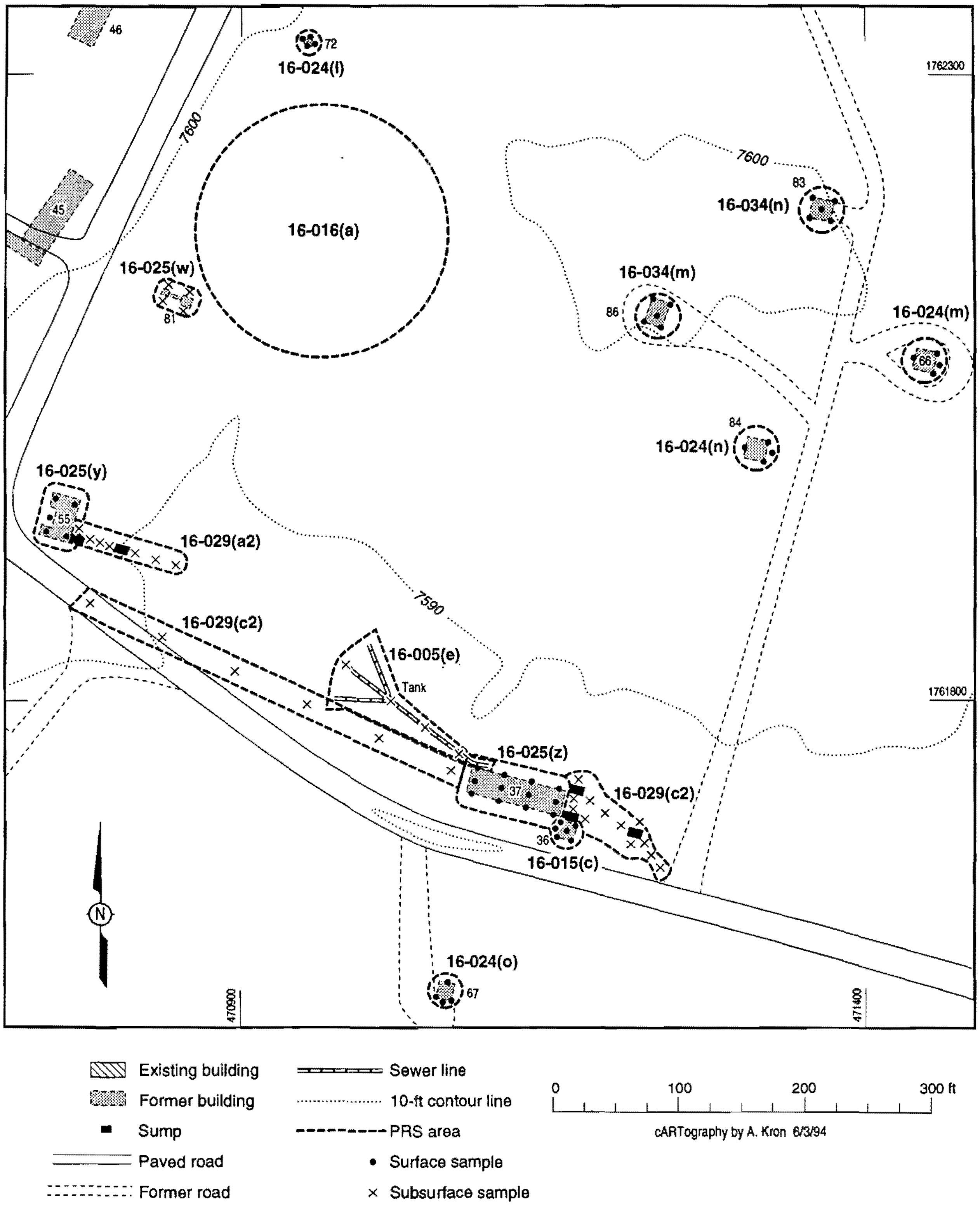


Fig. 5-78. Sampling locations at GMX-2 east.

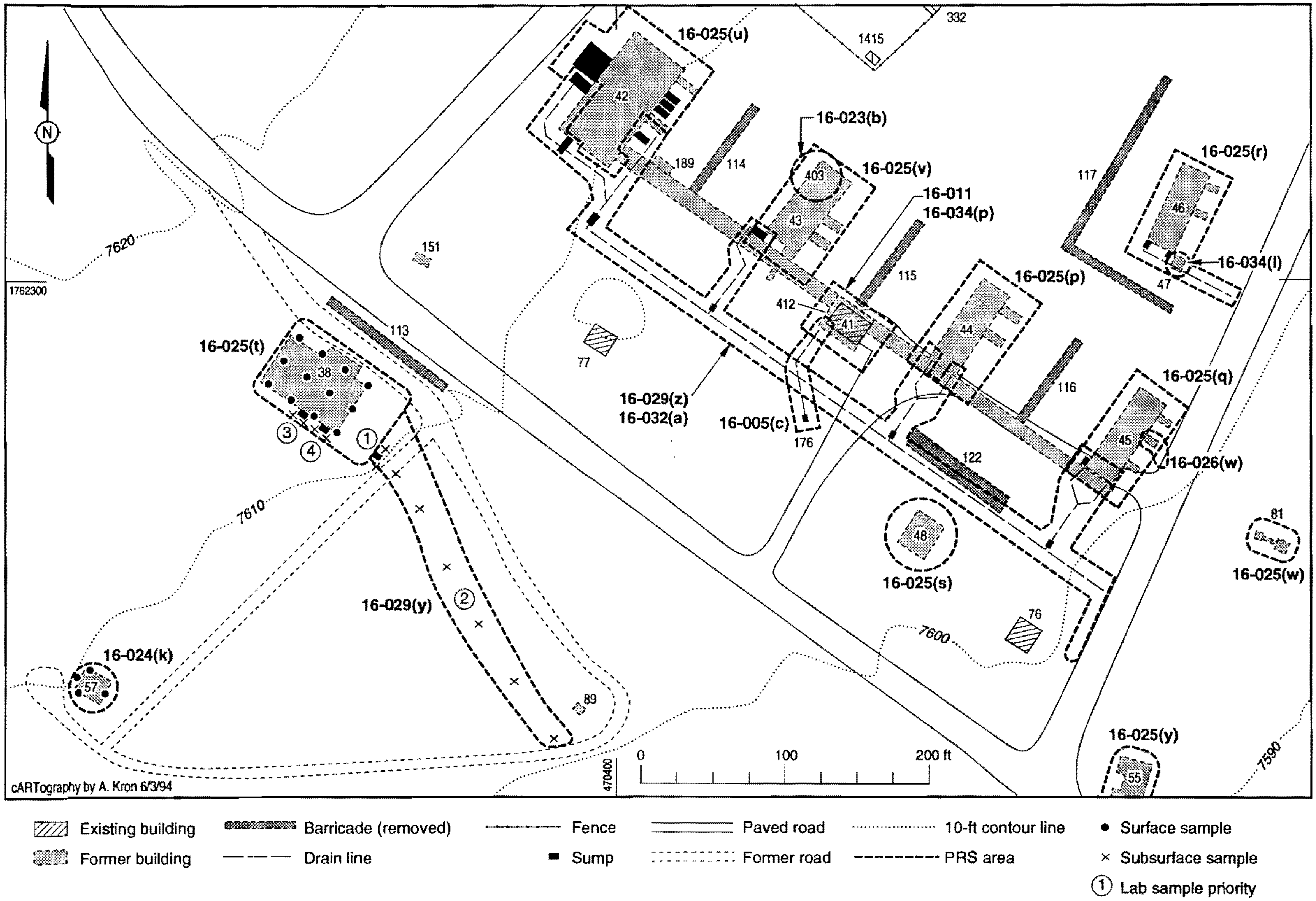


Fig. 5-79. Sampling locations at GMX-2 west.

building. If more than two field screening samples yield positive values, select the laboratory samples at random from within the positive screening samples and use the other positive samples to help design Phase II sampling plans.

SWMU 16-025(c2), 16-034(m), 16-034(n), and 16-034(o). The sampling for these four laboratory building footprint SWMUs is designed to detect surface HE contamination of heterogeneous soil with minimal likely severity of potential contamination. Therefore, in each building footprint five field screening samples will be taken to choose one laboratory sample for analysis. The field screening samples will be taken in the four quarters and center of each SWMU (Figs. 5-77 and 5-78). In the absence of screening indicators, or if fewer than one sample provides positive screening indicators, each SWMU will be sampled for laboratory analysis in its center. In cases where more than one sample yields a positive field screening indicator, choose the laboratory samples randomly from these positive samples, and use the other positive samples to help design the Phase II sampling plan.

SWMU 16-025(y). The sampling for the barium nitrate grinding facility footprint SWMU is designed to detect surface barium contamination of heterogeneous soil at a site with potential contamination of minimal severity. Therefore, in the building footprint five field screening samples will be taken to choose one laboratory sample for analysis (Fig. 5-78). The samples will be screened for barium by LIBS or XRF as well as the techniques described above. The field screening samples will be taken in the four quarters of the SWMU, and adjacent to the known location of the door of the structure (Fig. 5-78). The highest barium sample will be chosen for laboratory analysis and other positive indicators will be used in designing Phase II sampling.

SWMUs 16-024(k), 16-024(l), 16-024(m), 16-024(n), 16-024(o), 16-024(p), 16-024(q), 16-024(r). The sampling of these eight decommissioned magazines is designed to detect residual HE on the disturbed surfaces of these SWMUs. Within each SWMU, four surface samples will be field screened, as described above, in order to select at most a single sample for laboratory analysis for each SWMU. The four field screening samples will be located in two of the four quadrants of each building, on the side of the footprint opposite the door, and one foot downgradient from the door of each structure (Figs. 5-77, 5-78, 5-79). A laboratory sample will be taken if any screening sample yields a positive screening reading. If all field screening samples are negative, take no laboratory sample. If more than one sample yields a positive reading, select the laboratory sample at random from within the positive samples and use the other positive samples to help design the Phase II investigation.

C-16-069. The sampling of the machine shop trailer is designed to detect residual petroleum hydrocarbons within the boundary of the PRS. One surface sample will be taken from each of the four quadrants of the former location of the structure and will be screened for BTEX (Fig. 5-77). The screening will be done at the bottom of each 12 in. sample. The highest positive screening sample by BTEX will be sent for laboratory analysis. The screening samples will be biased to any oil-stained locations observed during the field survey. In the absence of a positive field screening observation, a sample will be selected at random to be submitted to the laboratory.

5.20.4.2.2 Subsurface Samples

All subsurface samples will be cored to the tuff/fill interface.

SWMU 16-029(y). The objective of sampling the two sumps, one secondary sump, and adjacent drain lines for TA-16-38 is to detect residual subsurface HE within the boundaries of the SWMU. Twelve field screening subsurface samples will be used to select four samples for laboratory analysis. Two field screening samples will be taken adjacent to each sump and the secondary sump (Fig. 5-79). Six samples will be taken in the east-west drainage for TA-16-38. In the absence of positive field screening results, or if one to three positive screening hits occur, take one laboratory sample at random at each sump and one at random within the drain line. Rank these samples in the order shown on Fig. 5-79. In the case that more than four samples yield a positive reading, take the westernmost positive samples because PCOC concentrations are likely to be highest near the building and use the additional results in the design of Phase II sampling.

SWMUs 16-029(v), 16-029(b2), 16-029(c2), 16-029(d2), 16-029(e2). The objective of sampling the former locations of sumps, drain lines, and outfalls associated with TA-16-49, TA-16-53, TA-16-37, TA-16-50, and TA-16-52 is to detect subsurface and surface residual HE within the boundaries of each SWMU. For each SWMU eight to twenty-four field screening samples will be used to select five laboratory samples for analysis. Two field screening samples will be located directly adjacent to the former location of each building's sumps, and six field screening samples will be located in each drainage (Figs. 5-77 and 5-78). This yields eight screening samples for SWMUs 16-029(v), ten for 16-029(b2), eighteen for SWMU 16-029(c2), sixteen for SWMU 16-029(d2), and twenty-four for SWMU 16-029(e2). In the absence of positive indications, or if fewer than five samples yield any positive indications in a SWMU, select the additional laboratory samples using the following locations in this order: 1) a sample near each sump; 2) a sample 20 ft downgradient from each sump; and, 3) the remaining samples chosen at random from within the screened cores. If more than five samples yield positive readings, select those nearest the former location of the buildings and use the rest to help design the Phase II sampling investigations.

SWMU 16-029(a2). The objective of sampling the sumps and drain line associated with operations in the barium nitrate grinding facility is detection of residual barium in the boundaries of the SWMU. Seven field screening samples will be used to select three laboratory samples for analysis. Two screening samples will be adjacent to each sump, and three screening samples will be located along the drain line. The disposition of those samples is shown on Fig. 5-78. Barium screening will be by field XRF or LIBS. The samples with the highest three barium values will be selected for laboratory analysis.

SWMU 16-005(e). The sampling of this decommissioned septic tank is designed to detect the presence of subsurface HE. Four subsurface cores to bedrock will be field-screened within the surveyed SWMU boundaries as described above in order to select one laboratory sample. These cores will be located at evenly spaced intervals along the SWMU (Fig. 5-78). In the absence of positive field screening indications of HE or radionuclides, the laboratory sample will be chosen at the location of the tank itself. If more than one sample yields positive screening indicators, choose the sample nearest the site of the decommissioned tank.

SWMU 16-025(w). The sampling of the nitrocellulose drying building is designed to detect residual organic compounds in the subsurface soil. One core hole to bedrock will be taken from each of the four quadrants of the former location of the structure and the highest positive screening sample by PID for volatile organics will be sent for laboratory analysis (Fig. 5-78). Only the lowest 6 in. of each core hole will be field screened. In the absence of a positive field screening observation, a sample will be selected at random to be submitted to the laboratory.

5.20.4.2.3 Drainage Samples

Six laboratory samples will be taken in the drainage to the east of the southern GMX-2 area (Fig. 5-80). These samples will be to a depth of 6 in. or the tuff interface, because the drainages have not been disturbed by decommissioning activities. These will be located due south of the road bisecting the GMX-2 area and at approximately 200 ft intervals to the south, ending just south of the road to K-Site. Samples will be taken in well-defined sediment traps, with emphasis on those traps containing clay-rich sediments.

5.20.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal radionuclide of concern is carbon-14. The principal HE of concern are TNT and RDX and the principal HE byproducts of concern are DNT, TNB, and DNB. The principal metals of concern are barium and silver.

5.20.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-102.

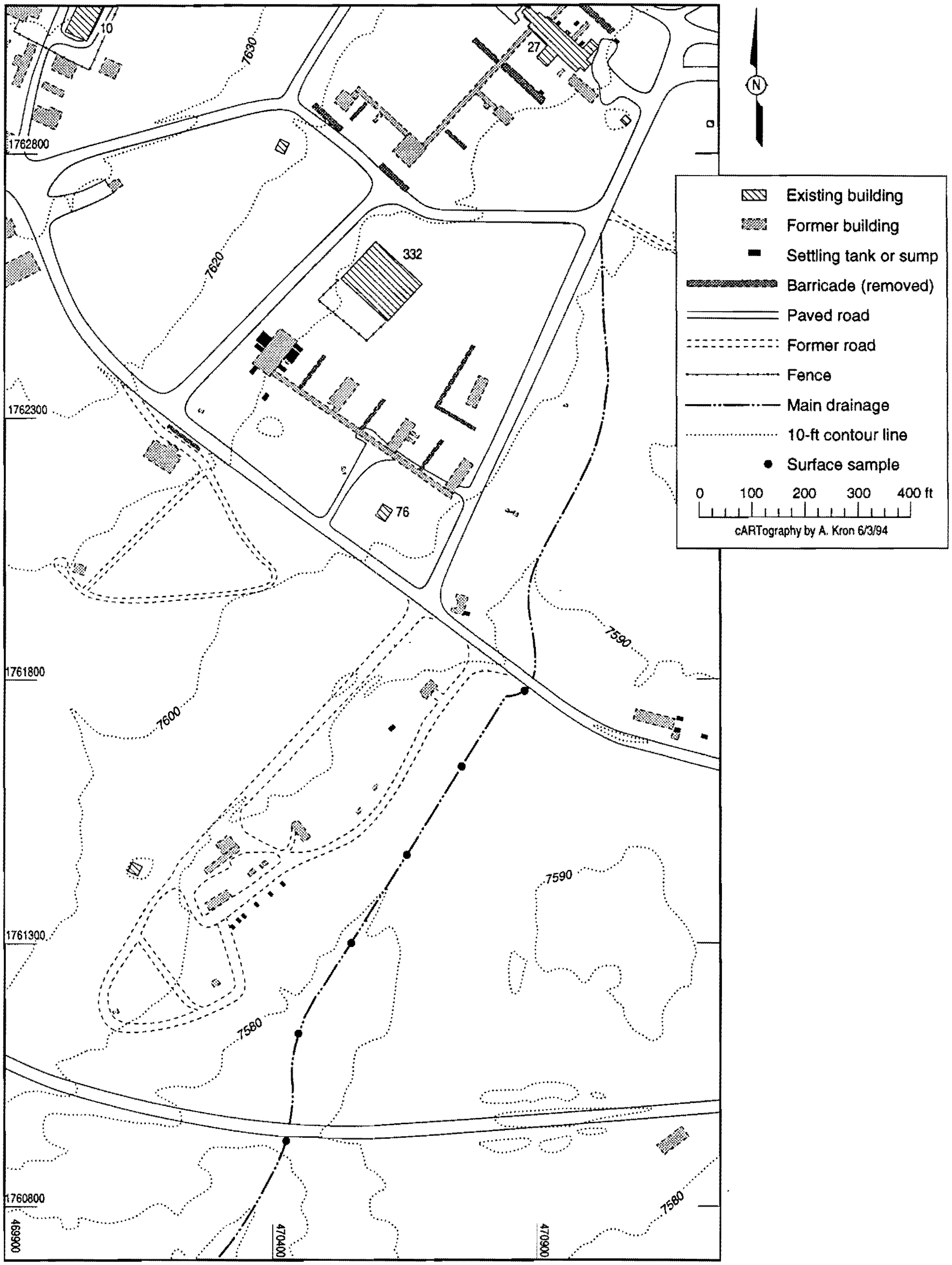


Fig. 5-80. Sampling locations for the main drainage, south.

5.21 Administration Area

5.21.1 Background

The PRSs in the administration area are aggregated as a result of their common geographical location. They may be considered together in a future baseline risk assessment. Most of the AOCs located within the administration area are proposed for no further action (NFA) in Chapter 6. Those remaining are considered below and are listed in Table 5-103.

TABLE 5-103

SUMMARY OF ADMINISTRATION AREA PRSs

PRS	CURRENT STRUCTURE NUMBER	FORMER STRUCTURE NUMBER	DESCRIPTION	DIMENSIONS (FT)
16-015(a)	TA-16-15	S-12	Laundry	28 x 131 x 8 21.5 x 8.6 x 20.6
16-015(b)	TA-16-18	S-15	Steam wash house	16 x 20 x 11
16-026(s)	TA-16-5	NA*	Instrument shop outfall	NA
C-16-028	TA-16-5	NA	Instrument shop	25 x 40 x 9
C-16-030	TA-16-181	NA	Tank housing	8.5 x 5 x 1.6
C-16-031	TA-16-182	NA	Diesel unit building	13 x 14

* NA = not available

5.21.1.1 Description and History

The administration area is located east of Anchor Ranch Road in the western region of TA-16 (Fig. 5-81). The site is relatively level with a few scattered trees. Currently, there are only four structures remaining: TA-16-10, a warehouse enclosed by a fence; TA-16-7, a storage building; TA-16-13, a dock for unloading heavy equipment; and, TA-16-54, originally a barium nitrate grinding facility but now an office building for Group ESA-11. The area north of TA-16-10 drains to the northeast and the area south of TA-16-10 drains to the southeast.

The administration area of the World War II era S-Site complex was used by the S-Site groups (X-3, GMX-2, GMX-3) primarily for activities that did not involve HE processing, although the PRSs investigated in this subsection include the buildings in which HE was used. Construction in the administration

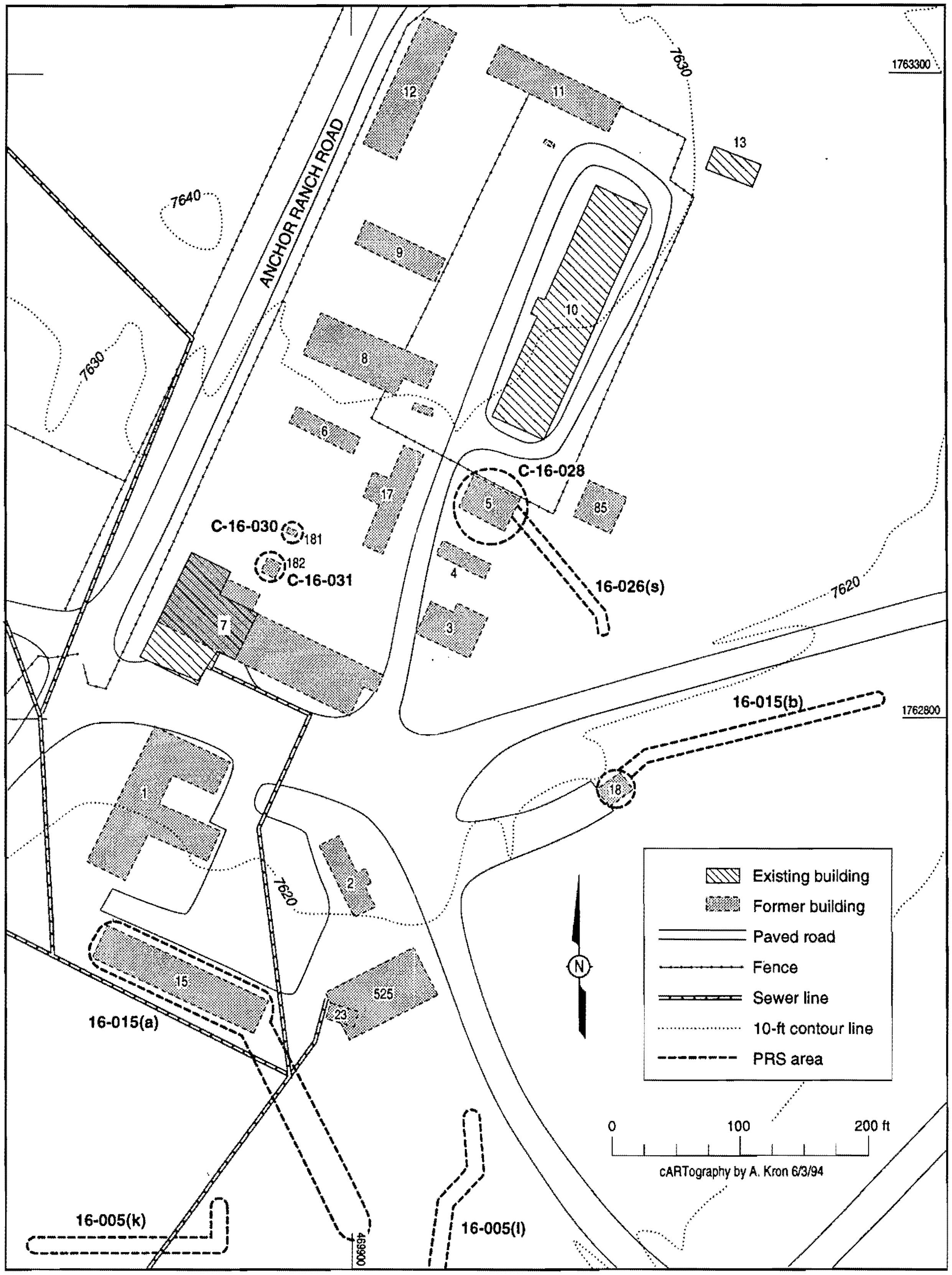


Fig. 5-81. Location of PRSs at the administration area.

area began in early 1944 with the construction of buildings TA-16-1, TA-16-2, and TA-16-7 and continued into the early 1950s. Many buildings in this area went through numerous renovations and additions throughout their periods of use. This area contained office buildings (TA-16-1 and TA-16-2), warehouses (TA-16-10, TA-16-11, and TA-16-12), a steam plant (TA-16-7), and several repair shops (e.g., TA-16-6). There were also two laundry facilities (TA-16-15 and TA-16-525), a steam cleaning building (TA-16-18), a tank housing (TA-16-181), and a diesel unit building (TA-16-182). Most of these structures were removed in 1956. The buildings were torn down, and the debris was removed.

Minimal amounts of HE were brought into the administration area; this HE was primarily residue on clothing and equipment that was cleaned or decontaminated in the administration area. For example, casting molds were washed out in the north end of TA-16-10, and this activity may have contaminated this structure with HE (Martin 1993, 15-16-477). Buildings that may have been contaminated with HE are most of the SWMUs considered in this subsection. Another PCOC associated with these structures is asbestos, which was present as shingles and as insulation on steam lines. A brief discussion of the treatment of asbestos in PRSs associated with this work plan is provided in Subsection 6.1.1.

The following SMWUs and AOCs resulted from operations at the administration area. All PRSs for which asbestos is the only PCOC are being considered in Chapter 6.

SWMU 16-015(a) contains potentially contaminated surface and subsurface soil associated with a decommissioned men's locker room and laundry facility, TA-16-15, and its associated drain line (Fig. 5-81). TA-16-15 was of wooden-frame construction and was located in the southern part of the administration area on level ground. The structure was built in June 1945 and removed in April 1956. As shown on Engineering drawing ENG-C 5661, there was a washer and dryer in the equipment room. This drawing also shows a sump discharge from the washer that leads into a 6-in. cast iron drain line. This drain line led from the southeast corner of the building and then went south into the field for an unknown distance. It is not known if the outfall was exposed on the surface (Martin 1993, 15-16-477).

According to a memo from a former site worker, HE is listed as a hazard for TA-16-15 (Blackwell 1983, 15-16-076). TA-16-15 was surveyed before demolition to assess the safety of removing the structure and the drain line in the floor, which may have been contaminated with HE (Burch 1956, 15-16-237). It was also recommended that this line should be plugged and left in the ground. Since workers' HE-contaminated clothing was laundered in this building, it is reasonable to believe that HE residues were present in the drains (Martin and Hickmott 1993, 15-16-498).

SWMU 16-015(b) contains potentially contaminated surface and subsurface soil associated with a decommissioned steam washing house, TA-16-18, and its associated drain field. It was located to the east of TA-16-1 on level ground (Fig. 5-81). The building was of wooden-frame construction with a concrete foundation and floor. TA-16-18 was constructed in 1945 and burned in place in 1960.

TA-16-18 was originally used for steam cleaning machinery and was later used by the Zia Company for storing drums of motor oil. An outfall was associated with a drain from the north side of the building. There was a concrete trough from the building that extended approximately 23 ft to the northeast. From there, an underground drain line ran east for 188 ft (ENG-R 868). This drain line was removed in July 1966, six years after TA-16-18 was burned. Chunks of HE were visible in photographs (LASL 66-5590) showing the removal of the drain line. In addition, a memo from LASL engineering suggests that TA-16-18 was contaminated with HE prior to removal of the building (Engineering Department 1957, 15-16-479).

SWMU 16-026(s) contains potentially contaminated surface soil in a drainage from an inactive outfall associated with TA-16-5, an instrument shop (see C-16-028 below). The outfall originated from the east corner of the building and drained roughly 100 ft to the southeast of TA-16-5. The end of the outfall shows two 4-in. vitreous clay pipes emptying into the drainage; the source of one of the pipes is unknown.

Although TA-16-5 was removed in 1956, the presence of the outfall pipe would indicate that the drain line was never removed. Because oils and solvents were used in TA-16-5, contamination of the outfall is possible.

C-16-028 is the former location of an instrument shop, TA-16-5. It was constructed in 1945 and removed in 1956 (LANL 1989, 15-16-363). TA-16-5 had a wooden frame construction and was located 50 ft south of TA-16-10. TA-16-5 was used to repair instruments such as gauges (Martin 1993, 15-16-477). A former site worker claimed that there were no hazards associated with the building (Blackwell 1983, 15-16-076), although the building probably had asbestos shingles. TA-16-5 also has an inactive outfall [SWMU 16-026(s)] associated with it. Contamination from oils and solvents or metals used in the instrument shop could have occurred.

C-16-030 and C-16-031 contain potentially contaminated surface soil associated with decommissioned tank housing (TA-16-181) and diesel unit building (TA-16-182), respectively. They were located within 20 ft of each other, roughly 40 ft northeast of TA-16-7 (Fig. 5-81) on level ground. The diesel unit building was of wooden construction and the nearby tank housing was concrete and partially buried (1.5 ft) in the soil. It is likely that the fuel for the diesel unit was stored in a tank located within the tank housing.

The diesel unit building was completed in March 1944 and the tank housing was added in May 1948. Both structures were removed in March 1956. A former site worker (Blackwell 1983, 15-16-076) stated that no hazardous materials were expected at these buildings.

5.21.1.2 Conceptual Exposure Model

The conceptual exposure model for the administration area is presented in Fig. 4-9. Site specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.21.1.2.1 Nature and Extent of Contamination

The PCOCs at the administration buildings include: 1) HE, HE byproducts (barium), oils, and grease from the laundry facility and steam washing house; 2) diesel, oils, and solvents contained in the instrument shop; and, 3) asbestos shingles from the demolished buildings (Table 5-104).

Quantitative data are unavailable for these PRSs. A former site worker's memo, discussed above, states that HE contamination was present prior to

TABLE 5-104

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, ADMINISTRATION AREA

				HE			RAD	METALS			
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES
16-015(a)	TA-16-15	Laundry facility	N	X	X				X		
16-015(b)	TA-16-18	Steam wash house	N	X	X	X			X		X
16-026(s)	Outfall associated with TA-16-5	Instrument shop	N					X		X	X
C-16-028	TA-16-5	Instrument shop	N					X		X	X
C-16-030	TA-16-181	Tank housing	N					X		X	X
C-16-031	TA-16-182	Diesel unit building	N					X		X	X

removal of the laundry facility [SWMU 16-015(a)] and the steam washing house [SWMU 16-015(b)].

5.21.1.2.2 Potential Pathways and Exposure Routes

The administration area consists of removed buildings, drain lines, and outfalls; therefore, potential contamination may be present in surface and subsurface soils. Although solvents associated with area of concern C-16-028 could have volatilized into the atmosphere, it is possible that releases may have reached the subsurface. The land in this region is fairly flat with drainage flowing southeast and eventually discharging into the main drainage ditch.

Current human receptors are limited to on-site workers. Chapter 4 of this RFI work plan contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.21.2 Remediation Decisions and Investigation Objectives

5.21.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2.

5.21.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 3 in Subsection 5.0.2.

5.21.3 Data Needs and Data Quality Objectives

5.21.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in generic DQO Step 3 in Subsection 5.0.2.

5.21.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries for the decommissioned structures in the administration area will be defined by the SWMU boundaries and include the soil to a depth of 12 in. or to the soil/tuff interface, whichever is less for surface samples. This depth is based on the likely mixing of constituents present on the soil surface (top few inches) during decommissioning. Subsurface samples will be from the surface to the soil-tuff interface.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.21.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, applies to the PRSs in this aggregate.

5.21.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-105). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that both can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on a HE for two PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Site-wide drainage sampling described in Subsections 5.18 and 5.20 is designed to provide non-biased insights into the transport of any PCOCs off site. The indicator PCOC at the remaining PRSs was BTEX. The steam wash house [SWMU 16-015(b)] was judged to present a very serious problem, due to the observation of HE chunks in the drain lines during decommissioning. None of the PRSs were judged to pose a serious problem. One PRS, the laundry [SWMU 16-015(a)], was judged to present a not very serious problem. The laundry may have been contaminated by HE on workers' clothing, but the original source of potential HE contamination was judged to be small. The

TABLE 5-105

GROUPING OF ADMINISTRATION PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious	16-015(b)	TA-16-18 Steam washing house				
Not very serious	16-015(a)	TA-16-15 Laundry				
Negligible			16-026(s) C-16-028 C-16-030 C-16-031	TA-16-5 Instrument shop and outfall Tank housing Diesel unit building		

other four PRSs were judged to contain a negligible amount of contamination due to a small original source term and the small size of the PRSs. SWMU 16-026(s) and PRS C-16-028 will be sampled as a single decision unit, since the potential for contamination was negligible and the outfall [SWMU 16-026(s)] will be used as an indicator for contamination in the instrument building (C-16-028).

The ranking of PRSs into heterogeneity categories was made based on the size of the PRSs, the process that led to the original distribution of the PCOCs within the PRS, and the likelihood of subsequent redistribution of the PCOCs by the decommissioning activities and weathering of the soil. Two PRSs were assumed to be very heterogeneous. The rest were classified as not very heterogeneous because of the small size of the PRS and degree of mixing during decommissioning.

The information on the severity and heterogeneity of the PCOCs was used to estimate the probability of observing a concentration less than the SALs (Table 5-106).

TABLE 5-106

SAMPLING PARAMETERS FOR GMX-3 ADMINISTRATION AREA

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-015(a)	HE	95%	2
16-015(b)	HE	60	3
16-026(s) C-16-028	BTEX	99	1
C-16-030	BTEX	99	1*
C-16-031	BTEX	99	1*

* These samples are contingent on a positive BTEX reading.

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Mapping from orthocorrected aerial photographs will allow accurate (+/- 2 ft) location of building footprints and many of the sumps. However, field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas. Field screening points were selected for each PRS to provide adequate coverage of each PRS, again considering both the likely heterogeneity of the PRS and the potential severity of contamination in the PRS.

5.21.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-107. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan. Sampling numbers and required analyses are shown in Table 5-108.

TABLE 5-107

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for the Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

TABLE 5-108

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR THE ADMINISTRATION AREA

			LABORATORY SAMPLES						FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
															A					B				C				D	E	F	G	H	
PRS	PRS TYPE	SAMPLED MEDIA	STRUCTURE	FIELD DUP	SURFACE	FIELD DUP	SUBSURFACE	FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	BTEX	HE SPOT TEST	GEOPHYSICS SURFACE	BARIUM - LIBS	GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	METALS (SW 6010)	ASBESTOS	HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-015(a)	Laundry	Soil					2***					10																	2	2		2	
16-015(b)	Steam washing	Soil					3***	1				13																	3	3		3	
16-026(s)	Outfall	Soil					1																					1	1	1			
C-16-028*	Building	Soil																															
C-16-030**	Tank housing	Soil					1				5																	1	1	1			
C-16-031**	Diesel unit building	Soil					1				5																	1	1	1			

* The sampling of C-16-028 is considered with 16-026(s).
** Laboratory samples will be taken only if positive indicators on the BTEX test are found.
*** These PRSs include screening of both surface and subsurface samples.
# The actual number of samples will depend on the depths of the cores.
Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
A, B, C = not applicable; D = full suite; E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc); H = full suite.

5.21.4.1 Engineering Surveys

The PRSs composing this aggregate will be field surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all building locations will be accurately located (within 2 ft) on a FIMAD base map by orthocorrection of 1947 and 1965 aerial photographs. In the field, the engineering survey will locate, stake, and document the location of each PRS and each point for field screening and sampling. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.21.4.2 Sampling

Most samples will be field-screened for HE by spot test and a few subsurface samples will be screened for volatiles by PID or other organics by BTEX spot test. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using biasing by HE spot test. In all cases where HE spot tests are negative, samples will be biased as described below on a PRS-specific basis. In cases where more field-screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to an individual PRS's potential source to better limit the PCOC list for a PRS. In the absence of positive field screening readings on subsurface cores, the sample above the soil-tuff interface will be chosen for any individual core.

All surface samples will be taken to a maximum depth of 12 in. A sufficient volume of soil will be removed from the entire length of the core to yield 300 ml. Each subsurface core will be augered to the soil-tuff interface. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval sample will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-108. Field screening locations are shown in Fig. 5-82.

5.21.4.2.1 Subsurface Sampling

Note that the sampling for SWMU 16-015(a) and 16-015(b) includes both surface and subsurface samples.

SWMU 16-015(a). The sampling of this decommissioned laundry facility and associated drain line is designed to detect the presence of HE associated with the building footprint and drain line. Five subsurface cores to bedrock and five surface samples will be screened in the field using the HE spot test. The five subsurface screening locations are located in the footprint of the building, as observed on a 1965 aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). The five subsurface samples will be collected from the inferred location of the drain line and will be augered to bedrock. If the drain line is encountered, it will be inspected for leaks and removed. The locations of these samples are shown on Fig. 5-82. Based on the field results, two laboratory samples will be selected by using the biasing scheme described above. If HE are not detected by field screening, or if one positive screening sample is found, the additional laboratory samples will be taken at leak points if observed or 1) near the sump location and 2) at the mapped location of the outfall. If more than two samples yield positive screening values, the samples will be taken at random from the samples exhibiting positive readings.

SWMU 16-015(b). The sampling of this decommissioned steam washing facility and associated drain line is designed to detect the presence of HE associated with the building footprint and drain line. Nine subsurface cores to bedrock and four surface samples will be screened in the field using the HE spot test. Four surface screening locations will be located in the footprint of the building, as observed on a 1965 aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). Four subsurface cores will be placed in the former location of the HE sump for TA-16-18. Finally, the last five

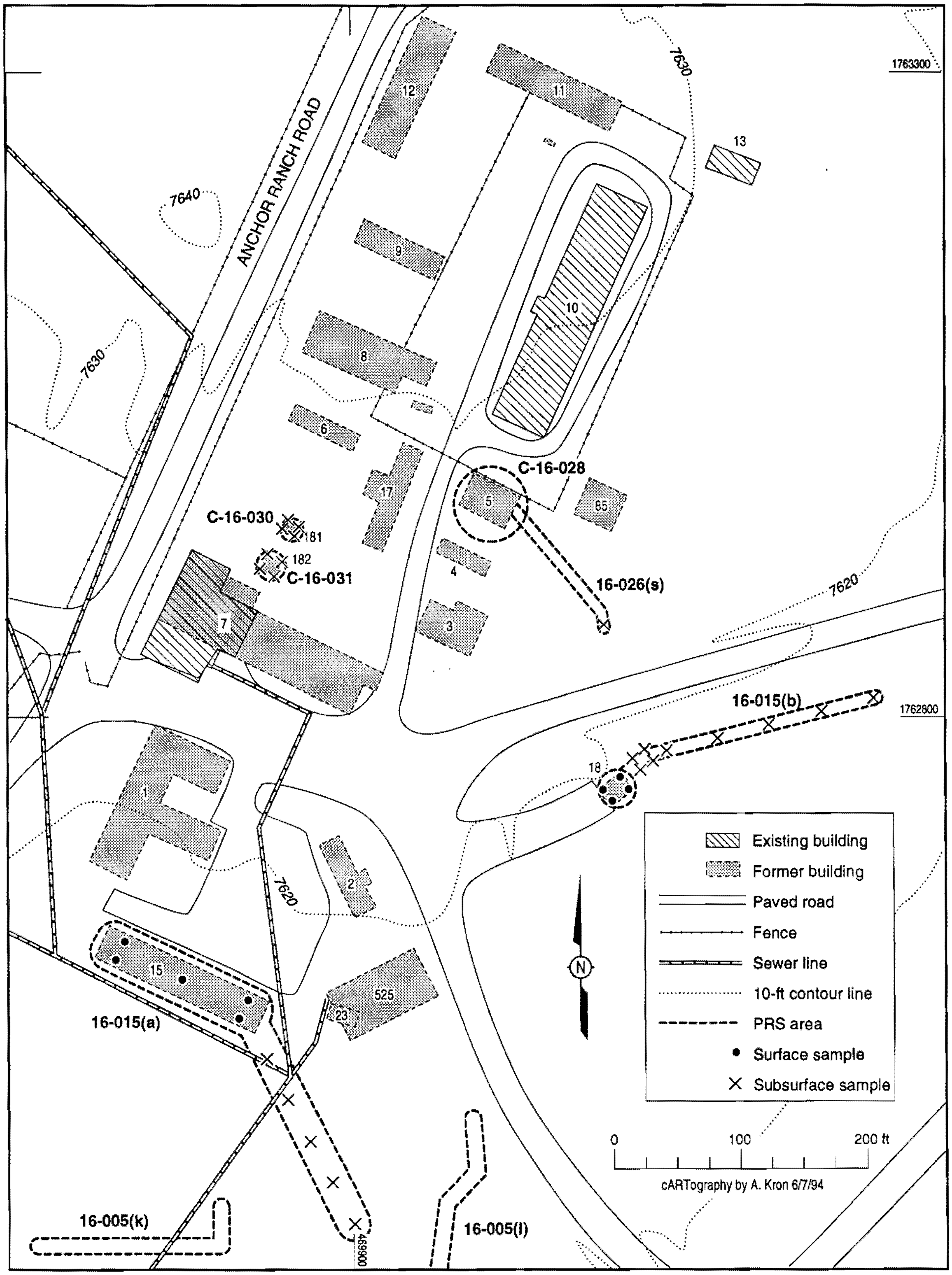


Fig. 5-82. Screening sample locations at the administration area.

subsurface samples will be evenly spaced along the inferred location of the drain line and will be augered to bedrock. The locations of these cores are shown on Fig. 5-82. Three samples will be submitted for laboratory analysis based on the field screening results. These samples will be selected at random from the expected field screening above SAL readings. Positive field screening samples not selected for laboratory analysis will be used to help design any Phase II studies. In the unlikely instance that less than three samples yield positive screening results, select the additional laboratory samples in the following order: 1) a subsurface sample near the sump; 2) a subsurface sample approximately 20 ft down the drain line from the sump; and 3) a subsurface sample from within the building footprint.

SWMUs 16-026(s) and C-16-028. The sampling of this inactive outfall is designed to detect residual oil and solvents originating from TA-16-5, an instrument shop. SWMU 16-026(s) will be used as an indicator for C-16-028. For SWMU 16-026(s), a single sample, augered to bedrock, will be taken at the mouth of the outfall (Fig. 5-82).

C-16-030 and C-16-031. The sampling of these AOCs is designed to detect residual gasoline, oil, or diesel that may have spilled in the vicinity of either the diesel unit or the nearby storage tank. For each PRS, four subsurface cores to bedrock will be screened by BTEX kit. Visible oil stained locations (Fig. 5-82) will be preferentially screened. In each PRS, the sample with the highest reading will be submitted for laboratory analysis. In the absence of a positive reading, no laboratory sample will be taken.

5.21.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), volatiles (SW 846 Method 8240) and HE and its byproducts (SW 846 Method 8330). The principal HE of concern are TNT and RDX; the principal HE byproducts of concern are DNT, TNB, and DNB; and the principal volatiles of concern are benzene, toluene, and xylene.

5.21.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples to be collected during the course of the field investigations are outlined in Table 5-108.

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5.22 Septic Tanks

5.22.1 Background

The following inactive septic systems and a grease trap have been aggregated as a result of their common construction details and sampling methods to be used. They all represent restricted areas of subsurface potential contamination. These SWMUs are listed in Table 5-109.

5.22.1.1 Description and History

SWMU 16-005(a) contains potentially contaminated subsurface soil adjacent to a decommissioned reinforced concrete septic tank, TA-16-161, with its associated drain field. This tank was built in 1945, abandoned in place in 1952, and removed in May 1967. TA-16-161 was located in the southwest region of TA-16 and drained toward Water Canyon (Fig. 5-83). The tank served TA-16-1, TA-16-2, TA-16-7, TA-16-10, TA-16-16, TA-16-22, and TA-16-525 (Engineering drawings ENG-R 868 and ENG-R 875).

TA-16-1 and TA-16-2 are both decommissioned office buildings (see C-16-021 and C-16-022 in Chapter 6). TA-16-7 was a steam plant and machine shop but is now used for storage. The steam plant part of the building was removed in 1956. The machine shop repaired equipment from around the site and, according to a former site worker, machines were decontaminated before they were sent to the shop (Martin 1993, 15-16-477). TA-16-10 was a storage building for casting molds and could possibly have introduced HE contamination into the septic system. TA-16-10 is not currently being used. TA-16-16 was a cafeteria, decommissioned in 1992. TA-16-22 was an office building, removed in 1961. TA-16-525 was a women's change house and laundry facility that was built in 1951 and demolished in 1989. TA-16-161 served the toilets, a floor drain in the equipment room, and two roof drains from TA-16-525 (ENG-C 1201). All other wastewater from this building went to the grease trap, TA-16-1137 [see SWMU 16-005(l) below].

Presently, the majority of the 6-in. vitreous clay pipeline that was connected to septic tank TA-16-161 is active and is now tied in with an intersecting line that carries sanitary waste from other buildings at the site to the TA-16 wastewater treatment plant. The line was plugged at a point just beyond the new connection at manhole TA-16-776. The section of line that connected

TABLE 5-109

SUMMARY OF SEPTIC SYSTEM COMPONENTS AND POSSIBLE SAMPLING BOUNDARIES

PRS	CURRENT STRUCTURE NUMBER	DRAIN FIELD	DRAIN LINE REMOVED	OUTFALL VISIBLE	MANHOLES	DIMENSIONS	YEAR BUILT	YEAR REMOVED
16-005(a)	TA-16-161	Yes, 1 pipe	Partially - 300 of 700 ft	No	Yes	11.5 x 13.5 x 9.5 ft	1945	1967
16-005(h)	TA-16-431	Yes	Unknown	No	No	Unknown	1952	
16-005(k)	TA-16-1132 (1&7)	Yes	Unknown	No	No	3 x 7 x 5 ft	1944	1945
16-005(l)	TA-16-525	Yes	NA	NA	Yes	NA	1945	

NA - not applicable

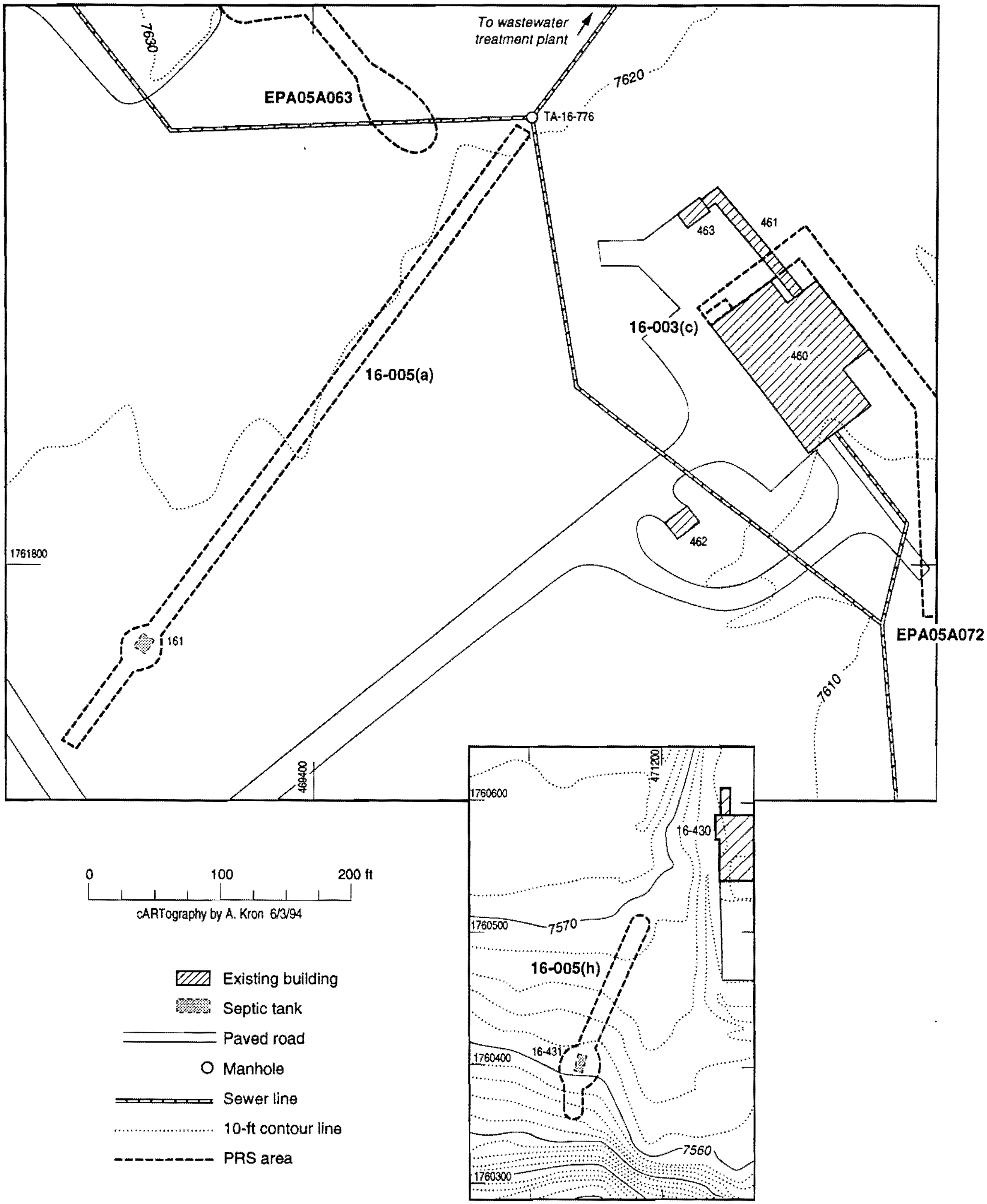

Fig. 5-83. Location of septic PRSs.

TA-16-1, TA-16-2, TA-16-10, TA-16-16, TA-16-22, and TA-16-525 to the main line is inactive. A former site worker suggested that laundry facilities were quite likely to be contaminated with HE because fairly large amounts of HE adhered to the workers' clothing (Martin 1993, 15-16-477). It is likely that TA-16-10 and TA-16-525 introduced HE contamination into the TA-16-161 septic system.

SWMU 16-005(h) contains potentially contaminated subsurface soil associated with septic tank TA-16-431 that once served HE pressing building, TA-16-430, where plastic-bonded explosives and mock HE powders were pressed into shape (Fig. 5-83). The tank was built in 1951 and was located approximately 200 ft from the southwest corner of TA-16-430 (ENG-C 8246). According to the engineering structure list, the septic tank was abandoned on completion in January 1952 and removed in 1968 (although the structure location plan implies a removal date of 1960).

However, TA-16-430 was completed in July 1951 and sanitary sewer lines were not connected to TA-16-430 until January 1952. Therefore, it is possible that the tank was in operation during the first six months that TA-16-430 was in use. Because of this discrepancy, it is likely the septic tank received sanitary or industrial waste during this time.

Septic tank TA-16-430 had an associated outfall 16-003(l), which was addressed in the first phase of the work plan for OU 1082. The PCOCs for the outfall were methyl ethyl ketone, acetone, and HE; therefore, the PCOCs for SWMU 16-005(h) are identical.

SWMU 16-005(k) contains potentially contaminated subsurface soil adjacent to decommissioned TA-16-1132. The tank was built in January 1944 and served TA-16-1, the administration building, and TA-16-7, a steam plant and machine shop (Fig. 5-84). The tank was removed in 1956 and is listed as never having received any hazardous materials. The tank was found to be free of contamination upon removal (Blackwell 1983, 15-16-076).

Septic tank TA-16-1132 was the original septic system for TA-16-1 and TA-16-7. Sewer lines from these buildings joined at manhole TA-16-784 and led to the septic tank. The tank ultimately drained 140 ft to the west into a field (ENG-C 5708). When the sewer system for septic tank TA-16-161 was

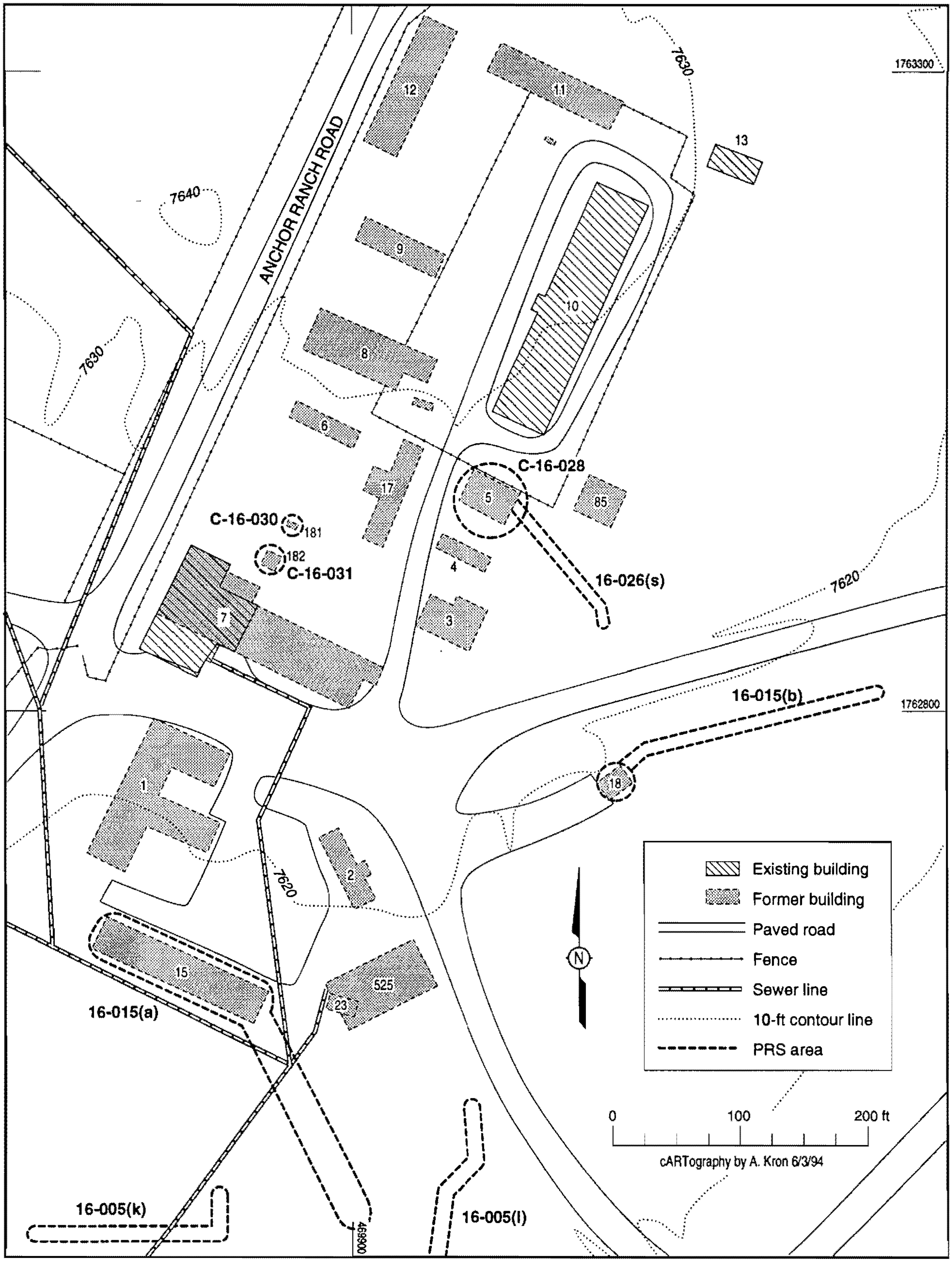

Fig. 5-84. Locations of PRSs at the administration area.

constructed in 1945, the tank was connected to manhole TA-16-784. The vitreous clay pipeline from the manhole to TA-16-1132 was then decommissioned as well as the septic tank itself. TA-16-1132 was removed in 1956.

SWMU 16-005(l) contains potentially contaminated subsurface soil adjacent to decommissioned manhole/grease trap, TA-16-1137, that served TA-16-525 the women's change house. The grease trap was located approximately 98 ft to the south of the building, next to structure TA-16-1082, which is still present (Fig. 5-84). TA-16-1137 was a 6.5 ft in diameter x 4 ft deep reinforced concrete cylinder with a steel cover that resembled a manhole. The grease trap was partially buried 5.5 ft in the ground with the top protruding 1 ft above the ground (ENG-C 1194). TA-16-1137 had a separate drain line to the southwest and then south, finally draining to an outfall ditch (ENG-C 1193 and ENG-R 875). This drainage is clearly seen in a site photo taken on May 5, 1993. The 4-in. vitreous clay pipe drain lines were located a minimum of 3 ft below the surface (ENG-C 1194). TA-16-1137 was removed; however, no date was given.

TA-16-525 was originally a women's change house with laundry facilities (ENG-R 2438). Wastewater from all showers, sinks, and all but one floor drain and two roof drains emptied into TA-16-1137. Wash water from the laundry room also drained into the grease trap (ENG-C 1201). According to a former site worker, laundries were likely to contaminate drains with HE from workers' clothing (Martin and Hickmott 1993, 15-16-498).

5.22.1.2 Conceptual Exposure Model

The conceptual exposure model for the septic tanks is presented in Fig. 4-7. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.22.1.2.1 Nature and Extent of Contamination

PCOCs that may be associated with the septic systems include: 1) metals (chromium) used in steam plants; 2) solvents and oils from the machine repair shop; and, 3) HE and byproducts from the HE machining and pressing laboratories and laundry facilities (Table 5-110). No quantitative data is available for SWMUs in this aggregate.

TABLE 5-110

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, SEPTIC TANKS

				HE			RAD	METALS			
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES
16-005(a)	Septic system TA-16-161	Steam plant, metal shop, laundry facility, HE storage	N	X	X			X	X	X	X
16-005(h)	Septic system TA-16-431	HE pressing	N	X	X				X	X	X
16-005(k)	Septic system TA-16-1132	Steam plant and machine shop	N					X		X	X
16-005(l)	Manhole/grease trap TA-16-525	Women's change house with laundry facilities	N	X	X				X		X

5.22.1.2.2 Potential Pathways and Exposure Routes

The septic systems (septic tank, drain lines, and drain fields) may have released contaminants to the surrounding subsurface soils through leaks and cracks in the pipes and structures. Potential subsurface contamination does not pose a human health risk until excavation or erosion has exposed subsurface soils to the surface. Potential surface contamination may be present as the result of discharge from the outfalls into drainages and eventual accumulation in sedimentation areas.

Current land use is restricted to on-site workers. A detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes is presented in Chapter 4.

5.22.2 Remediation Decisions and Investigation Objectives

5.22.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. This aggregate consists of decommissioned septic systems at S-Site. PCOCs include HE, metals, volatiles, and semivolatiles. The probability of contamination is low for most PRSs, with the exception of the grease trap [SWMU 16-005(l)] where HE was found during decommissioning.

5.22.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.22.3 Data Needs and Data Quality Objectives

5.22.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are identical to those presented in generic DQO Step 3 in Subsection 5.0.2.

5.22.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination for the septic systems include the surface and subsurface soil surrounding the tanks and the drain lines (Table 5-109). Some drain lines have manholes or an outfall, which can be used as indicators of PCOCs in the septic system. Only the outfalls of the septic system will be viewed as surface contamination, all other system components are viewed as subsurface contamination. The soil is shallow at S-Site, usually less than a depth of three feet. The tanks and drain lines were most likely excavated into bedrock (tuff), and the depth boundary for Phase I subsurface samples will include all soil above tuff.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.22.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, shows the decision logic for PRSs in this aggregate.

5.22.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-111). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in Addendum 1 to the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that both can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Site-wide drainage sampling, described in Subsections 5.18 and 5.20, is designed to provide non-biased insights into the transport of any PCOCs off site. For three PRSs in this aggregate, TNT was selected to be the indicator PCOC. The indicator PCOC at the remaining PRS was BTEX. No PRS was judged to present a very serious or serious problem. One PRS was judged to

TABLE 5-111

GROUPING OF SEPTIC PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF PCOCs

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious						
Not very serious	16-005(l)	TA-16-525 Grease trap				
Negligible	16-005(a) 16-005(h) 16-005(k)	TA-16-161 TA-16-431 TA-16-1132 Septic systems				

present a not very serious problem: the grease trap, SWMU 16-005(l). The grease trap was determined to be contaminated when decommissioned, and it is not known how effective the cleanup was beyond the goal of removing all HE greater than 3 wt %. The other PRSs were judged likely to pose a negligible amount of contamination due to a small original source term, the small size of the PRSs, and the likely effectiveness of the cleanup during decommissioning.

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of PCOCs within the PRS, and the subsequent redistribution of PCOCs by the decommissioning activities and weathering of the soil. All PRSs were assumed to be heterogeneous.

The information on the severity and heterogeneity of PCOCs was used to estimate the probability of observing a concentration less than SALs (Table 5-112).

TABLE 5-112

SAMPLING PARAMETERS FOR GMX-3 SEPTIC TANKS

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-005(a)	HE	99%	1
16-005(h)	HE	99	1
16-005(k)	BTEX	99	1
16-005(l)	HE	97	2

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas. Field screening points were selected for each PRS based on professional judgment, considering both the likely heterogeneity of the PRS and the potential severity of contamination in the PRS.

5.22.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-113. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan. Sampling numbers and required analyses are shown in Table 5-114.

TABLE 5-113

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for the Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

5.22.4.1 Engineering Surveys

The PRSs composing this aggregate will be field-surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all structure locations will be accurately located (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. For subsurface structures, historic engineering drawings will be used in concert with the aerial photographs to accurately locate the structures. In the field, the engineering survey will locate, stake, and document the location of each PRS and each point for field screening and sampling. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new positions will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

TABLE 5-114

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR SEPTIC TANKS

		LABORATORY SAMPLES							FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
			STRUCTURE		SURFACE		SUBSURFACE								A					B				C				D	E	F	G	H	
PRS	PRS TYPE	SAMPLED MEDIA		FIELD DUP		FIELD DUP		FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	GEOPHYSICS SURFACE	BTEX	GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	METALS (SW 6010)	ASBESTOS	HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-005(a)	Septic tank	Soil					1	1		6		6																1	1	1		1	
16-005(h)	Septic tank	Soil					1			5		5																1	1	1		1	
16-005(k)	Septic tank	Soil					1			5				5														1	1	1			
16-005(l)	Septic tank	Soil					2			5		5																	2	2		2	

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
\# = The actual number of samples will depend on the depth of the cores.
A, B, C = not applicable; D, E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc);
H = full suite.

5.22.4.2 Sampling

All samples will be field-screened for HE by spot test and a few subsurface samples will be screened for gasoline components by the BTEX spot test. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using biasing by HE spot test. In all cases where HE spot tests are negative, samples will be biased as described below on a PRS-specific basis. In cases where more field screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to the potential contaminant source in an individual PRS, to better limit the PCOC list for a PRS. In the absence of positive field screening readings, the sample above the soil-tuff interface will be chosen for any individual core.

Each subsurface core will be augered to the soil-tuff interface.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-114. Field screening locations are shown in Figs. 5-85, 5-86, and 5-87.

SWMU 16-005(a). The sampling of this large decommissioned septic tank is designed to detect the presence of HE associated with septic tank operations. Six subsurface cores to bedrock will be screened in the field using the HE spot test. Three screening locations are in the former location of septic tank TA-16-161, as observed on a 1965 aerial photo (Koogle and Pouls Engineering, Inc. 1965, 15-16-516). The other three will be placed along the inferred location of the drain line. The locations of these cores are shown on Fig. 5-85. Because wastewater was discharged to the subsurface, and is likely to accumulate at the soil-tuff interface, the subsurface field screening samples will be taken from the bottom 12 in. of each core hole. Based on the field results, one 12-in. laboratory sample will be selected by using the biasing scheme described above. If HE are not detected by field screening, the one laboratory sample will be taken in the manhole located to the north of the location of the septic tank. If more than one sample yields positive screening results, select the laboratory sample at random and use the screening data from the other samples to help design Phase II sampling.

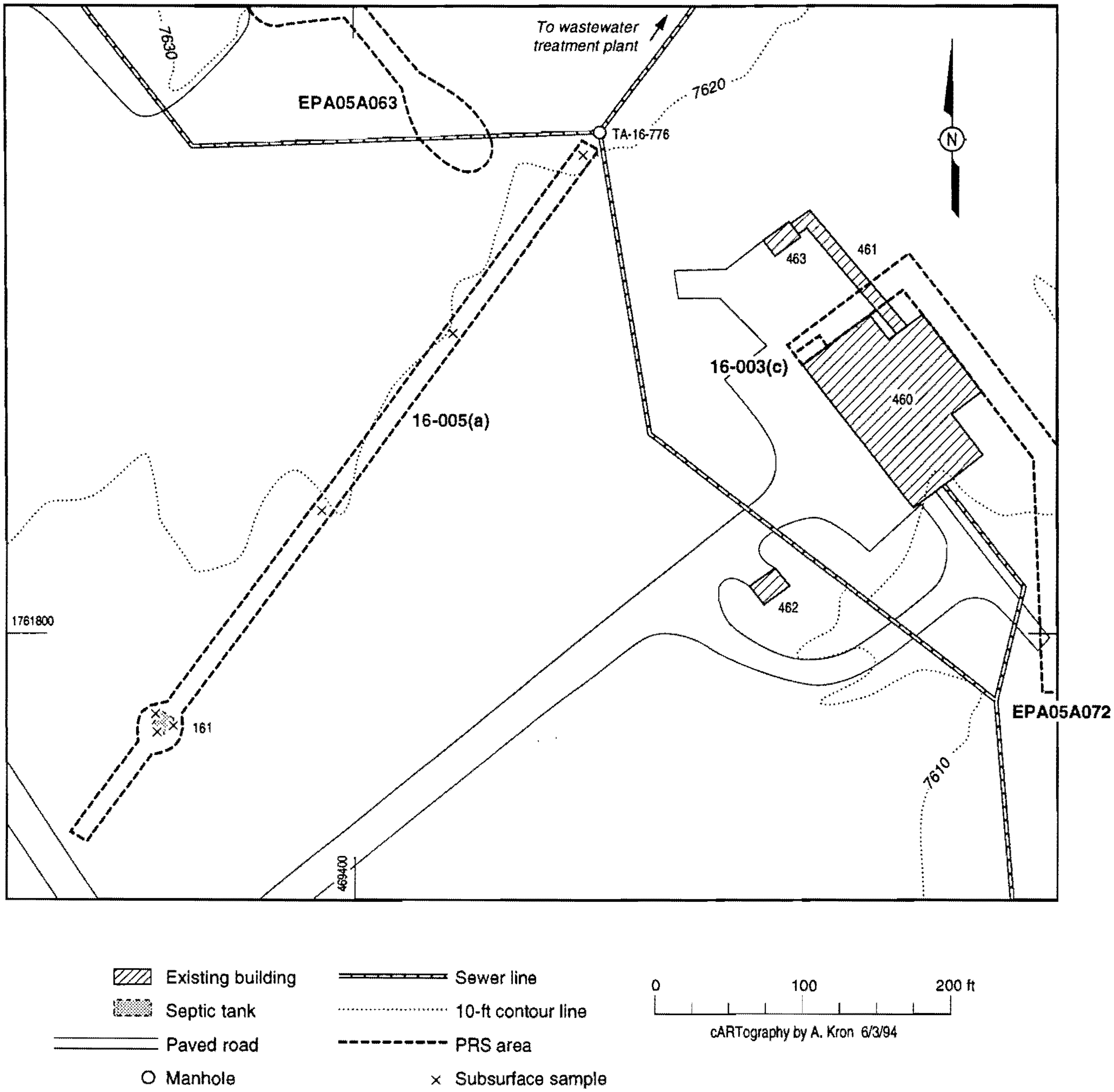

Fig. 5-85. Sampling locations for septic tank TA-16-161.

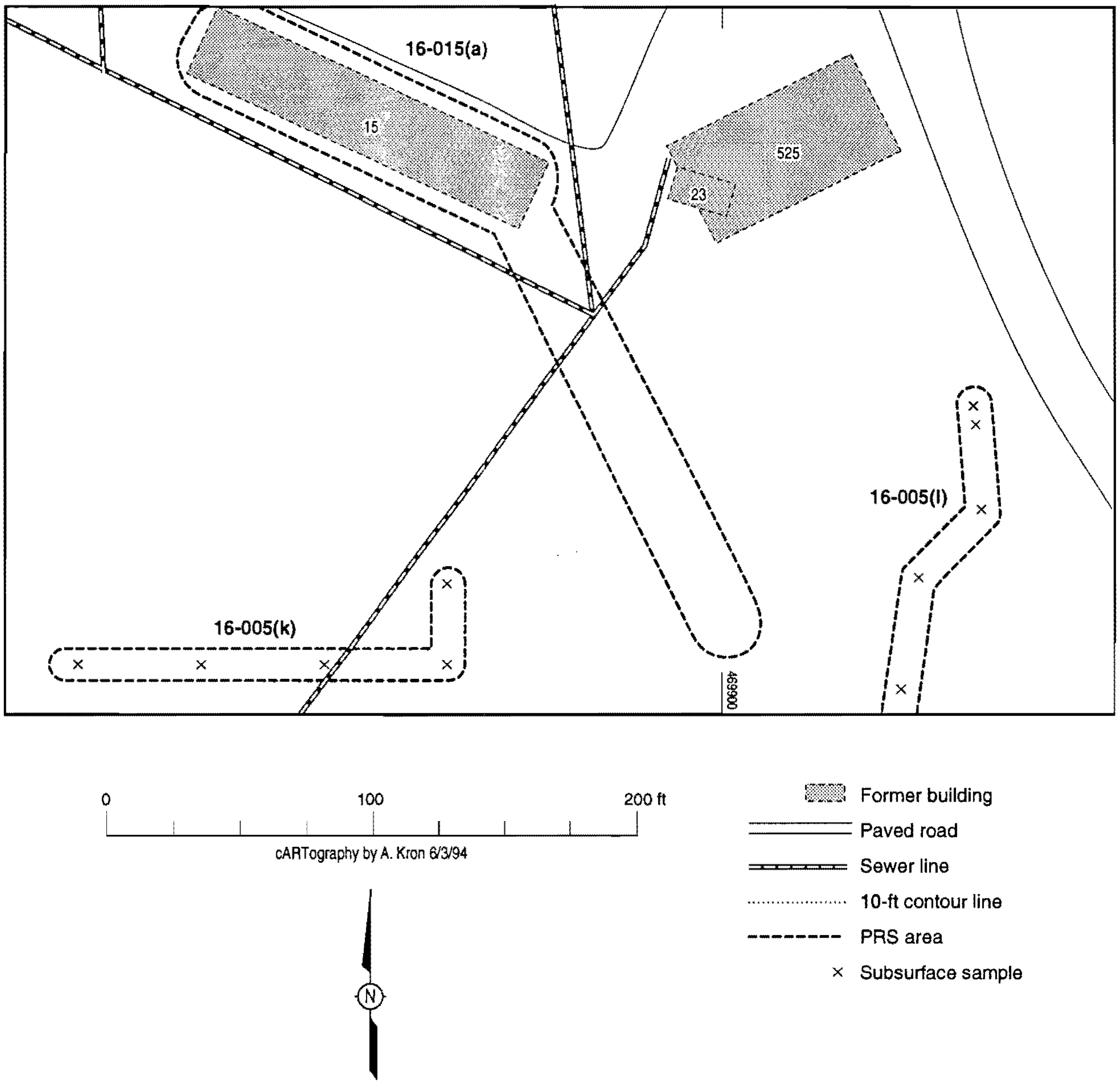

Fig. 5-86. Sampling locations for septic tanks in the administration area.

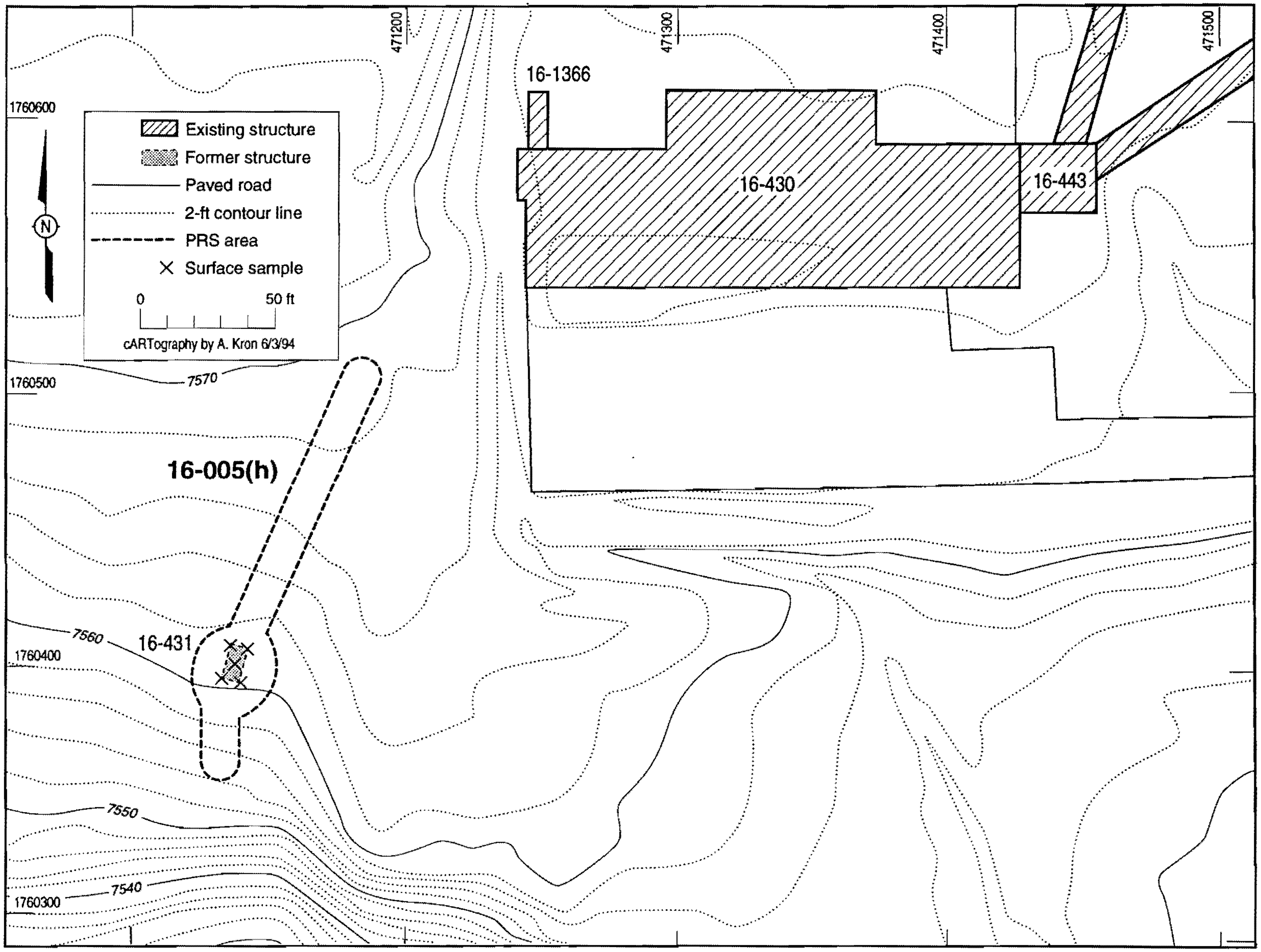

Fig. 5-87. Screening sample locations, septic tanks.

SWMU 16-005(h). The sampling of this decommissioned septic tank is designed to detect the presence of HE associated with septic tank operations. For this SWMU, five subsurface cores to bedrock will be screened in the field using the HE spot test in each tank location. These proposed screening locations are in the former location of the septic tank, which can be seen on a 1965 aerial photograph (Koogle and Pouls Engineering, Inc. 1965, 15-16-516) or as gleaned from engineering drawings. The locations of these cores are shown on Fig. 5-87. Because wastewater was discharged to the subsurface and is likely to accumulate at the soil-tuff interface, the subsurface field screening samples will be taken from the bottom 12 in. of each core hole. Based on the field results, one 12-in. laboratory sample will be selected by using the biasing scheme described above. If HE are not detected by field screening, each laboratory sample will be taken in the center of the septic tank. If more than one sample yields a positive screening result, the sample will be randomly selected from those field screening samples showing positive screening readings.

SWMU 16-005(k). The sampling of this decommissioned septic tank is designed to detect any residual petroleum hydrocarbons that may be associated with this tank. Five subsurface cores to bedrock will be screened in the field using the BTEX spot test. These screening locations (shown on Fig. 5-86) are in the former location of the septic tank, as inferred from engineering drawings. Because wastewater was discharged to the subsurface, and is likely to accumulate at the soil-tuff interface, the subsurface field screening samples will be taken from the bottom 12 in. of each core hole. Based on the field results, one 12-in. laboratory sample will be selected by using the biasing scheme described above. In the absence of positive screening indicators, the laboratory sample will be taken in the center of the septic tank. If more than one sample yields positive BTEX spot test readings, then choose the sample with the highest reading as the laboratory sample.

SWMU 16-005(l). The sampling of this decommissioned grease trap is also designed to detect HE contamination in the subsurface. Five subsurface cores to bedrock will be screened in the field using the HE spot test. These screening locations (shown on Fig. 5-86) are in the former location of the grease trap and its drain line, as inferred from engineering drawings.

Because wastewater was discharged to the subsurface and is likely to accumulate at the soil-tuff interface, the subsurface field-screening samples will be taken from the bottom 12 in. of each core hole. Based on the field results, two 12-in. laboratory samples will be selected using the biasing scheme described above. If HE are not detected by field screening, the laboratory samples will be taken at the north and south screening cores within the grease trap. If more than two samples yield positive HE readings, then choose the laboratory samples at random from among the positive field screened samples.

5.22.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), volatiles (SW 846 Method 8240), and HE and its byproducts (SW 846 Method 8330). The principal HE of concern are TNT and RDX, the principal HE byproducts of concern are DNT, TNB, and DNB.

5.22.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-114.

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5.23 Inactive Sumps and Outfalls in the GMX-3 Area

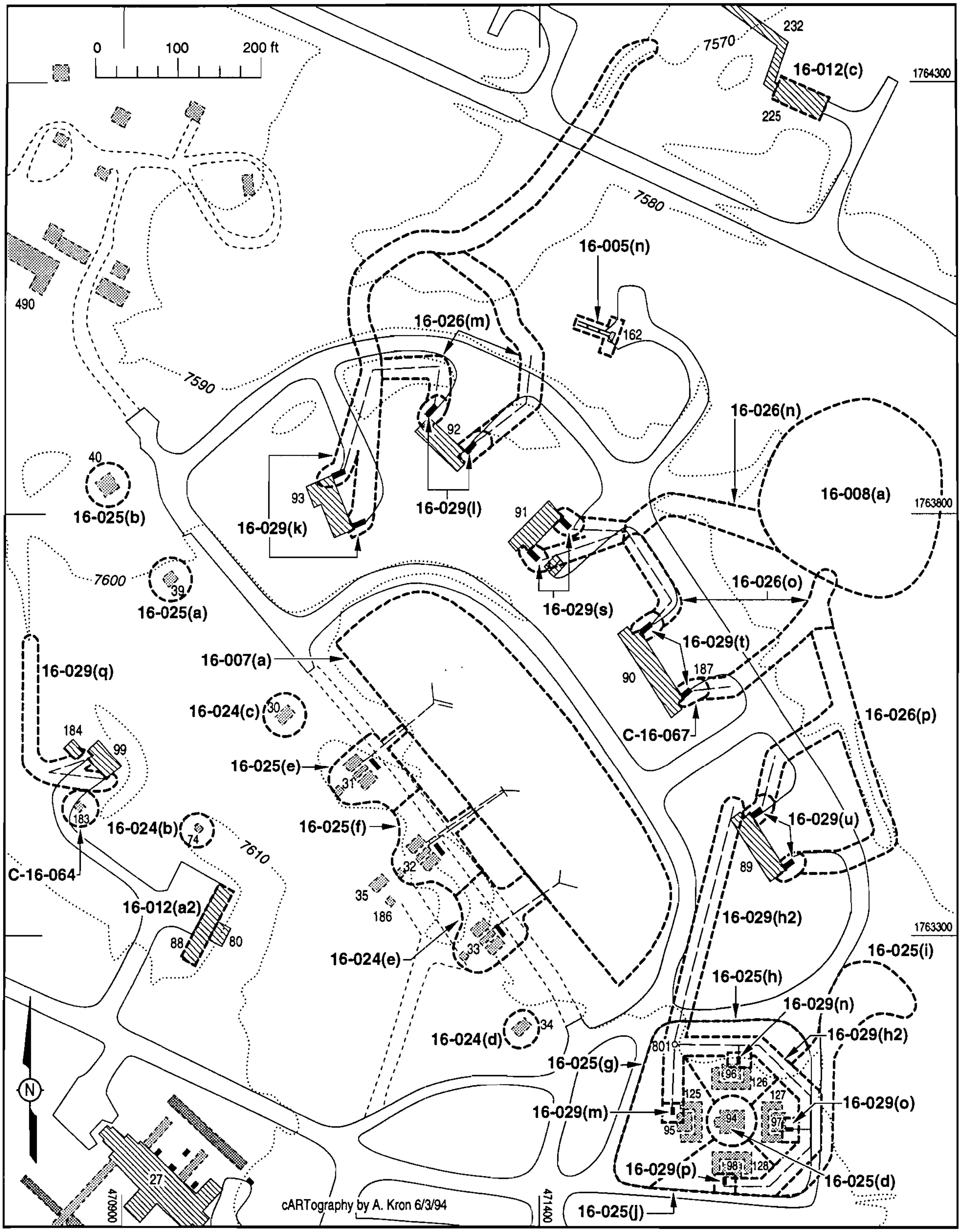
5.23.1 Background

This aggregate contains sumps and drain lines associated with TA-16-89, TA-16-90, TA-16-91, TA-16-92, TA-16-93, and TA-16-99, which were constructed after World War II. They still exist but are long inactive (Fig. 5-88). The first five buildings compose the 90s-Line. These PRSs are an aggregate because they are geographically contiguous and because their sumps are still present. Operations in all of these structures were initially part of HE processing activities in the World War II era S-Site complex. This aggregate covers only sumps and outfalls associated with these structures. The buildings with which they are associated are part of SWMU 16-017, existing World War II era buildings scheduled for decontamination and decommissioning (D&D), and are considered in Chapter 6. The sumps are attached to the buildings, and their buried drains are proposed for VCA during Phase I sampling. The D&D list does not include the aboveground outfalls beyond these sumps or the buried pipe, all of which will be treated within this RFI. Removal and cleanup through D&D will occur in the future, so sampling of the sumps and buried pipes should be done at the same time it is done for the outfalls. In most cases each building has a separate sump and outfall SWMU. In cases where a building has a single SWMU, that SWMU is defined as including both the sumps and outfalls [e.g., SWMU 16-029(k)]. The PRSs in this aggregate are listed in Table 5-115.

5.23.1.1 Description and History

All of the inactive sumps discussed in this aggregate lie in the northernmost portion of the World War II era S-Site complex (Fig. 5-88). Drainage from these SWMUs is to the north. TA-16-89, TA-16-90, and TA-16-91 sumps all drain to a pond [SWMU 16-008(a)], and TA-16-92, TA-16-93, and TA-16-99 sumps drain to a northeast drainage that empties into Cañon de Valle 600 ft north of the 90s-Line (Fig. 5-88). Unlike many of the PRSs considered in this work plan, all considered in this subsection are easily located because the structures associated with potential contamination are all present.

GMX-3 developed and used production techniques for shaped HE charges. This process involved large quantities of HE and seriously contaminated many buildings and their associated sumps and drain lines. HE production



Existing building — Former building — Barricade (removed) — Sump — Manhole — Drain line — Paved road — Former road — 10-ft contour line — PRS area

Fig. 5-88. Locations of PRSs at GMX-3, north.

TABLE 5-115

PRSs FOR INACTIVE GMX-3 STRUCTURES

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION	DIMENSIONS (FT)
16-026(m)	TA-16-92	S-101	Machining/equipment cleaning	NA
16-026(n)	TA-16-91	S-105	Machining/equipment cleaning (same as o)	NA
16-026(o)	TA-16-90	S-102	HE machining	NA
16-026(p)	TA-16-89	S-104	HE machining outfall	NA
16-029(k)	TA-16-93	S-103	Machining/plating	5 x 15
16-029(l)	TA-16-92	S-101	Machining/equipment cleaning	5 x 15
16-029(q)	TA-16-99	S-87	Sawing risers	5 x 15
16-029(s)	TA-16-91	S-105	Machining/equipment cleaning	5 x 15
16-029(t)	TA-16-90	S-102	Machining	5 x 15
16-029(u)	TA-16-89	S-104	Machining	5 x 15

operations at World War II era S-Site are discussed in greater detail in Subsection 5.18. TA-16-99, the riser sawing building associated with SWMU 16-029(q), was part of the 20s-Line operation discussed in Subsection 5.18. All other buildings associated with the SWMUs of this aggregate were originally completed in March 1950 (Engineering Structure List) for HE machining. Shortly after these buildings were constructed, the Laboratory began using HE pressing techniques rather than casting, reducing the volume of HE that was removed by machining. As a result, HE machining in the 90s-Line was at a smaller, more experimental scale than in the 30s-Line. Machining operations continued in some of these buildings for several years.

When TA-16-260 opened in 1951, many machine tools were transferred to that building. Some time after this transition, TA-16-89 and TA-16-90 were converted into storage facilities, and TA-16-91 and TA-16-92 were converted for cleaning and refurbishing HE-contaminated equipment. Operations at TA-16-92 may have resulted in uranium contamination because disassembled items may have contained uranium. TA-16-93 became an electroplating building and according to a former site worker had no real exposure to HE (Martin 1993, 15-16-477). Another former site worker suggests the electroplating was directly on HE charges (Martin and Hickmott 1993, 15-16-498). A storage platform, TA-16-191, for copper and chromium sulfates used in electroplating was located adjacent to TA-16-93. The sumps of this building are likely to have been used for the disposal of electrolytes used in plating. After 1970 all of these buildings were used for storage except TA-16-93, which was in very poor condition. They were totally abandoned by 1991.

The following SWMUs resulted from operations in TA-16-89, TA-16-90, TA-16-91, TA-16-92, TA-16-93, and TA-16-99.

SWMUs 16-026(m,n,o,p) contain potential soil contamination associated with the drain lines and outfalls for buildings TA-16-89, TA-16-90, TA-16-91, and TA-16-92. Their operations are briefly described above. Each outfall SWMU contains buried vitreous clay pipe from the sump or sumps to the road, depressions next to the road where the pipes daylight, additional vitreous clay pipe beneath the road to the north of the road, and an open air drainage channel (Fig. 5-88). In addition to effluent from the sumps, drainage for driveways, roof drains, and building environs wash into these drainages. These drains service buildings as shown in Table 5-116.

TABLE 5-116

RELATIONSHIP BETWEEN SUMPS, OUTFALLS, AND BUILDINGS

OUTFALL SWMU	SUMP SWMU	BUILDING SERVED	DESTINATION
16-026(p)	16-029(u)	TA-16-89	Pond
16-026(o)	16-029(t)	TA-16-90	Pond
16-026(n)	16-029(s)	TA-16-91	Pond
16-026(m)	16-029(l)	TA-16-92	Drainage
16-029(k)	16-029(k)	TA-16-93	Drainage
16-029(q)	16-029(q)	TA-16-99	Drainage

SWMUs 16-029(k,l,s,t,u) contain potential contamination associated with sumps for TA-16-89, TA-16-90, TA-16-91, TA-16-92, and TA-16-93. For TA-16-93, SWMU 16-029(k) also includes the drain line, outfall, and drainage because no outfall SWMU was defined for this building. Each building has two sumps, roughly 5 ft wide x 15 ft long, which received effluent from drain troughs in the concrete slab floors. The sumps are in place, filled with gravel, and have no lids. Initially, the sumps contained filter baskets, but later were converted to the modern variety of sump (see Subsection 5.2), which is cleaned by vacuuming (Martin 1993, 15-16-477). The sumps for TA-16-92 were remodeled in 1967 to aid the machine cleaning operations, but all sumps were inactive by 1970 [Thrap 1970, 15-16-001]. Drain lines from the sumps will usually be treated as part of the outfalls, which are described above. Operational effluents for these buildings were listed as effectively negligible in 1971 (Panowski and Salgado 1971, 15-16-038) except from TA-16-92, which discharged small or moderate amounts of explosives, solvents, gases, or other materials of concern.

SWMU 16-029(q) includes the two sumps for TA-16-99, their drains, and the outfall (Fig. 5-88). The primary operation in TA-16-99 was sawing risers off cast explosives following casting in TA-16-27 and cooling in TA-16-88 (Martin 1993, 15-16-477). In 1970 the sumps of TA-16-99 were declared surplus and HE contaminated and were recommended for removal. They are, however, still present and filled with gravel. TA-16-99 also remains and is included in SWMU 16-017, discussed in Chapter 6.

5.23.1.2 Conceptual Exposure Model

The conceptual exposure model for the GMX-3 90s-Line is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.23.1.2.1 Nature and Extent of Contamination

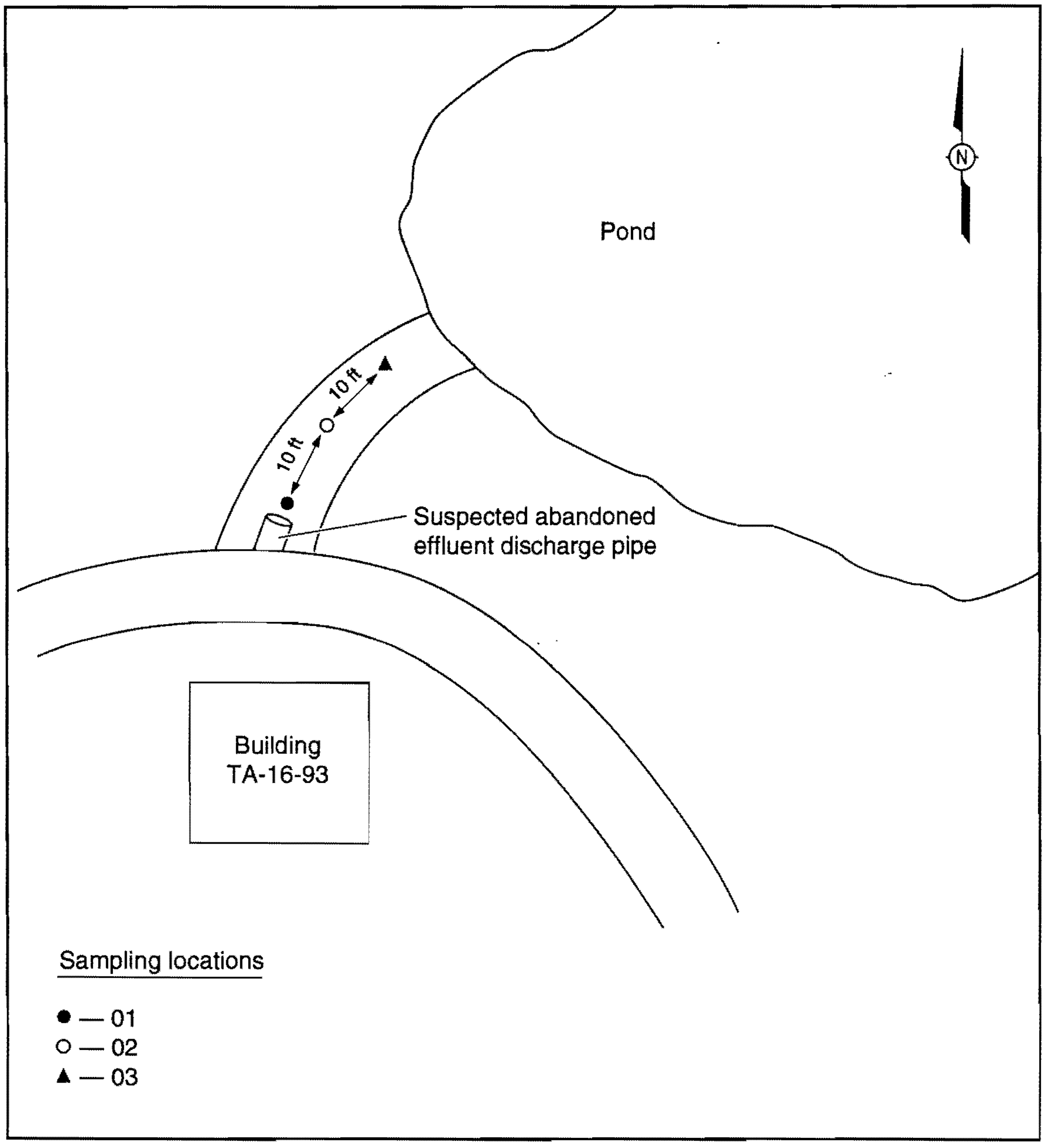
The principal PCOCs in the sumps, drain lines, and outfall discharge areas for the 90s-Line structures are uranium, HE (principally TNT and RDX), HE byproducts (e.g., DNT, TNB, and DNB), cyanide, organics, and metals, particularly those that might be associated with electroplating activities in TA-16-93. These metals are chromium, copper, nickel, and cadmium. TNT/RDX are deemed to be the PCOCs most likely to be of concern in these PRSs (Table 5-117).

Environmental Problem #24 (LANL 1989, 0425) reports surface soil data for the plating outfall draining TA-16-93. These data are summarized in Table 5-118 and the sampling locations are shown in Fig. 5-89. The authors of the report state that the outfall could not be located with certainty and that

TABLE 5-117

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, INACTIVE SUMPS AND OUTFALLS IN THE GMX-3 REGION

				HE			RAD	METALS				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	CYANIDE	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	URANIUM
16-026(m)	Outfall and drain line associated with TA-16-92	HE machining/equipment cleaning	N	X	X				X		X	X
16-026(n)	Outfall and drain line associated with TA-16-91	HE machining/equipment cleaning	N	X	X				X		X	
16-026(o)	Outfall and drain line associated with TA-16-90	HE machining	N	X	X				X		X	
16-026(p)	Outfall and drain line associated with TA-16-89	HE machining	N	X	X				X		X	
16-029(k)	Sump and drain line associated with TA-16-93	HE machining/plating	N	X	X		X	X	X	X	X	
16-029(l)	Sump associated with TA-16-92	HE machining/equipment cleaning	N	X	X				X	X	X	X
16-029(q)	Sump, drain lines, and outfall associated with TA-16-99	Sawing risers	N	X	X				X		X	
16-029(s)	Sump associated with TA-16-91	HE machining/equipment cleaning	N	X	X				X	X	X	
16-029(t)	Sump associated with TA-16-90	HE machining	N	X	X				X	X	X	
16-029(u)	Sump associated with TA-16-89	HE machining	N	X	X				X	X	X	



Source: LANL 1989, 0425
Modified by: cARTography by A. Kron 6/3/94

Fig. 5-89. Sampling locations at TA-16-93 outfall from Environmental Problem #24 (LANL 1989, 0425).

TABLE 5-118

ANALYSES OF TA-16-93 EFFLUENT, ENVIRONMENTAL PROBLEM #24 (LANL 1989, 0425)

SAMPLE	824-1	824-2	824-3	SALs
Medium	Soil	Soil	Soil	
Units (ppm)	mg/kg	mg/kg	mg/kg	mg/kg
Metals				
Barium	420	1 120	1 590	5 600
Beryllium(a)	1.8	1.7	1.8	0.16
Cadmium(a)	1.8	1.7	5.6	80
Chromium(b)	9.2	9.2	8.6	400 (VI)
Copper(b)	10.2	11.1	14.5	3 000
Lead		332		500
Zinc	130	206	234	24 000
Other				
Thorium-232	< 12 500 pCi/kg	< 13 600 pCi/kg	< 17 000 pCi/kg	880 pCi/kg
Uranium-238	< 11 100 pCi/kg	< 6 600 pCi/kg	< 16 100 pCi/kg	59 000 pCi/kg
Cesium-137	250 pCi/kg	380 pCi/kg	1 220 pCi/kg	4 000 pCi/kg
Cyanide(c)	0.39		0.40	1 600

A blank cell indicates the analyte was not detected
NA indicates that the sample was not analyzed for the analyte
[a] Analyte found in blank; result may be biased high.
[b] Copper and chromium outside of QA/QC control limits.
[c] Cyanide analyses likely to be biased low up to 250%; holding times exceeded.

the sample locations were based on utility drawings. All samples were analyzed for HE, cyanide, metals, and VOCs. Field measurements were made for HE, radionuclides, and organic vapors. Metals detected in these samples included barium (420 to 1 590 ppm), beryllium (roughly 2 ppm), cadmium (2 ppm to 6 ppm), chromium (roughly 9 ppm), copper (10 to 15 ppm), lead (330 ppm), and zinc (130 to 323 ppm). Cyanide was found in two samples at 0.4 ppm. None of these values exceeds both SALs and LANL background. Beryllium was above SALs but within the LANL background range. Some metals (e.g., barium and lead) exceed local backgrounds. Surprisingly, no HE were found in these samples.

No previous analyses within the boundaries of SWMUs associated with TA-16-99, TA-16-89, TA-16-90, TA-16-91, and TA-16-92 were found. However, several samples have been analyzed from the pond into which the drain lines for TA-16-89, TA-16-90, and TA-16-91 discharge. These are reported in Subsection 5.12.1.2.1 within the 1993 OU 1082 work plan. To summarize those data, barium, nickel, cadmium, and acetone in soils were reported at levels above background and below SALs. Barium in water and HE in soils exceeded SALs within the pond. The barium and HE are likely to be COCs in the PRSs considered in this aggregate.

5.23.1.2.2 Potential Pathways and Exposure Routes

This aggregate contains potential subsurface contamination (sumps and drain lines) and potential surface contamination (sumps and outfalls). PCOCs could have been released from the sumps and drain pipes through cracks and leaks in the structures and joints into surrounding subsurface soils. Potential subsurface contamination does not pose a risk to human health unless it is exposed to the surface through excavation or erosion. Spillage from the sumps and discharge from outfalls could have contaminated surrounding surface soils and sediments in drainages. The land surrounding the HE machining and equipment cleaning building [SWMU 16-026(m)] and electroplating building [SWMU 16-029(k)] is fairly flat with discharge and surface water runoff flowing to the north toward Cañon de Valle. The drainage from the sump in TA-16-99 ultimately joins this drainage. The remaining PRSs discharge north into a pond.

Current land use is for industrial purposes only. Chapter 4 of this work plan contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.23.2 Remediation Decisions and Investigation Objectives

5.23.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. This aggregate consists of sumps, drain lines, and outfalls associated with inactive buildings in the 90s-Line. PCOCs include HE, metals, cyanide, uranium, volatile organics, and semivolatiles. The probability of contamination is moderate to high for most PRSs, since all buildings involved HE processing, and none has been decommissioned and cleaned up. The buildings are slated for D&D and, given the operations in these buildings, a VCA of the sumps and drain lines is warranted. The VCA will facilitate sampling under these buried structures to determine if PCOCs have migrated into the environment.

There is one PRS where the problem is not based primarily on potential HE contamination. PCOCs for the plating building [SWMU 16-029(k)] include plating metals (e.g., chromium).

5.23.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.23.3 Data Needs and Data Quality Objectives

5.23.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in the generic DQO Step 3 in Subsection 5.0.2.

5.23.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination include the PRS boundaries for the sumps and outfalls. This sampling will be coordinated with the VCA and will consider the trenches exposed by removing the sumps and drain lines. The depth boundary within these trenches will be 6 in. or the depth of bedrock, whichever is less. The depth boundary in drainages will be 6 in. or the depth of bedrock, whichever is less. The depth interval is smaller than in other aggregates because these PRSs are associated with buildings that have not been decommissioned. Therefore, no soil disturbance has occurred in these PRSs.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.23.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, applies to the PRSs in this aggregate.

5.23.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-119). Relative ranks were assigned based on severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that both can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on an HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Drainage sampling is designed to provide non-biased insights into the transport of any PCOCs off site.

The other indicator PCOC that was selected in the GMX-3 inactive sumps-outfalls aggregate was chromium. No PRSs were judged to present a very serious problem. All of the PRSs were judged to pose a serious risk of contamination due the type and duration of operations for these buildings. No PRSs were judged to pose a not very serious or negligible risk of contamination.

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of the PCOCs within the PRS, and the subsequent redistribution of the PCOCs by the weathering of the soil. All sumps, except for SWMU 16-029(k) and 16-029(q) were considered to be not very heterogeneous because the sumps are small and did not include the vitreous clay drain lines. All of the outfalls were judged to be heterogeneous, because they included the vitreous clay drain lines where connections between pipes are locations for PCOC migration into the environment.

The information on the severity and heterogeneity of PCOCs was used to estimate the probability of observing a concentration less than SALs (Table 5-120).

TABLE 5-119

GROUPING OF GMX-3 INACTIVE PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious	16-026(m) 16-026(n) 16-026(o) 16-026(p) 16-029(k) 16-029(q)	TA-16-92 TA-16-91 TA-16-90 TA-16-89 TA-16-93 TA-16-99 Drain lines/outfalls/sumps	16-029(l) 16-029(s) 16-029(t) 16-029(u)	TA-16-92 TA-16-91 TA-16-90 TA-16-89 Sumps		
Not very serious						
Negligible						

TABLE 5-120

SAMPLING PARAMETERS FOR GMX-3 INACTIVE PRSs

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-029(k)	Chromium	80%	5
16-026(m) 16-026(n) 16-026(o) 16-026(p) 16-029(q)	HE	95	3
16-029(l) 16-029(s) 16-029(t) 16-029(u)	HE	50	2

5.23.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-121. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan. Sampling numbers and required analyses are shown in Table 5-122.

TABLE 5-121

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for the Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

TABLE 5-122

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR 90s-LINE

		LABORATORY SAMPLES							FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
PRS	PRS TYPE	SAMPLED MEDIA	STRUCTURE	STRUCTURE FIELD DUP	SURFACE	SURFACE FIELD DUP	SUBSURFACE	SUBSURFACE FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	GEOPHYSICS SURFACE	CHROMIUM - LIBS	A GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	B XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	C BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	D VOA (SW 8240)	E SEMIVOLATILES (SW 8270)	F METALS (SW 6010)	G ASBESTOS	H HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-026(m)	Drain line TA-16-92	Soil			3					10		10													3				3	3		3	
16-026(n)	Drain line TA-16-91	Soil			3	1				10		10																	3	3		3	
16-026(o)	Drain line TA-16-90	Soil			3					10		10																	3	3		3	
16-026(p)	Drain line TA-16-89	Soil			3					10		10																	3	3		3	
16-029(k)	Sump/drain line TA-16-93	Soil			5	1				17		17		17											5			5	5	5		5	5
16-029(l)	Sump TA-16-92	Soil			2					6		6													2			2	2	2		2	
16-029(q)	Sump/drain line TA-16-99	Soil			3					10		10																	3	3		3	
16-029(s)	Sump TA-16-91	Soil			2	1				6		6																2	2	2		2	
16-029(t)	Sump TA-16-90	Soil			2					6		6																2	2	2		2	
16-029(u)	Sump TA-16-89	Soil			2					6		6																2	2	2		2	

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
= The actual number of samples will depend on the depth of the cores.
A, B, C = not applicable; D, E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc);
H = full suite.

5.23.4.1 Engineering Surveys

The PRSs composing this aggregate will be field surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. In the field, the engineering survey will locate, stake, and document the location of each PRS, each point for field screening and sampling, and the main drainages exiting this portion of S-Site. Geomorphic sediment mapping will be completed in the drainages. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.23.4.2 Sampling

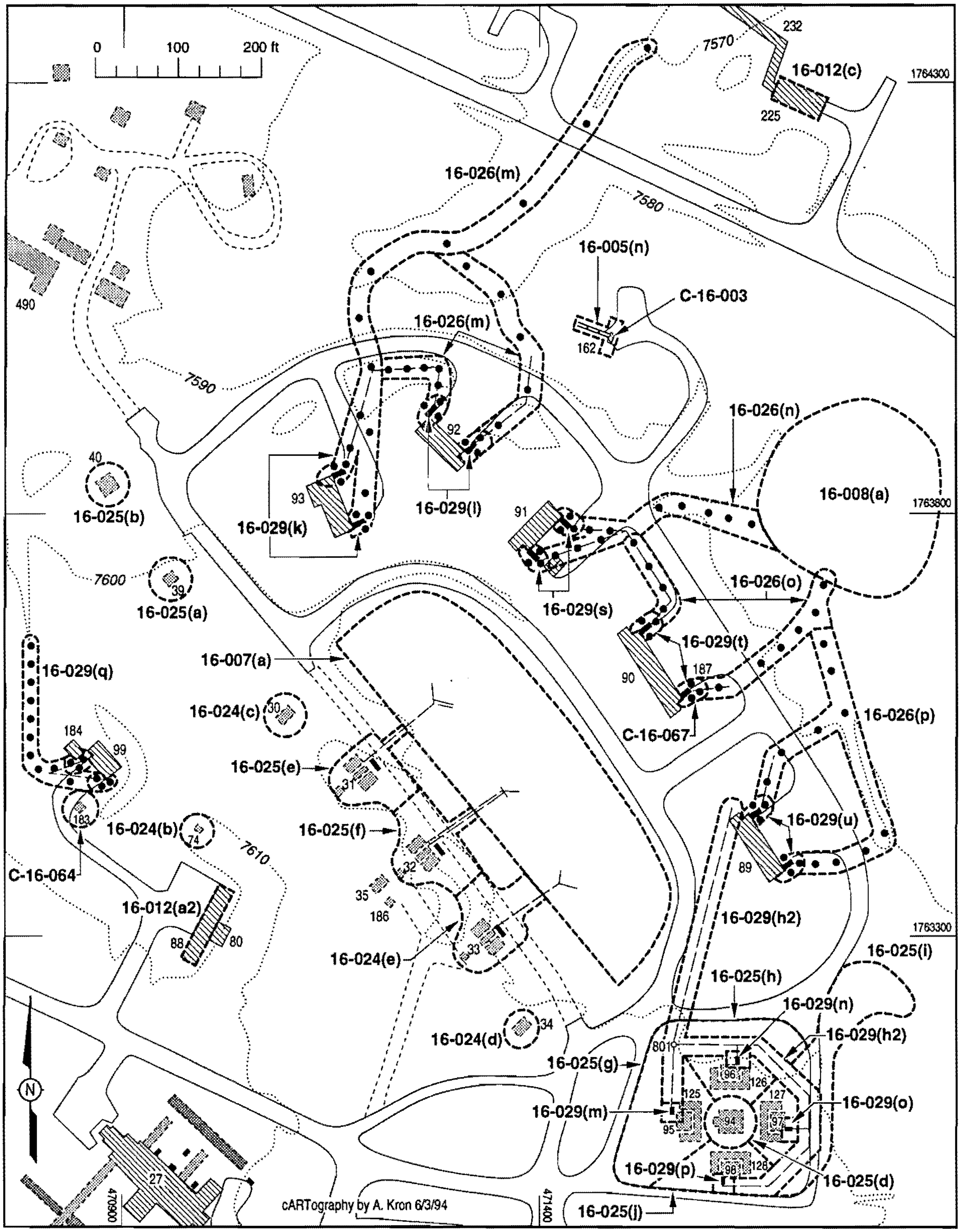
All samples will be field-screened for HE by spot test and radionuclides by gross beta-gamma. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using the following prioritized biasing scheme: 1) samples with positive HE spot test readings, 2) samples with above-background radiation readings (two times background or more), and, 3) samples biased as described below on a PRS-specific basis. In cases where more field-screening samples yield positive HE readings than are required for laboratory analysis, select those samples nearest to the potential contaminant source in an individual PRS to better limit the PCOC list for a PRS.

The existing sumps and vitreous clay drain lines will be removed in a VCA. Visible HE will be removed during this VCA.

All surface samples will be sampled to a 6 in. maximum depth. At least 300 ml of soil will be collected from each surface sample.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-122. Field-screening locations are shown in Fig. 5-90.



Existing building
Former building
Barricade (removed)
Sump
Manhole
Drain line
Paved road
Former road
10-ft contour line
PRS area
Surface sample (some on excavated surface)

Fig. 5-90. Sampling locations at the 90s-Line.

SWMUs 16-026(m), 16-026(n), 16-026(o), 16-026(p), 16-029(q). Sampling of these drain lines and outfalls is designed to detect residual HE in the excavated drain lines and exposed drainages for the sumps of the 90s-Line and TA-16-99. For each drain line ten field screening samples will be used to select three laboratory samples. The screening samples will be distributed as shown in Fig. 5-90, but may be biased to areas of visible HE that are exposed during removal of the drain lines. In the absence of positive field screening results, or if less than three samples yield positive screening results, any additional samples will be selected randomly from within the negative field screened samples. If more than three samples yield positive screening results, select the samples that are nearest to the sumps. These samples are most likely to contain additional PCOCs.

SWMU 16-029(k). Sampling of this sump, drain line, and outfall is designed to detect residual chromium in the sump area, excavated drain lines, and exposed drainages from TA-16-93. Seventeen field screening samples will be used to select five laboratory samples. The samples will be screened for HE, radionuclides, and chromium by LIBS or XRF. In the absence of positive HE or radionuclide readings, or if less than five samples yield such readings, the highest chromium samples will be selected as the additional samples. If more than five samples yield positive HE or radionuclide readings, then select those positive samples nearest the sump and use the other positive readings in the design of Phase II sampling. The screening samples will be distributed as shown in Fig. 5-90.

SWMUs 16-029(l), 16-029(s), 16-029(t), 16-029(u). Sampling of these sump regions is designed to detect residual HE in the excavated sumps of the 90s-Line. For each set of sumps for an individual SWMU three field screening samples for each sump (six total) will be taken to yield two laboratory samples for the SWMU. If no positive readings occur, or if one positive reading occurs, select the laboratory samples at random from within the set of screened samples. In the likely case that more than two samples yield positive screening results for a SWMU, select the samples nearest to the sumps. Sampling locations are shown on Fig. 5-90.

5.23.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846 Method 6010), volatiles (SW 846 Method 8240), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal HE of concern are TNT and RDX; the principal HE byproducts of concern are DNT, TNB, and DNB; and, the principal metals of concern are chromium, nickel, copper, barium, and silver.

5.23.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-122.

5.24 TA-24 (T-Site)

5.24.1 Background

This aggregate consists of all the PRSs associated with radiographic inspection activities at former TA-24 (T-Site). These PRSs are a SWMU aggregate because they are geographically contiguous and because they have a similar suite of PCOCs. Thus, drainage sampling in the east and south drainage from T-Site may provide information on off-site migration from all of the PRSs, and data from them may potentially be combined in future baseline risk assessments. The PRSs at TA-24 are listed in Table 5-123. Several AOCs located at TA-24 are proposed for NFA.

TABLE 5-123

PRSs AT TA-24

PRS	CURRENT STRUCTURE NUMBER	FORMER BUILDING NUMBER	DESCRIPTION	DIMENSIONS (FT)
16-005(j)	TA-16-504	T-15	Septic system	4 x 5 x 3
16-005(m)	TA-16-507	T-18	Chemical pit	8.5 x 4.5 x 5
16-024(f)	TA-16-493	T-3 (?)	Decommissioned magazine	6 x 6 x 7
16-024(g)	TA-16-494	T-5	Decommissioned magazine	6 x 6 x 7
16-024(h)	TA-16-497	T-8	Decommissioned magazine	15 x 40 x 9
16-025(m)	TA-16-495	T-6	Decommissioned hutment	16 x 16 x 9
16-025(n)	TA-16-499	T-10	Decommissioned hutment	16 x 16 x 9
16-025(o)	TA-16-500	T-11	Decommissioned hutment	16 x 16 x 9
16-034(b)	TA-16-490	T-1	Decommissioned laboratory	Two wings 72 x 18 x 12 and 93 x 18 x 12
16-034(c)	TA-16-491	T-2	Decommissioned storage	16 x 24 x 9
16-034(d)	TA-16-492	T-3 (?)	Decommissioned shop	16 x 16 x 9
16-034(e)	TA-16-496	T-7	Decommissioned warehouse	Unknown
16-034(f)	TA-16-498	T-9	Decommissioned laboratory	16 x 42 x 9
C-16-017	TA-16-502	T-13	Decommissioned steam building	16 x 16 x 9

5.24.1.1 Description and History

Decommissioned TA-24 is located in the northwestern portion of TA-16 (Fig. 5-91). During World War II, T-Site was located northwest of the S-Site explosives manufacturing complex. The site is currently devoid of structures;

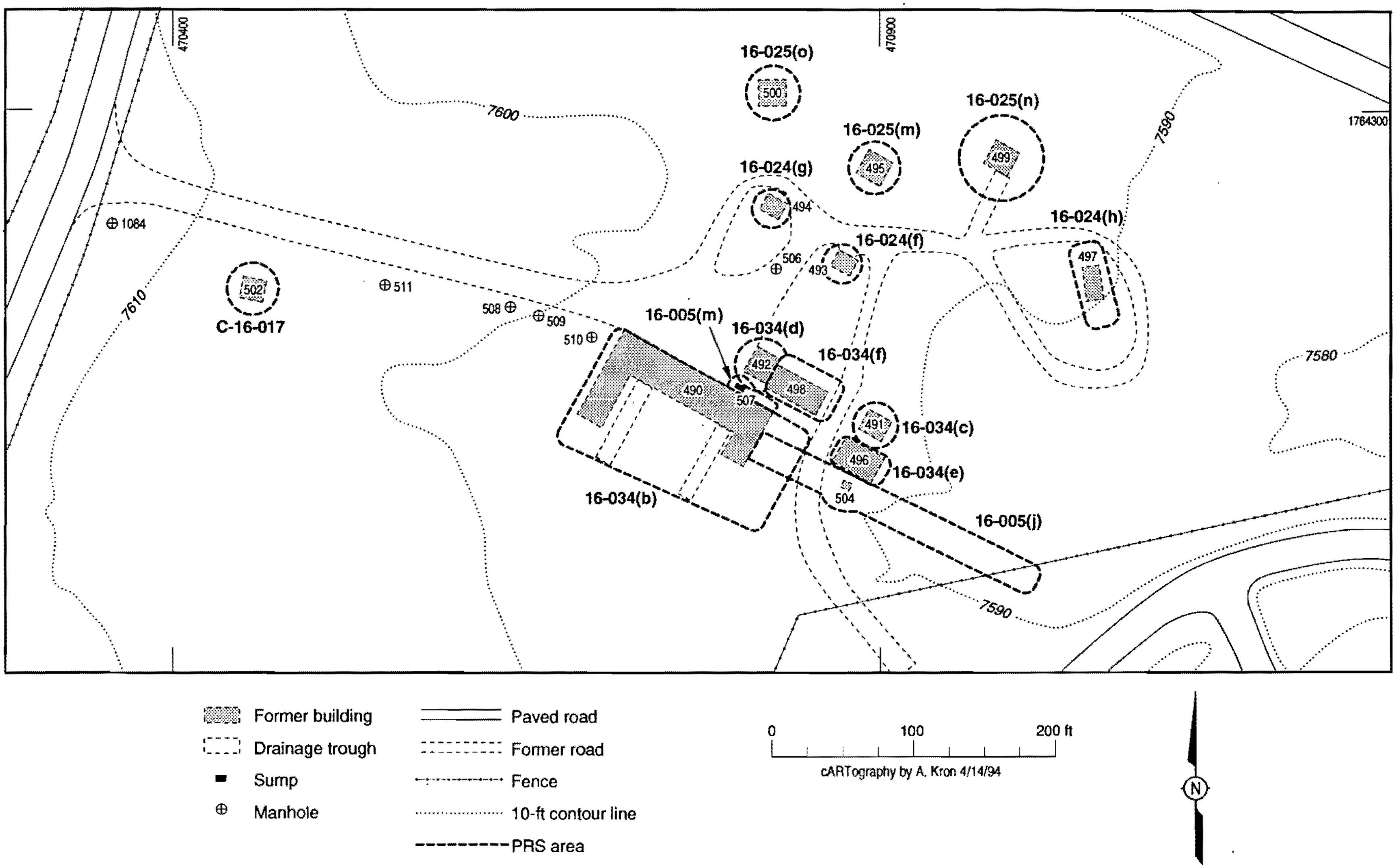


Fig. 5-91. Locations of PRSs at T-Site.

trees have overgrown the northern portion of the site. The site is fairly level with a change in elevation of less than 30 ft sloping roughly from west to east. Site drainage is primarily to the east, along two principal channels, although the northernmost three SWMUs at the site drain to the north.

TA-24 was used primarily for radiographic operations. Although the nature and magnitude of radiography at TA-24 changed during the six years the site was operational, processes remained similar throughout this time. Construction occurred continuously at T-Site due to the increased needs for radiography of the HE charges produced at S-Site.

The first structure built at TA-24, the western portion of TA-16-490, was constructed during late summer of 1944 (Tenney 1944, 15-16-182). At this time Staff Sergeant G. Tenney pioneered the application of x-ray radiography to HE charges. He remained in charge of T-Site throughout the operational history of the site. The x-ray group was called X-1E in 1945, X-1 in 1946, and GMX-1 in 1948. During fall and winter of 1944 the first additions to TA-16-490 were completed, and an associated septic tank (TA-16-504) and a sump (TA-16-507) were completed. Operations in TA-16-490 consisted of x-ray radiography of HE charges and film developing of the resulting x-ray films. During September 1944, 1 519 charges were radiographed (Tenney 1944, 15-16-182).

During early 1945 several new facilities were completed at T-Site and further additions were made to TA-16-490. At least two darkrooms and two x-ray rooms were in the eastern portion of this building. Office space was located west of a barricade that transected the building. The new buildings were a machine shop (TA-16-492), a storage building (TA-16-491), and a hut for source radiography (TA-16-499) (Tenney 1945, 15-16-157). The last facility used radium-226 to produce gamma rays that could be used to examine the dense baratol charges and uranium-238 parts that were used in the implosion device. It is reputed that half the world's supply of radium was located in the radiography buildings at T-Site and S-Site during World War II (Martin and Hickmott 1993, 15-16-514). Just prior to the Trinity test in April 1945 over 8 000 x-ray films were developed in a single month at T-Site (Tenney 1945, 15-16-181).

Two magazines (TA-16-493 and TA-16-494) and a building (TA-16-498) used for storage and as a lunchroom were built in June 1945 (Martin and Hickmott 1993, 15-16-514). By the end of 1945, the steam plant (TA-16-502) and a second source radiography hut (TA-16-495) had been completed.

After World War II, the level of operations at T-Site decreased markedly. This slowdown was due both to the decreased level of HE processing at S-Site and to the increase in the amount of radiography that was being done at S-Site. In 1946 a fire destroyed a darkroom in TA-16-490, which impeded radiography operations (Martin and Hickmott 1993, 15-16-514).

Although operations slowed somewhat during the postwar years, additions were made to T-Site between 1946 and 1950. TA-16-490 was rebuilt and modified in 1947 to include a concrete slab to stabilize an instrument, and the large west wing was added in 1948 to provide vault storage for developed x-ray films. A third hut (TA-16-500) was constructed in 1947. By 1950 the eastern hut (TA-16-499) contained a cobalt-60 source, and the western hut (TA-16-500) contained a radium-226 source (Martin and Hickmott 1993, 15-16-500). TA-16-496 was moved from Anchor Ranch Site to T-Site in 1948 to serve as a storage building.

Radiographic inspections at T-Site were expanded to include materials other than HE during the five years following World War II. Sources containing radioactive lanthanum, which has a short half-life of 1.7 days but which invariably contained strontium-90 as an impurity, were used as sources for radiography of steel. One of these sources broke in magazine TA-16-497, contaminating the structure with strontium-90 (Buckland 1954, 15-16-217). Depleted and enriched uranium parts were examined, leading to alpha contamination of huts TA-16-495, TA-16-499, and TA-16-500. An electron microscope for examination of beryllium parts was installed in TA-16-490 in 1948 (Tenney 1948, 15-16-141). By 1950, TA-16-498 had been converted to a laboratory used for autoradiography of plutonium components of weapons.

TA-24 ceased to be used as an active site in the fall of 1950 (Martin and Hickmott 1993, 15-16-500). Site activities were transferred to the newly constructed GT-Site, located at the old Anchor East Site. Most of the structures remaining at TA-24 were destroyed by burning in February 1960.

The residual debris from the burning and the remaining subsurface structures was cleaned up in 1966. HE was remediated to better than 3 wt % (Martin and Hickmott 1993, 15-16-497), and radionuclides were cleaned up to background using 1960s hand-held screening equipment (Buckland 1966, 15-16-136).

The following SWMUs and AOCs resulted from operations at TA-24. All of the structures at TA-24 were surveyed for radiation, HE, and toxic chemicals prior to being burned February 5, 1960. Unless otherwise noted, the results of these surveys were negative. A former site worker (Blackwell 1983, 15-16-076) recalled that most of the structures at T-Site were contaminated with uranium-238; however, examination of documentation for the radiation surveys done in the late 1950s suggests that only a subset of the structures at T-Site were uranium-238 contaminated. All of the structures at T-Site were free of residual radioactivity in 1966 when they were resurveyed after being burned (Buckland 1966, 15-16-136).

SWMU 16-005(j) contains potentially contaminated subsurface soil associated with septic tank (TA-16-504) that served the lavatories and darkrooms in TA-16-490. It was located about 75 ft east of that building and was connected by a 4-in. vitrified clay pipe (Fig. 5-91).

SWMU 16-005(m) contains potentially contaminated subsurface soil adjacent to decommissioned concrete sump (TA-16-507) located north of TA-16-490 that received effluent from the large room in the central section of TA-16-490 (Fig. 5-91). The SWMU Report lists TA-16-507 as a chemical pit, but engineering drawings suggest it was an HE sump. During World War II this room contained x-ray equipment. The sump drained to the east of TA-16-490 through a 6-in. vitrified clay pipe. Prior to its removal in 1960, TA-16-507 was shown to be contaminated with HE (Engineering Department 1959, 15-16-256).

SWMUs 16-024(f) and 16-024(g) contain potentially contaminated surface soil within the former footprints of decommissioned HE magazines (TA-16-493 and TA-16-494) located northeast of TA-16-490 (Fig. 5-91). Their former site is level. They were both of wooden-frame construction with earthen barricades on three sides and the top. A former site worker described an incident that occurred in 1950 in which a large chunk of baratol was dropped in TA-16-493 (Martin and Hickmott 1993, 15-16-500). Prior to being burned in 1960, both structures were found to be contaminated with HE (Engineering Department 1959, 15-16-256).

SWMU 16-024(h) contains potentially contaminated surface soil within the footprint of decommissioned HE magazine (TA-16-497) located at the east end of T-Site on level ground (Fig. 5-91). It was of wooden-frame construction with earthen barricades on three sides and on its top. Unlike the other two magazines at T-Site, it had a concrete foundation and floor. A radioactive lanthanum source broke open in this building, contaminating it with residual strontium-90 activity (Buckland 1954, 15-16-217). Prior to burning and demolition, strontium-90 activity of up to 20 mr/hr was noted on three spots on the floor of the building and additional activity was noted in a floor crack (Buckland 1957, 15-16-243). At this time it was also determined that the building was contaminated with residual HE (Engineering Department 1959, 15-16-256).

SWMU 16-025(m) contains potentially contaminated surface soil associated with a decommissioned x-ray or gamma-ray radiography facility (TA-16-495). TA-16-495 was located on level ground in the north-central portion of T-Site (Fig. 5-91). It was a wooden-frame structure with a concrete floor. Although it did not have a pit in its center, as did the other source buildings, two former site workers suggest that it was a source building which contained either radium-226 or cobalt-60 gamma sources (Martin and Hickmott 1993, 15-16-514; Martin and Hickmott 1993, 15-16-500). Prior to burning, it was determined that this building was contaminated both with HE (Engineering Department 1959, 15-16-256) and with uranium-238 at 500 cpm (Buckland 1957, 15-16-243).

SWMUs 16-025(n) and 16-025(o) contain potentially contaminated surface soils associated with two identical source hutments (TA-16-499 and TA-16-500) used for gamma-ray radiography of baratol lenses and other dense weapon parts. They were located along the northern margin of T-Site (Fig. 5-91). Each was of wooden-frame construction with a concrete floor and had a pit in the center 2 ft long x 4 ft wide x 2.5 ft deep. These structures were used for radium-226 sources (Martin 1993, 15-16-477) and for cobalt-60 sources (Martin and Hickmott 1993, 15-16-500). It is highly likely that the radioactive lanthanum source was used in one of these buildings, probably TA-16-500 (Buckland 1966, 15-16-136). A shelf in TA-16-499 [SWMU 16-025(n)] was contaminated with alpha (up to 6 000 cpm) when it was surveyed prior to being burned. Radioactive contamination was not detected in SWMU 16-025(o) during the 1957 survey, but it was recommended that the concrete floor be sent to the contaminated landfill at TA-54 (Buckland 1957, 15-16-243). Both hutments were also contaminated with HE according to the pre-demolition survey (Engineering Department 1959, 15-16-256).

SWMU 16-034(b) contains potentially contaminated surface soil associated with decommissioned TA-16-490, the primary laboratory and office building at T-Site. The building is located in the south-central portion of TA-24 on ground sloping slightly to the south (Fig. 5-91). It was a wooden-frame, L-shaped building with an internal radiation/explosion barrier transecting it, and a concrete slab as part of its foundation and floor. Two drainage troughs exited from the south side of the building. As described above, the principal experimental activities in the structure were x-ray radiography of HE using 150 KeV and 250 KeV x-ray units (Martin and Hickmott 1993, 15-16-514), photoprocessing in two separate darkrooms, electron microscopy, and reading of x-ray films. Chemicals known to be associated with these activities include silver (Martin 1993, 15-16-477) and solvents, including amyl acetate, ethylene dichloride, and dioxane (Tenney 1948, 15-16-141). Portions of the building were also used for storage. Prior to its demolition by burning, this building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

SWMU 16-034(c) contains potentially contaminated surface soil associated with decommissioned warehouse hut TA-16-491, which was located northeast of TA-16-490 on ground sloping slightly to the east (Fig. 5-91). It was a wooden-frame building. During World War II the building was used to store tools (Martin and Hickmott 1993, 15-16-514), but by 1950 it was being used for x-ray exposure experiments on rats and rabbits (Martin and Hickmott 1993, 15-16-500). Prior to destruction by burning, this building was determined to be contaminated with HE (Engineering Department 1959, 15-16-256).

SWMU 16-034(d) contains potentially contaminated surface soil associated with decommissioned machine shop TA-16-492, a small building of wooden-frame construction located north of TA-16-490 on fairly level ground (Fig. 5-91). Interviews with site workers suggest that its only function was as a staff machine shop. No HE machining was done in the shop (Martin and Hickmott 1993, 15-16-500; Martin and Hickmott 1993, 15-16-514). TA-16-492 was shown to be contaminated with residual HE during the surveys preceding destruction by burning in 1960 (Engineering Department 1959, 15-16-256).

SWMU 16-034(e) contains potentially contaminated surface soil associated with decommissioned storage building TA-16-496, a wooden-frame building located east of TA-16-490 on ground sloping slightly to the east (Fig. 5-91). Most site workers interviewed believed this was a storage building (Martin and Hickmott 1993, 15-16-514). It was shown to be contaminated with HE during the pre-burning inspection in 1959 (Engineering Department 1959, 15-16-256).

SWMU 16-034(f) contains potentially contaminated surface soil associated with decommissioned laboratory TA-16-498. This wooden-frame building is located northeast of TA-16-490 on fairly level ground (Fig. 5-91). The building was initially used for storage and as an eating area (Martin and Hickmott 1993, 15-16-514), but by 1950 it was being used by draftsmen in its western end, by site photographers in its center, and for plutonium autoradiography experiments in its eastern end (Martin and Hickmott 1993, 15-16-500). Small-scale photoprocessing was done in this building in support of the plutonium autoradiography experiments. TA-16-498 was shown to be contaminated with HE during the health and safety survey that preceded destruction by burning in 1960 (Engineering Department 1959, 15-16-256).

C-16-017 contains potentially contaminated surface soil associated with decommissioned steam plant, TA-16-502, which was located on level ground near the entrance of T-Site south of the road to the operational area (Fig. 5-91). It was a wooden-frame building that contained the boilers that provided heat to the laboratories at T-Site. It is not known what algaecides were used in this facility, but chromates are the most likely additive.

5.24.1.2 Conceptual Exposure Model

The conceptual exposure model for T-Site is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.24.1.2.1 Nature and Extent of Contamination

The PCOCs that may be present at the TA-24 PRSs include: 1) long-lived radionuclides such as radium-226 and strontium-90 formerly contained in sources used in gamma- and alpha-radiography experiments; 2) chemicals such as silver and cyanide from photoprocessing and the solvents used in cleaning such as amyl acetate, ethylene dichloride, and dioxane (Tenney 1948, 15-16-141); 3) HE, particularly TNT, RDX, and PETN, contained in the charges examined using X-rays; 4) HE burn and byproducts such as barium (from baratol), polycyclic aromatic hydrocarbons, DNT, TNB, and DNB; 5) other materials such as depleted uranium, beryllium, and plutonium that were examined with the radiographic techniques in use at the site; 6) chemicals used in the steam plant as algaecides such as chromium; and, 7) materials used in construction of the buildings such as lead (Table 5-124).

No quantitative data relevant to the PRSs discussed in this subsection are available. Screening data collected in the 1950s and summarized above showed that most of the structures were contaminated with HE, and a few were contaminated with radionuclides.

5.24.1.2.2 Potential Pathways and Exposure Routes

The potentially contaminated structures at T-Site have been removed and/or burned and the area has been razed, leveled, and graded. The potential areas of contamination consist of surface (building footprints) and subsurface soils (septic system and sump).

Because contaminants were released many years ago, it is believed that the majority of the volatile organic compounds will no longer be present in surface soils; however, it is possible that releases may have reached the subsurface environment. The area has been revegetated with weeds and grasses; therefore, it is unlikely that fugitive dust generation will contribute greatly to contaminant migration and subsequent human exposure. Three SWMUs drain to the north, and the remaining SWMUs drain to the east into

TABLE 5-124

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, T-SITE

				HE			RAD					METAL				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM - DEPLETED & ENRICHED	RADIUM	COBALT-60	PLUTONIUM	STRONTIUM-90	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-005(j)	Septic system, TA-16-504	Served lavatories and darkrooms in TA-16-490	N	X	X		X	X	X	X	X	X	X	X	X	X
16-005(m)	Sump associated with TA-16-507	Received effluent from TA-16-490	N	X	X		X	X	X	X	X	X	X	X	X	X
16-024(f)	TA-16-493	Magazine	N	X	X	X							X			
16-024(g)	TA-16-494	Magazine	N	X	X	X							X			
16-024(h)	TA-16-497	Magazine	N	X	X	X	X	X	X		X		X			
16-025(m)	TA-16-495	Source hutment	N	X	X	X	X	X	X		X		X			
16-025(n)	TA-16-499	Source hutment	N	X	X	X	X	X	X		X		X			
16-025(o)	TA-16-500	Source hutment	N	X	X	X	X	X	X		X		X			
16-034(b)	TA-16-490	X-ray radiography laboratory	N	X	X	X	X	X	X			X	X		X	X
16-034(c)	TA-16-491	Warehouse	N	X	X	X							X			
16-034(d)	TA-16-492	Machine shop	N	X	X	X						X	X		X	
16-034(e)	TA-16-496	Storage	N	X	X	X							X			
16-034(f)	TA-16-498	Laboratory	N	X	X	X	X			X		X	X	X	X	X
C-16-017	TA-16-502	Steam plant	N									X			X	

a small drainage ditch that runs north to south and eventually discharges into Cañon de Valle. Surface water runoff could potentially carry contaminants away from the site and accumulate in sedimentation areas.

T-Site is located in a remote area; therefore, current use by on-site workers is limited. Chapter 4 presents a more detailed description of migration pathways, conversion mechanisms, potential receptors, exposure pathways, and exposure routes that are appropriate for the entire OU.

5.24.2 Remediation Decisions and Investigation Objectives

5.24.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. T-Site may contain potential HE, organics, metals, cyanide, and radiological contamination in both surface and subsurface soils due to explosives and radiographic operations. The structures, buildings, and subsurface utilities (septic system and sump) at T-Site have been razed with much of the debris removed, and the area has been graded and leveled. Therefore, surface soil and contaminants may have been mixed and redistributed to some limited extent over the site. Constituents associated with previous site activities may be above some level of concern. S-Site trench background data will be used to determine naturally occurring background levels. Background data from the S-Site trench are located in the same soil horizon as T-Site and are not suspected to have been influenced by contamination (Nyhan et al. 1978, 0161).

The site contained three HE magazines (TA-16-493, TA-16-494, TA-16-497), two laboratories (TA-16-490, TA-16-498), three radiological hutments (TA-16-495, TA-16-499, TA-16-500), two storage buildings (TA-16-491, TA-16-496), a machine shop for metal working (TA-16-492), and a steam plant (TA-16-502). Associated with one laboratory (TA-16-490) were a septic system and an HE sump. Sediments in the east and south drainage channels from this laboratory building are also of potential concern for off-site contaminant migration.

5.24.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.24.3 Data Needs and Data Quality Objectives

5.24.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in generic DQO Step 3 in Subsection 5.0.2.

5.24.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of contamination for PRSs at T-Site are as follows:

1. Surface soil is defined by the individual SWMU boundaries and extends from the surface to 12 in. This depth was chosen because when this site was razed, the top layer of soil was disturbed by grading and leveling. The depth at which soil mixing was likely to have occurred was less than 12 in.

2. Potential subsurface soil contamination is limited to SWMUs 16-005(m) and 16-005(j). The boundaries for these SWMUs extend from the surface to bedrock (tuff), which is typically 3 ft below the surface. This boundary is selected due to the possible mixing of soils during removal of the subsurface structures and may now represent potential contamination from the surface to the depth the structure was placed in the tuff.

3. The sediments in the south and east drainage areas will be sampled from the surface to a depth of 6 in.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on archival data, field screening, and the results of land surveys.

5.24.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, applies to the PRSs in this aggregate.

5.24.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-125). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that both can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Site-wide drainage sampling is designed to provide non-biased insights into the transport of any PCOCs off-site. For most PRSs in T-Site, HE was selected to be the indicator PCOC.

No PRS was judged to present a very serious problem. Three PRSs were judged to present a serious problem: the septic system [16-005(j)], the laboratory [16-034(b)], and the chemical pit [16-005(m)]. The problem at the septic system was ranked as serious, since the principal PCOC is silver from photoprocessing, which was not a target compound during the decommissioning of T-Site. Although the indicator PCOC for other serious PRSs was HE, these PRSs were judged to contain an original source term large enough to pose a serious problem after decommissioning. The hutments [16-025(m), 16-025(n), 16-025(o)], and the laboratory [16-034(f)] were judged to pose a not very serious problem because of a minimal source term for the indicator PCOCs. The remainder of the PRS posed a negligible risk of contamination because of a small original source term, the size of the PRSs, and the likely effectiveness of the cleanup during decommissioning.

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of the PCOCs

TABLE 5-125

GROUPING OF T-SITE PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF THE INDICATOR PCOC

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious	16-005(j) 16-034(b)	TA-16-504 Septic system TA-16-490 Laboratory	16-005(m)	TA-16-507 Chemical pit		
Not very serious	16-034(f) 16-025(m) 16-025(n) 16-025(o)	TA-16-498 Laboratory TA-16-495 TA-16-499 TA-16-500 Hutment				
Negligible	16-034(c) 16-034(d) 16-034(e) C-16-017	TA-16-491 Storage TA-16-492 Shop TA-16-496 Warehouse TA-16-502 Steam building	16-024(f) 16-024(g) 16-024(h)	TA-16-493 TA-16-494 TA-16-497 Magazines		

within the PRS, and the subsequent redistribution of the PCOCs by the decommissioning activities and weathering of the soil. Most PRSs were assumed to be very heterogeneous, with the exception of the chemical pit and the magazines, where the small size of the PRSs and degree of mixing during decommissioning were used to classify these PRSs as not very heterogeneous.

The information on the severity and heterogeneity of PCOCs was used to estimate the probability of observing a concentration less than SALs (Table 5-126).

TABLE 5-126

SAMPLING PARAMETERS FOR T-SITE

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-005(j)	Silver	60%	3
16-005(m)	HE	64	3
16-034(b)	HE	90	3
16-025(m) 16-025(n) 16-025(o)	Gross $\beta\gamma$	97	2
16-034(f)	HE	93	2
C-16-017	Chromium	99	1
16-034(c)	HE	99	0-1
16-034(d)	HE	99	0-1
16-034(e)	HE	99	0-1
16-024(f) 16-024(g) 16-024(h)	HE	99	0-1

Because all of these PRSs were decommissioned and removed, a primary goal of the RFI sampling is locating the most likely regions of potential contamination. Mapping from orthocorrected aerial photographs will allow accurate (+/- 2 ft) location of building footprints and the sump. However, field screening of many points, particularly for HE, is the principal method that will be used to focus the investigation on contaminated areas. Field screening points were selected for each PRS to provide adequate coverage of each PRS; again considering both the likely heterogeneity of the PRS and the potential severity of contamination in the PRS.

A judgmental sampling design was developed for the south and east drainages from T-Site. These samples will serve as a QA completeness check for PCOCs and will help evaluate possible off-site migration. These data will also help design a Phase II sampling plan if one is needed.

5.24.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-127. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan. Sampling numbers and required analyses are shown in Table 5-128.

TABLE 5-127

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for the Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

5.24.4.1 Engineering Surveys

The PRSs composing this aggregate will be field surveyed before sample collection. Site mapping is required to accurately record the location of the PRSs. Prior to fieldwork, all building locations will be accurately located (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. Subsurface structures will be located based on historic engineering drawings and field indications. In the field, the engineering

TABLE 5-128

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR T-SITE

			LABORATORY SAMPLES						FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
															A					B				C				D	E	F	G	H	
PRS	PRS TYPE	SAMPLED MEDIA	STRUCTURE	FIELD DUP	SURFACE	FIELD DUP	SUBSURFACE	FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	GEOPHYSICS SURFACE	CHROMIUM/SILVER - LIBS	GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	METALS (SW 6010)	ASBESTOS	HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-005(j)	Septic system	Soil					3	1		10		10		10									3	3	3	3	3	3	3	3		3	3
16-005(m)	Sump	Soil					3			5		5											3	3	3	3	3	3	3	3		3	3
16-024(f)	Burned magazine	Soil			1*					5		5																	0-1	0-1		0-1	
16-024(g)	Burned magazine	Soil			1*					5		5																	0-1	0-1		0-1	
16-024(h)	Burned magazine	Soil			1*	1				5		5											1	1	1		1		0-1	0-1		0-1	
16-025(m)	Burned hutment	Soil			2					5		5											2	2	2		2		2	2		2	
16-025(n)	Burned hutment	Soil			2					5		5											2	2	2		2		2	2		2	
16-025(o)	Burned hutment	Soil			2					5		5											2	2	2		2		2	2		2	
16-034(b)	Burned laboratory	Soil			3	1				15		15											3	3	3		3		3	3		3	3
16-034(c)	Burned building	Soil			1*					5		5																	0-1	0-1		0-1	
16-034(d)	Burned building	Soil			1*					5		5																	0-1	0-1		0-1	
16-034(e)	Burned building	Soil			1*					5		5																	0-1	0-1		0-1	
16-034(f)	Burned building	Soil			2					5		5														2	2		2	2		2	2
C-16-017	Burned steam plant	Soil			1*					5		5		5															0-1	0-1			
Drainages		Soil			6	1				6		6											6	6	6	6	6		6	6		6	6

* Laboratory sampling is contingent upon field screening.
Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
= The actual number of samples will depend on the depth of the cores.
A, B = not applicable; C =strontium-90; D,E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc);
H = full suite.

survey will locate, stake, and document the location of each PRS, each point for field screening and sampling, and the two primary drainages exiting T-Site. Geomorphic sediment mapping will be completed in the drainages. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.24.4.2 Sampling

All samples will be field screened for HE by spot test and radionuclides by gross beta-gamma. SOPs for these procedures are currently in preparation. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL.

Unless otherwise indicated, laboratory samples will be selected using the following hierarchical biasing scheme: 1) samples with positive HE spot test readings, 2) samples with above-background radiation readings (two times background or more), and, 3) samples biased as described below on a PRS-specific basis. In cases where more field-screening samples yield positive screening readings than are required for laboratory analysis, select those samples nearest to the potential contaminant source in an individual PRS to better limit the PCOC list for that PRS.

All surface samples will be taken to a 12 in. maximum depth. At least 300 ml of soil will be collected from each surface core. Each subsurface core will be augered to the soil-tuff interface. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

Sample parameters, including complete lists of PCOCs to be analyzed in the laboratory, are summarized in Table 5-128. Field-screening locations are shown in Fig. 5-92.

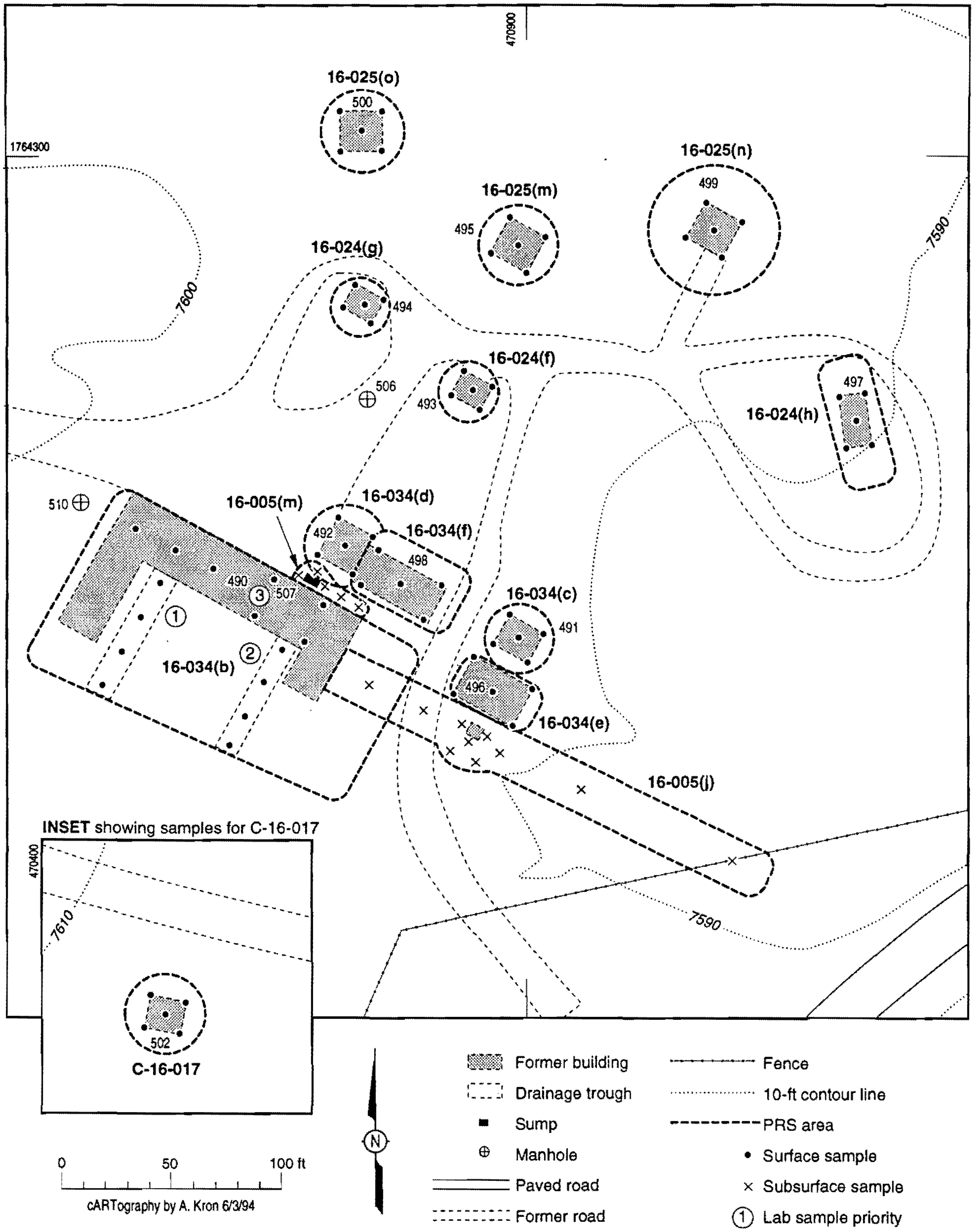


Fig. 5-92. Sampling locations at T-Site.

5.24.4.2.1 Surface Sampling

SWMUs 16-024(f,g,h) and 16-034(c,d,e). The sampling of these three decommissioned magazines and three decommissioned process buildings is designed to detect residual HE and HE byproducts on the disturbed surfaces of these SWMUs. For each SWMU five surface samples will be field screened, as described above, in order to select at most a single sample for laboratory analysis. The five field screening samples will be located in each of the four quadrants of each building and in the center of each structure (Fig. 5-92). One laboratory sample will be taken only if a positive field screening result is obtained. If more than one sample yields positive screening indicators, choose the laboratory sample at random from within the positive samples and use the additional positive samples in designing Phase II sampling.

SWMUs 16-025(m,n,o). The sampling of these three source hutments is designed to detect residual radionuclides on the disturbed surfaces of these SWMUs. For each SWMU, five surface samples will be field screened for HE and radionuclides, as described above, in order to select two surface samples for laboratory analysis. The positions of these field-screening samples are shown on Fig. 5-92 with one in each of the four quadrants and one in the center of each building. However, unlike the other SWMUs in this aggregate, the hierarchy of biasing samples submitted for laboratory analysis for these SWMUs will be: 1) an above-background (two times) radionuclide reading; 2) positive HE readings; and, 3) a sample from the position of the lead-lined pit in the center of each decommissioned building. In the absence of positive field screening results, the samples submitted to the laboratory will include the core hole from the center of the SWMU and another sample selected at random from the four quadrants of the hutments. If more than two samples yield positive indicators, choose the laboratory samples at random from within the positive samples and use the additional information in designing Phase II sampling.

SWMU 16-034(b). The sampling of the decommissioned laboratory building is designed to detect residual HE on or near the disturbed surface within this SWMU. Fifteen surface samples will be field screened as described above. Four samples will be located in each of the drainage troughs that were located on the south of the building, and seven will be located within the footprint of the building itself. Field-screening locations are shown on Fig. 5-92. Three laboratory samples will be selected using the hierarchical biasing scheme described above. In the absence of positive screening indicators, the three augered samples will be taken on the proximal screening points in each southern drainage and in the south-central area of the building, at the former location of the x-ray machines. These sampling locations are indicated on Fig. 5-92. If more than three samples yield positive indicators, choose the laboratory samples at random from within the positive samples.

SWMUs 16-034(f). Sampling of this decommissioned building is also designed to detect residual HE on or near the disturbed surface of the SWMU. Five surface samples will be field screened for HE and radionuclides, as described above, to select two surface samples for laboratory analysis. Field screening points will be located in each of the four quadrants of the building, and in the center of the building (Fig. 5-92). In the absence of positive field indicators or if less than two samples yield positive indicators, choose samples in the following order: one laboratory sample from the center of the building and one at random from the other four screened points. If more than two samples are positive, choose the laboratory samples randomly from within the positive screened samples.

C-16-017. Sampling in this decommissioned steam plant is designed to detect residual metals associated with algaecides on or near the disturbed surface of the SWMU. Five surface samples will be screened in the field laboratory by XRF or LIBS to determine if any metals, particularly chromium, are above local background levels. A single surface sample will be selected based on the highest chromium concentration. If no chromium values are above local background, no laboratory sample will be taken. The locations of the five screening points are shown on Fig. 5-92. Four points are located in the quadrants of the building, and one point will be located in the center of the building.

5.24.4.2.2 Subsurface Sampling

SWMU 16-005(j). The sampling of this decommissioned septic system and associated drain line is designed to detect the presence of subsurface silver associated with the septic system. Ten subsurface cores to bedrock will be screened in the field laboratory for silver using x-ray fluorescence or LIBS. Five core locations are concentrated in the location of the septic tank, as observed on a 1965 aerial photograph. The other five will be located along the inferred location of the drain line. The locations of these cores are shown on Fig. 5-92. Based on the field-laboratory results, three 12-in. core hole segments with the highest silver values from different cores will be submitted to the laboratory. If silver is not detected on the field XRF, the laboratory samples will represent the soil-bedrock interface at three locations. These samples include the two core holes at the proximal and distal ends of the septic tank, and the core hole in the drain line farthest from the tank.

SWMU 16-005(m). The sampling of this decommissioned chemical pit/sump is designed to detect the presence of subsurface HE. Five subsurface cores to bedrock will be field screened as described above in order to select three laboratory samples. These cores will be located at 3 ft intervals along the length of this chemical pit (Fig. 5-92) beginning at the west end of the PRS. In the absence of field-screening indications of HE or radionuclide contamination, or if less than three samples yield positive HE or radionuclide readings (two times background or more) in any of the screened cores, the additional laboratory samples will be selected randomly from the bottom 12 in. of the core holes. If more than three samples yield positive indicators, select the laboratory samples at random from within the positive samples.

5.24.4.2.3 South and East Drainages

Three laboratory samples at roughly 50 ft intervals will be taken in the drainage south of the former location of TA-16-490 (Fig. 5-93). Similarly, three laboratory samples will be taken in the east drainage from this PRS aggregate (Fig. 5-93). These samples are designed to identify any contaminants that may be migrating off site. Each sample will be augered to 6 in. or bedrock and will be collected in regions of clay-rich sediment when possible.

5.24.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846

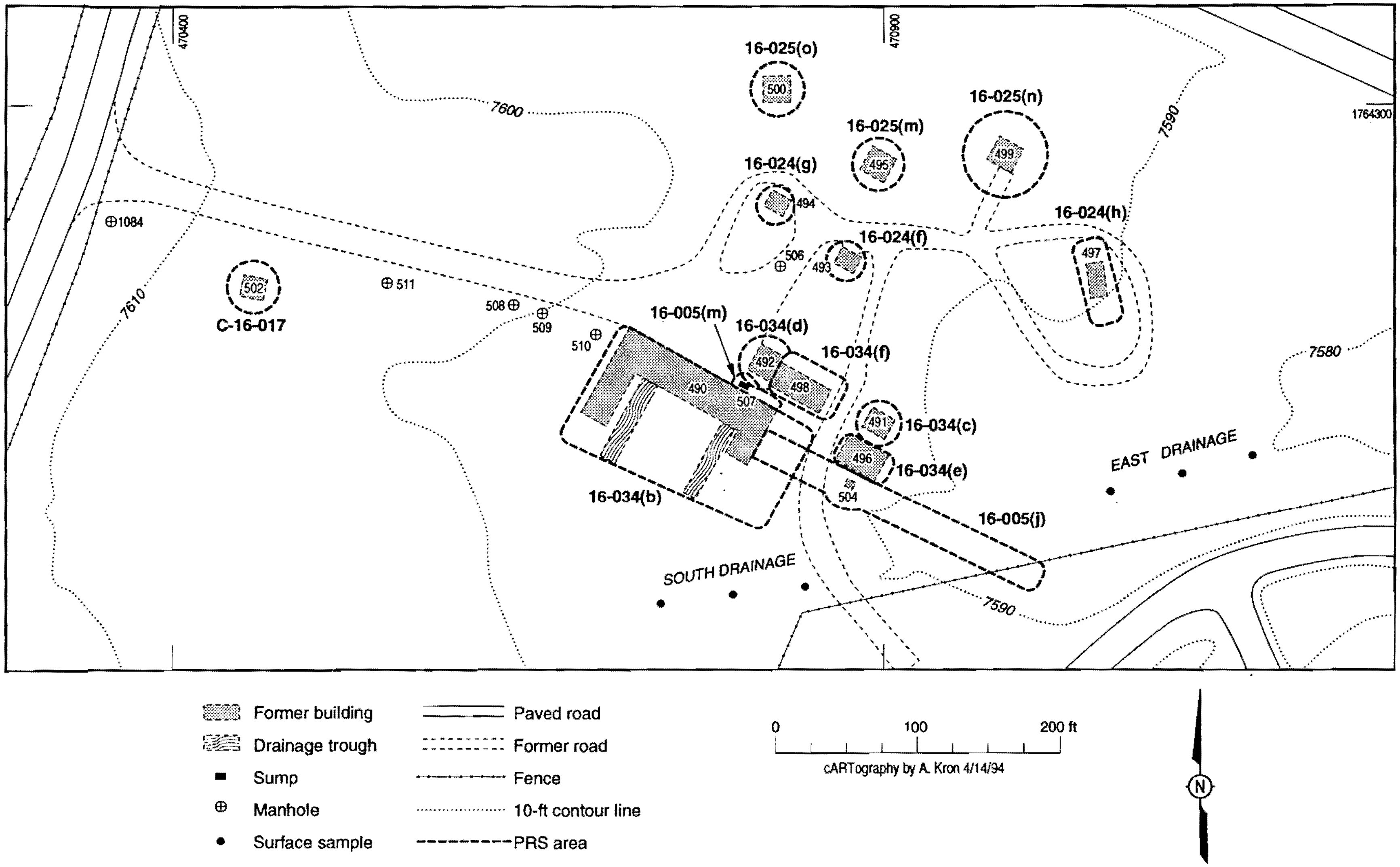


Fig. 5-93. Schematic sampling locations in T-Site drainages.

Method 6010), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal radionuclides of concern are uranium, cobalt-60, strontium-90, radium-226, and plutonium; the principal HE of concern are TNT and RDX; the principal HE byproducts of concern are DNT, TNB, and DNB; and the principal metals of concern are beryllium, chromium, barium, and silver.

5.24.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-128.

5.25 TA-25 (V-Site)

5.25.1 Background

This aggregate consists of PRSs associated with HE processing activities at former TA-25 (V-Site), as well as PRSs associated with TA-16-100. The TA-16-100 sump drained to the sump system for TA-16-515 which is located at V-Site. Hence, the TA-16-100 sump is considered with the V-Site PRSs. All of the structures have a similar suite of PCOCs and are geographically contiguous. Thus, data from these PRSs may ultimately be combined in a future baseline risk assessment. The PRSs in this aggregate are listed in Table 5-129. PRSs located at TA-25 and proposed for NFA are described in Chapter 6. SWMU 16-013, also located at V-Site, was listed in the HSWA Module. It was therefore covered in Subsection 5.17.

TABLE 5-129

PRSs LOCATED AT V-SITE

PRS	CURRENT STRUCTURE NUMBER	FORMER STRUCTURE NUMBER	DESCRIPTION	DIMENSIONS (FT)
16-006(g)	TA-16-527	V-12	Septic tank	6 x 10 x 4.5
16-025(x)	TA-16-100	SM-3	Laboratory	30 x 30 x 9
16-029(w)	TA-16-100	NA	Inactive sump	*
16-029(x)	TA-16-515	V-1, V-2	Inactive sump	4 x 6
16-031(c)	TA-16-515	V-1, V-2	Cooling tower	NA
C-16-068	TA-16-522	V-3	Decommissioned building	Unknown
C-16-074	TA-16-517	NA	Storage pad	11 x 16

* Sumps are typically 6 to 12 ft long x 4 ft wide x 5 ft deep.

5.25.1.1 Description and History

TA-25 is located southwest of the corner of K-Site Road and P-Site Road at the eastern edge of the old World War II era complex (Fig. 5-94). The site is wooded, level, and fenced. A paved road leads 250 ft to a 360 ft^2, paved courtyard. Six dilapidated buildings occupy V-Site; entry to five buildings is prohibited for safety reasons; the sixth is a storage shed open on one side. Runoff is to the southeast. The road and courtyard drain to a small ditch north of the road, which leads to a ditch west of the K-Site Road.

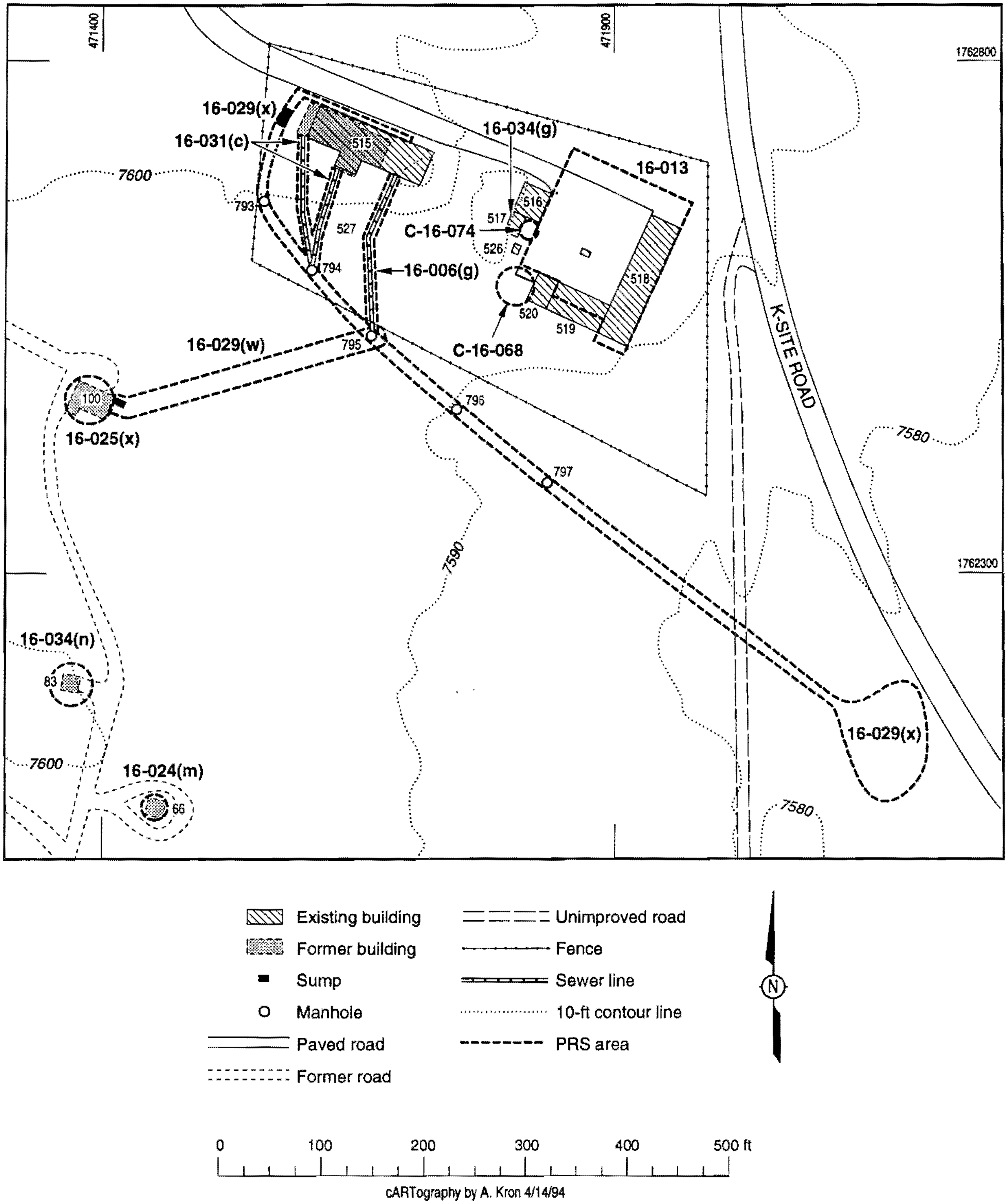


Fig. 5-94. Locations of PRSs at V-Site.

V-Site was constructed in 1944 for Group E-7, Delivery, to conduct tests involving handling, loading, shake-testing, and cold-testing of mock-ups of the atomic bomb, Fat Man. For that purpose, a mock-up of the bomb bay of a B-29 was erected at the site (Hawkins 1946, 16-663). The first structures constructed at the site were TA-16-515 (V-1, V-2), a warehouse, and TA-16-517, a laboratory. Group E-7 was renamed O-2 during the August 1944 Laboratory reorganization. V-Site was expanded in spring 1945 with the construction of TA-16-516, TA-16-519, and TA-16-520. TA-16-519 and TA-16-520 were used for varnishing and assembly of Fat Man mock-ups. V-Site was under the control of Group X-6, Assembly and Assembly Tests, at this time. Group X-2B, High Explosives, also operated at V-Site during early 1945. In July 1945, final testing of the fit of the Trinity Device was performed in TA-16-516. Group X-3 took over operations of V-Site in July 1945. At that time the site was remodeled for testing explosive lenses and inner charges of implosion devices and for final process work on explosive parts (Truslow 1973, 15-16-264). An x-ray system was installed to inspect explosive charges (Ackerman 1945, 15-16-162).

After World War II, primary operations at V-Site were X-Division x-ray work and photoprocessing in the west end of TA-16-515, HE casting in the east end of TA-16-515, pioneering work on plastic explosives in TA-16-516, and photoprocessing in TA-16-519 and TA-16-520. TA-16-100 was moved from TA-3 to the S-Site complex in 1949 to be used as an electroplating laboratory. TA-16-100 was destroyed by intentional burning in 1960.

All active work at the site ceased by 1980. The courtyard and shed TA-16-518 are still used for general storage; the rest of the site is abandoned, although the buildings are still standing.

The following PRSs resulted from operations at V-Site and TA-16-100.

SWMU 16-006(g) is septic tank (TA-16-527) and associated potentially contaminated subsurface soil located in a level wooded area about 50 ft south of TA-16-515 (Fig. 5-94). The tank is 6 ft long x 10 ft wide x 4.5 ft deep, has a capacity of 1 500 gal., and is constructed of reinforced concrete with a wooden cover. The septic tank is still in place. Engineering drawing ENG-C 6031 indicates that the septic tank was connected by a 4-in. vitreous clay pipe to sinks and toilets at the southeast corner of TA-16-515 and that the system did not serve any of the HE processing areas in the building. Drawing ENG-C 6028 indicates effluent from the tank discharged to the outfall line from sump SWMU 16-029(x) at manhole TA-16-795.

SWMU 16-025(x) contains potentially contaminated soil associated with electroplating laboratory TA-16-100. It was located about 400 ft southwest of the V-Site enclave in a level field (Fig. 5-94). A former site worker suggests that the electroplating was directly on HE charges (Martin and Hickmott 1993, 15-16-498). Engineering drawing ENG-C 596 indicates that this wooden-frame, 25 ft long x 33 ft wide building contained a utility room and a work room and was set on concrete piers.

SWMU 16-029(w) contains potentially contaminated soil associated with a 6.3 ft long x 14 ft wide HE sump located on the east side of the electroplating laboratory TA-16-100 (Fig. 5-94). It drained via a 4-in. pipe to manhole TA-16-796 and then to the outfall of the V-Site system described above. The building, sump, and line were removed in 1960. TA-16-100 was formerly TA-3-3 and was moved to S-Site in 1949. Little is known about the activities in TA-16-100. The S-Site electroplating operations were moved to building TA-16-93, which was completed in 1950. PCOCs associated with electroplating are metals and cyanide.

SWMU 16-029(x) contains potentially contaminated surface and subsurface soil associated with the inactive HE sump from floor troughs in building TA-16-515 (Fig. 5-94). Engineering drawing ENG-C 6030 indicates that effluent flowed from two work areas inside the building to an open trough under the north porch. ENG-C 6028 shows effluent flowed through a drop inlet, then through an underground 6-in. vitreous clay pipe to the sump west of the building. The 4 ft long x 11 ft wide x 4 ft deep sump contained three chambers. The first was fitted with a wire catch basket. Outflow from the final chamber was through a standpipe inlet 2 ft above the bottom of the sump, and then into a 6-in. vitreous clay drain pipe. Site map ENG-C 6028 indicates that drains from the darkroom and utility room in TA-16-515 entered the system within 50 ft of the sump. From the sump a 6-in. vitreous clay pipe led through seven manholes (TA-16-793, TA-16-794, TA-16-795, TA-16-796, TA-16-797, TA-16-798, and TA-16-799) to daylight about 800 ft southeast of V-Site. Branch lines from septic tank TA-16-527, SWMU 16-006(g), and laboratory building TA-16-100 entered the system at manhole TA-16-795. The entire system drained into a low, level swale, then into a drainage ditch beside K-Site Road (see Fig. 5-94).

Building TA-16-515 was completed in June 1944 as part of the original TA-25. Drawing ENG-C 1839 suggests it was built as a warehouse, but also housed a shop and small office. By fall of 1945, the building was remodeled into a laboratory, inspection room, and repair area for HE parts. The laboratory housed an x-ray machine and included a darkroom. Drawing ENG-C 6030 indicates that part of the walls near the x-ray machine were lead-covered; the lead panels are still in place. The inspection and repair room floors were fitted on three sides with lead-lined troughs leading outside to the trough under the porch. The floor was configured with a one percent slope draining toward the troughs. Drawing ENG-C 639 indicates that lead was removed from the troughs in 1950. The laboratory area was remodeled again in 1963 for a temperature cycling chamber. The sump and drainage system were scheduled for demolition and restoration programs in 1970, as were manholes TA-16-793, TA-16-794, TA-16-795, TA-16-796, TA-16-797, TA-16-798, and TA-16-799 (Thrap 1970, 15-16-001). A survey for hazardous material in the drain line found no toxic substances (Kennedy 1970, 15-16-006) or radioactive contamination (Mitchell 1970, 15-16-007), but did find HE contamination (Courtright 1970, 15-16-004). The demolition was never performed.

Former employees indicate that the building was used for multiple purposes over the years, including assembly and varnishing of HE parts, boracitol and Composition B casting (water jackets were used for cooling), a remote-control shake table (Martin 1993, 15-16-477), and storage.

Boracitol is an HE that contains TNT and boric acid. Employees report that boracitol casting caused environmental stress, dead trees, in the outfall area of this drain system (Martin and Hickmott 1993, 15-16-497). A prevalent rumor indicates that a large pile of unusable barium nitrate was stored in the building. TA-16-515 is now abandoned and deteriorating. Entry is prohibited for safety reasons.

SWMU 16-031(c) is described in the SWMU Report as an inactive cooling tower for building TA-16-515 (LANL 1990, 0145). There are no indications on engineering drawings or aerial photographs that the building ever housed a cooling tower. Former employees deny that a cooling tower was ever associated with the building (Martin 1993, 15-16-477; Martin and Hickmott 1993, 15-16-497). Engineering drawings indicate that all effluent from the building entered the drain system described for SWMU 16-029(x). Thus, any potential contamination from this SWMU will be discovered through the analyses for 16-029(x).

C-16-068 represents soil associated with the site of TA-16-522 (Fig. 5-94). The Release Site database suggests that TA-16-522 was constructed in 1944 and removed in 1945. This building has not been located on any existing engineering drawings or in aerial photographs. Interviews with early site workers have not provided any clues to the location or nature of operations in the building. An unidentified foundation west of TA-16-519 may be the former site of this building. A former site worker suggests that TA-16-522 was contaminated with beryllium (Blackwell 1983, 15-16-076).

C-16-074 was potential contamination associated with a drum storage area located on the concrete pad east of TA-16-517 (Fig. 5-94). The pad is level, empty, and surrounded by the asphalt paving of the adjacent courtyard. No oil stains remain; only a few rust rings are on the concrete pad. Drainage is to the north around TA-16-516 to a ditch leading east to the ditch along K-Site Road (Fig. 5-94). C-16-074 is west of SWMU 16-013, discussed in Subsection 5.17

V-Site was used for many years as a general storage area at S-Site. The SWMU Report states that drums containing residual HE-contaminated hydraulic oil were stored in this location (LANL 1990, 0145). PCOCs associated with drum storage may be HE, metals, SVOCs, and perhaps radionuclides.

5.25.1.2 Conceptual Exposure Model

The conceptual exposure model for V-Site and TA-16-100 is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.25.1.2.1 Nature and Extent of Contamination

The PCOCs that may be present at the TA-25 PRSs include: 1) chemicals such as silver and cyanide from photoprocessing; 2) metals such as chromium, cadmium, and nickel associated with plating operations in TA-16-100; 3) other metals such as beryllium and lead, possibly associated with World War II era operations at V-Site; 4) volatile and semivolatile organic compounds used in cleaning, varnishing, and gluing operations; 5) HE, particularly TNT, and RDX that were cast in TA-16-515; 6) HE byproducts such as boron, barium, TNB, DNB, and TNB; and, 7) uranium-238, which the SWMU Report suggests was used at V-Site (Table 5-130) (LANL 1990, 0145). No quantitative data for any of these PRSs have been found.

5.25.1.2.2 Potential Pathways and Exposure Routes

The V-Site aggregate contains sumps, septic tanks, drain lines, outfall, and inactive buildings that may have released PCOCs into subsurface soils through leaks or cracks in structures and pipe joints. Surface soil may have been contaminated through spillage from the sumps, discharge from the outfall, and leaks from the buildings.

The drain lines from TA-16-515 and TA-16-100 converged and eventually daylighted into a low, level swale. The drainage could have continued past the swale into a drainage ditch beside K-Site Road. It is suspected that potential contamination accumulated in this swale; therefore, this area is likely to contain high PCOC concentrations. It was reported that the swale contained dead trees, indicating a potential environmental concern. The structures associated with TA-16-100, including drain lines, were removed and the area has been graded and leveled. TA-16-515 and its associated structures are still intact.

The main courtyard is fairly level and covered with asphalt; therefore, sheet drainage discharges into a small ditch on the north side of the road leading east to the ditch beside K-Site Road.

Potential subsurface contamination does not pose a current health risk until it is brought to the surface either through excavation or erosion. Because of institutional controls, current receptors are limited to on-site workers. A

TABLE 5-130

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, V-SITE

				HE			RAD	METALS					
PRS	**DESCRIPTION**	**PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM**	**ACTIVE**	**UNDETONATED HE**	**HE DEGRADATION PRODUCTS**	**HE BURN PRODUCTS**	**URANIUM**	**METALS SUITE**	**BARIUM**	**BORON**	**VOLATILES**	**SEMIVOLATILES**	**CYANIDE**
16-006(g)	Septic tank TA-16-527	Served TA-16-515 sinks and toilets	N	X	X		X	X	X	X	X	X	X
16-025(x)	TA-16-100	Electroplating laboratory	N	X	X	X		X	X			X	X
16-029(w)	Sump associated with TA-16-100	Electroplating laboratory	N	X	X			X	X		X	X	X
16-029(x)	Sump associated with TA-16-515	Darkroom/laboratory	N	X	X		X	X	X	X	X	X	X
16-031(c)	TA-16-515	Cooling tower	N					X					
C-16-068	TA-16-522	Laboratory	N	X	X		X	X	X				
C-16-074	TA-16-517	Drum storage area	N	X	X		X	X	X			X	

detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes is in Chapter 4.

5.25.2 Remediation Decisions and Investigation Objectives

5.25.2.1 Problem Statement (DQO Step 1)

In general, the problem statement for this aggregate follows the generic DQOs presented in Subsection 5.0.2. V-Site has potential HE, VOCs, SVOCs, and metals contamination of both surface and subsurface soils due to explosives production operations. The TA-16-100 surface structures and drain lines have been decommissioned with most of the debris removed, and the area has been graded and leveled. Therefore, surface soil and contaminants may have been mixed and redistributed to some limited extent over the site. PRSs associated with TA-16-100 are not expected to exceed SALs because of the original decommissioning/decontamination activities and the small original source term. Most of the PRSs associated with TA-16-515 are intact, but some of the vitreous clay drain lines have been removed. The dead trees in the swale downstream of the outfall for the TA-16-515 drainage system are an indicator of environmental impact. Thus, PRSs associated with TA-16-515 have a greater chance of exceeding SALs compared to PRSs associated with TA-16-100.

The site contained an HE electroplating facility (TA-16-100) and an explosives production building (TA-16-515). Associated with TA-16-515 is a septic system and an HE sump. Sediments in the channel southeast of the outfall from the TA-16-515 drainage system are also of potential concern for off-site contaminant migration.

5.25.2.2 Decision Process (DQO Step 2)

The decision process for this aggregate is identical to the generic DQO Step 2 presented in Subsection 5.0.2.

5.25.3 Data Needs and Data Quality Objectives

5.25.3.1 Decision Inputs (DQO Step 3)

The decision inputs for this aggregate are those presented in the generic DQO Step 3 in Subsection 5.0.2.

5.25.3.2 Investigation Boundaries (DQO Step 4)

The spatial boundaries of potential contamination for PRSs at V-Site are:

1. Surface soil is defined by the PRS boundaries and extends from the surface to 12 in. unless otherwise indicated. This depth was chosen to include the top layer of soil that was disturbed by grading and leveling during D&D. The depth at which soil mixing was likely to have occurred was less than 12 in.

2. Potential subsurface soil contamination may be present at PRSs 16-029(w) and 16-029(x). The boundaries for these PRSs extend from the surface to tuff, which is typically 3 ft below the surface. This boundary is placed here because soils were lifted to the surface during removal of some subsurface structures and may now represent potential contamination from the surface to the depth the structure was placed in the tuff.

3. The sediments in the swale below the outfall from the TA-16-515 drainage system will be sampled from the surface to the tuff interface, expected to be 3 ft.

4. The sediment in the inactive septic tank [PRS 16-006(g)] will be used as an indicator for the presence of contamination in the septic system. The septic system consists of the line running from TA-16-515 to the tank and the line running from the tank for manhole TA-16-795. This septic system is connected to the drainage system for TA-16-515, which eventually daylights at an outfall several hundred feet southeast of manhole TA-16-795.

For each PRS, sampling points will be biased to areas believed to most likely contain the highest concentrations of PCOCs based on field screening, archival data, and the results of land surveys.

5.25.3.3 Decision Logic (DQO Step 5)

Generic DQO Step 5, presented in Subsection 5.0.2, applies to all PRSs in this aggregate.

5.25.3.4 Design Criteria (DQO Step 6)

The design for the PRSs in this aggregate follows the general strategy outlined in Subsection 5.0.2.

In order to formalize the design criteria described in Subsection 5.0.2, the PRSs were categorized by the likely severity of any potential contamination and the expected heterogeneity of each PRS (Table 5-131). Relative ranks were assigned based on the severity of the contamination of all PRSs considered in this phase of the OU 1082 RFI work plan. Each design is based on an indicator PCOC, which is a PCOC that both can easily be detected using field screening and that represents the constituents most likely to present a health risk at a PRS. Based on our knowledge of operations in World War II era S-Site, the low SALs for TNT and RDX, and the shallow soil in the area, it was deemed prudent to base our design on an HE for most PRSs. This decision may limit the ability of the sample design to detect additional potential contaminants that had different initial dispersal mechanisms or environmental transport pathways than HE. Sampling in the swale is designed to provide non-biased insights into the transport of any PCOCs off site.

For three PRSs at V-Site, HE was selected to be the indicator PCOC. The indicator PCOC for the PRSs at TA-16-100 was chromium. The indicator PCOC for C-16-068 was beryllium. Three PRSs were judged to pose a serious problem: the HE sump, drain line, and drainage [SWMU 16-029(x)], the laboratory sump and drain line [SWMU 16-029(w)], and the laboratory [SWMU 16-025(x)]. The problem for the HE sump and drainage was judged to be serious because of the experimental nature of the processing activities in V-Site. Despite the presence of dead trees in the drainage area, SWMU 16-029(x) was not designated as very serious. This decision was made because it is believed that it was boric acid, which would have reacted with natural materials in the drainage, that killed the trees. The area in which the dead tree stumps exist is currently well vegetated. Full-scale production of HE components did not take place in V-Site. The potential contamination at the decommissioned laboratory and sump was judged to be serious since the principal PCOCs are plating metals which were not cleaned up during the decommissioning activities. The decommissioning activities were concerned with HE and radioactive contamination in formerly utilized sites.

TABLE 5-131

GROUPING OF V-SITE PRSs INTO SEVERITY AND HETEROGENEITY CATEGORIES OF PCOCs

LIKELY AMOUNT OF CONTAMINATION	LIKELY HETEROGENEITY OF POTENTIAL CONTAMINATION WITHIN PRS BOUNDARIES					
	VERY HETEROGENEOUS		NOT VERY HETEROGENEOUS		HOMOGENEOUS	
	PRS	DESCRIPTION	PRS	DESCRIPTION	PRS	DESCRIPTION
Very serious						
Serious	16-029(x) 16-029(w)	TA-16-515 HE sump Associated with TA-16-100 Plating sump	16-025(x)	TA-16-100 Laboratory		
Not very serious						
Negligible			16-006(g) C-16-068 C-16-074	Septic tank TA-16-522 Building TA-16-517 Adjacent drum storage area		

The ranking of PRSs into heterogeneity categories was made based on the size of the PRS, the process that led to the original distribution of PCOCs within the PRS and the subsequent redistribution of PCOCs by the decommissioning activities and weathering of the soil. The sumps and drainages were assumed to be very heterogeneous due to the length of the system and the possibility for leakage of PCOCs at vitreous clay pipe joints. The laboratory and other PRSs were judged to be not very heterogeneous due to mixing of potential contamination during the decommissioning activities and their small size.

The information on the severity and heterogeneity of the PCOCs was used to estimate the probability of observing a concentration less than SALs (Table 5-132).

TABLE 5-132

SAMPLING PARAMETERS FOR V-SITE

PRS	INDICATOR PCOC	BAYESIAN PRIOR PROBABILITY OF ALL CONCENTRATIONS BELOW SALs	NUMBER OF SAMPLES SUBMITTED FOR LABORATORY ANALYSIS
16-029(x)	HE	70%	7
16-029(w)	Chromium	90	3
16-006(g)	HE	99	1
16-031(c)*	Chromium		
C-16-068	Beryllium	99	1
C-16-074	HE	99	1
16-025(x)	Chromium	90	3

* SWMU 16-031(c) is being considered in the sampling plan for SWMU 16-029(x).

Quantitative design criteria were not developed for the septic system, since the drainage system that received effluent from the septic system will be extensively sampled. A single laboratory sample of sediment is recommended for the septic tank to confirm the presence and nature of PCOCs in the tank. If there is no sediment, then a swipe sample on the bottom of the tank is recommended.

5.25.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-133. Appropriate health and safety precautions will be undertaken according to the site-specific health and safety plan. Sampling numbers and required analyses are shown in Table 5-134.

TABLE 5-133

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP[a]	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.03, R1	Handling, Packaging, and Shipping of Sample	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
03.01 R0	Land Surveying Procedures	Applied to all laboratory samples
06.09, R0	Spade and Scoop Method for Collection of Soil Samples	Used for surface samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to all augered subsurface samples

[a] A later revision of any SOP will be used if the cited version is superceded.

5.25.4.1 Engineering Survey

The PRSs in this aggregate will be field surveyed before sample collection. Site mapping is required to accurately record the boundaries of the PRSs. Prior to fieldwork, all building and subsurface structure locations will be accurately located (within 2 ft) on a FIMAD base map by ortho-correction of 1947 and 1965 aerial photographs. In the field, the engineering survey crew will locate, stake, and record the location of each PRS and each point for field screening or laboratory analysis. Both field screening and laboratory sampling locations will be registered on a base map, scale 1:7 200. If any sampling point must be relocated, then the new position will be surveyed and the revised locations will be marked on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

TABLE 5-134

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR V-SITE

		LABORATORY SAMPLES							FIELD SCREENING #							FIELD						LABORATORY ANALYSES											
			STRUCTURE		SURFACE		SUBSURFACE								A					B				C				D	E	F	G	H	
PRS	PRS TYPE	SAMPLED MEDIA		FIELD DUP		FIELD DUP		FIELD DUP	GROSS ALPHA	GROSS GAMMA/BETA	ORGANIC VAPOR	HE SPOT TEST	GEOPHYSICS SURFACE	LIBS/XRF	GEOLOGICAL CHARACTERIZATION	GROSS ALPHA	GROSS GAMMA/BETA	TRITIUM	VOLATILE ORGANICS	XRF	SOIL MOISTURE	ALPHA SPECTROSCOPY	GAMMA SPECTROSCOPY	BETA SPECTROSCOPY	TOTAL URANIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	VOA (SW 8240)	SEMIVOLATILES (SW 8270)	METALS (SW 6010)	ASBESTOS	HIGH EXPLOSIVES (SW 8330)	CYANIDE
16-006(g)	Septic tank	Soil					1			1		1													1			1	1	1		1	1
16-025(x)	Burned building	Soil			3	1				8		8		8															3	3		3	3
16-029(w)	Sump	Soil					3			10		10		10														3	3	3		3	3
16-029(x)	Sump	Soil					7	1		20		20													7			7	7	7		7	7
16-031(c)	Cooling tower **	Soil																															
C-16-068	Decommissioned building	Soil			1					4		4													1				1	1		1	
C-16-074	Drum storage	Soil			1					4		4													1				1	1		1	

Integers indicate anticipated numbers of laboratory, field laboratory, and field screening samples for each PRS.
\# = The actual number of samples will depend on the depth of the cores.
** = Any potential contamination associated with this unlocated cooling tower will be detected in sampling for 16-029(x)
A, B, C, E = full suite; F = 1082 suite (barium, beryllium, cadmium, chromium, mercury, copper, lead, nickel, thallium, zinc) includes boron in this aggregate;
H = full suite.

5.25.4.2 Sampling

All samples will be field screened for HE by spot test and for radionuclides by gross-beta gamma. The detection limits of the HE spot test are at a level such that a positive reading for TNT or RDX indicates a sample with contamination at a level above its SAL. Certain samples will be surveyed in the field laboratory for metals by XRF or LIBS. Some subsurface segments of soil cores will be screened for volatile organics by photoionization detector (PID). These field screening results will be used to select samples submitted for laboratory analysis.

Unless indicated otherwise, the following selection hierarchy will be used: first priority is samples with positive HE spot tests, second priority is samples with above background radiation readings (twice background or greater), and the third priority is positive VOC readings from the PID or highest metal values by XRF or LIBS. In cases where there are more positive readings than samples required (for HE, VOC, or radiation), samples will be selected at intervals within the PRS boundaries that provide adequate coverage of the PRS and information to limit the PCOC list.

Table 5-134 summarizes the field screening and laboratory analytical data collection planned for this aggregate. Each surface sample will extend to a depth of 12 in., unless otherwise indicated. Each subsurface core will be augered to the soil-tuff interface unless noted otherwise. Subsurface cores will be divided into 12 in. intervals, and each interval will be screened near its midpoint. In cases where multiple positive field screening hits are obtained on a single augered core, the shallowest positive interval will be submitted to the laboratory. At most one interval from a single core will be submitted to the laboratory.

5.25.4.2.1 Surface Sampling

SWMU 16-025(x). This SWMU has potential surface contamination from the TA-16-100 HE electroplating facility. Spatial distribution of PCOCs may be fairly uniform due the removal and grading during D&D. Three laboratory samples will be selected from eight random points sampled by field screening (XRF or LIBS) within the former structure area (see Fig. 5-95). The samples will be chosen based on the highest metal (copper, chromium, nickel) values

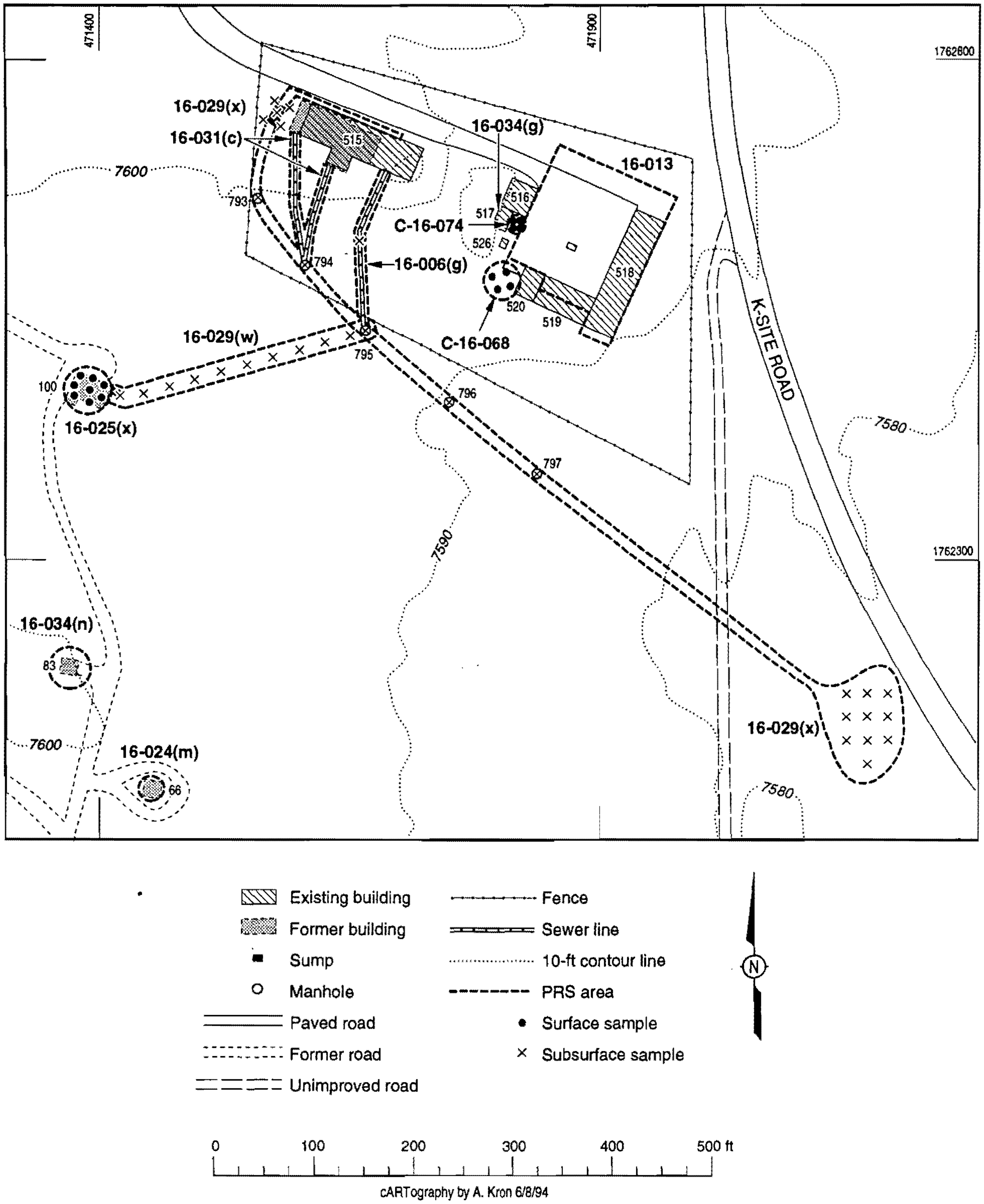


Fig. 5-95. Sampling locations at V-Site.

divided by the appropriate SALs. Phase II sampling is not considered to be likely for this PRS due to the short period of use.

C-16-068. This AOC, which represents potentially contaminated soil in the disturbed footprint of decommissioned TA-16-522, represents a surface contamination problem within the boundary of the foundation that is assumed to be the remains of this building. One laboratory sample will be selected based on field screening of four points (Fig. 5-94). Field screening analyses will include metals by XRF or LIBS and beryllium by LIBS, as well as HE spot test analyses and radionuclide screening. If no field screening samples yield positive indicators on the HE or radionuclide screening analyses, the laboratory sample based on the highest beryllium reading by LIBS will be chosen. If more than one sample yields a positive HE or radionuclide reading, select the laboratory sample at random from the samples yielding positive readings.

C-16-074. It will be assumed that potential contamination associated with this decommissioned drum storage area will be detected by the sampling for SWMU 16-013. This sampling is described in Subsection 5.17. In addition, four 6-in. cement cores will be taken to select a single laboratory sample within the drum stains in front of TA-16-517. These cores will be to 6 in. rather than 12 in., because this SWMU is undisturbed. If no positive readings occur, select the laboratory sample randomly. If more than one positive reading occurs, choose randomly from the positive samples.

5.25.4.2.2 Subsurface Sampling

SWMUs 16-029(x), 16-031(c). This inactive sump is primarily a subsurface problem, in which buried vitreous clay lines and manholes represent downstream subsurface components of the sump drainage system. A total of seven samples from this PRS will be submitted to the analytical laboratory. These samples will be selected from four sub-domains of the PRS: the swale below the outfall, manhole TA-16-795, near the sump for TA-16-515, and near the existing manholes.

A single laboratory analysis of the sediment (or swipe sample) will be analyzed for two of the five manholes (TA-16-793, TA-16-794, TA-16-795, TA-16-796, and TA-16-797), each of which will get one field screening analysis in sediment. Within the swale, ten field screening samples will be taken from a stratified random sampling pattern. The stratified random sampling pattern will be based on dividing the swale into ten roughly equal areas (Fig. 5-95). Three laboratory samples will be taken within the swale, based on the biasing hierarchy described above.

Five field screening samples will be taken from sump TA-16-515, four field screening samples will be collected from the soil on the four sides of the sump, and a single field screening sample will be taken from sediment within the sump (Fig. 5-95). Two of the screening samples from near the sump will be submitted to the laboratory based on the biasing hierarchy presented above.

In each sampling sub-domain, additional laboratory samples will be taken at random in the absence of sufficient positive field screening results. Similarly, within each sub-domain if more field screening hits occur than laboratory samples are required, take the laboratory samples at random from within the positive screening samples.

SWMU 16-029(w). There is potential subsurface contamination at the sump for TA-16-100 (HE electroplating facility). Spatial distribution of PCOCs should be similar to the removed portion of the vitreous clay pipe outside of the fence south of the V-Site buildings. Three analytical samples will be selected from 10 random points sampled by field screening (XRF or LIBS) within the former drain line area (see Fig. 5-95). Again, values for nickel, copper, and chromium compared to SALs will be used to select the three samples for laboratory analysis. Phase II is not considered to be likely for this PRS, but the concentrations are expected to be higher than those observed for the building footprint.

Note that the sump drain line connects to the TA-16-515 drainage system at manhole TA-16-795. Thus, data collected at TA-16-795 could provide further information about the presence of electroplating materials in the drain line.

SWMU 16-006(g). The septic tank will have a qualitative design that assumes that the presence of PCOCs is unlikely and, if present, would be fairly homogeneously distributed. For this reason one laboratory analytical sample in the tank is proposed. These measurements will be made at a random location, where sediment or sludge can be collected.

5.25.4.3 Laboratory Analysis

Fixed-base laboratory analyses of samples will be with detection limits and at a QA/QC level acceptable to EPA. We plan to use the following methods or equivalents for radionuclides (LANL or DOE method), metals (SW 846 Method 6010), SVOCs (SW 846 Method 8270), and HE and its byproducts (SW 846 Method 8330). The principal HE of concern are TNT and RDX; the principal HE byproducts of concern are DNT, TNB, and DNB; and, the principal metals of concern are chromium, barium, and silver.

5.25.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the QAPjP, Appendix T of the IWP (LANL 1991, 0553). Any QA/QC duplicate samples planned to be collected during the course of the field investigations are outlined in Table 5-134.

REFERENCES

No author, September 2, 1944. "Dautriche Measurements of Velocity of Slow High Explosives Cast Explosives," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico. **(No author 1944, 15-16-507)**

Ackerman, Major J. O, February 1945. "Monthly Progress Report of Group X-3 Explosives Development and Production 1-28 February 1945," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico. **(Ackerman 1945, 15-16-166)**

Ackerman, Major J. O., April 2, 1945. "Organization of S-site," Los Alamos Scientific Laboratory Memorandum to R. Popham, J. Price, D. Gurinsky, W. Smith, B. Weidenbaum, Lt. J. D. Hopper, Lt. (jg) E. Wilder, Lt. (jg) Chappell, and Ens. W. Wilson from Major J. O. Ackerman (X-3), Los Alamos, New Mexico. **(Ackerman 1945, 15-16-512)**

Ackerman, Major J. O., June 11, 1945. "Preparedness for Emergency Production at S-Site," Los Alamos Scientific Laboratory Memorandum to G. B. Kistiakowsky (X Division) from J. O. Ackerman (X-3), Los Alamos, New Mexico. **(Ackerman 1945, 15-16-509)**

Ackerman, Major J. O., July 24, 1945. "Alterations at S-Site," Los Alamos Scientific Laboratory Memorandum to G. B. Kistiakowsky (X-Division) from J. O. Ackerman (X-3), Los Alamos, New Mexico. **(Ackerman 1945, 15-16-162)**

Blackwell, C. D., November 17, 1983. " Structures Removed From TA-16," Los Alamos National Laboratory Memorandum HSE 8-83-794 to A. J. Ahlquist (HSE-8) from C. D. Blackwell (HSE-1), Los Alamos, New Mexico. **(Blackwell 1983, 15-16-076)**

Buckland, C. W., May 12, 1954. "Sr90 Contaminant Located at old T-Site Magazine," Los Alamos National Laboratory Memorandum to D. P. MacDougall (GMX-DIV) from C. W. Buckland, Los Alamos, New Mexico. **(Buckland 1954, 15-16-217)**

Buckland, C. W., August 15, 1957. "Radiation Health Clearance at 'S' and 'T' Site Buildings," Los Alamos National Laboratory Memorandum to S. E.

Russo (ENG-3) from C. W. Buckland (H-1), Los Alamos, New Mexico. **(Buckland 1957, 15-16-243)**

Buckland, C. W., July 18, 1966. "Monitoring Results from Survey of Concrete Pads and Debris Following Burning of Superstructures," Los Alamos National Laboratory Memorandum to W. C. Courtwright from C. W. Buckland, Los Alamos, New Mexico. **(Buckland 1966, 15-16-136)**

Buckland, C., March 4, 1970. "Contamination Survey: Buildings and Structures, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from C. Buckland, Los Alamos, New Mexico. **(Buckland 1970, 15-16-005)**

Burch, C. A., March 12, 1956. "S-Site Building Demolition," Los Alamos Scientific Laboratory Report to Engineering Department from C. A. Burch (H-3), Los Alamos, New Mexico. **(Burch 1956, 15-16-237)**

Courtwright, W. C., March 3, 1970. "Contamination Survey: Buildings and Structures, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from W. C. Courtwright (H-3), Los Alamos, New Mexico. **(Courtwright 1970, 15-16-004)**

Engineering Department, November 18, 1957. "Return of Laboratory Structures," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. **(Engineering Department 1957, 15-16-479)**

Engineering Department, October 2, 1959. "Vacated LASL Structures," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. **(Engineering Department 1959, 15-16-256)**

Gurinsky, D. H., May 1945. "Section X-3-B Special Research Problems," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico. **(Gurinsky 1945, 15-16-505)**

Hawkins, D., 1946. "Project Y: The Los Alamos Story, Part 1, Toward Trinity," Los Alamos Scientific Laboratory Report LAMS-2532, Los Alamos New Mexico. **(Hawkins 1946, 663)**

Hopper, J. D., May 1945. "Section X-3-A Development and Control Work May 1945," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico. **(Hopper 1945, 15-16-504)**

Huselton, E. P., November 20, 1945. "Report on the Possible Hazard to Casting Buildings Caused by HE Contamination of the Earth Under Buildings," Los Alamos Scientific Laboratory informal report, Los Alamos, New Mexico. **(Huselton 1945, 15-16-152)**

Kennedy, W. R., March 9, 1970. "Contaminated Survey: Buildings and Structures, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from W. R. Kennedy (H-6), Los Alamos, New Mexico. **(Kennedy 1970, 15-16-006)**

Koogle and Pouls Engineering, Inc., June 28, 1965. Aerial photograph, Albuquerque, New Mexico. **(Koogle and Pouls Engineering, Inc. 1965, 15-16-516)**

LANL (Los Alamos National Laboratory), August 1989. "Release Site Database; Task 14; TA-11, 13, 16, and 25" (Preliminary Draft, Volumes I and II), Prepared by Roy F. Weston, Inc., for the Department of Energy, Los Alamos, New Mexico. **(LANL 1989, 15-16-363)**

LANL (Los Alamos National Laboratory), November 1989. "Sampling and Analysis Data Document, Volume 1A, Draft, Report EGG-ES-8204 prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. **(LANL 1989, 0425)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

LANL (Los Alamos National Laboratory), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory Report LA-UR-91-3310, Los Alamos, New Mexico. **(LANL 1991, 0553)**

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)**

LANL (Los Alamos National Laboratory), July 1993. "RFI Work Plan for Operable Unit 1082," Los Alamos National Laboratory Report LA-UR-93-1196, Los Alamos, New Mexico. **(LANL 1993, 1094)**

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

LANL (Los Alamos National Laboratory), January 1993. "Environmental Restoration Standard Operating Procedures," Los Alamos, New Mexico. **(LANL 1993, 0875)**

Layton, D., B. Mallon, W. Mitchell, L. Hall, R. Fish, L. Perry, G. Snyder, K. Bogen, W. Mallock, C. Ham, and P. Dowd, 1987. *Conventional Weapons Demilitarization: A Health and Environmental Effects Data-Base Assessment, Explosives and Their Co-Contaminants, Final Report, Phase II.* US Army Medical Research and Development Command, Fort Detrick, Frederick, MD, P.O. 83PP3813, AD-UCRL-21109. **(Layton et al. 1987, 15-16-447)**

Martin, W. B., November 17, 1993. "Early S-Site History: Lee Hilton Interview," Los Alamos National Laboratory Memorandum CST-6-ER/BM-93-060 to File from W. B. Martin (CST-6), Los Alamos, New Mexico. **(Martin 1993, 15-16-477)**

Martin, B. and D. Hickmott, April 2, 1993. "Early S-Site History: C. Courtright Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:021 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. **(Martin and Hickmott 1993, 15-16-497)**

Martin, B. and D. Hickmott, May 6, 1993. "Early S-Site History: Melvin Brooks Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:022 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. **(Martin and Hickmott 1993, 15-16-498)**

Martin, B. and D. Hickmott, June 14, 1993. "Early T-Site History: L. Bailey Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:35 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. **(Martin and Hickmott 1993, 15-16-500)**

Martin, B. and D. Hickmott, December 6, 1993. "Early S-Site History: L. Norman Interview," Los Alamos National Laboratory Memorandum CST-ER/BM-93-061 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. **(Martin and Hickmott 1993, 15-16-514)**

Mitchell, R. N., March 18, 1970. "Contamination Survey: Building and Structure Survey, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from R. N. Mitchell (H-5), Los Alamos, New Mexico. **(Mitchell 1970, 15-16-007)**

Nyhan, J. W., L. W. Hacker, T. E. Calhoun, and D. L. Young, June 1978. "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. **(Nyhan et al. 1978, 0161)**

Panowski, J. B., and P. G. Salgado, July 28, 1971. "Group GMX-3 Effluents," Los Alamos Scientific Laboratory Memorandum to H. F. Schulte (H-8) from J. B. Panowski and P. G. Salgado (GMX-3), Los Alamos, New Mexico. **(Panowski and Salgado 1971, 15-16-038)**

Russo, S. E., July 30, 1957. "Return of Structures, TA-29 and TA-0," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico. **(Russo 1957, 15-16-443)**

Schulte, H. F., May 14, 1959. "Contamination Surveys - Abandoned Structures," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from H. F. Schulte (H-5), Los Alamos, New Mexico. **(Schulte 1959, 15-16-263)**

Smith, F. S., April 27, 1950. "Handling Thallium at 'S-Site' by GMX-2," Los Alamos Scientific Laboratory Memorandum to E. C. Hyatt from F. S. Smith, Los Alamos, New Mexico. **(Smith 1950, 15-16-189)**

Tenney, G. H., September 10, 1944. "Group X-1 Progress Report," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. **(Tenney 1944, 15-16-182)**

Tenney, G. H., April 4, 1945. "Progress Report T-Site," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. **(Tenney 1945, 15-16-157)**

Tenney, G. H., June 2, 1945. "Progress Report T-Site," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. **(Tenney 1945, 15-16-181)**

Tenney, G. H., June 17, 1948. "T-Site," Los Alamos National Laboratory Memorandum to H. F. Schulte (H-Division) from G. H. Tenney, Los Alamos, New Mexico. **(Tenney 1948, 15-16-141)**

Thrap, R. L., February 11, 1970. "S-Site Demolition and Restoration Projects to Remove Potential Explosives Hazards," Los Alamos Scientific Laboratory Memorandum to C. A. Reynolds from R. L. Thrap (GMX-3), Los Alamos, New Mexico. **(Thrap 1970, 15-16-001)**

Truslow, E. R., March 1973. "Nonscientific Aspects of Los Alamos Project Y, 1942 through 1946," "Early S-Site Experiences," Appendix by E. Wilder, Jr., LA-5200, Los Alamos, New Mexico. **(Truslow 1973, 15-16-264)**

Wingfield, E. E., January 29, 1960. "Demolition of Buildings by Fire," Atomic Energy Commission Memorandum from E. E. Wingfield (AEC), Los Alamos, New Mexico. **(Wingfield 1960, 15-16-111)**

Wingfield, E. E., May 27, 1960. "Demolition of Buildings by Burning" Atomic Energy Commission Memorandum from E. E. Wingfield (AEC), Los Alamos, New Mexico. **(Wingfield 1960, 15-16-117)**

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Chapter 6

RFI Work Plan (1993)

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Addendum 2

(To be completed in 1995)

NOTE: ALL PRSs LISTED IN TABLE 6-9 AND SUBSEQUENTLY DESCRIBED BELOW ARE PART OF THE JULY 1994 ADDENDUM 1 TO THIS WORK PLAN.

TABLE 6-9

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION IN ADDENDUM 1

PRS AGGREGATE(S), DESCRIPTION(S)	EVALUATION STEP CRITERION	SUBSECTION
16-006(h), inactive septic system; 16-017, WW II era HE complex; and 16-029(g2), inactive HE sump	Third (DA)	6.4.1.1
16-006(i), active septic system	First (NFA)	6.4.2.1
16-034(g), soil contamination	First (NFA)	6.4.2.2
16-026(i2), inactive outfall from building drain	First (NFA)	6.4.2.3
16-032(d), decommissioned HE sump	First (NFA)	6.4.2.4
16-005(i), septic tank	First (NFA)	6.4.2.5
16-028(a), outfall	First (NFA)	6.4.2.6
16-005(b), decommissioned septic system	Fourth (NFA)	6.4.3.1
16-025(c), soil contamination	Fourth (NFA)	6.4.3.2
16-031(g), inactive outfall from cooling tower	Fourth (NFA)	6.4.3.3
16-005(f), decommissioned septic system	Fourth (NFA)	6.4.3.4
16-025(g2), magazine	Fourth (NFA)	6.4.3.5
16-032(e), decommissioned HE sump	Fourth (NFA)	6.4.3.6
16-023(a), incinerator	First (NFA)	6.5.1.1
25-001, pit	First (NFA)	6.5.1.2
16-032(b), decommissioned HE sump	First (NFA)	6.5.1.3
C-25-001, beryllium operation	First (NFA)	6.5.1.4
C-16-004, C-16-032, C-16-039, and C-16-040, hose houses	Fourth (NFA)	6.5.2.1
C-16-021, C-16-022, C-16-024, administrative support buildings	Fourth (NFA)	6.5.2.2
C-16-025, C-16-026, C-16-027, C-16-029, Zia shops	Fourth (NFA)	6.5.2.3
C-16-023 and C-16-033, warehouses; C-16-037 and C-16-038, product storage buildings; and C-16-066, storage area	Fourth (NFA)	6.5.2.4
C-16-003, latrine	Fourth (NFA)	6.5.2.5
C-16-007, tank stand; and C-16-055, switch box	Fourth (NFA)	6.5.2.6
C-16-059, electrical pit	Fourth (NFA)	6.5.2.7
C-16-042, C-16-043, C-16-045, C-16-048, C-16-052, C-16-053, C-16-054, C-16-056, and C-16-057, manholes	Fourth (NFA)	6.5.2.8

6.4 SWMUs Listed in the February 1993 Request for a Class 3 Permit Modification to the HSWA Module

6.4.1 SWMUs Recommended for Deferred Action Under Step Three of the Four-Step Criteria

The following PRSs are associated with intact structures. It is recommended that further action be deferred until the sites undergo decontamination and decommissioning (D&D). The D&D project leader will coordinate all activities with the 1082 OUPL.

6.4.1.1 Active/Inactive Septic System, SWMU 16-006(h); World War II Era HE Complex, SWMU 16-017; and Inactive HE Sump, SWMU 16-029(g2)

6.4.1.1.1 Background

SWMU 16-006(h) is listed in the SWMU Report under active/inactive septic systems; however, upon field verification it was found to be a steam heating distribution pump pit, TA-16-526 (formerly V-11), located against the berm retaining wall about 12 ft south of building TA-16-517 (LANL 1990, 0145). The 6 x 6 x 6 ft pit was built in 1945 and holds a condensate pump. Drawing ENG-C 1842 shows that steam discharge from the 40-psi boiler in TA-16-517 and from the 100-psi system serving all of S-Site was routed through pressure reduction valves to 15-psi radiator feeder lines. Condensate from the radiators was routed to pump pit TA-16-526 to be returned to the source boiler. The system served buildings TA-16-515, TA-16-516, TA-16-519, and TA-16-520. Drawing ENG-C 6031 indicates that each condensate stream was pumped back to its source boiler. Some pipes in the pit are insulated with asbestos, as are all steam lines at S-Site.

SWMU 16-017 is a set of twenty-three intact, abandoned structures in, or closely associated with, the World War II era S-Site. Table 6-10 includes the building number, function and, where applicable, a reference to the subsection in this addendum where the building is discussed further as part of other non-deferred sampling activities.

SWMU 16-029(g2) was pit TA-16-523 (formerly V-9). Drawing ENG-C 1837 indicates that it was an 11 x 16 x 4 ft concrete structure located directly in front of the doors of building TA-16-517. The pit was fitted with three wooden section lids and had a 0.5 ft raised concrete section covering most of the

TABLE 6-10

STRUCTURES INCLUDED IN SWMU 16-017

STRUCTURE NUMBER	DESCRIPTION (ORIGINAL/LATER)	SUBSECTION
TA-16-10	Storage	5.21
TA-16-27	HE processing/storage	5.18
TA-16-59	Magazine/storage	NA
TA-16-61	Magazine/storage	NA
TA-16-63	Storage	NA
TA-16-73	Magazine/storage	NA
TA-16-75	Magazine/storage	NA
TA-16-76	Magazine/storage	NA
TA-16-77	Magazine/storage	NA
TA-16-78	Magazine/storage	NA
TA-16-79	Magazine/storage	NA
TA-16-80	Magazine/storage	NA
TA-16-89	Process building/storage	5.23
TA-16-90	Process building/storage	5.23
TA-16-91	Process building/storage	5.23
TA-16-92	Inspection building/storage	5.23
TA-16-93	Process building/storage	5.23
TA-16-99	Process building/storage	5.23
TA-16-164	Storage shed	NA
TA-16-515	Process building	5.25
TA-16-516	Process building	5.25
TA-16-517	Equipment storage	5.25
TA-16-519	Storage building	5.25
TA-16-520	Storage building	NA
TA-16-523	Pit	NA

bottom. It was completed in 1944 and a year later was abandoned in place, filled with dirt, and covered with a slab of concrete.

The pit held the shake table used in vibration tests on the Fat Man device. Because the device had an HE component, the table was controlled remotely from a bunker west of V-Site. No radioactive material was used in the tests. No incidents occurred during operation of the shake table. A memo written in 1983 lists pit TA-16-523 as having been used in association with HE and beryllium (Blackwell 1983, 15-16-076).

6.4.1.1.2 Recommendation

Defer action on these three SWMUs until D&D.

6.4.1.1.3 Rationale for Recommendation

These three SWMUs consist of structures which are intact or buried, but inactive, and which are slated to go through D&D (LANL 1992, 15-16-550). While the structures themselves are in various states of disrepair and may be contaminated with HE internally, no record of any release to the environment has been found. They present no current human health or environmental risk on or off site and characterization would be needlessly disruptive of the surrounding active operations (see Appendix I of the IWP) (LANL 1993, 1017).

6.4.2 SWMUs Recommended for No Further Action Under Step One of the Four-Step Criteria

6.4.2.1 Septic System, SWMU 16-006(i)

6.4.2.1.1 Background

SWMU 16-006(i) is an active septic tank. The septic tank was originally designated as structure TA-16-00 and listed in the 1990 SWMU Report as SWMU 16-006(i) (LANL 1990, 0145). Review of Laboratory job #6416-16 of August 1987 indicates that TA-16-00 was a temporary placeholder for septic tank TA-16-1153 (Engineering drawing ENG-C 43838). TA-16-1153, which serves TA-16-370, has been addressed in Subsection 6.1.5.6 under SWMU 16-006(f).

6.4.2.1.2 Recommendation

SWMU 16-006(i) is recommended for NFA because it is inaccurately listed as a separate site from 16-006(f), which has been addressed (see Appendix I of the IWP) (LANL 1993, 1017).

6.4.2.1.3 Rationale for Recommendation

SWMU 16-006(i) and SWMU 16-006(f) are identical, and SWMU 16-006(f) has already been addressed as noted above.

6.4.2.2 Soil Contamination, SWMU 16-034(g)

6.4.2.2.1 Background

SWMU 16-034(g) is described in the SWMU Report as soil contamination associated with the operation and decommissioning of building TA-16-517. It goes on to say that, "These structures were flash burned prior to demolition due to health and safety concerns" (LANL 1990, 0145). This implies that TA-16-517 has been removed; however, this building is intact and is addressed as part of SWMU 16-017 in Subsection 6.4.1 above.

6.4.2.2.2 Recommendation

SWMU 16-034(g) is recommended for NFA because the SWMU Report inaccurately identified this site as a former structure.

6.4.2.2.3 Rationale for Recommendation

The intact structure is addressed as part of SWMU 16-017.

6.4.2.3 Inactive Outfall From Building Drain, SWMU 16-026(i2)

6.4.2.3.1 Background

SWMU 16-026(i2) is identified in the SWMU Report as an inactive outfall from the building drains associated with TA-16-54 (LANL 1990, 0145).

6.4.2.3.2 Recommendation

SWMU 16-026(i2) is recommended for NFA because it is covered under the sampling plan for SWMU 16-006(a) in Subsection 5.4 of this work plan.

6.4.2.3.3 Rationale for Recommendation

Based on a review of engineering drawing BLDG54 in the Wastewater Characterization of Building Drains and Outfalls at S-Site (Palmer and Abercrombie 1991, 15-16-366) and a conversation with a former site worker who conducted evaluations of wastewater streams at TA-16 (Buksa 1993, 15-16-517), the building drains in TA-16-54 went to interior sumps and from there to the septic tank system. This septic system will be sampled as outlined in Subsection 5.4 of this work plan.

6.4.2.4 Decommissioned HE Sump, SWMU 16-032(d)

6.4.2.4.1 Background

SWMU 16-032(d) is identified in the SWMU Report as a decommissioned HE sump associated with TA-16-24 (LANL 1990, 0145).

6.4.2.4.2 Recommendation

SWMU 16-032(d) is recommended for NFA because it is a duplicate of SWMU 16-029(f2), which is covered in Subsection 5.18 of this work plan.

6.4.2.4.3 Rationale for Recommendation

Based on a review of the description of SWMUs 16-032(d) and 16-029(f2) in the SWMU Report (LANL 1990, 0145) and a review of the Release Site Database (LANL 1989, 15-16-361), it is apparent that these two SWMUs are the same. SWMU 16-029(f2) is evaluated in Subsection 5.18 of this work plan.

6.4.2.5 Septic tank, SWMU 16-005(i)

6.4.2.5.1 Background

SWMU 16-005(i) was a septic tank originally designated as structure TA-13-12. According to the TA-16 Engineering Structure List, when TA-16 merged with TA-13, TA-13-12 was redesignated TA-16-486. TA-16-486 has been addressed as SWMU 13-003(a) in Subsection 5.4 of this work plan.

6.4.2.5.2 Recommendation

SWMU 16-005(i) is recommended for NFA because it is inaccurately listed as a separate SWMU from SWMU 13-003(a) which has been addressed as noted.

6.4.2.5.3 Rationale for Recommendation

SWMU 16-005(i) is a duplicate of SWMU 13-003(a). They are, in fact, identical and SWMU 13-003(a) has already been addressed in this work plan.

6.4.2.6 Outfall, SWMU 16-028(a)

6.4.2.6.1 Background

SWMU 16-028(a) is listed as an active outfall associated with TA-16-228. The SWMU Report gives two slightly different descriptions of this SWMU. It describes a drainage system discharging to the canyon between TA-16-228 (which was renamed TA-16-363) and the liquid impoundment SWMU 16-008(b) which has undergone closure (LANL 1990, 0145). It also describes an outfall discharging water from the treatment of HE sludge through a permitted activated charcoal treatment facility (EPA05A055). The latter description is under SWMU 16-010(g) in Chapter 6 of the first part of this RFI work plan. The former description in the SWMU Report describes an area that is referred to as the south drainage in Subsection 5.8 of this RFI work plan. The area is being sampled under that subsection. Since it appears that the south drainage and the drainage area described in this SWMU 16-028(a) are identical, the heading SWMU 16-028(a) will replace the words "south drainage" in the final draft of the first work plan.

6.4.2.6.2 Recommendation

SWMU 16-028(a) as it is associated with TA-16-363 is recommended for NFA because it is inaccurately listed as separate from SWMU 16-010(g). SWMU 16-028(a), as it is associated with the drainage, is covered as the south drainage in Subsection 5.8 of this work plan.

6.4.2.6.3 Rationale for Recommendation

This SWMU is a duplicate of SWMU 16-010(g) and the south drainage in Subsection 5.8 of this work plan.

6.4.3 SWMUs Recommended for No Further Action Under Step Four of the Four-Step Criteria

6.4.3.1 Decommissioned Septic System, SWMU 16-005(b)

6.4.3.1.1 Background

SWMU 16-005(b) was septic tank TA-16-174, along with associated drain line, distribution box, and outfall. It was a 4 x 8 x 5 ft reinforced-concrete pit built in 1945. The SWMU Report incorrectly associates the septic tank with a small steam plant, TA-16-502, which served the old T-Site (LANL 1990, 0145). Upon close inspection of Engineering drawing ENG-R 860, it is apparent that the tank served TA-16-142, a firehouse removed in 1955. The septic system was located 197 ft south of TA-16-502 and 91 ft east of Anchor Ranch Road. The septic system drained to the east and, eventually, into the T-Site drainage ditch. There were no known hazardous materials used at the firehouse (Blackwell 1983, 15-16-076). The septic tank was removed at an unknown later date (ENG-R 2435). During a 1983 cataloging of possible contamination at various S-Site buildings, it was judged to be free of radioactive and chemical toxins (Blackwell 1960,15-16-114; Westfall 1960, 15-16-115).

6.4.3.1.2 Recommendation

SWMU 16-005(b) is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (see Appendix I of the IWP) (LANL 1993, 1017).

6.4.3.1.3 Rationale for Recommendation

Documentation indicates that this septic tank received only sanitary waste from a firehouse that was located several hundred feet from the nearest process building and, in the absence of hazardous constituents, there is no potential for a release to the environment. The location of the removed tank is an open field that has regrown with vegetation. Septic tanks that manage only domestic waste are excluded from being SWMUs under 40 CFR 261.4(a)(1)(i) (EPA 1990, 0093).

6.4.3.2 Soil Contamination at Decommissioned HE Facilities, SWMU 16-025(c)

6.4.3.2.1 Background

SWMU 16-025(c) was a utility building, TA-16-35, which supported machining buildings TA-16-31, TA-16-32, and TA-16-33. Completed in 1945, it was a 15 x 13 x 8 ft wood and gypsum building. Steam heat and other utility lines came first to TA-16-35 and were then distributed to the buildings it served. TA-16-35 was removed after May 1960 (the exact date of its removal is not known). Records indicate that this building presented no known radiological, HE, or toxic chemical contamination problems (Blackwell 1959, 15-16-251; Penland 1959, 15-16-255; LASL 1959, 15-16-256).

6.4.3.2.2 Recommendation

SWMU 16-025(c) is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.4.3.2.3 Rationale for Recommendation

There is no documentation indicating that this building was used for the handling or storage of hazardous materials. There is no record of any spills or releases associated with this structure. The area is currently vacant and regrown with vegetation.

6.4.3.3 Inactive Outfall Cooling Tower, SWMU 16-031(g)

6.4.3.3.1 Background

SWMU 16-031(g) was cooling tower TA-16-189. It was a small structure located just east of casting building TA-16-42 and was used to provide noncontact cooling water for the casting molds. It was constructed in 1946 and removed in 1960. Only ordinary tap water was used in this equipment (Martin 1993, 15-16-477). There were no known hazardous materials used at TA-16-189 (Blackwell 1983,15-16-076).

6.4.3.3.2 Recommendation

SWMU 16-031(g) is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.4.3.3.3 Rationale for Recommendation

The available information, supplied by a former site worker, indicates that this cooling system used untreated tap water (Martin 1993, 15-16-477). No record of any release of hazardous constituents is known. The area is currently vacant and regrown with vegetation.

6.4.3.4 Decommissioned Septic Systems, SWMU 16-005(f)

6.4.3.4.1 Background

SWMU 16-005(f) was a 1 500-gal. septic tank, TA-16-272, associated line, doser chamber, distribution box, and outfall. TA-16-272 was built in February 1951, abandoned in December 1952, and later removed; no removal date was given (ENG-R 2436). According to Engineering drawing ENG-R 135, the tank was located approximately 190 ft from the northeast corner of TA-16-260, an HE machining facility. Operations in TA-16-260 are described in Subsection 5.3 of this work plan (LANL 1993, 1094). The exact location of TA-16-272, in relation to TA-16-260, could not be verified, but fragments of clay pipe were found and the ground was depressed (Weston 1988, 15-16-094). Available drawings indicate that the system was connected to several bathrooms along the west side of building TA-16-260 (Engineering drawing ENG-R 857).

As reported in a memo from a former site worker, septic tank TA-16-272 was monitored and found to be free of radioactive contamination (Buckland 1967, 15-16-131). According to a memo, TA-16-272 was not listed as having an HE hazard (Blackwell 1983, 15-16-076).

6.4.3.4.2 Recommendation

SWMU 16-005(f) is recommended for NFA because there is no reasonable basis to believe this unit handled hazardous waste or for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.4.3.4.3 Rationale for Recommendation

Documentation indicates that this septic tank received only sanitary waste from TA-16-260 and, in the absence of hazardous constituents, there is no potential for a release to the environment. Septic tanks that manage only domestic waste are excluded from being SWMUs under 40 CFR 261.4(a)(1)(i) (EPA 1990, 0093).

6.4.3.5 Magazine, SWMU 16-025(g2)

6.4.3.5.1 Background

SWMU 16-025(g2) is described in the SWMU Report as possible soil contamination at TA-16-108. TA-16-108 was a 6 ft^2 storage building built in mid-1944 on the western edge of S-Site. The structure was constructed similar to a magazine with earthen berms on three sides and a door on the fourth. According to a former site worker (Martin and Hickmott, 15-16-549), it was used for the storage of non-HE materials such as aluminum powder, lead oxide, and barium nitrate, but the site worker did not rule out small quantities of containerized HE. The building was destroyed in 1950 for the construction of State Road 501.

6.4.3.5.2 Recommendation

SWMU 16-025(g2) is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.4.3.5.3 Rationale for Recommendation

TA-16-108 was a very small, lightly used building. If HE was stored at this location, it would have been in some type of containerized or packaged form. No machining or shaping was ever done at this location, and there were never any documented cases of a release to the environment. In February 1945, construction began on a line of four magazines on the southeast side of S-Site. These magazines were 1 200 ft^2 in size and developed primarily for storing HE. If HE was stored at TA-16-108, it would have been for a period of less than one year. Based on a review of aerial photographs, it is probable that TA-16-108 is under State Road 501 which is elevated and fully graded for drainage. Construction of the road involved moving quantities of soil that would have dispersed any traces of contaminants.

6.4.3.6 Decommissioned HE Sump, SWMU 16-032(e)

6.4.3.6.1 Background

SWMU 16-032(e) is listed in the 1990 SWMU Report as a decommissioned HE sump (LANL 1990, 0145) but according to ENG-R 124, it was actually water pump pit TA-16-20, located about 30 ft directly east of TA-16-16, the S-Site cafeteria. The pit, constructed of reinforced concrete with a double wooden cover, was removed in 1953. A service manhole associated with the pump pit still remains. The pit was associated with TA-16-21, a pump house, and Engineering drawing ENG-C 8541 clearly shows that structure TA-16-20 was used to pump water from a tank on Jemez Road. This function was confirmed by a former site worker (Martin and Hickmott, 15-16-549). A 1983 memo indicates that HE may have been associated with TA-16-20, but given its function and its location outside of the HE exclusion area, this does not seem plausible (Blackwell 1983, 15-16-076). Before work began on the Los Alamos Information Communication System in 1991, SWMU 16-009(a) and SWMU 16-032(e) were sampled and screened for gross alpha, beta, and gamma radioactivity and then submitted to HSE-9 for analysis of TCLP metals and RCRA regulated VOC, SVOC, and PCB compounds. According to a 1991 memo, no levels of concern for any of the above PCOCs were found in the surface and subsurface samples taken (Fresquez 1991, 15-16-523).

6.4.3.6.2 Recommendation

SWMU 16-032(e) is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.4.3.6.3 Rationale for Recommendation

SWMU 16-032(e) is misidentified in the SWMU Report as a decommissioned HE sump (LANL 1990, 0145), but is actually a water pump pit that would not have come into contact with HE (ENG-C 8541) (Martin and Hickmott, 15-16-549). In addition, surface and subsurface sampling done at SWMU 16-032(e) in 1991 prior to installation of the Los Alamos Information Communication System revealed no levels of concern for gross alpha, beta, and gamma radioactivity, nor for TCLP metals, and RCRA regulated VOC, SVOC, and PCB compounds (Fresquez 1991, 15-16-523).

6.5 SWMUs and AOCs Not Listed in the HSWA Module That Are Recommended for No Further Action

6.5.1 SWMUs Recommended for No Further Action Under Step One of the Four-Step Criteria

6.5.1.1 Incinerator, SWMU 16-023(a)

6.5.1.1.1 Background

SWMU 16-023(a) was incinerator TA-16-199. After considerable archival research, its location and history cannot be clearly established. It is possible that it is identical to TA-16-403, which is addressed in Subsection 5.19. The SWMU Report contains a self-contradictory chronological discussion which may reflect the confusion between TA-16-199 and TA-16-403 (LANL 1990, 0145).

6.5.1.1.2 Recommendation

SWMU 16-023(a) is recommended for NFA because its location cannot be established.

6.5.1.1.3 Rationale for Recommendation

The existence of this SWMU cannot be verified based on the information in the SWMU Report or as a result of an extensive archival search. Since the location of SWMU 16-023(a) cannot be established, it is impossible to develop an applicable sampling plan. The extensive sampling which will be carried out in the general area cited in the SWMU Report for this SWMU is likely to locate any residual contamination if it exists (see Subsection 5.18). If any contamination is detected as the result of the sampling, its nature and extent will be explored during Phase II.

6.5.1.2 Pit, SWMU 25-001

6.5.1.2.1 Background

SWMU 25-001 is a pit associated with TA-25-9. Engineering drawing ENG-C 1840 indicates that V-9 (TA-25-9) is the same as TA-16-523. SWMU 25-001 is, therefore, a duplicate of SWMU 16-029(g2), which is addressed in Subsection 6.4.1.1.

6.5.1.2.2 Recommendation

SWMU 25-001 is recommended for NFA because it is inaccurately listed as a separate site from SWMU 16-029(g2), which has been addressed (see Appendix I of the IWP) (LANL 1993, 1017).

6.5.1.2.3 Rationale for Recommendation

SWMU 25-001 is a duplicate of SWMU 16-029(g2). SWMU 16-029(g2) has already been addressed as noted above.

6.5.1.3 Decommissioned HE Sump, SWMU 16-032(b)

6.5.1.3.1 Background

SWMU 16-032(b) is identified in the SWMU Report as a sump associated with a former HE storage building TA-16-148, which was located southwest of TA-16-27 near TA-16-24 (LANL 1990, 0145).

6.5.1.3.2 Recommendation

SWMU 16-032(b) is recommended for NFA because TA-16-148 was not an HE storage building and had no sump associated with it (LANL 1993, 1017).

6.5.1.3.3 Rationale for Recommendation

Engineering drawing ENG-C 1096 shows TA-16-148 as a simple wooden-frame storage shed (12 x 6 x 7 ft) on skids that was located adjacent to TA-16-24. It was designed in such a way that it would not have made an acceptable repository for the storage of HE, nor did it have a sump associated with it. The SWMU associated with TA-16-148 itself was covered in Subsection 5.19.

6.5.1.4 Beryllium Operations, C-25-001

6.5.1.4.1 Background

C-25-001 is identified in the SWMU Report as a former location of beryllium operations housed in building V-3 (LANL 1990, 0145).

6.5.1.4.2 Recommendation

C-25-001 is recommended for NFA because it is inaccurately listed as a separate site from C-16-068, which has been addressed in Subsection 5.25.

6.5.1.4.3 Rationale for Recommendation

Based on a review of engineering drawings, C-25-001, which is associated with building V-3, is a duplicate of C-16-068, which is associated with TA-16-522 (a later designation for V-3). C-16-068 has already been addressed as noted above.

6.5.2 AOCs Recommended for No Further Action Under Step Four of the Four-Step Criteria

6.5.2.1 Hose Houses, C-16-004, C-16-032, C-16-039, and C-16-040

6.5.2.1.1 Background

These four hose houses, TA-16-150, TA-16-167, TA-16-151, and TA-16-152 were constructed in 1945 or 1946 and were removed in 1958. TA-16-150 was located southwest of TA-16-26; TA-16-167 was located northeast of TA-16-49; TA-16-151 was located southwest of TA-16-42; and, TA-16-152 was located southwest of TA-16-37. Hose houses, as the name implies, were situated adjacent to fire hydrants and were used to protect lengths of fire hose from the elements. Each was wooden-frame construction approximately 7 x 3 x 8 ft with two doors to protect the interior from the weather.

6.5.2.1.2 Recommendation

C-16-004, C-16-032, C-16-039, and C-16-040 are recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.1.3 Rationale for Recommendation

There were no known hazardous materials used at these locations (Blackwell 1983,15-16-076).

6.5.2.2 Administrative Support Buildings, C-16-021, C-16-022, C-16-024

6.5.2.2.1 Background

C-16-021 was administration building TA-16-1, which was constructed in 1944 and removed in March 1956. It was located in the southeast section of the administration area. The building went through numerous renovations and additions, and was F-shaped at the time of its removal. There were no known hazardous materials used at this location (Blackwell 1983, 15-16-076).

C-16-022 was office building TA-16-2, which was constructed in 1944 and removed by the First Baptist Church of Bayfield, Colorado in March 1956. It was a 20 x 64 x 9 ft structure of wooden-frame construction, located in the southeast section of the administration area. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-024 was motor pool dispatch office TA-16-9, which was constructed in 1945 and removed in March 1956. It was of wooden-frame construction, and was located west of TA-16-10 and south of TA-16-12. There were no known hazardous materials used at this location (Blackwell 1983, 15-16-076).

6.5.2.2.2 Recommendation

C-16-021, C-16-022, and C-16-024 are recommended for NFA because there is no reasonable basis to believe there was any release from these units or for characterization of the sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.2.3 Rationale for Recommendation

None of these structures was used for the handling or storage of hazardous materials (Blackwell 1983,15-16-076).

6.5.2.3 Zia Shops C-16-025, C-16-026, C-16-027, and C-16-029

6.5.2.3.1 Background

C-16-025 was Zia cabinet shop TA-16-8, which was constructed in 1945 and removed in March 1956. It was of wooden-frame construction and was located to the west of TA-16-10 and to the south of TA-16-9. It was used as a carpentry shop and no known hazardous materials were used at this location (Blackwell 1983,15-16-076).

C-16-026 was Zia repair shop TA-16-6, a wooden-frame structure located south of TA-16-10. It was constructed in 1945 and removed in March 1956. It appears that the building was used for the storage of tools and supplies. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-027 was Zia plumbing shop TA-16-17, which was constructed in 1945 and removed in March 1956. It was of wooden-frame construction and was located south of TA-16-10 on the west side of the road leading to TA-16-10. While there is an indication that this building was used for the handling of HE (Blackwell 1983,15-16-076), a private contractor was allowed to remove the structure in March 1956. Given that rigorously enforced site policy dictated that all buildings contaminated with HE were destroyed by burning, there is no reason to believe that the building or surrounding area was affected.

C-16-029 was Zia electrical shop TA-16-3, which was constructed in 1944 and removed in March 1956. It was of wooden-frame construction and located south of TA-16-10 on the east side of the road leading to TA-16-10. Dimensions of the building were 25 x 48 x 8 ft. It appears that the building was used for storage of electrical supplies such as conduit and fixtures. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

6.5.2.3.2 Recommendation

C-16-025, C-16-026, C-16-027, and C-16-029 are recommended for NFA because there is no reasonable basis to believe there was any release from these units or for characterization of the sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.3.3 Rationale for Recommendation

Three of these structures were not used for handling or storage of hazardous materials (Blackwell 1983,15-16-076). There is no record of any spills or releases associated with any of these structures. Policy in effect in 1956 required that any building found to be contaminated with HE, however slightly, would be burned. The removal of TA-16-17 by a private contractor therefore precludes the possibility of residual HE contamination.

6.5.2.4 Warehouses, Product Storage Buildings, and Storage Area, C-16-023, C-16-033, C-16-037, C-16-038, and C-16-066

6.5.2.4.1 Background

C-16-023 was warehouse TA-16-12, which was constructed in 1950 and removed in March 1956. It was a 20 x 108 x 12 ft wooden structure located at the northwest end of the administration area west of TA-16-10. The concrete foundation of this building remains in place. It was used to store decontaminated HE casting molds; HE was not stored in this type of building (Martin 1993, 15-16-477). There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-033 was warehouse TA-16-85, which was constructed in 1945 and removed about January 1947. It was located just east of TA-16-3, TA-16-4, and TA-16-5. The structure consisted of four adjoining Pacific huts; dimensions were 32 x 32 x 9 ft. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-037 was product storage area TA-16-23, which was constructed in 1945 and removed in March 1951. It was a wooden structure 16 x 24 x 9 ft in dimension, and was located at the south end of the administration area. It was used for the storage of decontaminated HE casting molds (Martin 1993, 15-16-477). There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-038 was product storage area TA-16-11, which was constructed in 1949 and removed in March 1956. It was a 20 x 110 x 12 ft wooden structure, with a concrete foundation that is still present. The building was located to the west of TA-16-10. This area was used for storage of decontaminated HE casting molds (Martin 1993, 15-16-477). There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-066 was storage area TA-16-186, which was established in 1945, abandoned in place in 1960, and removed some time thereafter. It served utility room TA-16-35. While the structure list designates this as drum storage/bandstand, which usually meant a place where drums of scrap HE were accumulated, it was actually used to store tools and equipment for servicing TA-16-35. TA-16-35 was an equipment room that housed machinery such as the air compressors that were used to drive the HE machining equipment in nearby machining bays. A former site worker states that the SWMU Report erroneously designates this as a chemical storage area (Martin 1993, 15-16-477).

6.5.2.4.2 Recommendation

C-16-023, C-16-033, C-16-037, C-16-038, and C-16-066 are recommended for NFA because there is no reasonable basis to believe there was any release from these units or for characterization of the sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.4.3 Rationale for Recommendation

Four of these structures were not used for handling or storage of hazardous materials (Blackwell 1983,15-16-076), and there is no record of any spills or releases associated with any of these structures.

6.5.2.5 Latrine, C-16-003

6.5.2.5.1 Background

The background of this structure and its associated septic tank, also recommended for NFA, are given in Subsection 6.1.5.3.

6.5.2.5.2 Recommendation

C-16-003 is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.5.3 Rationale for Recommendation

There is no documentation to indicate that this septic tank received anything other than sanitary waste from its associated guardhouse and, in the absence of hazardous constituents, there is no potential for a release to the environment.

6.5.2.6 Tank Stand, C-16-007 and Switch Box, C-16-055

6.5.2.6.1 Background

C-16-007 was water tank stand TA-16-521, which stood in the area between the berms sheltering TA-16-515 and TA-16-517. It was a 15-ft wooden tower mounted on concrete piers, topped with a wooden water tank 15 ft in diameter and 10 ft high. Engineering drawing ENG-C 1840 indicates that all equipment within the structure was moved to the US Engineers' warehouse. The tank was abandoned in place in 1967 and demolished in 1968. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-055 was switch box TA-16-510 used for electrical switch gear, constructed in 1945, and removed in 1960. It was located at T-Site south of the entrance road at the east end. The switch box was of wooden-frame construction with dimensions of 2 x 11 x 5 ft, and was supported 3 ft above ground by two power poles. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

6.5.2.6.2 Recommendation

C-16-007 and C-16-055 are recommended for NFA because there is no reasonable basis for characterization of the sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.6.3 Rationale for Recommendation

These structures were not used for handling or storage of hazardous materials (Blackwell 1983,15-16-076). There is no record of any spills or releases associated with any of these structures.

6.5.2.7 Electrical Pit, C-16-059

6.5.2.7.1 Background

C-16-059, TA-16-524, was the location of an electrical pit constructed in 1944 and removed and backfilled in 1945. This pit, which was lined with railroad ties, provided electrical service outlets and working space under a section of B-29 fuselage that was used to conduct environmental, loading, and arming exercises on Fat Man mock-ups (Martin 1993, 15-16-477).

6.5.2.7.2 Recommendation

C-16-059 is recommended for NFA because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.7.3 Rationale for Recommendation

This structure was not used for the handling or storage of hazardous materials (Blackwell 1983,15-16-076; Martin 1993, 15-16-477). There is no record of any spills or releases associated with this structure.

6.5.2.8 Manholes C-16-042, C-16-043, C-16-045, C-16-048, C-16-052, C-16-053, C-16-054, C-16-056, and C-16-057

6.5.2.8.1 Background

C-16-042 was steam manhole TA-16-511, which was constructed in 1945 and removed in 1968. It was a 4 x 4 x 4 ft reinforced concrete structure located on the south side of the entrance road to T-Site. It was used for the heating system distilled steam vapor or return cool-condensate water only. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-043 was steam manhole TA-16-1084, which was constructed in 1944 (the removal date is unknown). It was located southeast of the intersection of T-Site Road and Anchor Ranch Road. It was used for the heating system distilled steam vapor or return cool-condensate water only. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-045 was manhole TA-16-168, which was removed in 1952 (the construction date is unknown). It was located in the administration area. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-048 was steam manhole TA-16-1083, which was constructed in approximately 1944 and abandoned in 1956. It was located in the administration area south of TA-16-10. It was used for the heating system distilled steam vapor or return cool-condensate water only. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-052 was steam manhole TA-16-506, which was constructed in 1944 and removed in 1968. It was built of reinforced concrete with a wooden cover. The manhole was located at T-Site northwest of building TA-16-498. Dimensions were 4 x 4 x 4 ft. It was used for the heating system distilled steam vapor or return cool-condensate water only. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-053 was water manhole TA-16-508, which was constructed in 1944 and removed in 1968. It was located at T-Site south of the entrance road. Dimensions were 3 x 3 x 3 ft. It was used only for water. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-054 was steam manhole TA-16-509. This manhole was built of reinforced concrete; dimensions were 4 x 4 x 4 ft. It was located at T-Site south along the entrance road. It was used for the heating system distilled steam vapor or return cool-condensate water only. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-056 is a steam manhole TA-16-1087. It is located near the 300-Line and is used only for the heating system distilled steam vapor or return cool-condensate water. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

C-16-057 was steam manhole TA-16-1086, which was removed in 1970 (construction date unknown). It was located near the 300-Line. It was used only for the heating system distilled steam vapor or return cool-condensate water. There were no known hazardous materials used at this location (Blackwell 1983,15-16-076).

6.5.2.8.2 Recommendation

C-16-042, C-16-043, C-16-045, C-16-048, C-16-052, C-16-053, C-16-054, C-16-056, and C-16-057 are recommended for NFA because there is no reasonable basis for characterization of the sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1993, 1017).

6.5.2.8.3 Rationale for Recommendation

These structures were not used for the handling or storage of hazardous materials (Blackwell 1983,15-16-076). There is no record of any spills or releases associated with any of these structures.

REFERENCES

Barr, M. J., June 25, 1992. "Rest House Evaluation and Operations at TA-16 and TA-11," Los Alamos National Laboratory Memorandum to W. B. Martin (CLS-DO) from M. J. Barr (WX-3), Los Alamos, New Mexico. **(Barr 1992, 15-16-329)**

Baytos, J. F., May 14, 1986. "Water Contaminants In The S-Site Retaining Pond TA-16," Los Alamos National Laboratory Memorandum to A. P. Torres (WX-3) from J. F. Baytos (M-1), Los Alamos, New Mexico. **(Baytos 1986, 15-16-365)**

Blackwell, C., October 31, 1949. "Contamination at K-Site," Los Alamos Scientific Laboratory Memorandum to T. White from C. Blackwell, Los Alamos, New Mexico. **(Blackwell 1949, 15-11-009)**

Blackwell, C., February 13, 1956. "Radiation Survey at K-Site," Los Alamos Scientific Laboratory Memorandum to J. Bolton (ENG-DO) from C. Blackwell (H-1), Los Alamos, New Mexico. **(Blackwell 1956, 15-11-013)**

Blackwell, C., April 30, 1959. "Radiation Clearance of Surplus Laboratory Structures," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from C. Blackwell (H-1), Los Alamos, New Mexico. **(Blackwell 1959, 15-16-251)**

Blackwell, C. D., March 15, 1960. "Contamination Survey, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from C. D. Blackwell (H-1), Los Alamos, New Mexico. **(Blackwell 1960, 15-16-114)**

Blackwell, C., November 17, 1983. "Structures Removed From TA-16," Los Alamos National Laboratory Memorandum to A. J. Ahlquist (HSE-8) from C. Blackwell (HSE-1), Los Alamos, New Mexico. **(Blackwell 1983, 15-16-076)**

Bodenstein, S., November 1, 1992. "TA-16 Category 'C' Surplus Facility List," Los Alamos National Laboratory Memorandum EM-7C92-220 to B. Bradley (WX-DO) from S. Bodenstein (EM-7), Los Alamos, New Mexico. **(Bodenstein 1992, 15-16-550)**

Brown, F., W. D. Purtymun, A. Stoker, and A. Barr, February 1988. "Site Geology and Hydrology of Technical Area 16, Area P," Los Alamos National

Laboratory Report LA-11209-MS, Los Alamos, New Mexico. **(Brown et al. 1988, 0034)**

Buksa, M., September 13, 1993. "Status of SWMU 15-026(i2), Inactive Outfall at TA-16-54," Los Alamos National Laboratory Memorandum CLS-WBM-93-048 to File from M. Buksa (CLS-DO), Los Alamos, New Mexico. **(Buksa 1993, 15-16-517)**

Courtwright, W. C., September 9, 1969. "Safety Problems with Abandoned Explosive Facilities," paper presented at the Armed Services Explosives Safety Board 11th Annual Meeting at Memphis, Tennessee. **(Courtwright 1969, 15-16-318)**

Courtwright, W. C., March 12, 1971. "Contamination Survey: Building and Structures," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from W. C. Courtwright (Safety Engineer), Los Alamos, New Mexico. **(Courtwright 1971, 15-16-029)**

DeField, J. D., March 3, 1971. "Contamination Survey: Building & Structures, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from J. D. DeField (H-5), Los Alamos, New Mexico. **(DeField 1971, 15-16-028)**

Delta H Engineering, Ltd., November 1985. Area P Landfill Closure Plan, prepared for Los Alamos National Laboratory by Delta H Engineering, Ltd., Los Alamos, New Mexico. **(Delta H Engineering, Ltd. 1985, 15-16-408)**

Delta H Engineering, Ltd., January 1988. Area P Landfill Closure Plan, prepared for Los Alamos National Laboratory 1985, modified by Waste Management Group (HSE-8), Los Alamos, New Mexico. **(Delta H Engineering, Ltd. 1988, 15-16-407)**

DOE (US Department of Energy), October 1991. "DOE Explosives Safety Manual," (DOE/EV/06194) Revision 6, Washington, DC. **(DOE 1991, 15-16-309)**

DuBois, F. W. and J. F. Baytos, June 1972. "Effect of Soil and Weather on the Decomposition of Explosives," Los Alamos Scientific Laboratory Report LA-4943, Los Alamos, New Mexico. **(DuBois and Baytos 1972, 15-16-286)**

DuBois, F. W. and J. F. Baytos, May 1991. "Weathering of Explosives for Twenty Years," Los Alamos National Laboratory Report LA-11931, Los Alamos, New Mexico. **(DuBois and Baytos 1991, 0718)**

Ellvinger, J., February 2, 1990. "TA-16 Surface Impoundment Closure Plan Approval," New Mexico Health and Environment Department letter to J. R. Anderson (DOE) from J. Ellvinger (Hazardous Waste Bureau) Santa Fe, New Mexico. **(Ellvinger 1990, 15-16-372)**

EPA (US Environmental Protection Agency), March 29, 1990. "Hazardous Waste Management Systems; Identification and Listing of Hazardous Waste; Toxicity Characteristics Revisions," Final Rule, 40 CFR Parts 261, 264, 265, 268, 271, and 302, Federal Register, Vol. 55, No. 61, p. 11798. (**EPA 1990, 0093**)

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55., pp. 30798-30884. **(EPA 1990, 0432)**

Griffin, J. H., February 26, 1992. "Material Disposal Area S, TA-11," Los Alamos National Laboratory Memorandum to W. B. Martin (CLS-DO) from J. H. Griffin (CLS-DO), Los Alamos, New Mexico. **(Griffin 1992, 15-11-048)**

Griffin, J. H., February 28, 1992. "TA-11 (K-Site) Operations, W. A. Spencer Telecon," Los Alamos National Laboratory Memorandum to W. B. Martin (CLS-DO) from J. H. Griffin (CLS-DO), Los Alamos, New Mexico. **(Griffin 1992, 15-11-052)**

Griffin, J. H., October 29, 1992. "TA-11 (K-Site) Sphere Shot, Bob Donham Telecon," Los Alamos National Laboratory Memorandum to W. B. Martin (CLS-DO) from J. H. Griffin (CLS-DO), Los Alamos, New Mexico. **(Griffin 1992, 15-11-070)**

Kennedy, W. R., March 9, 1970. "Contamination Survey: Buildings and Structures, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from W. R. Kennedy (H-6), Los Alamos, New Mexico. **(Kennedy 1970, 15-16-006)**

LANL (Los Alamos National Laboratory), November 1988. RCRA Part B Permit Application, Volume I - Text, Tables & Figures Rev. 4.1, Project No. 301215.02.09, prepared by International Technology Corporation (IT) for Los Alamos National Laboratory Environmental Surveillance Group (HSE-8), Los Alamos New Mexico. **(LANL 1988, 15-16-388)**

LANL (Los Alamos National Laboratory), August 1989. "Release Site Database; Task 12; TA-11, 13, 16, and 25," (Preliminary Draft, Volumes I and II), prepared by Roy F. Weston, Inc., for the Department of Energy, Los Alamos, New Mexico. **(LANL 1989, 15-16-361)**

LANL (Los Alamos National Laboratory), November 1990. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report LA-UR-90-3400, prepared by International Technology Corporation under Contract 9-XS8-0062R-1, Los Alamos, New Mexico. **(LANL 1990, 0145)**

~~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)**~~

LANL (Los Alamos National Laboratory), November 1993. "Installation Work Plan for Environmental Restoration," Revision 3, Los Alamos National Laboratory Report LA-UR-93-3987, Los Alamos, New Mexico. **(LANL 1993, 1017)**

LASL (Los Alamos Scientific Laboratory), October 2, 1959. "Vacated LASL Structures," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. **(LASL 1959, 15-16-256)**

Martin, W. B., October 28, 1992. "Air Gun Operations at K-Site," Los Alamos National Laboratory Memorandum to CLS-DO/ER File from W. B. Martin, Los Alamos, New Mexico. **(Martin 1992, 15-11-069)**

Martin, W. B., November 17, 1993. "Early S-Site History: Lee Hilton Interview," Los Alamos National Laboratory Memorandum CST-6-ER/BM-93-060 to File from W. B. Martin (CST-6), Los Alamos, New Mexico. **(Martin 1993, 15-16-477)**

Mayfield, D. L., A. K. Stoker, and A. J. Ahlquist, June 1979. "Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Bayo Canyon, Los Alamos, New Mexico," (DOE/EV-0005/15) Los Alamos, New Mexico. **(Mayfield et al. 1979, 15-16-342)**

McLin, S. G., August 1989. Vadose Zone Monitoring Observations at the TA-16 Area P Landfill (Preliminary Report), Los Alamos National Laboratory, Los Alamos, New Mexico. **(McLin 1989, 15-16-405)**

Nyhan, J. W., March 1989. "A Hydrologic Modeling Study of Water Balance Relationships at the Area P Landfill in Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-11521-MS, Los Alamos, New Mexico. **(Nyhan 1989, 0154)**

Palmer, D. M., May 22, 1992. "Septic Tank, TA-16-240," Los Alamos National Laboratory Memorandum to W. B. Martin (CLS-DO) from D. M. Palmer (WX-12), Los Alamos, New Mexico. **(Palmer 1992, 15-16-373)**

Palmer, D. M., and P. L. Abercrombie, September 27, 1991. "Wastewater Characterization of Building Drains and Outfalls at S-Site," Los Alamos National Laboratory Group WX-12 unpublished report WX-12-91-301, Los Alamos, New Mexico. **(Palmer and Abercrombie 1991, 15-16-366)**

Penland, J. R., July 13, 1959. "HE Contamination of Abandoned Structures," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from J. R. Penland (H-3), Los Alamos, New Mexico. **(Penland 1959, 15-16-255)**

Purtymun W. D., March 17, 1971. "Contamination Survey: Building and Structure, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from W. D. Purtymun (H-8), Los Alamos, New Mexico. **(Purtymun 1971, 15-16-030)**

Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987. "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory LA-11134-MS, Los Alamos, New Mexico. **(Purtymun et al. 1987, 0211)**

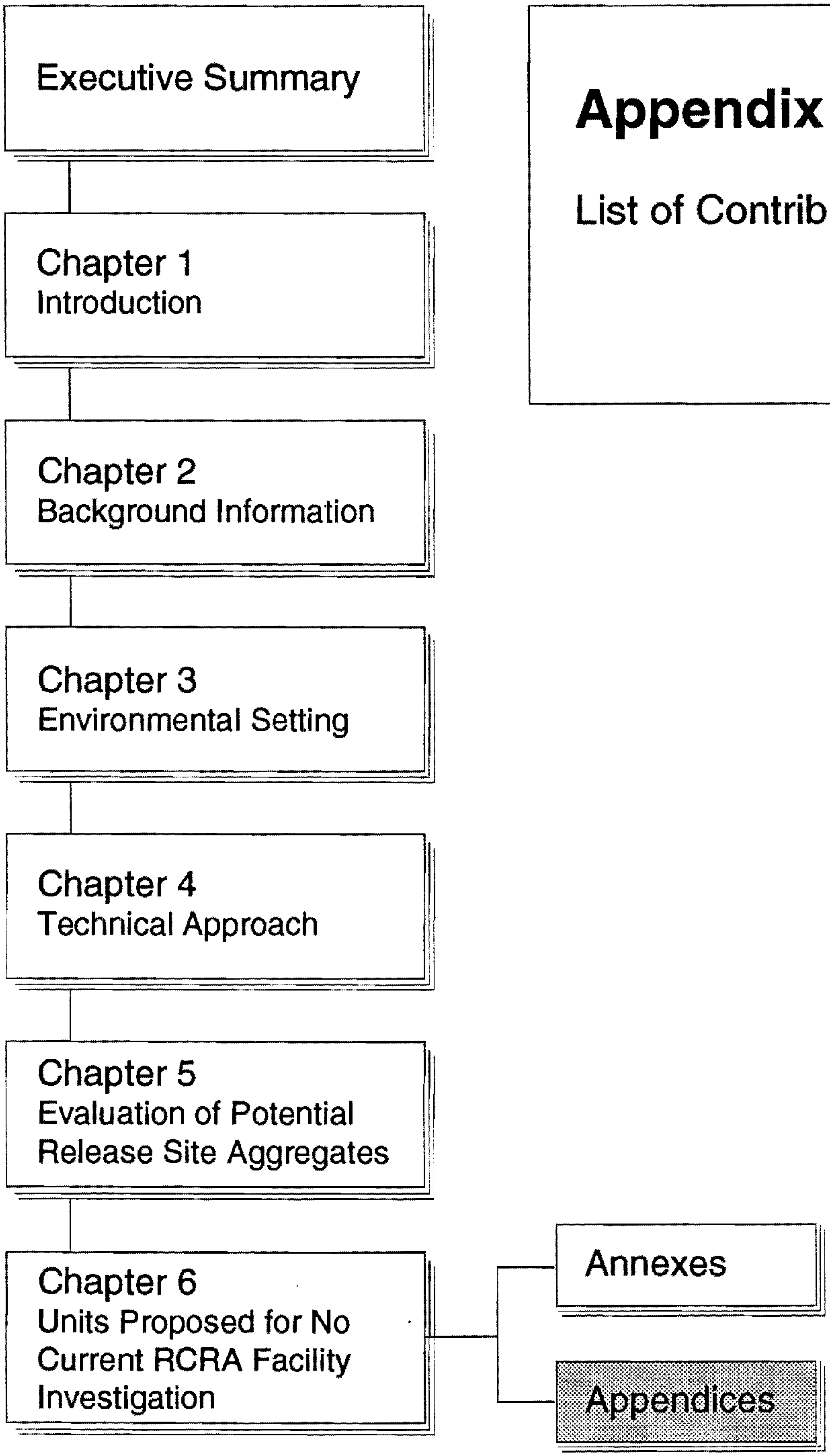
Stephens, W., April 14, 1983. "Disposal of Unused Process Buildings, TA-16," Los Alamos National Laboratory Memorandum to W. A. Bradley (WX-DO) from W. Stephens (WX-12), Los Alamos, New Mexico. **(Stephens 1983, 15-16-074)**

Westfall, C. B., March 21, 1960. "Contamination Survey, TA-16," Los Alamos Scientific Laboratory Memorandum to S. E. Russo (ENG-3) from C. B. Westfall (H-5), Los Alamos, New Mexico. **(Westfall 1960, 15-16-115)**

Weston, Roy F., August 26, 1988. "Site Reconnaissance Visits to TA-16, August 23-26, 1988," Field Notebook #70, Albuquerque, New Mexico. **(Weston 1988, 15-16-094)**

Appendix C

List of Contributors



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Appendix D

Introduction to High Explosives

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Site Aggregates

Chapter 6
Units Proposed for No Current RCRA Facility Investigation

Annexes

Appendices

1.0 INTRODUCTION TO HIGH EXPLOSIVES USED AT THE S-SITE COMPLEX

There are several types of explosives and associated co-constituents that may be present in soils and/or sediments at sites where explosives were or are currently processed, assembled, machined, stored, tested (i.e., detonated), or disposed. Potential contaminants from these operations may consist of the residual parent explosive and other co-constituents, such as inorganic metals, production impurities, degradation products, or products of detonation and/or combustion. The migration and dispersal characteristics of these potential contaminants in the environment are governed by the physical and chemical properties of the constituents, as well as by the physical characteristics of the sediments and soils on site. Some of these potential contaminants are carcinogens or systemic toxicants and may pose a health hazard upon exposure through inhalation, incidental ingestion, and dermal contact.

Explosives used at the Los Alamos National Laboratory (LANL) may be divided into three classes: 1) primary or initiating, 2) boostering, and 3) secondary (bursting charge) or high explosives (LANL 1986, 15-16-315). High explosives (HE) that contain HMX (cyclotetramethylenetetranitramine), RDX (cyclonitrite, cyclotrimethylenetrinitramine), or TNT (trinitrotoluene) as explosive components represent the vast majority of explosives that have been processed at Technical Area (TA) 16.

Primary explosives are not currently processed at the Laboratory but are used in squibs, low-energy detonators, fuses, explosive bolts and fasteners, and are assembled into test devices. Primary explosives are extremely sensitive to friction, heat, and impact, and some are sensitive to an electrical discharge. When exposed to flame, these explosives can be expected to detonate without burning. Lead azide and lead styphnate are examples of primary explosives. These and other detonator materials were used, processed, and disposed of at S-Site during the 1940s and 1950s.

The majority of detonators handled and assembled into test devices at these locations are the exploding bridge wire type which contain boostering explosives. High-energy exploding bridge wire detonators approved for use at LANL may be found in the Fabrication and Assembly Group's (WX-3) Standard Operating Procedure (SOP) 1.1.0, Explosives (LANL 1986, 15-16-315). Boostering explosives are less sensitive to explosion initiators than primary explosives, but may be set off by heat, friction, or impact. These explosives may detonate when burned in large quantities. Examples of boostering explosives include HMX, PETN (pentaerythritol tetranitrate), RDX, and tetryl (trinitrophenyl methylnitramine).

HMX, PETN, and RDX are also processed in the first steps of making molding powders for secondary or high explosives such as plastic-bonded explosives (PBX) and extrudable explosives [e.g., Extex (XTX)].

Most of the explosives processed at S-Site are secondary or high explosives (LANL 1986, 15-16-315). These explosives require more energy for initiation than either primary or boostering explosives. All will detonate if they receive a strong shock from an impact or from a boostering explosive. Unless confined, secondary explosives will burn without detonating. Examples of high explosives include baratol, the cyclotols, TNT, several PBXs, and extrudable explosives.

The types of secondary or high explosives that may be processed at TA-16 fall into the categories of established explosives, developmental explosives, and detonators. Table D-1 lists the nominal compositions of established secondary explosives that contain HMX, RDX, or TNT; these include the explosives most commonly used at TA-16. Table D-2 lists the nominal compositions of established secondary explosives used at TA-16 that do not contain HMX, RDX, or TNT. The type of bonding materials used in these explosives (e.g., plasticizers, polystyrenes, waxes, etc.) are not considered to be of human health or environmental concern and are not included in these tables. Developmental explosives contain the same types of chemicals that compose the established explosives; however, they are generally used in extremely small quantities (<100 lbs) in a limited number of TA-16 facilities (TA-16-340 and TA-16-460). However, there are some additions to this list. These are included in Table D-3. A complete listing of each of these explosives may be found in WX-3 Standard Operating Procedure (SOP) 1.1.0, Explosives (LANL 1986, 15-16-315). Table D-4 summarizes the explosives components of concern from Tables D-1 through D-3, with estimates of the total quantities of each that have been processed at TA-16 over the past 50 years. These estimates were made by Mr. L. Hatler of

TABLE D-1
NOMINAL COMPOSITION OF ESTABLISHED EXPLOSIVES THAT CONTAIN HMX, RDX, OR TNT (LANL 1986, 15-16-315)

CHEMICAL / EXPLOSIVE	Al	BA	BDNPA/ BDNPF	BN	CEP	DEHS	DOP	FO or MO	HMX	$NaNO_3$	NC	PETN	RDX	TATB	TNT	TOP	OTHER
Baratol *				76%											24%		
Boracitol		60%													40%		
Composition A-3													91%				9%
Composition A-4													97%				3%
Composition A-5													98.5%				1.5%
Composition B *													60%		40%		
Composition B-3													60%		40%		
Composition C-3													88%				12%
Composition C-4						5.3%		1.6%					91%				
Cyclotol, 75/25													75%		25%		
Cyclotol, 70/30													70%		30%		
DBA-1										X					X		X
EDC-8												76%					24%
EDC-28													94%				6%
EDC-32									85%								15%
EDC-37											1%		91%				8%
EDC-38									9.5%								5.5%
HBX-1	17%												40%		38%		5%
HMX									100%								
LX-04									85%								15%
LX-07									90%								10%
LX-14									95.5%								4.5%
Octol									75%						25%		
PBX-9001							1.5%	1.5%					90%				8.5%
PBX-9007							0.5%						90%				9.5%
PBX-9010													90%				10%
PBX-9011									90%								10%
PBX-9205							2%						92%				6%
PBX-9206									92%								8%
PBX-9401													94.2%			2.2%	3.6%
PBX-9404 *					3%						3%		94%				
PBX-9405					3%						3%		94%				
PBX-9407													94%				6%
PBX-9501 *			2.5%						95%								2.5%
PBX-9503									15%				80%				5%
PBXW-113									88%								12%
Pentolite												50%			50%		
RDX													100%				
TNT															100%		
TNT/NC											20%				80%		
Tritonal	20%														80%		
XTX													80%				20%

* These explosives represent those processed in the largest quantities.
All percentages are wt %. (LANL 1986, 15-16-315)

Al	Aluminum powder	CEP	Chloroethyl phosphate	MO	Motor oil	RDX	Cyclonite, cyclotrimethylenetrinitramine
BA	Boric acid	DEHS	Di(2-ethylhexyl)sebacate	NaNO3	Sodium nitrate	TATB	Traminotrinitrobenzene
BDNPA	Bis(dinitropropyl) acetal	DOP	Dioctyl phthalate	NC	Nitrocellulose, cellulose nitrate	TNT	Trinitrotoluene
BDNPF	Bis-dinitropropyl) formal	FO	Fuel oil	Other	Binders	TOP	Trioctyl phosphate
BN	Barium nitrate	HMX	Cyclotetramethylenetetranitramine	PETN	Pentaerythritol tetranitrate	X	Constituent present (% not available)

TABLE D-2

COMPOSITION OF ESTABLISHED SECONDARY EXPLOSIVES THAT DO NOT CONTAIN HMX, RDX, OR TNT (all percentages in wt %) (LANL 1986, 15-16-315)

EXPLOSIVE	COMPOSITION
Al ANFO	Aluminum powder (Al)/ammonium nitrate (AN)/fuel oil (FO)
AN	100% ammonium nitrate
ANFO	Ammonium nitrate/fuel oil
BDNPA	100% Bix(dinitropropyl acetal)
Black powder	74% Potassium nitrate/104% sulfur/14.6% other
BTX	5,7-Dinitro-1-picrylbenzotriazole
DATB	100% Diaminotrinitrobenzene
Datasheet C	63% Pentaerythritol tetranitrate (PETN)/8% nitrocellulose (NC)/ 29% other
Datasheet D	75% Pentaerythritol tetranitrate/25% other
DINGU	100% Dinitroglycoluril
DNPA	100% 2,2-Dinitropropyl acrylate polymer
EDC-8	76% Pentaerythritol tetranitrate/ 14% other
High energy propellants	100% Solid propellants
HNS	100% Hexanitrostilbene
K-10	65.3% Dinitroethylbenzene/34.7% trinitroethylbenzene
NC	100% Nitrocellulose
Nitromethane	100% Nitromethane
NQ	100% Nitroguanidine
NTO	100% 1,2,4-nitro-triazole-5-one
PBX-9502	95% Triaminotrinitrobenzene/5% other
PETN	100% Pentaerythritol tetranitrate
PYX	100% 2,6-Bix(picrylamino)-3,5-dinitropyridine
Smokeless powder (single base)	Nitrocellulose/inorganic nitrates
Smokeless powder (double base)	Nitrocellulose/inorganic nitrates/nitroglycerin or nitroglycol
STRATABLAST C	Slurry blasting explosive
TAGN	100% Triaminoguanidine nitrate
TAL-1005E	Slurry blasting explosive
TATB	100% Triaminotrinitrobenzene
Tetryl	100% 2,4,6-Trinitrophenylmethylnitramine
TNS	100% Trinitrostilbene
TPM	100% Tripicrylmelamine
XTX-8003	80% Pentaerythritol tetranitrate/20% other

LANL 1986, 15-16-315. All percentages in wt %.

TABLE D-3

ADDITIONAL CHEMICALS THAT ARE COMPONENTS OF DEVELOPMENTAL SECONDARY EXPLOSIVES (all percentages in wt %) (LANL 1986, 15-16-315)

EXPLOSIVE	CHEMICAL
X-0231	40 - 90% Tungsten
X-0232	40 - 90% Tungsten
X-0233	40 - 90% Tungsten
X-0239	40 - 90% Tungsten
X-0249	0 - 70% Barium carbonate
X-0250	0 - 70% Cyanuric acid
X-0251	0 - 70% Barium carbonate
X-0252	0 - 70% Cyanuric acid
X-0254	Barium carbonate
X-0256	Less than 44.9% Barium carbonate
X-0258	Less than 46.8% Barium carbonate
X-0260	Less than 47.1% Barium carbonate
X-0262	Less than 46.7% Barium carbonate
X-0264	Less than 45.2% Barium carbonate
X-0266	Less than 47.1% Barium carbonate
X-0268	Less than 27.4% Barium carbonate
X-0271	Approximately 0.5% Decyclgallophenone
X-0276	35.9% Copper
X-0277	33% Iron
X-0279	40.8% Cesium nitrate
X-0284	0 - 70% Potassium nitrate
X-0294	Approximately 15% MAN
X-0295	Approximately 30% MAN

EXPLOSIVE	CHEMICAL
X-0302	100% FKM
X-0364	52.4% ADNT
X-0365	39% EDD
X-0366	50% EDD
S-0367	50% EDD
X-0368	7.5% Potassium nitrate
X-0369	40.3% Potassium nitrate
X-0370	36.2% Potassium nitrate
X-0382	3.75% Potassium nitrate
X-0386	6.4% Potassium nitrate
X-0387	7.4% Potassium nitrate
X-0388	4.9% Potassium nitrate
X-0389	85.24% Tungsten
X-0390	85.36% Tungsten
X-0415	40% EAK
X-0416	60% EAK
X-0417	80% EAK
X-0421	80% EAK
X-0460	11.5% TCP/18% CT
X-0466	Less than 30% cyanuric acid
X-0467	Less than 30% zinc oxide
X-0515	50% Cyanuric acid
X-0516	50% Zinc oxide

ADNT 3,5-Dinitro-1,2,4-triazole
CT Calcium tartrate
EAK Mixture of ethylene diamine dinitrate, ammonium nitrate, and potassium nitrate
EDD Ethylene diamine dinitrate
FKM Mixture of HMX, nitrate, esters, oxidizers, and binders
MAN Methyl amine nitrate
TCP Tricresyl phosphate

TABLE D-4

SUMMARY OF HE COMPONENTS USED AT TA-16 THAT ARE POTENTIAL CONTAMINANTS OF CONCERN

HE COMPONENT	AMOUNT (lbs)	NOTES
ADNT		
Ammonium nitrate	< 2 500	
Barium nitrate	> 500 000	
BDNPA	2 500	Plasticizing agent
BDNPF	2 500	Plasticizing agent
BTX	< 100	
CT		
Cyanuric acid	25 000 - 50 000	Mock HE component
DATB	10 000 - 25 000	
Decyclgallophenone	< 100	Cast HE additive, viscosity
Di(2-ethyl) sebacate	< 100	Cast HE additive, viscosity
Dinitroethylbenzene	< 10	
Dinitroglycolutil	< 500	
DNPA	6 000	Plastic
EAK	< 2 500	
EDD	< 2 500	
FKM	<1 000	
Hexanitrostilbene	< 100	
HMX	> 500 000	
MAN	< 1 000	
Nitrocellulose	2 000 - 5 000	
Nitroguanadine	50 000 - 100 000	
Nitromethane	< 50 000	Liquid HE
NTO	500 - 1 000	
PETN	10 000 - 15 000	
PYX	< 1 000	
RDX	> 500 000	
TAGN	< 100	
TATB	100 000 - 500 000	
TCP	< 100	
Tetryl	1 000 - 5 000	
TNT	> 500 000	
Trinitroethylbenzene	< 10	
Trinitrostilbene	< 100	
Trioctyl phosphate	< 1 000	
Tripicrylmelamine	< 1 000	

Note: Abbreviations are identical to those in Tables D-1 through D-3.

Group WX-3, who has worked at TA-16 since 1968 (Hickmott and Martin 1993, 15-16-448).

2.0 POTENTIAL CONTAMINANTS OF CONCERN FROM EXPLOSIVES

The type of potential contaminants present at a particular site is directly dependent upon the type of operation conducted at the site (i.e., processing, assembly, machining, storage, testing, and/or disposal) and the type of explosive and test device used in the operation. Products of environmental degradation (e.g., photolysis and/or microbial degradation) of the potential contaminants located at each site may also be present. Table D-5 presents the type of potential contaminants of concern (PCOCs) associated with various explosive operations conducted at the Laboratory. Table D-6 presents the potential explosive impurities and environmental degradation products likely to be of concern in the environment that are associated with explosives that contain HMX, RDX, TNT, PETN, and tetryl.

TABLE D-5

CONSTITUENTS OF POTENTIAL CONCERN ASSOCIATED WITH EXPLOSIVE OPERATIONS AT THE LABORATORY

	OPERATION			
CONSTITUENTS OF POTENTIAL CONCERN	PROCESSING OPERATIONS	ASSEMBLY AND STORAGE	MACHINING	TESTING AND OPEN-AIR BURNING
Parent explosive (explosive, inorganic metal co-constituents, production impurities)	X	X	X	X
Inorganic metals (that compose the explosive device)			X	X
Products of incomplete detonation and/or incomplete combustion (nitroaromatics, lead, friable asbestos, polynuclear aromatic hydrocarbons)				X
Products of environmental degradation	X	X	X	X

Although Table D-6 lists a large number of potential co-contaminants of HE that may be detected in the environment, most have only been observed in laboratory experiments. The following HE impurities and degradation products have been observed in field investigations: in TNT - 2,4 DNT,

TABLE D-6

EXPLOSIVE CONSTITUENTS OF POTENTIAL CONCERN IN THE ENVIRONMENT

PRINCIPAL TYPE OF EXPLOSIVE	PARENT EXPLOSIVE (explosive, metal co-constituents)	PARENT EXPLOSIVE (production impurities)	INORGANIC METALS (that compose the explosive device)	PIDs and/or PICs	PRODUCTS OF ENVIRONMENTAL DEGRADATION	CONSTITUENTS DETECTED IN THE ENVIRONMENT
HMX	See Tables D-1, D-2, and D-3	RDX, aliphatic and cyclic nitro-compounds (a)	See Table D-11	Barium, lead, friable asbestos, polycyclic aromatic hydro-carbons (PAHs)(b)	Nitrate ions, nitrite ions, ammonia, formaldehyde, organic nitro-compounds, hydrogen cyanide (a), mono-, di-, and trinitroso-RDX analogues, hydrazine, 1,1-dimethylhydrazine, 1,2-dimethylhydrazine, methanol (a)	Parent explosive (HMX, RDX, aliphatic and cyclic nitro-compounds), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)
RDX	See Tables D-1, D-2, and D-3	HMX, aliphatic and cyclic nitro-compounds (a)	See Table D-11	Barium, lead, friable asbestos, PAHs (b)	Similar to those of HMX (a)	Parent explosive (RDX, HMX, aliphatic and cyclic nitro-compounds), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)
TNT	See Tables D-1, D-2, and D-3	2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB (a)	See Table D-11	Barium, TNT, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, 1,3-DNB, lead, friable asbestos, PAHs (b)	1,3,5-TNB, TNBOH, TNBAL, TNBA, anthranils (e.g., 2,6-dinitroanthranil), nitriles (e.g., 2,4,6-trinitrobenzonitrile), amines (2-amino-4,6-DNT, 4-amino-2,6-DNT, 3,5-dinitrophenol, 2-amino-4,6-dinitrobenzoic acid) (a), 2-NT, 3-NT, 4-NT, 2,3-DAT, 2,4-DAT, 2,6-DAT, 2,4,6-TAT, 2-Nitro-6-AT, 4-Nitro-6-AT (c) Nitrocresols (i.e., 2 Nitro-m-cresol), Dinitrocresols (i.e., dinitro-o-cresol) (c)	Parent explosive (TNT, 2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs), environmental degradation products (2-amino-4,6-DNT, 4-amino-2,6-DNT) (a) 2-NT, 3-NT, 4-NT,1,2-DNB, 3 Nitroaniline, 2 Methylaniline, 2 Nitro-4AT, 2 Nitro-6AT, 3 Nitro-4AT, 3 Nitro-2AT, 2,4-DiAT, 2,6-DiAT (c)

TABLE D-6 (continued)

EXPLOSIVE CONSTITUENTS OF POTENTIAL CONCERN IN THE ENVIRONMENT

PRINCIPAL TYPE OF EXPLOSIVE	PARENT EXPLOSIVE (explosive, metal co-constituents)	PARENT EXPLOSIVE (production impurities	INORGANIC METALS (that compose the explosive device)	PIDs and/or PICs	PRODUCTS OF ENVIRONMENTAL DEGRADATION	CONSTITUENTS DETECTED IN THE ENVIRONMENT
PETN	See Tables D-1, D-2, and D-3	PE-tri-N, di-pentaerythritol hexanitrate,tri pentaerythritol acetonitrate (a)	See Table D-11	Lead, friable asbestos, PAHs (b)	Pentaerythritol (PE or Pe-tri-N) (a)	Parent explosive, inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs), environmental degradation products (a)
Tetryl	See Tables D-1, D-2, and D-3	No production impurities of consequence (a)	See Table D-11	Lead, friable asbestos, PAHs (b)	N-methylpicramide, picric acid, methylnitramine (a)	Parent explosive, inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)

Notes: For the explosive and metal co-constituents of the parent explosives, see Tables D-1, D-2, and D-3.
For inorganic metals that compose the explosive device, see Table D-11.

Legend:

2-amino-4,6-DNT	2-amino-4,6-dinitrotoluene
4-amino-2,6-DNT	4-amino-2,6-dinitrotoluene
1,3-DNB	1,3-dinitrobenzene
2,4-DNT	2,4-dinitrotoluene
2,6-DNT	2,6-dinitrotoluene
1,3,5-TNB	1,3,5-trinitrobenzene
HMX	cyclotetramethylene-tetranitramine
PE-tri-N	pentaerythritol
PETN	pentaerythritol tetranitrate
PAH	polycyclic aromatic hydrocarbon
RDX	cyclonitrite, cyclortrimethylenetrinitramine
NT	nitrotoluene
DAT	diaminotoluene
TAT	triaminotoluene
AT	aminotoluene
TNBA	2,4,6-trinitrobenzoic acid
TNBAL	2,4,6-trinitrobenzaldehyde
TNBOH	2,4,6-trinitrobenzyl alcohol
TNT	2,4,6-trinitrotoluene

Footnotes:

(a) Layton et al 1987, 15-16-447
(b) US ATHMA 1986, 15-16-457
(c) Karg and Koss 1993, 15-16-555

2,6 DNT, TNB, DNB, NT, nitroaminotoluenes, nitrocresols, diaminotoluenes, and dinitrocresols; in RDX - HMX, nitrate; and in HMX - RDX. Thus, at TA-16 we will focus our investigation of HE co-contaminants on DNT, TNB, and DNB, all of which are determined by high performance liquid chromatograph (HPLC). Many other of these byproducts, such as the nitrocresols, will be determined by GC-MS during analyses for semivolatiles.

WX Division SOPs describe components of both standard and developmental explosives. The principal constituents of the explosives are generally the explosive components themselves, such as HMX, RDX, and TNT. However, subsidiary contaminants present in the explosive formulations may include: polycyclic aromatic hydrocarbons (PAH), metals, cyanide, and asbestos. Each of these co-contaminant types is described below. Inorganic metals that may compose the explosive device include, but are not limited to: lead, uranium, copper, or iron.

2.1 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons have been detected at firing sites and burning grounds. They may be the product of incomplete detonation or combustion of those explosives that contain motor or fuel oil or may be the product of incomplete combustion of fuels used to ignite explosives at disposal areas. At TA-16, these contaminants are most likely to be found at open burn/open detonation sites and at firing sites, rather than in association with process buildings.

The manner in which individual PAHs behave in the environment is linked directly to the molecular weight of each potential contaminant. For example, low molecular weight PAHs (e.g., acenaphthylene, anthracene, fluorene, and phenanthrene) are associated with significant volatilization compared to high molecular weight PAHs (e.g., benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) (Clement International Corporation 1990, 0873). Thus, it is likely that high molecular weight PAHs will be found in the soils and sediments.

In addition, sorption of PAHs to soil and sediments increases with increasing soil organic carbon content. The higher molecular weight PAHs have K_{oc}

values in the range of 10^{+5} to 10^{+6}, indicating a stronger tendency to adsorb to organic carbon (Clement International Corporation 1990, 0873). This tendency for sorption also governs the manner in which the individual PAHs will move in surface or groundwater. The high molecular weight PAHs will be transported in water adsorbed to particulates, whereas the lower molecular PAHs will tend to volatilize. Microbial metabolism is the major process for degradation of PAHs in the soil environment. Photo oxidation, chemical oxidation, and biodegradation are only of importance in water environments. Hydrolysis is not considered to be an important degradation process for PAHs (Clement International Corporation 1990, 0873).

2.2 Potential Metal Contaminants

Metals used in processing operations and in assembly and storage locations may be co-constituents of the parent explosive (see Tables D-1, D-2, and D-3). Metals may be co-constituents of parent explosives or may have composed the device that housed the explosive. Such metals may include barium, beryllium, lead, uranium, copper, and iron. These metals will be found in largest quantities at open burn/open detonation sites at TA-16. They will also be present at firing sites. Those that are components of the explosives themselves will be found associated with process buildings.

The primary factor governing the distribution of potential metal contaminants in the environment is soil pH. With the exception of lead, the potential metal contaminants will tend to be more mobile in acidic soils. Lead is mobile in soils under both alkaline and acidic conditions. Two metals of particular concern at TA-16 are barium and beryllium.

Barium exhibits low mobility in soil. Barium mobility is limited by adsorption in soils with high cation exchange capacity (Clement International Corporation 1992, 0874). Thus, in fine soils or soils with high organic content, barium is expected to be located near the soil surface.

Scanning electron microscopic and electron microprobe investigations of soils from the TA-16 burning ground (Brown et al. 1992, 15-16-389) and from within Cañon de Valle (Eppler unpublished data) show that barium is present in at least four forms within contaminated soils and sediments: 1) as barium carbonate, 2) as barium sulfate, 3) as barium adsorbed on organic particles, and 4) as a barium-iron-titanium silicate in reaction rims overgrowing steel fragments. No barium nitrate was found. Barium sulfate appears to predominate in Cañon de Valle and barium carbonate dominates in the Area P landfill and in a small drainage from the burning ground. Barium sulfate is quite insoluble and barium carbonate is moderately soluble.

Beryllium is also expected to have limited mobility in most soil types. Beryllium tightly adsorbs to soils by displacing divalent cations that share common sorption sites (Syracuse Research Corporation 1992, 0872).

2.3 Cyanide

Cyanuric acid, a co-constituent of some developmental secondary explosives and a component of mock HE (see Table D-3), contains cyanide. Upon heating, cyanuric acid evolves hydrogen cyanate (CHNO), which is soluble in water, decomposing to carbon dioxide and ammonia (Budavari et al. 1989, 15-16-454). Thus, cyanide may be detected at processing areas for developmental secondary explosives and mock HE. AT TA-16, outfalls associated with the 300-Line are most likely to be contaminated with cyanuric acid. However, it is unlikely that cyanide will be detected at testing or disposal sites.

The fate of cyanide in soils and/or sediments is pH dependent. Cyanide may adsorb to suspended solids and sediments, although adsorption is probably insignificant when compared to volatilization. The adsorption of cyanides increases with increasing iron oxide, clay, and organic material. However, instead of being more mobile in acidic environments, cyanide adsorption increases with increasing acidity (~~ATSDR 1991~~ Syracuse Research Corporation 1992, 15-16-451).

In the soil, cyanide may be present as hydrogen cyanide, soluble alkali metal salts, or as immobile metallocyanide complexes. Under aerobic conditions, low concentrations of cyanide undergo biodegradation with the formation of ammonia followed by nitrate. Under anaerobic conditions in the subsurface environment cyanides denitrify to gaseous nitrogen (~~Clement International Corporation 1991~~ Syracuse Research Corporation 1992, 15-16-451).

2.4 Asbestos

Asbestos is nonvolatile and insoluble. Thus, its fate is primarily controlled by deposition after airborne transport. However, some fibers are sufficiently small that they may remain suspended in the atmosphere or water and be transported long distances. Asbestos is not known to undergo significant transformation or degradation in the environment (Clement International Corporation 1990b, 15-16-450). Asbestos is most likely to occur at firing sites and WW II waste disposal sites at TA-16.

3.0 FATE AND TRANSPORT OF EXPLOSIVES AND EXPLOSIVES BY-PRODUCTS

In addition to environmental degradation, other factors affect the potential fate and migration of PCOCs in the environment. These include the physical and chemical properties of the constituents and their degradation products as well as the physical and geochemical characteristics of the sediments and soils on site. Factors such as soil pH, soil cation-exchange-capacity (CEC), water infiltration rate, soil porosity, along with chemical-specific factors [e.g., water partition coefficient (K_{oc}), and soil retention factors (K_d)] are key to understanding the potential migration patterns of these constituents. A summary of aspects of the environmental fate of some explosives is presented in Table D-7.

A site-specific investigation into the decomposition of HE used at TA-16 was initiated in the late 1960s. Test cylinders were spiked with HE, loaded into transite tubing, and buried at test plots at TA-11. The amount of HE remaining after four and one-half years (DuBois and Baytos 1972, 15-16-286) and twenty years (DuBois and Baytos 1991, 0718) was measured. Over ninety percent of the TNT had disappeared over twenty years; however, more than seventy percent of the RDX, HMX, and PETN remained.

Layton et al. (1987, 15-16-447) provide a detailed discussion of the distribution of HE in environmental media. They calculate the distribution of a number of HE, including TNT, HMX, RDX, and HE byproducts including DNT and DNB, in reference landscapes using the program GEOTOX. They also summarize existing data confirming HE and HE byproducts at open burn/open detonation sites nationwide.

TABLE D-7

ENVIRONMENTAL FATE OF EXPLOSIVES AND HE BYPRODUCTS

CONSTITUENT OF POTENTIAL CONCERN	WATER SOLUBILITY (mg/L)	Log K_{oc}	HENRY'S CONSTANT (atm-m^3/mol)	ENVIRONMENTAL FATE	PRIMARY LOCATION IN ENVIRONMENT
2-amino-4,6-DNT	2 800 (a)	0.15 (a)	~4 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
4-amino-2,6-DNT	2 800 (a)	0.26 (a)	~1 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
1,3-DNB	533 (b)	1.56 (b)	1.8 E-7 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
2,4-DNT	280 (b)	2.4 (b)	1.86 E-7 (b)	Gradual movement through soils and groundwater, diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
2,6-DNT	206 (b)	1.89 (b)	4.86 E-7 (b)	Gradual movement through soils and groundwater, diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
HMX	2.6 (a) or 5.0 (a)	2.11 (a)	1 E-16 (a)	Leaching through soils	Subsurface soils and groundwater (a)
PETN	2 (a) or 32 (a)	1.83 (a)	4 E-10 (a)	Leaching through soils	Subsurface soils and groundwater (a)
PE-tri-N	Very soluble (a)	Not available	Not available	Very stable in sunlight, resistant to microbial degradation (a)	Subsurface soils and groundwater (a)
RDX	42.2 (a)	0.89 to 2.43 (a)	6.58 E-12 (a)	RDX does not strongly adsorb to soils and sediments, soil adsorption affects RDX migration only in soils with an organic content >0.25 wt % (a)	Subsurface soils and groundwater (a)
Tetryl	75 (a)	2.43 (a)	2.0 E-12 (a)	Leaching through soils (a)	Subsurface soils and groundwater (a)
1,3,5-TNB	385 (b)	2.82 (b)	9 E-8 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
TNT	123 (a)	2.67 to 3.2 (a)	2.6 E-9 (a)	Migration of TNT is affected in soils with a cation exchange capacity (CAC) >10 meg/100 g; vapor-phase diffusion only important in soils where water infiltration is low (a)	Subsurface soils and groundwater (a)

(a) Layton et al. 1987, 15-16-447
(b) Burrows et al. 1989, 15-16-455

The most important result of the modeling is that all of the HE and HE byproducts are calculated to be distributed into both surface soils (A soil horizons) and subsurface soils (B soil horizons). In the western ecoregion models TNT, DNT, and RDX were all predicted to favor subsurface over surface soils. This modeling may not be directly relevant to TA-16 because a near-surface groundwater reservoir was included in the models.

The compiled data on concentrations of HE and HE byproducts for a wide variety of facilities also suggest that HE is distributed in surface and subsurface soils (Layton et al. 1987, 15-16-447). In general, the actual field data suggest greater concentrations of HE in surface soils than predicted by the GEOTOX modeling.

The implication for TA-16 of these data is that subsurface sampling for HE will be necessary at those sites where HE contamination is likely, such as at TA-16-260 and sump outfalls. However, the lack of evidence for decoupling of surface and subsurface HE suggests that surface screening can be used to locate subsurface HE contamination.

4.0 TOXICITY OF HE CONSTITUENTS

Several of the explosives, co-constituents, degradation products of the explosives, and associated experimental materials are carcinogens and/or systemic toxicants. Nearly all of the potential contaminants may exert their toxic effect (i.e., either carcinogenic and/or systemic effect) through any of the direct routes of exposure (i.e., inhalation, incidental soil ingestion, ingestion of water, and dermal exposure). The exceptions to this include the carcinogenic metals (cadmium, chromium VI, and nickel) and the carcinogenic mineral asbestos, which are considered by the US Environmental Protection Agency (EPA) to be carcinogenic only through the inhalation route of exposure.

Table D-8 lists the potential inorganic contaminants considered by the EPA to be carcinogenic only through the inhalation route of exposure (EPA 1992, 0830). They are placed in order of highest carcinogenicity to lowest carcinogenicity. The class of carcinogen refers to the evidence used to support the carcinogenic classification. For example, the evidence supporting

TABLE D-8

CARCINOGENIC INORGANICS VIA INHALATION – HE DEVICE CONSTITUENTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN
Chromium VI	A	Lung
Asbestos	A	Lung
Cadmium	B1	Respiratory tract

TABLE D-9

CARCINOGENIC CONSTITUENTS VIA ALL ROUTES OF EXPOSURE – HE AND BY-PRODUCTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN FOR ORAL ROUTE
Inorganics		
Beryllium	B2	Multiple organs
Organics		
PAHs (e.g., benzo[a]pyrene)	B2	Stomach
2,4-DNT	B2	Liver
2,6-DNT	B2	Liver
RDX	C	Liver
TNT	C	Bladder

TABLE D-10

ORGANIC SYSTEMIC TOXICS – HE AND BY-PRODUCTS

CONSTITUENT	ORAL RfD (mg/kg/day)	TARGET ORGAN OR EFFECT
1,3,5-TNB	5.00E-5	Spleen
1,3-DNB	1.0E-4	Spleen weight
Nitrobenzene	5.00E-4	Liver, kidney
2,4,6-TNT	5.00E-4	Liver
2,4-DNT	2.00E-3	Neurotoxic
RDX	3.00D-3	Prostate
Tetryl	1.00E-2	Liver, kidney, spleen
HMX	5.00E-2	Liver

the carcinogenic classification of A for a potential contaminant is stronger than that for a constituent with a carcinogenic classification of B.

Table D-9 lists the potential inorganic and organic contaminants that are explosives' components considered by the EPA to be carcinogenic through all direct routes of exposure (EPA 1992, 0830). The target organs identified are for the oral route of exposure. These potential contaminants are placed in decreasing order of carcinogenicity within each class of chemical (i.e., inorganics and organics).

All of the aforementioned constituents have the potential to exert a systemic toxic effect through all direct routes of exposure. However, systemic health criteria have not been developed for all of these constituents. Tables D-10 and D-11 list the constituents, oral target organ designation, and oral reference criteria [i.e., reference dose (RfD) in mg/kg-day] available from

TABLE D-11

INORGANIC SYSTEMIC TOXICS – HE DEVICE COMPONENTS

CONSTITUENT	ORAL RfD (mg/kg/day)	TARGET ORGAN OR EFFECT
Lead	10 ug/dl (blood) [a]	Central nervous system
Cadmium	5.00E-4	Kidney
Uranium	3.00E-3	Kidney
Beryllium	5.00E-3	Not available
Chromium VI	5.00E-3	Central nervous system
Vanadium	7.00E-3	Not available
Cyanide	2.00E-2	Myelin degradation
Nickel	2.00E-2	Decreased body weight
Barium	7.00E-2	Blood pressure
Boron	9.00E-2	Testicular effects
Manganese	1.00E-1	Central nervous system
Nitrite	1.00E-1	Methemoglobemia
Zinc	2.00E-1	Anemia
Copper	1.30E+0	GI irritation
Nitrate	1.60E+0	Methemoglobemia

[a] The blood lead level of 10 ug/dl has been selected as a cutoff for intervention. Lead does not have an RfD because lead does not have a known threshold for the induction of systemic effects (EPA 1990, 15-16-456).

the EPA. An RfD is the highest dose that an individual may receive throughout his lifetime without experiencing an adverse health effect. The more toxic systemic constituents have the lowest RfDs. These constituents are placed in decreasing order of systemic toxicity within each class of chemical (i.e., inorganics and organics).

REFERENCES

Budavari, S., M. J. O'Neil, A. Smith, and P. E. Heckelman (Eds.), November 1989. The Merck Index An Encyclopedia of Chemicals, Drugs, and Biologicals 11th ed. Merck & Co., Inc., Rahway, New Jersey. **(Budavari et al. 1989, 15-16-454)**

Brown, R. A., B. Martin, and D. Hickmott, 1992. "Barium Transport at S-Site and Laser-induced Breakdown Spectroscopy (LIBS): Its Application to Field Screening of Barium in Soils," unpublished report. **(Brown et al. 1992, 15-16-389)**

Burrows, E. P., D. H. Rosenblatt, W. R. Mitchell, and D. L. Palmer, 1989. Organic Explosives and Related Compounds: Environmental and Health Considerations, Draft Technical Report 8901. **(Burrows et al. 1989, 15-16-455)**

Clement International Corporation, December 1990. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons," prepared under Contract No. 205-88-0608 for Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. **(Clement International Corporation 1990, 0873)**

Clement International Corporation, December 1990. "Toxicological Profile for Asbestos," prepared under Contract No. 205-88-0608 for Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. **(Clement International Corporation 1990, 15-16-450)**

Clement International Corporation, April 1992. "Toxicological Profile for Barium and Compounds," prepared under Contract No. 205-88-0608 for Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. **(Clement International Corporation 1992, 0874)**

DuBois, F. W. and J. F. Baytos, June 1972. "Effect of Soil and Weather on the Decomposition of Explosives," Los Alamos Scientific Laboratory Report LA-4943, Los Alamos, New Mexico. **(DuBois and Baytos 1972, 15-16-286)**

DuBois, F. W. and J. F. Baytos, May 1991. "Weathering of Explosives for Twenty Years," Los Alamos National Laboratory Report LA-11931, Los Alamos, New Mexico. **(DuBois and Baytos 1991, 0718)**

EPA (US Environmental Protection Agency), 1990. Pharmacokinetic Evaluation of Lead. **(EPA 1990, 15-16-456)**

EPA (US Environmental Protection Agency), October 1, 1992. "Integrated Risk Information System (IRIS)," Office of Science and Technology; available from National Technical Information Service, Springfield, Virginia. **(EPA 1992, 0830)**

Hickmott, D. D., and W. B. Martin, March 15, 1993. "HE used at TA-16," Los Alamos National Laboratory Memorandum CLS-ER-BM:93-023 to File from D. D. Hickmott (EES-1) and W. B. Martin (CLS-DO), Los Alamos, New Mexico. **(Hickmott and Martin 1993, 15-16-448)**

Karg, F. and G. Koss, 1993. "Environmental Investigation of an Ammunition Repository: Contamination Characterization and Evaluation," *Environmental Sciences and Toxins Research: Journal for Environmental Chemistry and Toxicology*, Vol. 5:4, published by Ecomed, Inc., Zurich, Switzerland, pp 182-189. **(Karg and Koss 1993, 15-16-555)**

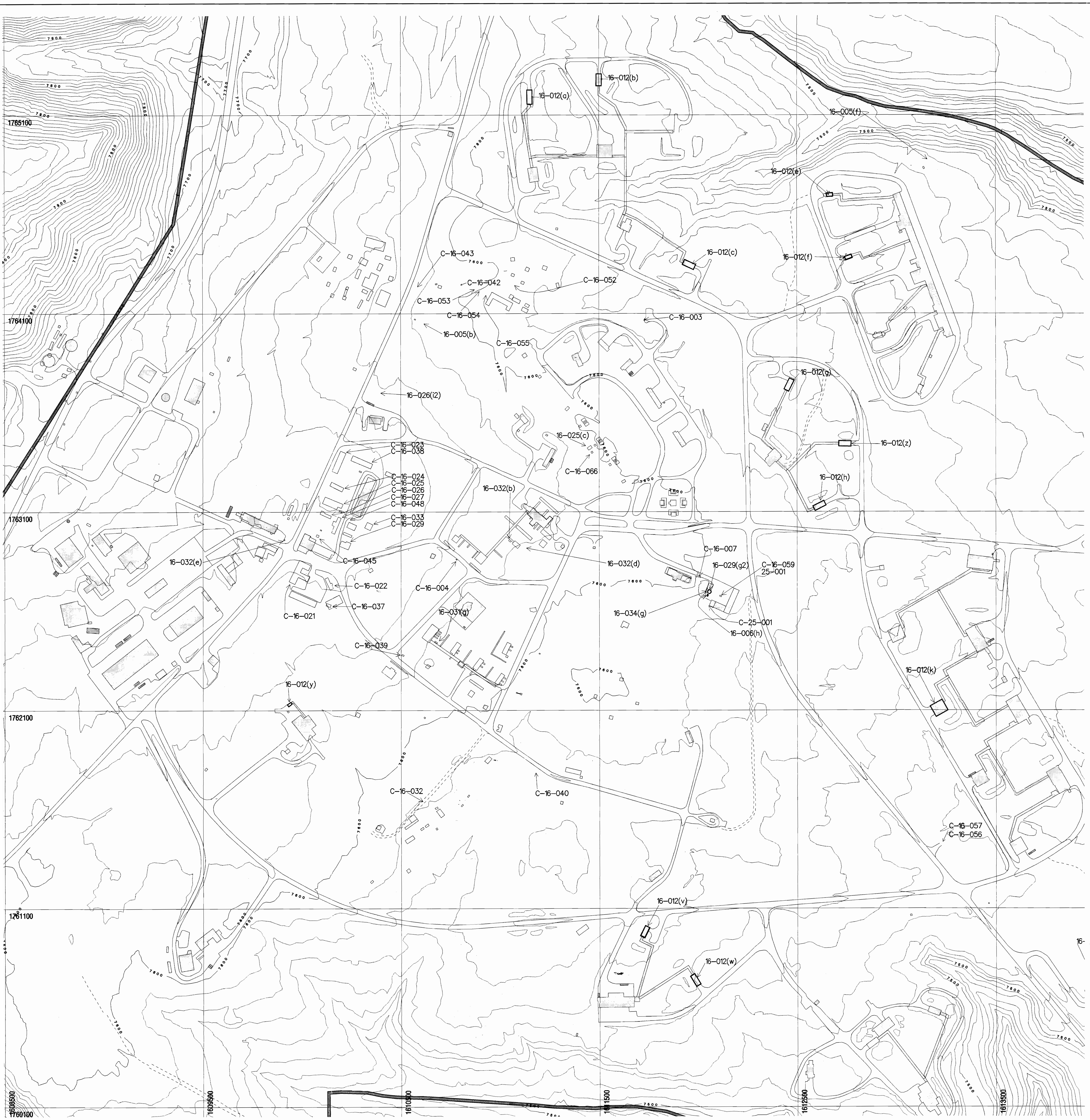
LANL (Los Alamos National Laboratory), 1986. WX-3 Standard Operating Procedure (SOP) 1.1.0, Revision 5, "Explosives." Los Alamos National Laboratory, Los Alamos, New Mexico. General Revision 8/86/rllk. **(LANL 1986, 15-16-315)**

Layton, D., B. Mallon, W. Mitchell, L. Hall, R. Fish, L. Perry, G. Snyder, K. Bogen, W. Mallock, C. Ham, and P. Dowd, 1987. "Conventional Weapons Demilitarization: A Health and Environmental Effects Data-Base Assessment, Explosives and Their Co-Contaminants," Final Report, Phase II, Lawrence Livermore National Laboratory Report UCRL-21109, Livermore, California. **(Layton et al. 1987, 15-16-447)**

Syracuse Research Corporation, December 1992. "Toxicological Profile for Beryllium," prepared under Contract No. 205-88-0608 to Clement International Corporation Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. **(Syracuse Research Corporation 1992, 0872)**

Syracuse Research Corporation, December 1992. "Toxicological Profile for Cyanide," prepared under Contract No. 205-88-0608 to Clement International Corporation Agency for Toxic Substances and Disease Registry, US Public Health Service, Washington, DC. **(Syracuse Research Corporation 1992, 15-16-451)**

US Army Toxic and Hazardous Materials Agency (US ATHMA), 1986. West Virginia Ordinance Works: Endangerment Assessment for Sewer Line, TNT Manufacturing Area, The Burning Grounds Final Report, US Army Toxic and Hazardous Materials Agency, Installation Restoration Division, Aberdeen Proving Ground, Maryland, Contract Co. DAAK11-83-D-0007. **(US ATHMA 1986, 15-16-457)**



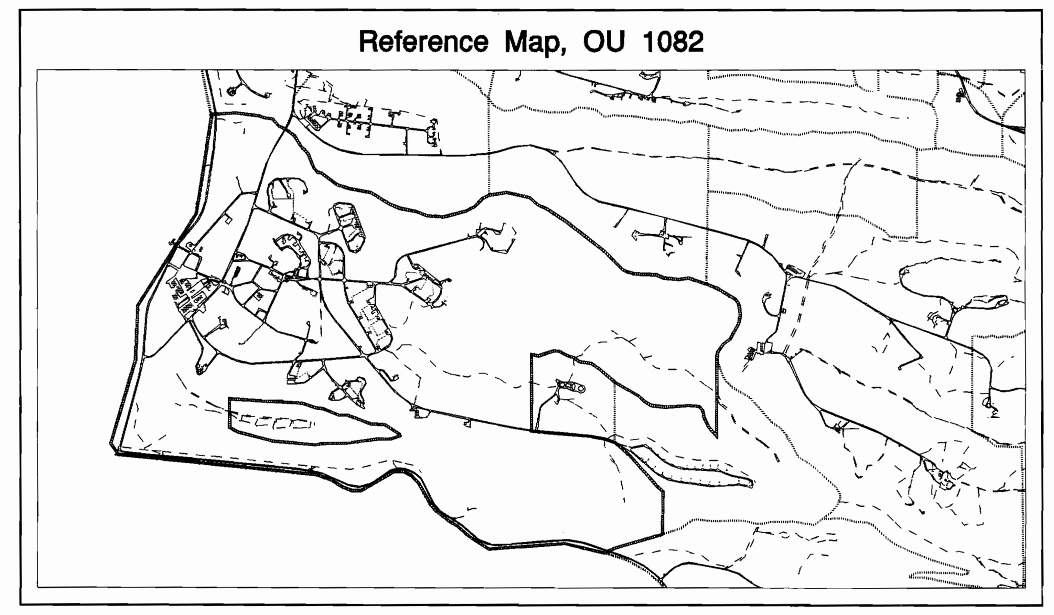
OU 1082 - Addendum I NFA (arrows only) and all DA PRS's

LEGEND

- Boundary, TA
- Contours, 10 foot
- Contours, 100 foot
- PRS, Deferred Action
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure
- Temporary Structure

NOT SHOWN:
SWMU 16-017 (23 buildings)
16-005(i) (located at P-Site)
16-006(i) (located at TA-16-370)
16-028(a) (located at burning ground)
16-023(a) (not located)

Reference Map, OU 1082



State Plane Coordinate System, New Mexico Central Zone.
1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet.
Grid interval, in feet: 1000
Feet per inch on map = 250

SCALE 1:3000

Notice: The information on this map is provisional and has not been checked for accuracy. Maps should not be relied upon to establish legal claims, boundary lines or locations of improvements.
Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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Earth & Environmental Sciences Division
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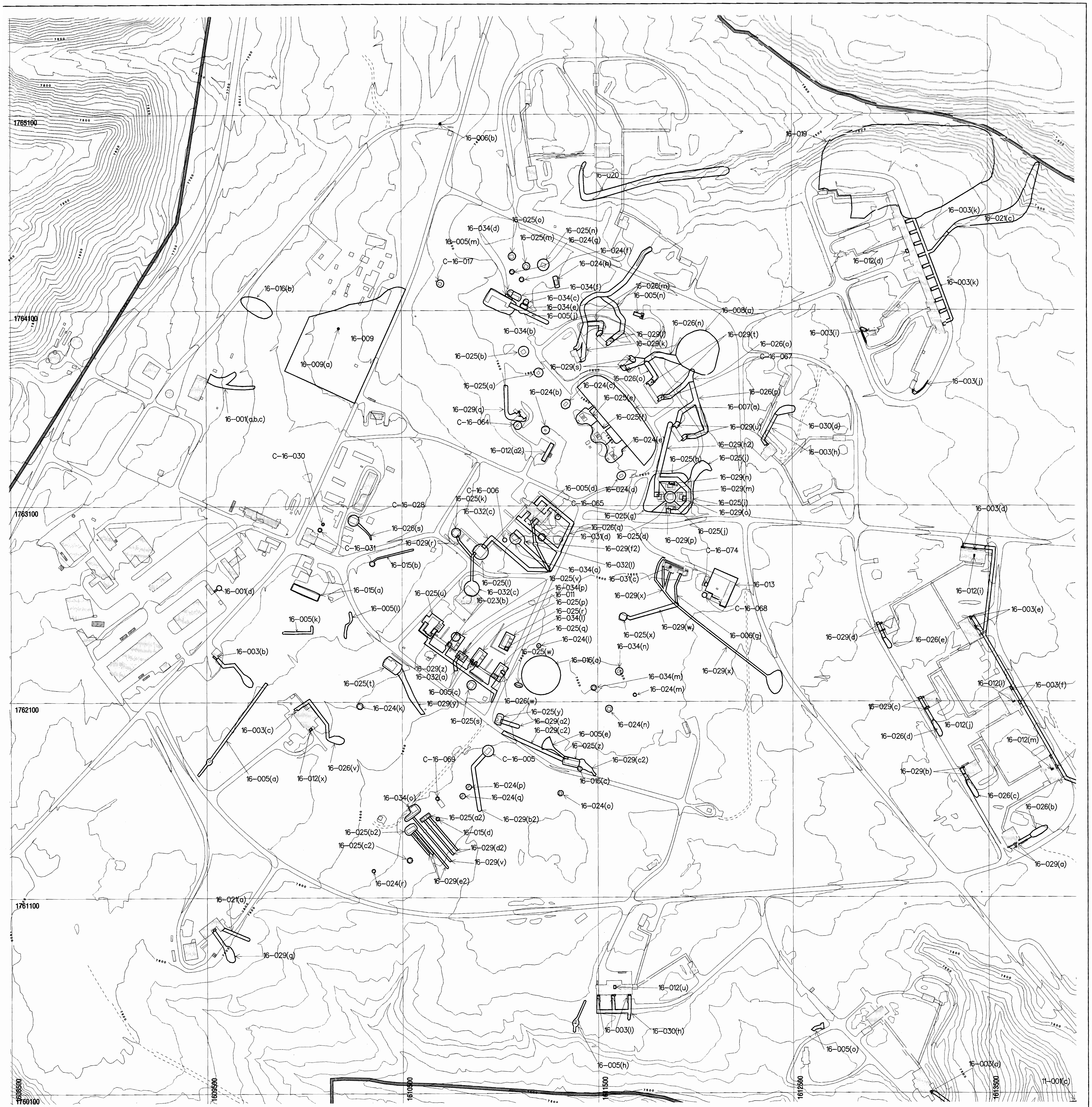
FIMAD is the electronic data repository for the Environmental Restoration Program at Los Alamos National Laboratory.

Produced by: Doug Walther
Date: June 13, 1994
FIMAD Plot ID: G102258

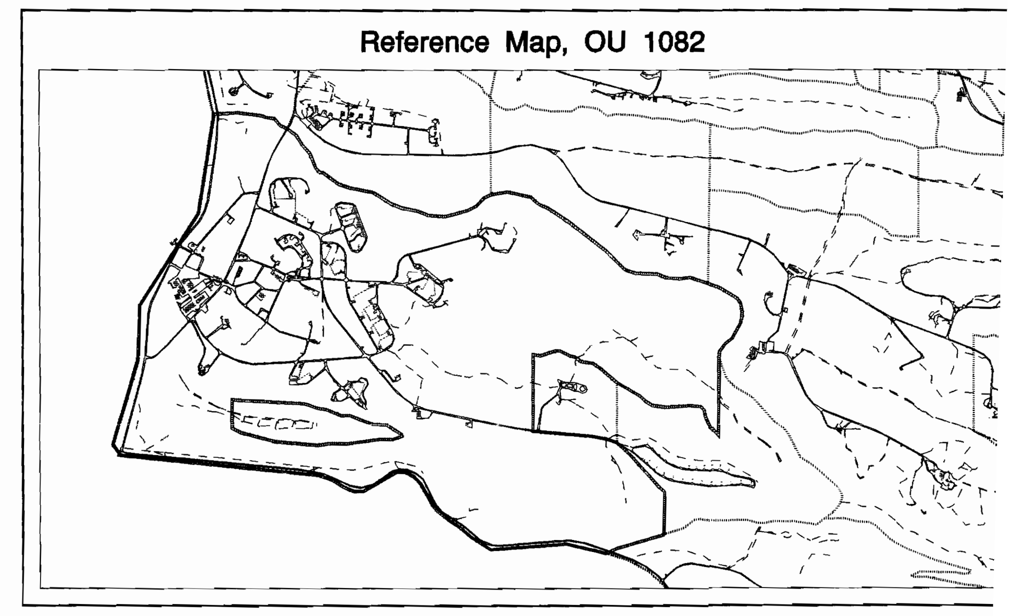


OU 1082 - 1993 & Addendum I, Chapter 5 PRS s

LEGEND

- Boundary, TA
- Contours, 10 foot
- Contours, 100 foot
- PRS
- Roads, Dirt
- Roads, Paved
- Road/Trail
- Former Structure
- Permanent Structure
- Temporary Structure
- PRS, point location

Reference Map, OU 1082



N

State Plane Coordinate System, New Mexico Central Zone. 1983 North American Datum

Grid provides New Mexico State Plane coordinates in feet. Grid interval, in feet: 1000 Feet per inch on map = 250

SCALE 1:3000

FEET

Notice: The information on this map is provisional and has not been checked for accuracy. Map should not be relied upon to establish legal claims, boundary lines or locations of improvements. Basemap Sources: Utility and structure data are from Los Alamos National Laboratory Engineering Division and Los Alamos County Utility and Engineering Departments. Contour data is from Los Alamos National Laboratory Environmental Restoration Program aerial survey, September, 1991.

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Date: June 13, 1994 FIMAD Plot ID: G102259

FIMAD Plot ID: G102259 13 Jun 94