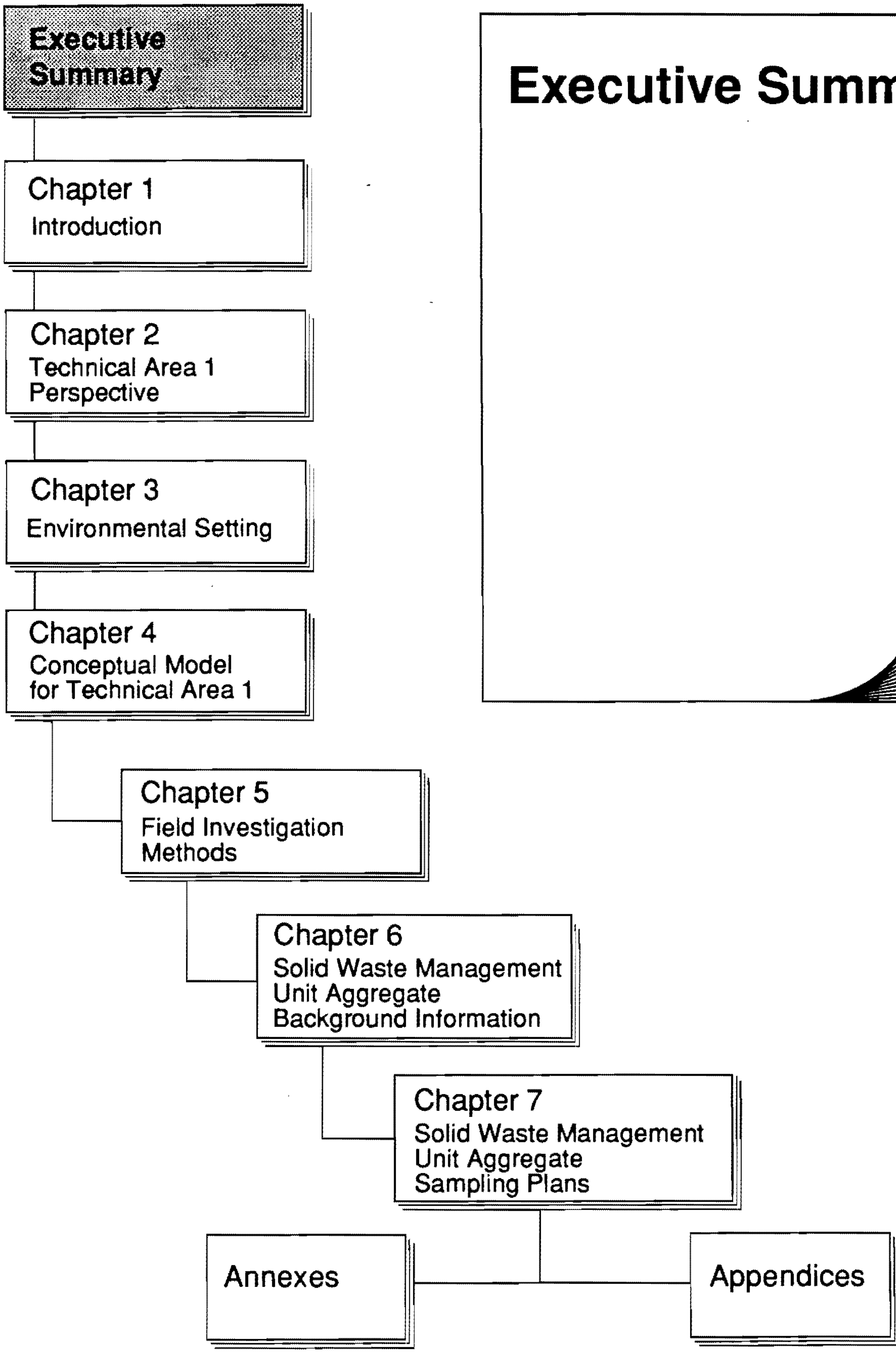
RFI Work Plan for Operable Unit 1078

Environmental Restoration Program

May 1992

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY



Executive Summary

EXECUTIVE SUMMARY

E.1 Introduction

The Operable Unit (OU) 1078 Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan, a part of the Los Alamos National Laboratory's (LANL's or the Laboratory's) Environmental Restoration (ER) Program, serves two purposes. The work plan will

- satisfy the regulatory requirements of the Hazardous and Solid Waste Amendment (HSWA) Module VIII of the Laboratory's RCRA Part B operating permit and
- serve as the field characterization guide for personnel who implement the RFI.

The OU 1078 work plan contributes to the Laboratory's commitment to address 40% of the HSWA Module's Table A solid waste management units (SWMUs) and 55% of the HSWA Module's Table B SWMUs. This work plan will meet the schedule requirements of Module VIII and will be submitted to the Environmental Protection Agency (EPA) and the New Mexico Environmental Department by May 23, 1992.

The installation work plan (IWP), updated yearly by the Laboratory's ER Program office, describes the history of the Laboratory, its environmental setting, past waste management practices, and the methodology set forth by the Laboratory for implementing the EPA RFI guidance. The OU 1078 work plan builds on the IWP and provides further OU-specific information. Annual reports on SWMU characterization will be submitted to update the EPA on the RFI progress.

The OU 1078 work plan addresses SWMUs in the area formerly designated as Technical Area (TA) 1 (Figure E-1). The TA-1 area covers approximately 80 acres. There are 68 SWMUs grouped into 16 aggregates. This RFI will proceed by iterative phase investigations and sequential sampling. Phased investigations allow the use of information gained from prior sampling to aid in the planning and implementing of additional sampling. The basic technical approach to the investigation of OU 1078 is summarized as follows.

- Archival data are gathered and evaluated to identify SWMUs for no further action or Phase I sampling.
- Quantitative risk assessment will be conducted for each site based on Phase I data to determine which SWMUs need further characterization.
- Phase II field investigations will be conducted to initiate subsurface sampling and to more fully characterize the nature and extent of contamination indicated after Phase I sampling.

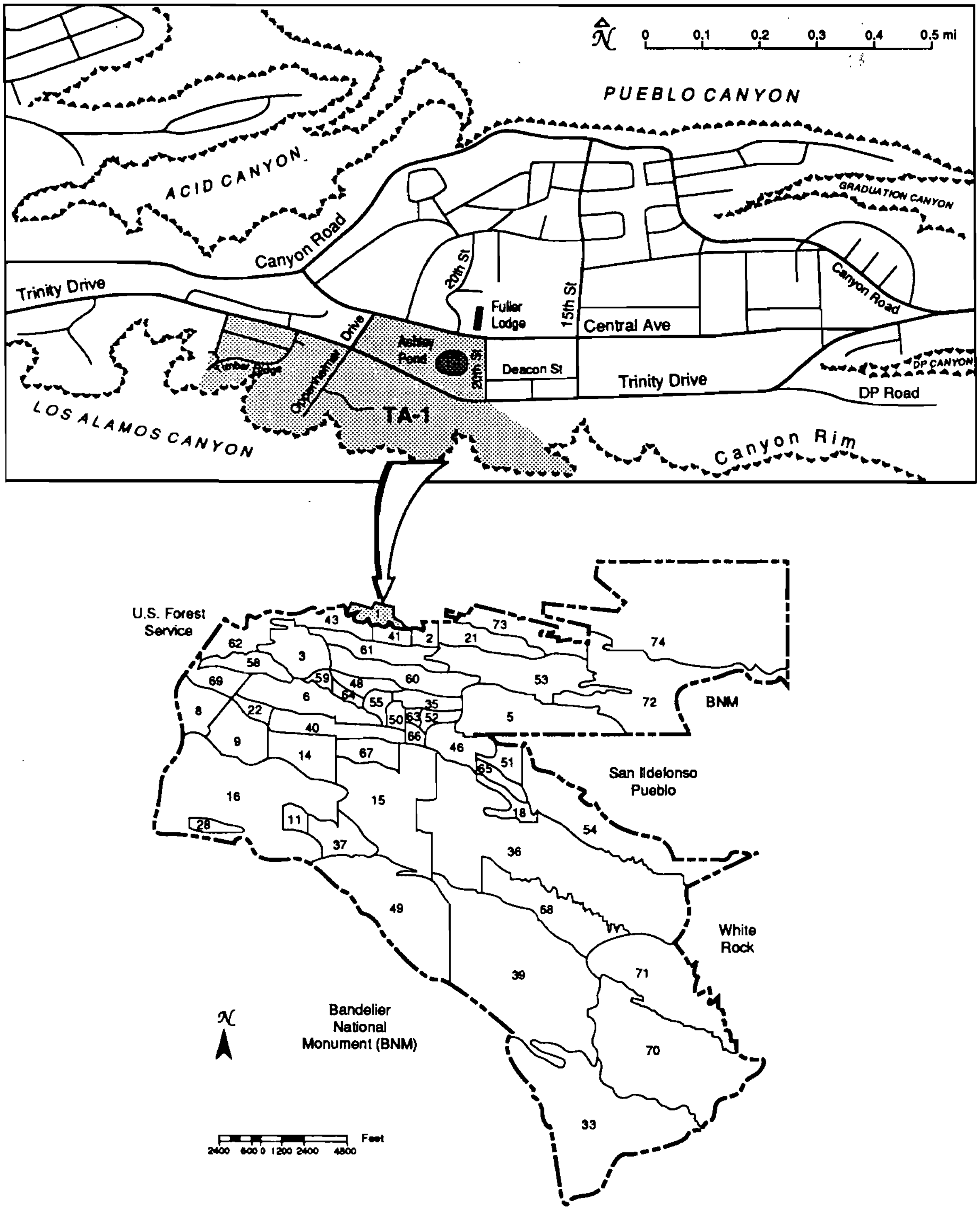


Figure E-1 TA-1 with respect to Los Alamos townsite and Laboratory Technical Areas.

- An RFI report will be compiled that contains a baseline risk assessment using results gained from the RFI.

E.2 TA-1 Perspective

During US participation in World War II (1941–1945), military strategists decided to develop a nuclear fission bomb. In 1942, J. Robert Oppenheimer was selected to head a developmental laboratory and direct the research effort on this project. Los Alamos, New Mexico, was identified as the location to establish the laboratory. On January 1, 1943, the University of California was selected to operate the new laboratory under a formal, nonprofit contract with the Manhattan Engineer District of the Army Corps of Engineers. The effort to develop a nuclear weapon was initiated on March 15, 1943, and culminated 28 months later on July 16, 1945, with the explosion of the first nuclear device (Fat Man) at Trinity Site.

Basic chemical operations that occurred at TA-1 included chemical laboratory wet chemistry experimentation and wet and dry chemistry processing. TA-1 also housed several mechanical operations, such as casting, machining, powder metallurgy, and metallurgical and solid materials procedures for shaping metals. These activities generated various hazardous and radioactive wastes. The Laboratory attempted to keep radioactively contaminated wastes separated from sanitary liquid wastes by dedicating a separate disposal line for the collection of industrial liquid wastes. The industrial waste line led from TA-1 to Pueblo Canyon. TA-1 sanitary waste was collected by three sanitary systems that discharged at points located outside of TA-1. Some outlying buildings used separate sanitary waste tanks to handle their sanitary waste. These tanks discharged to Los Alamos Canyon. Nonradioactive solid waste was burned in two on-site incinerators. Noncombustible, nonradioactive solid wastes were transported and removed to a landfill located outside of TA-1. There is no record of any radioactive solid waste landfill on the mesa top within the perimeter of TA-1. As operations gradually relocated to new technical areas (1945–1965), phased decommissioning and decontamination activities occurred at TA-1. All building superstructures were demolished and removed, and most sections of the industrial waste line were removed.

In 1974–1976, TA-1 became the focus of exploratory efforts to find possible areas of residual radiological soil contamination. Twenty thousand cubic yards of contaminated soil were removed during this decontamination effort. Clean fill was brought in to replace the removed soil. Many areas where OU 1078 SWMUs are now located were sampled for radioactivity during the decommissioning and decontamination activities of the mid-1970s. Although the sampled areas were considered clean at the time, no sampling was done to determine if hazardous nonradioactive chemical constituents were present in remaining soil. This work plan addresses these additional hazardous constituents as well as residual radioactivity.

E.3 Environmental Setting

The OU 1078 work plan characterizes the environmental setting of TA-1 and identifies available information that may be used to assess the presence, pathways, mobility, and importance of various potential contaminants in the environment. Additional information on the environmental setting of the Laboratory is available in Chapter 2 of the IWP. Discussions of the environmental setting in this document focus on the viable migration pathways at OU 1078.

Run-off and infiltration are the significant aspects of surface water hydrology at OU 1078. Undoubtedly, many small-volume liquid discharges of contaminants to soil occurred at TA-1 during its active years. It is expected that during the 26 years since the last technical building was demolished, surface water run-off has removed significant quantities of contaminants from OU 1078.

TA-1 does not contain any alluvial aquifers. The main aquifer below OU 1078 lies in the Santa Fe group, well below the base of the Bandelier Tuff. Laboratory studies indicate that relatively little water has infiltrated into the underlying tuff because infiltration rates are low and evapotranspiration rates are high. The main aquifer beneath the Laboratory is routinely sampled in the supply and distribution systems. No chemical or radionuclide constituents for which the main aquifer has been tested have been detected in concentrations that exceed EPA standards.

E.4 Conceptual Model for OU 1078

The OU 1078 work plan identifies relevant migration mechanisms and environmental pathways for dissemination of any existing contaminants that may be associated with SWMUs at OU 1078 (Figure E-2). Four release categories are operational at OU 1078.

- Surface contamination areas on mesa tops
- Subsurface liquid releases on mesa tops
- Solid waste disposal on canyon walls
- Liquid releases on canyon walls

Potential human exposure to residual contaminants may result from the migratory pathways that are relevant to OU 1078. These pathways are atmospheric dispersion, surface water run-off, and erosion.

The current residents of OU 1078, in particular, children playing and families who garden, are defined as the most susceptible population group in mesa-top areas. The most susceptible individual on the hillsides

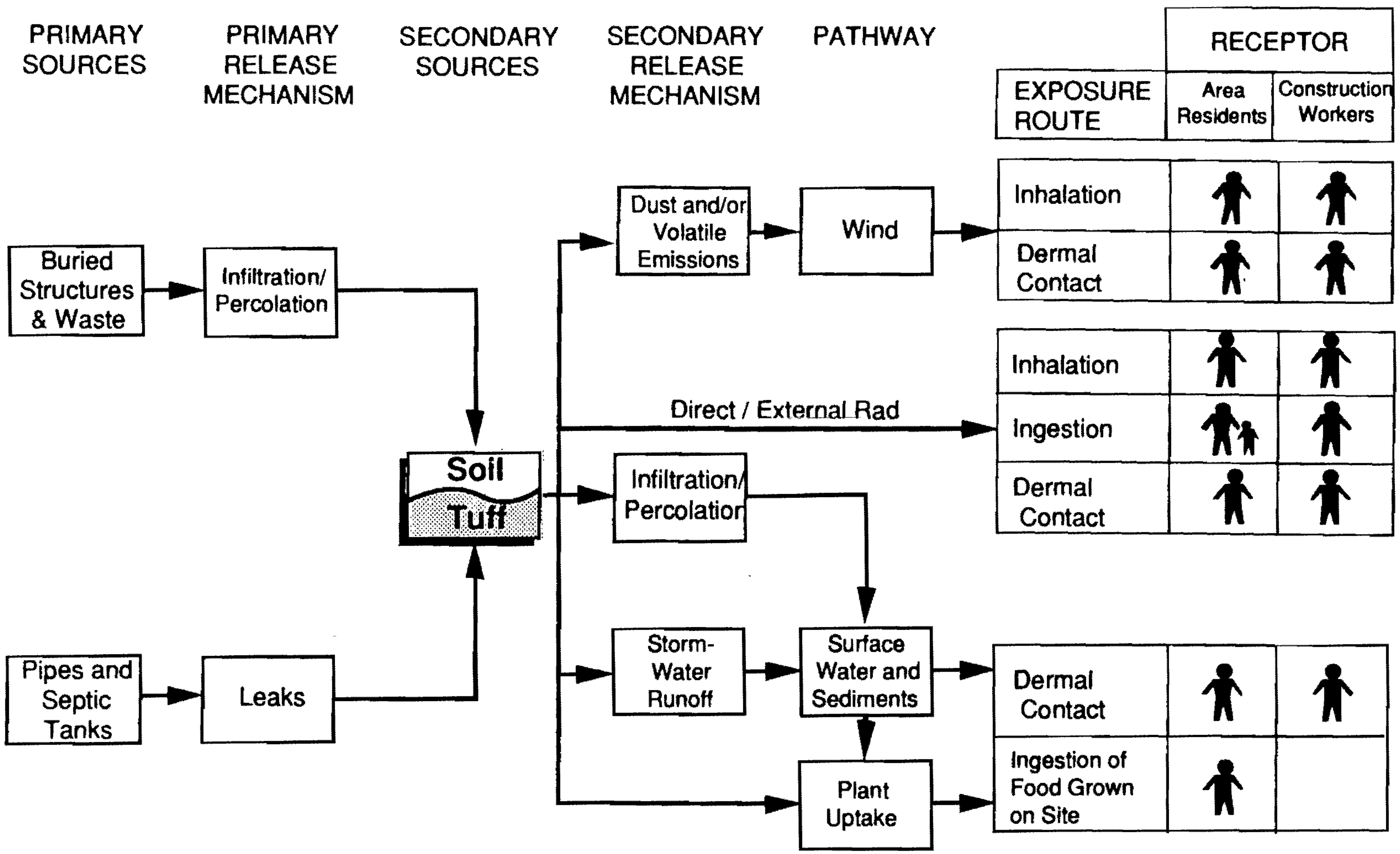


Figure E-2. Conceptual Site Model for Mesa Top.

is the occasional hiker. In the 1974–1976 radiological survey and cleanup, contaminated areas were excavated until radiation levels in remaining soil or sediments measured as low as reasonably achievable (generally less than 25 pCi/g gross alpha or beta above background). The preliminary dose estimates presented in this work plan have been used primarily to prioritize SWMU aggregates located on the mesa top; those of highest concern will be investigated first.

E.5 Field Investigation Methods

The OU 1078 work plan identifies and describes aspects of the phased field investigation process common among SWMUs. The principal investigation techniques to be used at OU 1078 include radiological field surveying and soil sampling. At many SWMU aggregates, insufficient current information necessitates sampling for a variety of possible contaminants. A full suite analysis indicates that the following measurements will be requested for a sample.

- Gamma spectrometry (including cesium-137)
- Total uranium
- Isotopic plutonium
- Semivolatile organic compounds
- Metals

Field surveys are primarily studies of radioactivity on the land surface performed on foot using direct-reading recording instruments. Land engineering surveys to identify and mark specific site locations are included as field surveys. For the soil-sampling plans used in Phase I of this OU 1078 work plan, a set of specific sampling methods (ER standard operating procedures) has been selected, and the details of their use and application in the field have been carefully defined. Surface and near-surface soil sampling are the principal sampling techniques at OU 1078.

E.6 SWMU Aggregate Investigation Unit

The 68 individual SWMUs at TA-1 have been combined into 16 aggregates. A SWMU aggregate can consist of an individual SWMU or two or more geographically related SWMUs that have the same conceptual model and receptors. Background information on SWMU aggregates includes descriptions of buildings as sources, rationale for determining which building process was the source of a SWMU, spills and discharges associated with particular buildings or processes, and any decontamination effort that might have taken place at a SWMU to mitigate past discharges of deleterious materials. Each SWMU aggregate is discussed in terms of the individual SWMUs composing that aggregate, the physical description of the SWMU, the historical use of the SWMU, and the summary of existing data. A figure depicting the arrangement of former buildings and defined SWMUs is presented in each SWMU aggregate discussion. SWMU aggregates are discussed in the order of dose priority as developed in Chapter 4.

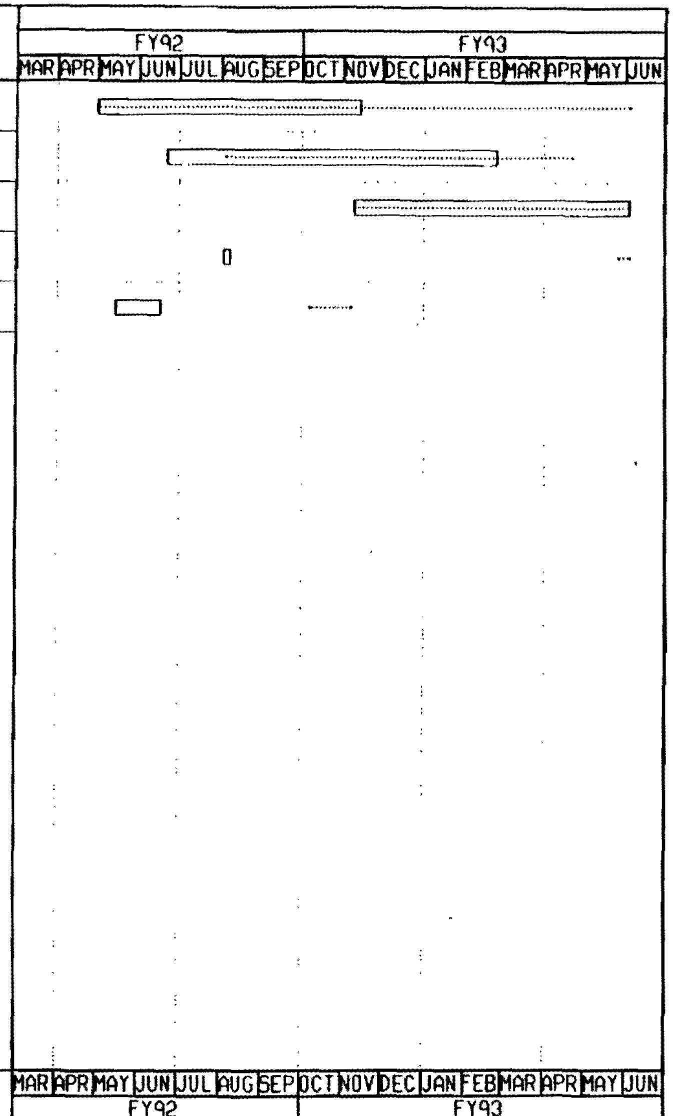
E.7 SWMU Investigation Strategy

This work plan discusses the first phase of the soil-sampling investigation. Different sampling approaches are developed for mesa-top and hillside SWMUs. Five of the mesa-top SWMU aggregates are not easily accessed for sampling because they are below the ground surface and/or are covered by manmade structures. These SWMU aggregates, which pose no current risk to public health, will be sampled when subsurface construction projects intersect these areas. The other mesa-top SWMU aggregates included in this work plan are the Sigma area, Ashley Pond, and industrial waste line aggregates. Eight hillside aggregates are also included in this work plan. Sampling of hillside aggregates will occur at outfalls and in drainages that carried contaminants to the canyon floor. Several hillside SWMU aggregates also contain construction debris that will require characterization. A combination of judgmental and statistically based soil sampling is planned for investigation of all the aggregates. Data assessment of Phase I sample results may indicate that additional sampling phases will be needed to characterize any existing contaminants.

The first phase of sampling will begin in June 1992. Approximately 1000 samples will be collected for gross alpha and beta analysis; approximately 200 of these samples will be submitted for full suite analysis. The schedule for the Phase I investigation and data assessment is found in Figure E-3. Figure E-4 contains the entire RFI investigation schedule.

Public participation is required by regulation during the OU 1078 RFI/corrective measures study. Meetings will be held periodically during the process to allow public input. This work plan, as well as other important information regarding the ER program, can be found in the ER Community Reading Room located at 2101 Trinity Drive in Los Alamos.

070155	ADS 1078: FIELD WORK			RFI PH1
RD 136	ES 1MAY92	EF 13NOV92	BC 593703	
070160	ADS 1078: SAMPLE ANALYSIS			RFI PH1
RD 167	ES 22JUN92	EF 24FEB93	BC 1174183	
070165	ADS 1078: DATA ASSESSMENT			RFI PH1
RD 140	ES 10NOV92	EF 3JUN93	BC 181825	
070575	ADS 1078: VOLUNTARY CORRECTIVE ACTIONS FY-92			
RD 5	ES 3AUG92	EF 7AUG92	BC 19760	
070580	ADS 1078: BENCH/PILOT STUDIES FY-92			
RD 22	ES 15MAY92	EF 16JUN92	BC 24800	



Plot Date 14APR92
Data Date 1OCT91
Project Start 1OCT91
Project Finish 3JUN93

(c) Primavera Systems, Inc

Sheet 1 of 1

LANL EM-8 R. CONRAD 667-0950
ADS 1078: TA-1 DETAIL FIELD WORK
SUMMARY SCHEDULE RFI PH1 FIELD WORK

ENVIRONMENTAL RESTORATION			
Date	Revision	Checked	Approved

Figure E-3. Field work summary schedule.

LANL EM-8 R. CONRAD FINEST HOUR ADS 1078: TA-1 TBS 2/17/92

REPORT DATE 13MAY92 RUN NO. 145 ENVIRONMENTAL RESTORATION START DATE 1OCT91 FIN DATE 21APR00
15:04
SCHEDULE REPORT SUMMARY ACTIVITIES WITH BUDGET DATA DATE 1OCT91 PAGE NO. 1

	DUR	%	SUMMARY DESCRIPTION	SCHEDULED START	SCHEDULED FINISH
1	212	0	ASSESSMENT - RFI WORK PLAN	1OCT91	6AUG92
2	823	0	ASSESSMENT - RFI	10JUL92	27OCT95
3	1359	0	ASSESSMENT - RFI REPORT	13AUG92	2FEB98
4	245	0	ASSESSMENT - CMS PLAN	10OCT97	5OCT98
5	245	0	ASSESSMENT - CMS	6OCT98	29SEP99
6	412	0	ASSESSMENT - CMS REPORT	25AUG98	21APR00
7	1883	0	ASSESSMENT - ADS MANAGEMENT	1OCT91	27APR99
8	1743	0	ASSESSMENT - VCA	1OCT91	30SEP98

Figure E-4. RFI schedule.

Annexes

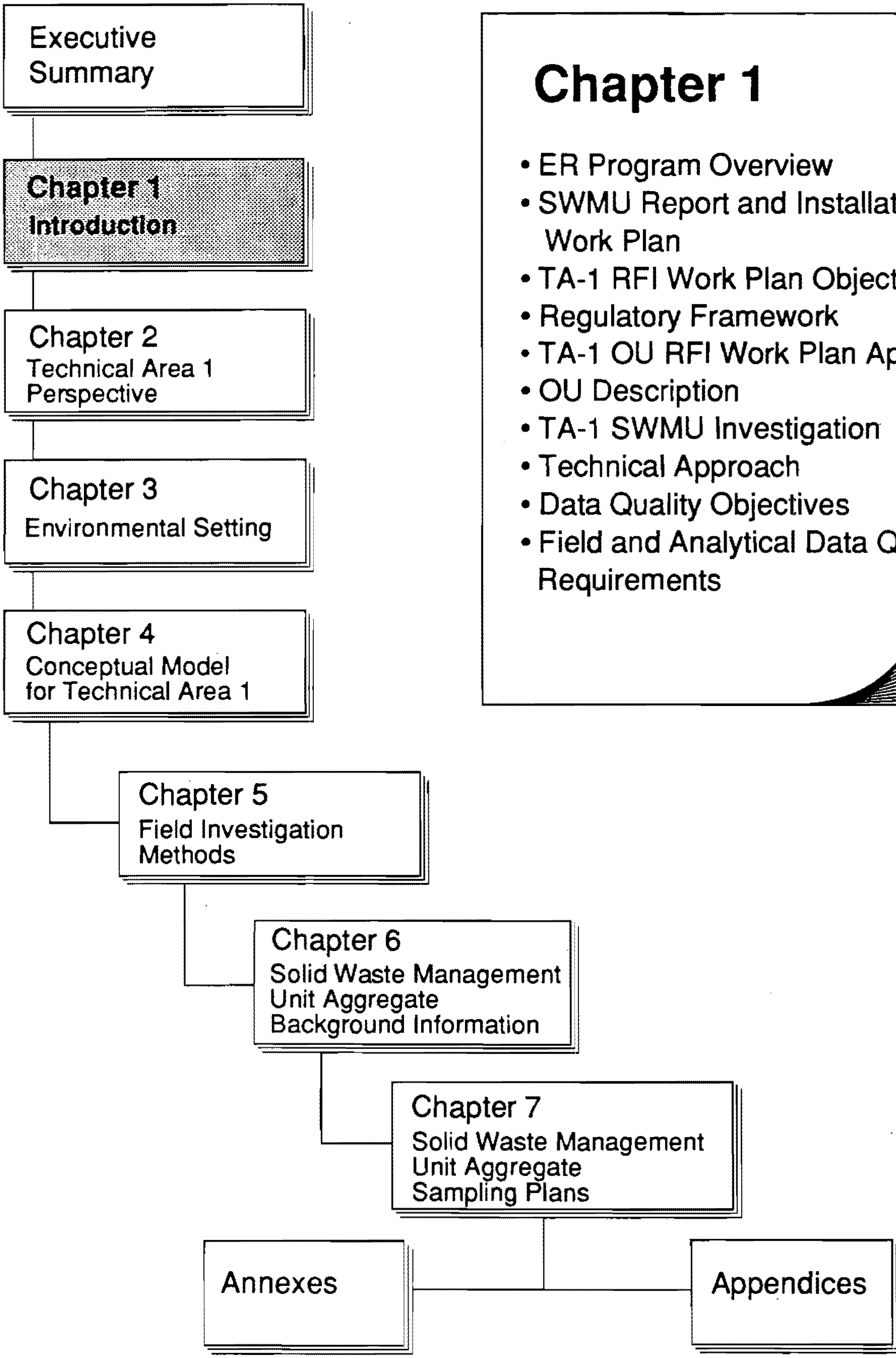
Appendices

FIGURES

TABLES

AA	Atomic absorption
ACGIH	American Conference of Governmental Industrial Hygienists
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
AP	Administrative procedure
AR	Administrative requirement
ARAR	Applicable or relevant and appropriate requirement
ASME	American Society of Mechanical Engineers
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	Committed effective dose equivalents
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	Contaminants of concern
COE	Corps of Engineers
DAC	Derived air concentration
DOE	US Department of Energy
DOT	Department of Transportation
DQO	Data quality objective
EM	Environmental management
EPA	US Environmental Protection Agency
ER	Environmental restoration
ERDA	US Energy Research and Development Administration
ES&H	Environment, safety, and health
FID	Foxboro Model OVA-128 vapor detector
FIMAD	Facility for Information Management, Analysis, and Display
GC/MS	Gas chromatograph/mass spectrometer
H&S	Health and safety
H&SPL	Health and safety project leader
HSWA	Hazardous and Solid Waste Amendments
ICAP	Inductively coupled Argonne plasma
IT	International Technology
IWP	Installation work plan
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (LANL before 1981)
MCA	Multichannel analyzer
MCL	Maximum contaminant level
MDA	Material disposal area
NEPA	National Environmental Policy Act
NFA	No further action
NIOSH	National Institute of Occupational Health and Safety
NMED	New Mexico Environment Department
NMEID	New Mexico Environmental Improvement Division

NPL	National Priorities List
NQA	Nuclear quality assurance
NRC	US Nuclear Regulatory Commission
OAA	Opportunity-available action
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader
OVA	Organic vapor analyzer
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PC	Personal computer
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PL	Project leader
PNA	Polynuclear aromatic compounds
PPE	Personal protective equipment
QA	Quality assurance
QAPjP	Quality assurance project plan
QC	Quality control
QP	Quality procedure
QPPL	Quality program project leader
RCRA	Resource Conservation and Recovery Act
RESRAD	Residual radioactive materials (computer code)
RFI	RCRA facility investigation
RPF	Records-Processing Facility
SMF	Sample Management Facility
SOP	Standard operating procedure
SWMU	Solid waste management unit
TA	Technical area
TB	Technical bulletin
TCLP	Toxicity characteristic leaching procedure
TLD	Thermoluminescent dosimeter
TTL	Technical team leader
UC	University of California
VCA	Voluntary corrective action
XRF	X-ray flourescence



Chapter 1

- ER Program Overview
- SWMU Report and Installation Work Plan
- TA-1 RFI Work Plan Objectives
- Regulatory Framework
- TA-1 OU RFI Work Plan Approach
- OU Description
- TA-1 SWMU Investigation
- Technical Approach
- Data Quality Objectives
- Field and Analytical Data Quality Requirements

1.0 INTRODUCTION

The initial research and development of the atomic bomb at Los Alamos National Laboratory (LANL or the Laboratory) took place at Technical Area (TA) 1. Activities at TA-1 began in 1943, reached a peak between 1945 and 1955, and then slowly declined as the Laboratory relocated to newly constructed technical areas. The last technical building was decommissioned in 1965. A second major decontamination effort occurred in the mid-1970s, followed by intense residential and commercial development that continues today.

Because of new environmental laws and regulations, TA-1 has again become a major focus of the Laboratory's Environmental Restoration (ER) Program. Today's main area of concern at TA-1 addresses the effectiveness of previous Laboratory decontamination efforts at this site.

Because much of the area that composed TA-1 has undergone severe alteration, a straightforward and direct investigation is not possible. Many of the previously decontaminated locations now classified as solid waste management units (SWMUs) are covered by residences, commercial buildings, paved roads, several feet of fill, or other manmade structures. Because these SWMUs are difficult to access, the Operable Unit (OU) 1078 work plan utilizes a phased sampling approach to obtain the necessary data to adequately assess any health risk at TA-1.

The quality data acquired from this investigation will be used to calculate a baseline risk assessment that is to be presented in the final Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) report due in October 1997. However, it is probable that the RFI can be completed well before that time. In the final RFI report, residents will be apprised of actual incremental risk to human health from any residual remnants of past Laboratory operations at TA-1. When the RFI report is completed, corrective measures, if necessary, will be proposed to diminish incremental risk at TA-1 to acceptable levels.

1.1 ER Program Overview

In 1976, RCRA came into effect and was placed under the administration of the US Environmental Protection Agency (EPA). Under RCRA, one of the primary tasks of the EPA was enforcing the cleanup of active Department of Energy (DOE) hazardous waste treatment, storage, or disposal facility units. The Hazardous and Solid Waste Amendments (HSWA), added to RCRA in 1984, considerably increased the EPA's authority and responsibility for requiring and overseeing cleanups at RCRA facilities. Under HSWA, the EPA issues operating permits to currently active hazardous waste treatment, storage, or disposal facilities.

In 1983, the Laboratory established the site characterization program to investigate past environmental practices and releases at the Laboratory. This was merged into the Comprehensive Environmental Assessment and Response Program (CEARP) in February 1984. CEARP was established by the Albuquerque Operations Office to investigate past environmental practices and releases and to assess Albuquerque facilities and their compliance with environmental laws and regulations (DOE 1987, 0264). The DOE established the ER Program in March 1987 to meet HSWA, address the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and respond to anticipated remediation of DOE facilities. The focal point of the ER Program is the investigation and cleanup, to EPA-approved guidelines, of all DOE facilities in the United States. The Laboratory, operated for the DOE by the University of California (UC), is one of those facilities.

1.2 SWMU Report and Installation Work Plan

The first commitments fulfilled under the Laboratory RCRA Corrective Action Plan in response to HSWA were the identification of the Laboratory's SWMUs (SWMU Report) and the drafting of a Laboratory-wide installation work plan (IWP). The SWMU Report, which identifies potential hazardous waste sites at the Laboratory, was completed and submitted to the EPA on November 16, 1990. The IWP, first submitted to EPA on November 19, 1990, is a working document that is updated yearly by the Laboratory's ER Program office. The IWP describes the history of the Laboratory, its environmental setting, past waste management practices, and the methodology set forth by the Laboratory for implementing the EPA RFI guidance (EPA 1989, 0088). The OU 1078 work plan provides OU-specific information and initiates the second-phase requirements of RCRA's Corrective Action Plan. This work plan is an exceptions documents and includes information pertinent to TA-1 not included in the IWP.

1.3 TA-1 RFI Work Plan Objectives

The primary objective of the OU 1078 work plan is to propose a methodology by which sufficient data are collected during the RFI process to assess potential health and environmental risks to residents and workers at TA-1. Sampling at the site will allow the collection of adequate data to assess extent and degree of potential contamination. This information will be used to complete a baseline risk assessment. If unacceptable health risks are discovered at any part of TA-1, cost-effective corrective measures will be taken to reduce these risks to acceptable levels.

1.4 Regulatory Framework

The ER Program at the Laboratory operates within the regulatory framework established under RCRA's Part B operating permit. The New Mexico Environmental Improvement Division (NMEID) issued a RCRA operating permit (NM0890010515) to the DOE and UC in November 1989 (NMEID 1989, 0595). On March 8, 1990, the EPA issued a HSWA Module, effective on May 23, 1990, to the RCRA operating permit (EPA 1990, 0306). The Laboratory's ER Program focuses primarily on implementing and fulfilling HSWA requirements established under the RCRA operating permit. Specifically, the HSWA Module VIII of the RCRA operating permit mandates procedural requirements for assessing and remediating sites that meet the definition of a SWMU.

The Laboratory was scored by the EPA under CERCLA, also known as Superfund. The purpose of Superfund is to investigate and clean up abandoned hazardous waste sites. By a priority numerical ranking system, the EPA ascertains whether a site poses an imminent threat to human health. If a facility achieves a high score, it is placed on the National Priorities List (NPL), and the mechanisms for site investigation are initiated according to the National Contingency Plan. The Laboratory did not have a high score and was not placed on the NPL. For this reason, RCRA's HSWA Module and Corrective Action Plan regulate the Laboratory's ER Program.

1.4.1 Permit Modification

Section 3.5 of the IWP states that each OU work plan may propose a HSWA Module Class III permit modification to adjust SWMUs listed in Table A of the HSWA Module (EPA 1990, 0306). Such adjustments may be made to remove SWMUs determined not to need further investigation and to add newly discovered SWMUs.

1.4.2 Phase Memoranda and Work Plan Modification

Because the OU 1078 RFI is scheduled to take five years, the Laboratory is prioritizing investigation activities for SWMUs. The Laboratory will submit annual reports on these site characterizations to update the EPA on the RFI progress. These reports will also serve as work plan modifications to revise sampling plans or field work, as appropriate, to reflect the results of Phase I investigations (the initial investigations occurring in the field). Phase reports will also be submitted and serve as interim RFI reports or interim RFI work plans. The schedule for submittal of annual and phase reports is presented in Annex I.

1.4.3 DOE Orders

A number of DOE orders applicable to the Laboratory's ER Program are identified in Annex I, Program Management Plan, of the IWP (LANL 1991, 0553). Compliance with the requirements of those orders is an integral part of operations at the Laboratory and is ensured through the documented polices, planning, auditing, and work review procedures. The Laboratory must meet the tenets of DOE Order 5400.4 (DOE 1989, 0078) during the RFI, corrective measures study (CMS), and corrective measures implementation (CMI) processes. This order deals with radiation protection of the public and the environment. It is also important to recognize two aspects of DOE Order 5820.2A, Radioactive Waste Management (DOE 1988, 0074), represented by the OU 1078 work plan: (1) the site characterization phase and (2) the site assessment phase. Chapter III of DOE Order 5820.2A specifies requirements (regarding low-level waste) that are applicable to some situations at OU 1078 or that provide useful guidance for assessments made as part of the RFI process. The OU 1078 work plan incorporates elements that will provide data to allow the evaluation of options for the assessment of low-level waste disposal guidance and requirements.

1.5 TA-1 OU RFI Work Plan Approach

The Laboratory has adopted the OU-specific RFI work plan approach. This strategy proposes a logical sequence of tasks to achieve the collection of quality-assured data. This information will allow the Laboratory to propose a cost-effective corrective action measure (if necessary) for each SWMU or aggregate of SWMUs composing OU 1078. This information will also be used to nominate certain SWMUs for no further action (NFA). Other areas of concern that may pose a risk to the public or the environment must also be addressed. However, no areas of concern have been identified at TA-1. The goal of the RFI is to verify the adequacy of past cleanups and to perform a risk-driven, cost-efficient investigation that provides sufficient information for the selection of corrective measures (if necessary).

Under HSWA Module VIII of the RCRA permit, the Laboratory is required to prepare a task-specific work plan for each of the 24 OUs defined at the Los Alamos site. The OU 1078 work plan addresses 3.3 % (20 of 603) of the SWMUs listed in Table A and 11.0 % (20 of 182)of the SWMUs listed in Table B.

Appendix G of the IWP identifies the TA-1 assessment task as OU AL-LA-1, Activity Data Sheet 1078. Sections 3.5 through 3.12 of the IWP (LANL 1991, 0553) served as guidance for the OU 1078 work plan. Under the HSWA Module of the RCRA permit, the work plan must be completed and submitted to the EPA by May 23, 1992.

1.5.1 Adherence to RFI Five Tasks

The EPA defines five general tasks within the RFI process (EPA 1989, 0088; EPA 1990, 0306). The fulfillment of each task is discussed separately; corresponding chapters are identified below. Table 1.5-1 (extracted from the HSWA Module) establishes the correspondence between the RFI tasks identified in EPA guidance documents (EPA 1989, 0088) and the equivalent ER Program tasks.

RFI Task I, Description of Current Conditions. This task consists of a presentation of facility background information and a discussion of the nature and extent of contamination. Chapter 1 presents the regulatory background that mandated the RFI. Chapter 2 includes a history and operations summary for TA-1. The environmental setting is described in Chapter 3, and the known data concerning the nature and extent of contamination for individual SWMUs are presented in Chapter 6.

RFI Task II, RFI Work Plan. This task requires plans for project management, quality assurance, health and safety, records management, and community relations. These plans are presented as Annexes I through V.

RFI Task III, Facility Investigation. This task sets out requirements for further characterization of TA-1's environmental setting, source terms, contamination, and potential receptors. The OU 1078 work plan describes the following efforts.

- Source characterization, individual SWMU descriptions (Chapter 6)
- Contaminant characterization, individual SWMU sampling plans (Chapter 7)
- Preliminary radiological dose assessment (Chapter 4)

RFI Task IV, Investigative Analysis. This task contains subsets of data analysis and protection standards. These considerations are addressed in the IWP.

RFI Task V, Reports. This task calls for preliminary, work plan, progress, draft, and final reports. Work plans are provided on an installation-wide basis (the IWP) and for specific OUs. This document is the RFI work plan for OU 1078. Progress, or phase, reports, technical review documents, and draft and final RFI reports will be submitted as described in the IWP.

1.5.2 TA-1 Work Plan Structure

The OU 1078 work plan gives an adequate picture of the OU 1078 sufficient for making decisions. Historical and physical data for the OU are presented, including a brief history, types of operations per-

TABLE 1.5-1

RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT

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

formed, and estimated discharges. A history of former decommissioning and decontamination efforts and a brief characterization of TA-1's environmental setting is included. The OU 1078 work plan presents a preliminary radioactive dose assessment for mesa-top areas based on available data for radioactive contaminants in surface soil. This assessment will be used to prioritize SWMUs enabling the RFI to examine priority SWMUs first. The existing soil contaminant data will lay the basis for any additional data needed to verify the radioactive dose assessment for SWMUs located on the mesa top, calculate dose assessment for SWMUs partially located on the canyon walls, and define the degree and extent of any existing contamination at common SWMU groupings or aggregates.

Additional data requirements will be determined by applying a data quality objectives (DQOs) approach. The SWMU aggregate sampling plans presented in Chapter 7 provide the methodology by which additional chemical and radiological data are to be accumulated. Once data have been validated and the baseline risk assessment completed for a specific TA-1 area, appropriate corrective measures (including the no-action alternative) will be proposed for individual SWMUs. Based on site-specific physical parameters and data collected in the RFI process, the Laboratory, in collaboration with the EPA and the New Mexico Environment Department (formerly the NMEID), will make a decision on soil contaminant guidelines based on health risk. If remediation is required for an area, corrective measures will be chosen with public participation, and the final stage of the corrective action process, the CMI, will be adopted.

Annex I, Project Management Plan, presents the technical investigation approach, management structure, schedule, budget, and reporting of milestones for the OU 1078 RFI. Annex II and IV provide guidance for the quality of information collected and data generated. Annex III assures the safety of investigators, of other site workers, and of local residents during the RFI and the CMI. Under the tenets of Annex V the Los Alamos community will be apprised of activities occurring at OU 1078 at each step in the ER process. Finally, appendices include detailed background information to supplement important theses presented in this work plan.

1.5.3 Technical Aspects

1.5.3.1 Management of Uncertainty

Past decontamination activities that occurred at TA-1 are well-documented. Only residual radioactive and chemical contamination remains on the mesa top and hillsides. The available information should allow the inherent uncertainties of the OU 1078 field investigation to be more easily managed than at OUs where no decontamination was accomplished and unknown quantities of unknown constituents were disposed. By utilizing available information and DQOs, following established ER standard operating procedures (SOPs) and quality assurance (QA) guidelines, and applying appropriate statistical techniques during sampling and data analysis, the uncertainties inherent in this investigation can be managed.

1.5.3.2 Phased Investigation

This RFI will proceed by iterative phases and sequential sampling (Section 1.8). The initial work discussed in the OU 1078 work plan has been termed Phase I investigations. This includes land surveying and surface soil, sediment, and water (Ashley Pond) sampling. The only subsurface sampling undertaken in Phase I will occur at shallow benches located on the hillsides. The Phase I data will be analyzed to determine whether SWMUs can be recommended for NFA at that time or if removal actions need to be taken immediately. Phase reports and technical memoranda presenting validated results and a schedule for upcoming task modifications to the work plan will be submitted to the EPA. Phase II investigation plans will be included in these interim documents. Phase II investigations will occur at SWMU aggregates where Phase I investigations document the presence of contaminants at concentrations greater than action levels or if additional information is required. Phase II tasks, if needed, will undoubtedly entail some subsurface investigations including augering, drilling, and/or trenching.

Phased investigations and sequential sampling occur simultaneously. This technique uses information gained from prior sampling to logically plan and implement additional sampling. Because radionuclides are considered the most prevalent residual contaminant at TA-1 and gross alpha and beta activity measurements are relatively inexpensive and quick to perform, this measurement will be heavily used as a guide to any additional sampling or analysis. Appendix A details how radioactivity can serve as a guide to sampling for metals and semivolatile organic compounds.

1.6 OU Description

During the initial stage of US involvement in World War II, Los Alamos, New Mexico, was identified by Dr. J. Robert Oppenheimer and the Army Corps of Engineers as the prime location for the operation of a top-secret project to develop an atomic bomb. In 1943, work on the project was initiated and the Laboratory's first technical area, known as TA-1, was established on a site formerly occupied by a boys' preparatory school known as the Los Alamos Ranch School. The first structures were erected next to the original ranch school buildings situated around Ashley Pond, a small lake used for recreational purposes by the school.

The TA-1 OU covers approximately 80 acres; 50 acres span the mesa top and 30 acres cover canyon walls or hillsides. TA-1 is located on East Mesa in an area that includes a portion of the present-day townsite of Los Alamos and extends east to west from what is now 18th Street to the edge of Timber Ridge Road. It extended north to south from Central Avenue to the rim of Los Alamos Canyon. Figure 1.6-1 depicts the location and extent of the TA-1 OU with respect to the Los Alamos townsite and the Laboratory's technical areas.

The majority of the theoretical and technical work accomplished at the Laboratory from 1943–1954 was conducted at TA-1. The Laboratory's initial bench-scale physical and chemical experiments involving plutonium, uranium, and other radionuclides were almost exclusively conducted at TA-1. During the early years of the Laboratory, purification and processing operations for ^{235}U and ^{239}Pu were also performed at TA-1. These activities generated considerable radioactive and hazardous waste products (none of which were purposefully disposed on the mesa top). In addition, hazardous waste constituents were produced from machining and fabrication operations, as well as general nonradioactive chemistry and physics laboratory work. From 1954 to 1965, operations steadily decreased through gradual relocation to newly constructed technical areas.

By 1965, all Laboratory technical structures erected at TA-1 had been decommissioned and/or demolished, sold to the public, or transferred to federal agencies and transported off site. Decontaminated property was transferred to the county and to private ownership for residential, commercial, and recreational development. The area formerly designated as TA-1 is currently occupied by residential developments and a portion of the the commercial sector of the Los Alamos townsite (Figure 1.6-2).

The remainder of the townsite is designated as TA-0 and will be investigated as part of OU 1071.

1.6.1 SWMUs Addressed In the TA-1 OU

Sixty-eight SWMUs have been identified in the TA-1 OU (LANL 1990, 0144). These include twenty-three sanitary systems, one industrial waste line, one landfill, four hillside disposal sites, three incinerators, twenty drain lines and outfalls, and sixteen areas of suspected subsurface soil contamination (Table 1.6-1). Table 1.6-2 presents a list of SWMUs and correlates SWMU numbers used in this OU 1078 work plan to SWMU numbers used in the 1990 HSWA Module and Laboratory SWMU Report. Buildings associated with individual SWMUs are described in Table 1.6-3 and the locations of all former structures are depicted in a map included as Appendix C.

It is possible that additional SWMUs might be detected during the course of RFI field work; however, the OU 1078 work plan addresses only currently identified SWMUs. Should additional SWMUs be identified, a mechanism for reporting previously unidentified SWMUs to the EPA is in place in the ER Program Office (LANL-ER-AP-04.1, Identification and Reporting of Solid Waste Management Units and Identification of Other Areas of Concern for the Environmental Restoration Program).

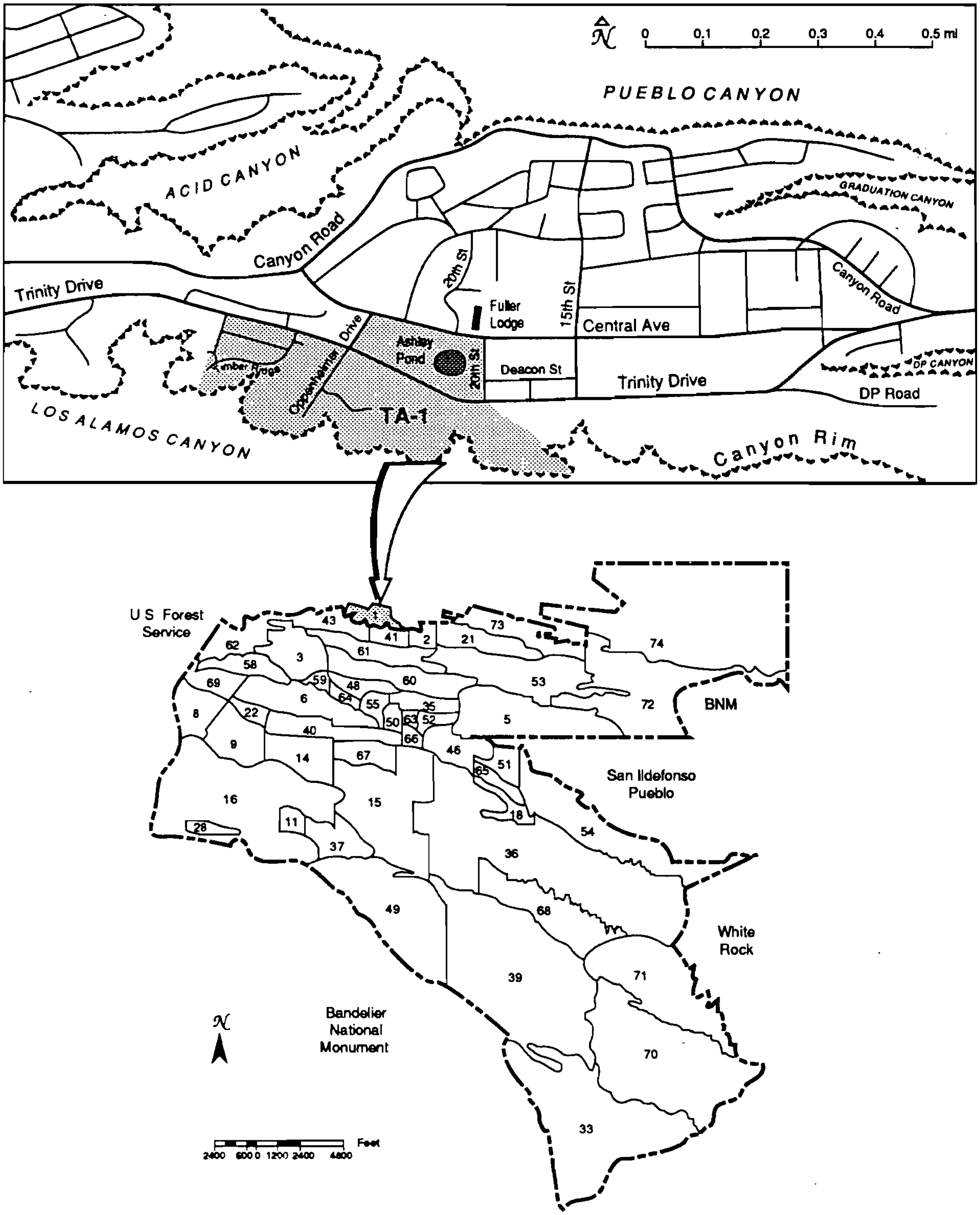


Figure. 1.6-1. TA-1 with respect to Los Alamos townsite and Laboratory technical areas.

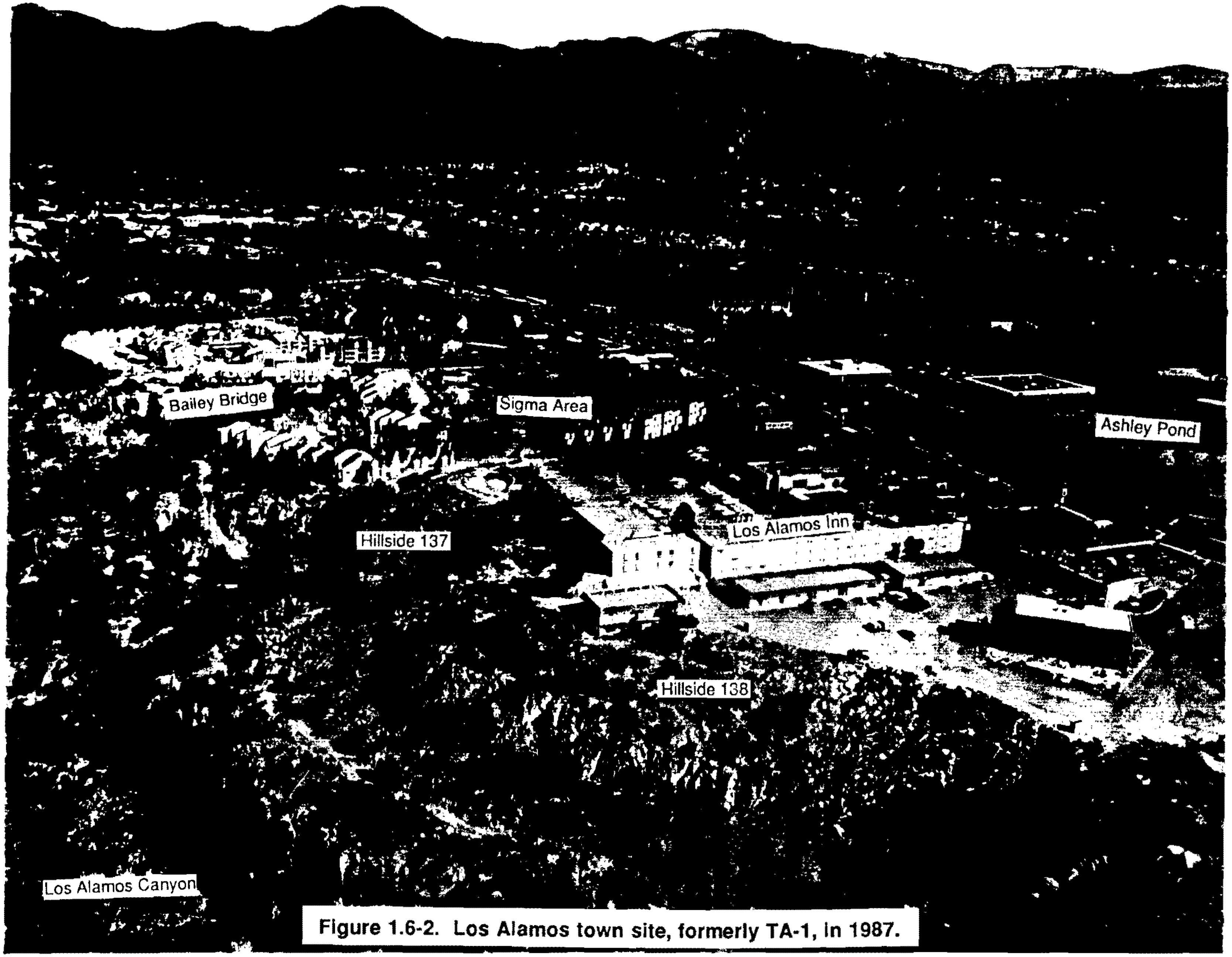


Figure 1.6-2. Los Alamos town site, formerly TA-1, in 1987.

A Laboratory-wide decision was made to consolidate SWMUs into logical units grouped according to the function these entities served during their active operation. This section identifies individual TA-1 SWMUs classified according to function. Table 1.6-1 lists all identified SWMUs and indicates their respective functions during the operational period of this OU. A discussion of SWMUs is given in Chapter 6 in preparation for the presentation of sampling plans in Chapter 7. Ahlquist et al. (1977, 0016) and IT Corporation (1991, 09-0003) provided the majority of the reference materials used in characterizing the nature of TA-1 SWMUs. SWMU classifications follow.

Sanitary Waste Disposal Systems: SWMU Numbers 1-001 (a-w).
Sanitary waste disposal system SWMUs consist of 14 individual septic tanks (Foldout Map A) and 9 sanitary waste drain lines (Foldout Map C) that composed TA-1's central and main sanitary waste systems.

Industrial Waste Disposal System: SWMU Number 1-002.
The industrial (acid) waste disposal system serving TA-1 (Foldout Map B) consisted of an extensive network of underground drains and pipelines that collected fluids from process buildings. This system discharged its liquid waste into Acid Canyon, a small branch of Pueblo Canyon.

Bailey Bridge Landfill: SWMU Number 1-003 (a).
This landfill is located in Bailey's Canyon (Foldout Map A). This area received concrete and other construction debris generated by the decommissioning and demolition of several of TA-1's original structures.

Hillside Disposal Sites: SWMU Numbers 1-003 (b-e).
Four hillside disposal sites are located adjacent to TA-1 along the side of Los Alamos Canyon (Foldout Map A). The types of waste observed in these disposal sites consist principally of construction debris, empty paint or solvent cans, and large fragments of scrap metal. The construction debris most likely originated from the decommissioning and demolition of TA-1.

Incinerators: SWMU Numbers 1-004 (a, b), 1-005. Three incinerators have been identified as SWMUs at TA-1 (Foldout Map B). Two of the incinerator units were dedicated to the disposal of standard combustible trash. The third unit, a bench-scale incinerator, is believed to have been exclusively used for uranium recovery from combustible laboratory materials.

Drain Lines and Outfalls: SWMU Numbers 1-006 (a-t).
Many buildings in TA-1 were served by drain lines that discharged directly into outfalls. These drain lines are of two types: building drains and storm drains. Several of these drain lines discharged directly into Los Alamos Canyon, while others simply released waste or storm water onto the ground surface in the general vicinity of the building which they served (Foldout Map B).

Suspected Subsurface Soil Contamination: SWMU Numbers 1-007 (a-p). Subsurface soil contamination may be present in soil and sediments beneath and adjacent to former TA-1 structures. Most of these locations are currently beneath paved roads, parking lots, commercial buildings, or townhouses, which compose a major portion of the present-day Los Alamos townsite. The suspected soil contamination could have resulted from original Laboratory operations or from the demolition and removal of buildings. Foldout Map B depicts locations of subsurface soil contamination areas.

TABLE 1.6-1

OU 1078, SWMU DESCRIPTIONS AND SOURCE AREAS

SWMU No.	SWMU Description	Source Buildings
1-001(a)	Septic Tank 134	Warehouse 19 (TA-1-103), Sheet Metal Shop (TA-1-104)
1-001(b)	Septic Tank 135	M-1 (TA-1-96)
1-001(c)	Septic Tank 137	D-2 (TA-1-8)
1-001(d)	Septic Tank 138	K (TA-1-40), V (TA-1-70), Y (TA-1-81)
1-001(e)	Septic Tank 139	D-5 Sigma Vault (TA-1-11), Delta (TA-1-16), I (TA-1-32)
1-001(f)	Septic Tank 140	FP (TA-1-20), HT (TA-1-29)
1-001(g)	Septic Tank 141	X (TA-1-79)
1-001(h)	Septic Tank 142	Latrine (TA-1-118)
1-001(i)	Septic Tank 143	TU (TA-1-67), J Div. Annex (TA-1-75)
1-001(j)	Septic Tank 149	TU (TA-1-67), or U (TA-1-69), or W (TA-1-71)
1-001(k)	Septic Tank 268	TU (TA-1-67)
1-001(l)	Septic Tank 269	S-1 (TA-1-54)
1-001(m)	Septic Tank 275	Warehouse 13 (TA-1-97)
1-001(n)	Septic Tank 276	Theta (TA-1-65)
1-001(o)	Sanitary waste line	J (TA-1-34), ML (TA-1-42)
1-001(p)	Sanitary waste line	Q (TA-1-49), ML (TA-1-42)
1-001(q)	Sanitary waste line	P (TA-1-46)
1-001(r)	Sanitary waste line	E (TA-1-17)
1-001(s)	Sanitary waste line	A (TA-1-1), B (TA-1-2), Boiler House No. 2 (TA-1-4), C (TA-1-5), D (TA-1-6), G (TA-1-21), M (TA-1-43), Sigma (TA-1-56), V (TA-1-70)
1-001(t)	Sanitary waste line	Gamma (TA-1-22), M (TA-1-43), P' (TA-1-47), R (TA-1-50), S (TA-1-53), T (TA-1-64), U (TA-1-69), V (TA-1-70), W (TA-1-71), Z (TA-1-83)
1-001(u)	Sanitary waste line	J-2 (TA-1-115)
1-001(v)	Sanitary waste line	P (TA-1-46)
1-001(w)	Sanitary waste line	AP (TA-1-127)
1-002	Industrial waste line	D (TA-1-6), Q (TA-1-49), ML (TA-1-42), M (TA-1-43), Boiler House No. 2 (TA-1-4), H (TA-1-26), Sigma (TA-1-56), J-2 (TA-1-115)
1-003(a)	Bailey Bridge Landfill	D-5 Sigma Vault (TA-1-11), Sigma (TA-1-56), HT (TA-1-29), Warehouse 19 (TA-1-103), Sheet Metal Shop (TA-1-104)
1-003(b)	Surface Disposal Site East of Bailey's Canyon	Unidentified
1-003(c)	Surface Disposal Site West of Bailey's Canyon	Unidentified
1-003(d)	Can Dump Site Surface Disposal	Unidentified (Eastern TA-1)
1-003(e)	Surface Disposal SE of Los Alamos Inn	Unidentified (Eastern TA-1)
1-004(a)	Incinerator 146	Combustible wastes from throughout technical area
1-004(b)	Incinerator 147	Combustible wastes from throughout technical area
1-005	Incinerator TU-1	TU-1 (TA-1-68)
1-006(a)	Drain lines/outfall	Cooling Tower 80 (TA-1-80)
1-006(b)	Drain lines/outfall	D (TA-1-6)
1-006(c)	Drain lines/outfall	D-2 (TA-1-8)
1-006(d)	Drain lines/outfall	D-3 (TA-1-9)
1-006(e)	Drain lines/outfall	P (TA-1-46)
1-006(f)	Drain lines/outfall	Warehouse 4 (TA-1-76)

Table 1.6-1 (continued)

SWMU No.	SWMU Description	Source Buildings
1-006(g)	Drain lines/outfall	X (TA-1-79), ML (TA-1-42), Q (TA-1-49), D (TA-1-6), D-4 (TA-1-10), D-7(TA-1-13)
1-006(h)	Drain lines/outfall	R (TA-1-50), Y (TA-1-81)
1-006(i)	Drain lines/outfall	S-1 (TA-1-54), R (TA-1-50)
1-006(j)	Drain lines/outfall	S (TA-1-53)
1-006(k)	Drain lines/outfall	J Div. Annex (TA-1-75), Warehouse 4 (TA-1-76)
1-006(l)	Drain lines/outfall	Warehouse 2 (TA-1-74), J Div. Annex (TA-1-75)
1-006(m)	Drain lines/outfall	Sigma (TA-1-56), Warehouse 2 (TA-1-74)
1-006(n)	Drain lines/outfall	D (TA-1-6)
1-006(o)	Drain lines/outfall	A (TA-1-1), B (TA-1-2), C (TA-1-5), H (TA-1-26), Sigma 4 (TA-1-61)
1-006(p)	Drain lines/outfall	HT (TA-1-29), K-1 (TA-1-98)
1-006(q)	Drain lines/outfall	T (TA-1-64)
1-006(r)	Drain lines/outfall	J (TA-1-34), X (TA-1-79)
1-006(s)	Drain lines/outfall	P (TA-1-46)
1-006(t)	Drain lines/outfall	C (TA-1-5)
1-007(a)	Soil contamination	D (TA-1-6)
1-007(b)	Soil contamination	D-2 (TA-1-8)
1-007(c)	Soil contamination	D (TA-1-6)
1-007(d)	Soil contamination	H (TA-1-26), Theta (TA-1-65)
1-007(e)	Soil contamination	Sigma (TA-1-56)
1-007(f)	Soil contamination	Delta (TA-1-16)
1-007(g)	Soil contamination	Warehouse 19 (TA-1-103)
1-007(h)	Soil contamination	TU (TA-1-67), TU-1 (TA-1-68)
1-007(i)	Soil contamination	Warehouse 5 (TA-1-77), Warehouse 6 (TA-1-78), Warehouse GR (TA-1-25)
1-007(j)	Soil contamination (scattered throughout technical area)	Boiler House No. 2 (TA-1-4), Q (TA-1-49), Sigma (TA-1-56), K-1 (TA-1-98), J-2 (TA-1-115), Sheet Metal Shop (TA-1-104), D-5 Sigma Vault (TA-1-11)
1-007(k)	Soil contamination	U (TA-1-69), W (TA-1-71)
1-007(l)	Soil contamination	D (TA-1-6)
1-007(m)	Soil contamination	C (TA-1-5)
1-007(n)	Soil contamination	J-2 (TA-1-115)
1-007(o)	Soil contamination	D-5 Sigma Vault (TA-1-11)
1-007(p)	Soil contamination	HT (TA-1-29)

TABLE 1.6-2

COMPARISON OF SWMU NUMBERS FROM THE HSWA MODULE OF THE RCRA PERMIT (LISTS A AND B), THE NOVEMBER 1990 SWMU REPORT, AND THE CURRENT OU 1078 RFI WORK PLAN

SWMU Nos. In 1990 HSWA Module (Included on Lists A and B)[a]	SWMU Nos. In SWMU Report November 1990[b]	SWMU Nos. Used In TA-1 RFI Work Plan[c]
1-001(a)	1-001(a)	1-001(a)
1-001(b)	1-001(b)	1-001(b)
1-001(c)	1-001(c)	1-001(c)
1-001(d)	1-001(d)	1-001(d)
1-001(e)	1-001(e)	1-001(e)
1-001(f)	1-001(f)	1-001(f)
1-001(g)	1-001(g)	1-001(g)
1-001(h)	1-001(h)	1-001(h)
1-001(i)	1-001(i)	1-001(i)
1-001(j)	1-001(j)	1-001(j)
1-001(k)	1-001(k)	1-001(k)
1-001(l)	1-001(l)	1-001(l)
1-001(m)	1-001(m)	1-001(m)
1-001(n)	1-001(n)	1-001(n)
	1-001(o)	1-001(o)
	1-001(p)	1-001(p)
	1-001(q)	1-001(q)
	1-001(r)	1-001(r)
	1-001(s)	1-001(s)
	1-001(t)	1-001(t)
	1-001(u)	1-001(u)
	1-001(v)	1-001(v)
	1-001(w)	1-001(w)
1-002	1-002	1-002
1-003	1-003(a)	1-003(a)
1-003	1-003(b)	1-003(b)
1-003	1-003(c)	1-003(c)
1-003	1-003(d)	1-003(d)
1-003	1-003(e)	1-003(e)
	1-004(a)	1-004(a)
	1-004(b)	1-004(b)
	1-005	1-005
	1-006(a)*	1-006(a)**
	1-006(a)	1-006(b)
	1-006(a)	1-006(c)
	1-006(a)	1-006(d)
	1-006(a)	1-006(e)
	1-006(b)	1-006(f)
	1-006(b)	1-006(g)
	1-006(b)	1-006(h)
	1-006(b)	1-006(i)
	1-006(b)	1-006(j)
	1-006(b)	1-006(k)
	1-006(b)	1-006(l)
	1-006(b)	1-006(m)
	1-006(b)	1-006(n)
	1-006(b)	1-006(o)
	1-006(b)	1-006(p)
	1-006(b)	1-006(q)

TABLE 1.6-2 (continued)

SWMU Nos. in 1990 HSWA Module(Included on Lists A and B)[a]	SWMU Nos. in SWMU Report November 1990[b]	SWMU Nos. Used in TA-1 RFI Work Plan[c]
	1-006(b)	1-006(r)
	1-006(b)	1-006(s)
	1-006(b)	1-006(t)
	1-007(b)	1-007(a)
	1-007(b)	1-007(b)
	1-007(b)	1-007(c)
	1-007(b)	1-007(d)
	1-007(b)	1-007(e)
	1-007(b)	1-007(f)
	1-007(b)	1-007(g)
	1-007(b)	1-007(h)
	1-007(b)	1-007(i)
	1-007(b)	1-007(j)
	1-007(b)	1-007(k)
	1-007(b)	1-007(l)
	1-007(b)	1-007(m)
	1-007(b)	1-007(n)
	1-007(b)	1-007(o)
	1-007(b)	1-007(p)

*SWMU Nos. in bold type indicate those that were changed from the November 1990 SWMU Report.
**SWMUs 1-006(a) and 1-007(b) retained the same number designation but have new definitions.
[a] (EPA 1990, 0306)
[b] (LANL 1990, 0145)
[c] (International Technology Corporation 1991, 09-0003)

TABLE 1.6-3

TA-1 BUILDING DESCRIPTIONS

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
A (TA-1-1)	10/43 2/59	Wood frame construction; 45 ft X 138 ft X 26 ft; 14-ft X 19-ft X 19-ft basement; 17-ft X 28-ft X 14-ft addition	Administrative offices; no radioactive materials used or stored; hazardous chemicals probably not managed at this location	
AP (TA-1-127)	1943 11/65	Three barracks built in 1943 of unknown construction were moved and joined together in 1950; each barrack was 150 ft X 20 ft	Offices; no indication exists that radioactive materials were managed at this location	
B (TA-1-2)	10/43 2/59 (by Los Alamos Transfer)	Wood frame construction; 50 ft X 203 ft	Administrative offices; small amounts of ^{232}Th, ^{238}U, and ^{235}U foils were stored in a concrete vault located inside	
Boiler House No. 2 (TA-1-4)	7/43 2/59	Wood frame construction; 40 ft X 126 ft X 23 ft; original six stoker fire boilers converted to gas in 4/49; additional modifications later	Supplied steam to TA-1; no associated radioactive materials; typical boiler house and cooling tower operations; no records of specific chemicals available, however, possibly could include chromates, biocides, and descalers	
C (TA-1-5)	9/43 12/64	Wood frame construction; 123 ft X 176 ft X 24 ft; burned and rebuilt 5/45	Standard machining except southeast section where uranium machining conducted	Contaminated concrete pad removed to contaminated disposal area; other concrete placed in Bailey's Canyon, 1965
D (TA-1-6)	12/43 11/54 (by Zia Co. after nine months of demolition)	Wood frame construction; 50 ft X 144 ft;	Plutonium chemistry, metallurgy and processing; significant amounts of ^{239}Pu and ^{235}U processed, resulting in high levels of contamination in various parts of the building and drain lines	Considerable amount of soil with low radioactive contamination excavated; drain lines to nearest manholes cut off and removed; remaining drain lines removed in 1970s cleanup of the eastern half of TA-1; debris and soil measuring more than 10 000 pCi/g packaged in plastic-lined steel drums and stored on-site at LANL retrievable storage facility; less-contaminated soil buried in pits at radioactive waste disposal site; area back - filled with clean soil (Ahlquist et al. 1977, 0016)

TABLE 1.6-3 (continued)

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
D-2 (TA-1-8)	7/44 10/53	Wood frame construction; 32 ft X 80 ft X 9 ft; three rooms added later; laundry moved to DP Site (TA-21) and Septic Tank 137 added in 1945; at this time, all lines were left in place and one was rerouted to the septic tank	Laundry facility for radioactively and chemically contaminated clothing, glassware, and equipment from the entire technical area; after laundry facility moved, used for electronics shop; drain lines were shallow and emptied to an open area near canyon rim; two outfall pipes were contaminated with plutonium, americium, and uranium	Septic tank, septic tank outfall pipe, and the two outfall pipes from building have been removed
D-3 (TA-1-9)	7/44 6/56	Construction materials and building dimensions unknown	Counting radioactivity on filter papers from H-1 Building; slight amounts of radium and strontium could have been transferred via contaminated filter paper	
D-5 Sigma Vault (TA-1-11)	1944 or 1945? 12/65	Reinforced concrete; 20 ft X 41 ft X 13 ft	Storage of ^{239}Pu and ^{235}U; minor spills may have occurred in vault, resulting in low-level radioactive contamination of , walls, shelving, and concrete floors	
D-7 (TA-1-13)	Unknown 1/54	Construction materials unknown	CMR-HF gas analysis; no record of radioactive materials being stored	
Delta (TA-1-16)	Unknown 4/65(to unspecified location)	Construction materials unknown	Research and ceramic fixation of radioactive waste; also used as an auditorium; may have been contaminated	
E (TA-1-17)	7/44 3/58(by private firm)	U-shaped, two-story building; wood frame construction; 60 ft X 125 ft with two 30-ft X 30-ft wings, 28 ft high	Office space for administration staff and theoretical physicists; radioactive materials were not managed in this building.	
G (TA-1-21)	8/43 6/59	Wood frame construction; 28 ft X 74 ft X 13 ft	Sigma Pile, constructed of graphite and uranium, located in middle section of the building; concrete floor became slightly contaminated; small amounts of radium may have been flushed down building's drains during decontamination of radium sources	Drain lines and concrete foundation were taken to a radioactive waste disposal area

TABLE 1.6-3 (continued)

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
Gamma (TA-1-22)	4/45 6/59	Two-story building; wood frame construction; 166 ft X 48 ft with two additional wings	Contained two laboratories listed as hot furnace rooms in which organic scintillators were made; beryllium and toluene were used as well as sealed sources of ^{210}Po and ^{137}Cs; building contaminated with ^{137}Cs, but details of contaminating event are unknown	Contamination was supposedly cleaned up without problem (Ahlquist et al. 1977, 0016)
H (TA-1-26)	2/44 6/57	Wood frame construction; 20 ft X 92 ft	Used initially for work with ^{210}Po and later for offices and work space; items contaminated with ^{140}Ba and ^{140}La are known to have been used and stored in and under the building, with some resulting contamination; material with short half-life decayed, but ^{90}Sr remained as a contaminant	Area was decontaminated and building was demolished; drain lines from building, as well as a substantial amount of soil excavated from under the building, were removed to an unspecified disposal area*
HT (TA-1-29)	Summer 1945 12/45	Wood frame construction; 62 ft X 269 ft X 30 ft, with a 15-ft X 69-ft X 10-ft basement	Used by Shops Department for heat treatment, machining, and processing of ^{235}U and ^{238}U; substantial levels of uranium contamination were found in the building	Much of the building was disposed of in an unspecified contaminated disposal area; parts may have been disposed of in Bailey's Canyon
HT Barrel House (TA-1-30)	7/45 7/64	Wood frame construction; 8 ft X 12 ft X 10 ft	Uranium storage; moderately contaminated; contained no drains	Demolished and hauled to the contaminated disposal area by Zia Company
I (TA-1-32)	7/45(by US Post Engineers); demolished in 1959	Wood frame construction; 30 ft X 60 ft X 16 ft	Storing and machining beryllium; sold to Dog Obedience Club in 1958 and moved to 1080 Airport Road; repurchased and demolished in 1959; no drain lines other than sanitary waste lines connected to this building	Suspected of being contaminated with nonradioactive beryllium; was repurchased by the government, demolished, and taken to the contaminated disposal area
J (TA-1-34)	1943 1954	Construction materials and dimensions unknown	Laboratory of unknown type; sealed sources, not including plutonium, were handled in the laboratory (Ahlquist et al. 1977, 0016); connected by a passageway to X-Building, which housed the cyclotron	Survey activities that may have taken place before demolition are unknown

• A memo found in the records states: *"the industrial waste line had overflowed behind H Building and had run across the drive be When all contaminated soil that was possible to remove was taken away, a load of gravel and binder was spread to a depth of fo area. The area was again monitored and found to run not over 50 c/m as against the 1,000 c/m to infinity count found to be there* et al. 1977, 0016). This memo resulted in an intensive survey for contamination in the area during the 1974–76 radiological surve gross alpha readings were obtained in the H-building area (up to 210 pCi/g) (Ahlquist et al. 1977, 0016). In July 1976, the areas and the old Theta Building were determined to be decontaminated (Ahlquist et al. 1977 0016).

TABLE 1.6-3 (continued)

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
O (TA-1-45)	8/43 11/56	Concrete construction; 10 ft X 15 ft X 9 ft	Storage of radium and radium-beryllium sources, all of which were sealed; some leaked, and the building and the adjacent walkway were contaminated; at the front of the building, radon was purged from radium sources on a hot plate before resoldering; no drains connected to this building	Demolished and taken to the contaminated disposal area
P (TA-1-46)	3/44 2/59(east portion removed)	Construction materials and dimensions unknown; a security addition was built onto the building sometime before 1953	Personnel offices; no radioactive materials were used in either structure; after 2/59, west portion (the security addition) was used as the Los Alamos County Courthouse (Ahlquist et al. 1977, 0016).	
P' (TA-1-47)	7/45 9/65	Wood frame construction; 34 ft X 265 ft X 26 ft	Supply and property offices; no record of radioactive or hazardous materials being managed at this location	
Q (TA-1-49)	7/43 2/59	Construction materials and dimensions unknown; in early 1951, a chamber was installed for testing sampling apparatus; only nonradioactive dusts were used in the tests to prevent introduction of more radioactive contamination in the basement	Used by the medical and health monitoring groups; film calibration done in the north basement where a small radium spill contaminated part of north basement and part of tunnel connecting Building Q with Boiler House No. 2; northern tributary of the storm drain system originated here	Spill was cleaned as thoroughly as possible
R (TA-1-50)	1943 7/54	Wood frame construction; 65 ft X 204 ft X 15 ft; foundry was moved to its own building (FP) in August 1945	Foundry, model shop, glass shop, and carpenter shop; radioactive materials were not used in the building	
S (TA-1-53)	7/43 2/59	Wood frame construction; 80 ft X 202 ft X 21 ft; modified several times	Electronic and general stock warehouse; no history of radioactive material management or storage	
S-1 (TA-1-54)	7/45 8/54(by private company)	Construction materials and dimensions unknown	Originally served as Garage No. 1; later used for storage of nonradioactive materials; not known if hazardous chemicals associated with building; located outside security fence	
Sheet Metal Shop (TA-1-104)	6/49 1965	Steel-craft construction; 40 ft X 100 ft X 17 ft	^{238}U spilled on concrete floor; ownership transferred to the Zia Company in 1964 and then to the Bureau of Indian Affairs in 1965	Parts of the building or its foundation may have been disposed in Bailey's Canyon

TABLE 1.6-3 (continued)

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
Sigma (TA-1-56)	9/44 12/65(by Zia Co.)	Major addition 1/50; 93 ft X 375 ft X 27 ft with a 133-ft X 100-ft basement	Western part of the building used for casting and machining of enriched uranium; eastern part used for casting and machining of natural uranium; thorium may also have been used in this structure	Parts of building were moderately contaminated, so building and some concrete removed to the contaminated disposal area; concrete with less than 2500 counts per minute radioactivity disposed of in Bailey's Canyon and later covered with dirt
T (TA-1-64)	3/43 2/59	Wood frame construction; 40 ft X 210 ft X 26 ft	First TA-1 building constructed; original Theoretical Physics and Administration Building; contained offices, a technical library, a document room, drafting rooms, and a photographic laboratory; a silver-soldering operation also housed in building; no history of radioactive material storage or management	
Theta (TA-1-65)	1/45 2/47	Construction materials and dimensions unknown	No known history of radioactivity but may have stored hazardous chemicals; no record exists of possible building contamination, and its short life span has not been explained	
TU (TA-1-67)	8/45	Wood frame construction; 38 ft X 16 ft X 12 ft; 7-ft X 4-ft X 7-ft compressor shed	Natural uranium processing; building was moderately contaminated	Moved to contaminated disposal area in 1964 and burned; sanitary waste and septic tank were also removed
TU-1 (TA-1-68)	7/48 7/65	Metal construction; 12 ft X 29 ft X 10 ft; concrete floor and foundation	Enriched uranium storage and recovery; bench-scale incinerator housed in building and used in uranium recovery process; no plumbing associated with this building	Removed to contaminated disposal area and burned
U (TA-1-69)	7/43 2/59	Wood frame construction; U-shaped; 48 ft X 316 ft X 26 ft	Exact use is not clear, however, tritium, ^{238}U, ^{235}U, ^{14}C, and ^{226}Ra were used in building; large quantities of mercury were spilled on the floor in one room, but the area was cleaned and monitored for some time; radioactive contaminants were sporadically poured down drains that were not connected to the industrial waste line	Some benches and floors were removed to contaminated disposal area in early 1958

TABLE 1.6-3 (continued)

Building/ Location	Built/ Removed	Building Materials/ Building Size	Uses	Decontamination Efforts
V (TA-1-70)	7/43 2/59	Wood frame construction; 64 ft X 94 ft X 22 ft	Original machine shop with uranium and beryllium managed at this location; dry grinding of boron was also conducted in this building; the building was later used for sheet-metal storage	Found free of contamination with the exception of some areas on concrete floor; these areas reportedly removed to contaminated disposal area; sanitary waste line showed no contamination, however, it is unclear whether this line was left in place or removed
W (TA-1-71)	4/43 2/59	Wood frame construction; 48 ft X 48 ft X 10 ft	Housed Van de Graaff accelerator; radioactive materials used were uranium, ^{210}Po, and tritium; radioactive contaminants were sporadically poured down drains, which were not connected to the industrial waste line	Contaminated portion of the concrete floor was removed to the contaminated disposal area in early 1958
Warehouse 19 (TA-1-103)	6/49 1965	Steel-craft construction; 40 ft X 100 ft X 17 ft	Specific materials stored are unknown; accountability of building was transferred to the Zia Company in 1964 and then to the Bureau of Indian Affairs in 1965	Parts of building or its foundation may have been disposed of in Bailey's Canyon
X (TA-1-79)	3/43 6/54 (LANL, undated)	Construction materials unknown; approximately 60 ft X 60 ft	Housed cyclotron; various radioactive targets were used; the storm drain system ran along eastern edge of building	
Y (TA-1-81)	7/43 6/56	Construction materials unknown; approximately 80 ft X 55 ft	Physics laboratory that handled tritium and ^{238}U; contained alpha contamination; in 1946, high alpha and gamma radiation confirmed at sanitary waste outlet of building; polonium observed at drain exit, but no plutonium detected; in 1946, Room Y-1 was found to be contaminated with up to 20 000 counts/min; not known whether this contamination was polonium or plutonium	
Z (TA-1-83)	4/43 2/59	Wood frame construction; 41 ft X 51 ft X 22 ft	High-voltage laboratory and two Cockcroft-Walton accelerators were housed in this building ; tritium was used at this location	Building moved to an unknown location

Areas of concern may pose risk to the public or the environment, but are not formally classified as SWMUs. To date, no areas of concern have been identified at TA-1; however, any areas of concern identified in the future will be examined.

1.6.2 SWMU Aggregates

In order to streamline RFI sampling, individual SWMUs have been combined into aggregates. A SWMU aggregate consists of an individual SWMU or two or more geographically related SWMUs that have the same conceptual pathway model (Section 4.3) and receptors. Combining geographically and conceptually comparable SWMUs avoids repetitive modeling, evaluation of migration pathways, and redundant sampling plans. A summary of the SWMU aggregates developed for TA-1 is presented in Table 1.6-4.

1.7 TA-1 SWMU Investigation

Of the 68 SWMUs composing the TA-1 OU, 21 are nominated for NFA. A complete listing of SWMUs proposed for NFA and a presentation of the decision logic used in proposing NFA status for each of these SWMUs can be found in Sections 1.9 and 2.5. Regulatory agencies may not necessarily concur that all OU 1078 SWMUs proposed for NFA should receive NFA status.

All SWMUs have been grouped into 16 aggregates, and a sampling plan has been designed for each aggregate. The logic for deciding whether a SWMU should be considered for NFA, undergo a Phase II investigation, or be proposed for a CMS is presented below in Section 1.8.

Two basic approaches have been developed to guide aggregate sampling at TA-1. One strategy guides the sampling of SWMU aggregates located principally along the hillsides of Los Alamos Canyon; another distinct strategy guides the sampling of SWMU aggregates located principally along the mesa top. The hillside areas are generally undisturbed because little human activity occurs there, and decontamination was not attempted previously because of the rugged nature of the terrain. Minimal data are available for these sites. In contrast, mesa-top aggregates were generally thoroughly examined in past investigations, subsequently decontaminated, and have a considerable amount of data associated with them. Today the mesa-top areas are generally covered by fill, pavement, or buildings, making sampling accessibility difficult. The two approaches and the rationale for each sampling strategy are presented in Chapter 7.

Two areas of the mesa top have remained relatively undisturbed since TA-1's operational years. One undisturbed area is the Sigma Building area SWMU aggregate; which was not filled, paved, or built over by mesa-top development efforts. Landmarks found in historic photographs of the Sigma Building area

TABLE 1.6-4

SWMU s INCLUDED IN EACH AGGREGATE

Aggregate	Aggregate Title	SWMUs Included In Aggregate
A	Sigma Building Area	Storm drain and outfall–SWMU 1-006m Storm drain and outfall–SWMU 1-006t Subsurface soil contamination in vicinity of H and Theta Buildings–SWMU 1-007d Subsurface soil contamination in vicinity of Sigma Building – SWMU 1-007e Subsurface soil contamination in vicinity of Sigma Building – SWMU 1-007j (partial, 2 sites) Subsurface soil contamination in vicinity of C Building– SWMU 1-007m
B	Bailey Bridge	Septic Tank 134–SWMU 1-001a Septic Tank 139–SWMU 1-001e Septic Tank 276–SWMU 1-001n Sanitary waste line from Buildings J and ML–SWMU 1-001o Sanitary waste line from Buildings Q and ML–SWMU 1-001p Bailey Bridge Landfill–SWMU 1-003a Incinerator–SWMU 1-004a Storm drain and outfall–SWMU 1-006o Storm drain and outfall–SWMU 1-006r Subsurface soil contamination in vicinity of Delta Building – SWMU 1-007f Subsurface soil contamination in Warehouse 19 Area– SWMU 1-007g Subsurface soil contamination–SWMU 1-007j (partial) Subsurface soil contamination in D-5 Sigma Vault Area– SWMU 1-007o
C	Hillside 140	Septic Tank 135–SWMU 1-001b Septic Tank 140–SWMU 1-001f Surface Disposal Site West of Bailey's Canyon–SWMU 1-003c Storm drain and outfall–SWMU 1-006p Subsurface soil contamination General Warehouse Area– SWMU 1-007i Subsurface soil contamination–SWMU 1-007j (partial–one site) Subsurface soil contamination in HT Building Area–SWMU 1-007p
D	J-2/TU Area	Septic Tank 143–SWMU 1-001i Septic Tank 268–SWMU 1-001k Bench-scale incinerator–SWMU 1-005 Storm drain and outfall–SWMU 1-006f Storm drain and outfall–SWMU 1-006k Storm drain and outfall–SWMU 1-004L Subsurface soil contamination in vicinity of TU and TU-1 Buildings–SWMU 1-007h Subsurface soil contamination at miscellaneous small areas–SWMU 1-007j (partial–2 sites) Subsurface soil contamination in vicinity of J-2 Building – SWMU 1-007n

Table 1.6-4 (concluded)

Aggregate	Aggregate Title	SWMUs Included In Aggregate
E	Cooling Tower 80	Septic Tank 141–SWMU 1-001g Surface Disposal East of Bailey's Canyon–SWMU 1-003b Drain line and outfall–SWMU 1-006a Storm drain and outfall–SWMU 1-006g
F	Hillside 138	Septic Tank 138–SWMU 1-001d Storm drain and outfall–SWMU 1-006h
G	Hillside 137	Septic Tank 137–SWMU 1-001c Drain line and outfall–SWMU 1-006b Drain lines and outfall–SWMU 1-006c Drain lines and outfall–SWMU 1-006d Storm drain and outfall–SWMU 1-006n Subsurface soil contamination–SWMU 1-007a Subsurface soil contamination–SWMU 1-007b Subsurface soil contamination–SWMU 1-007c Subsurface soil contamination at miscellaneous small areas–SWMU 1-007j (partial–2 sites)
H	Surface Disposal Site SE of LA Inn	Septic Tank 142–SWMU 1-001h Septic Tank 149–SWMU 1-001j Septic Tank 269–SWMU 1-001L Surface Disposal Site SE of LA Inn–SWMU 1-003e Incinerator–SWMU 1-004b (partial) Storm drain and outfall–SWMU 1-006i Storm drain and outfall–SWMU 1-006j Storm drain and outfall–SWMU 1-006q
I	Can Dump Site	Septic Tank 275–SWMU 1-001m Can Dump Site–SWMU 1-003d
J	Ashley Pond	Ashley Pond–SWMU 1-006e
K	Industrial waste line	Industrial waste line–SWMU 1-002
L	Eastern Sanitary Waste Line	Sanitary waste line from E Building–SWMU 1-001r Sanitary waste line in central TA-1–SWMU 1-001t
M	Northern Sanitary Waste Line	Storm drain and outfall–SWMU 1-001q Sanitary waste line to Manhole 195–SWMU 1-001v Sanitary waste line from the P and AP Buildings–SWMU 1-001w
N	Western Sanitary Waste Line	Sanitary waste line in central TA-1–SWMU 1-001s Sanitary waste line from the J-2 Building–SWMU 1-001u
O	Subsurface contamination at UW	Subsurface soil contamination 1-007k
P	Soil contamination under Trinity Drive	Storm drain and outfall–SWMU 1-006s Subsurface soil contamination under Trinity Drive–SWMU 1-007L

can be detected in that area today. A second undisturbed area runs along the mesa-top rim of Los Alamos Canyon, outside the DOE limited access fence on DOE land. These two undeveloped areas provide unique mesa-top sampling opportunities that are detailed in Chapter 7. The undeveloped areas investigation results should be representative in helping to characterize less accessible areas of the mesa top. Data collected from sampling the Sigma Building area and the mesa-top rim of Los Alamos Canyon will be used to verify or negate the preliminary mesa-top dose assessment presented in Chapter 4.

The Ashley Pond SWMU aggregate is the only TA-1 aggregate requiring water and sludge samples. The Industrial (Acid) Waste Line SWMU aggregate may require subsurface Phase II sampling in filled trench areas that once contained the industrial waste line. This investigation of the Industrial Waste Line SWMU aggregate will focus on acquiring representative samples from the filled trenches, surrounding soil, and associated tuff. Sampling plans for these aggregates are detailed in Chapter 7.

SWMU aggregate sampling plans discussed above are designed to acquire representative data in spite of the presence of manmade structures that prevent additional sampling that might have been done had these structures not been present. Sampling at five additional SWMU aggregates is especially restrictive because of the nature of the structures located above them. These include the Eastern, Northern, and Western Sanitary Systems, Trinity Drive, and the U and W Buildings Suspected Subsurface Soil Contamination Aggregates. All of these aggregates are located in the subsurface and most probably have no contamination associated with them. All are capped by various forms of consolidated material and as such they present minimal (if any) risk. These SWMU aggregates have undergone no previous examination, but will require some form of investigation at a future time. It is recommended that these five SWMU aggregates be sampled at a time when Los Alamos County or private construction projects intersect each aggregate. The proposed protocol to be followed for the opportunity-as-available SWMU aggregate sampling is found in Chapter 7.

1.8 Technical Approach

The goal of this RFI is to ensure that health and environmental impacts associated with past activities within OU 1078 are investigated in compliance with the Laboratory's RCRA Part B (HSWA Module) permit. To accomplish this goal, the nature and extent of contamination at source points and reasonable environmental pathways that may lead to potential human and environmental receptors must be identified. The technical approach used in this work plan focuses efforts on meeting required site characterization objectives in a cost-effective manner. This approach uses a health-risk-based decision-making process (consistent with a future version of the Laboratory IWP and Subpart S to 40 CFR 264 (EPA 1990, 0432) for recommending SWMUs for NFA or for further investigation.

1.8.1 Summary of the OU 1078 Technical Approach

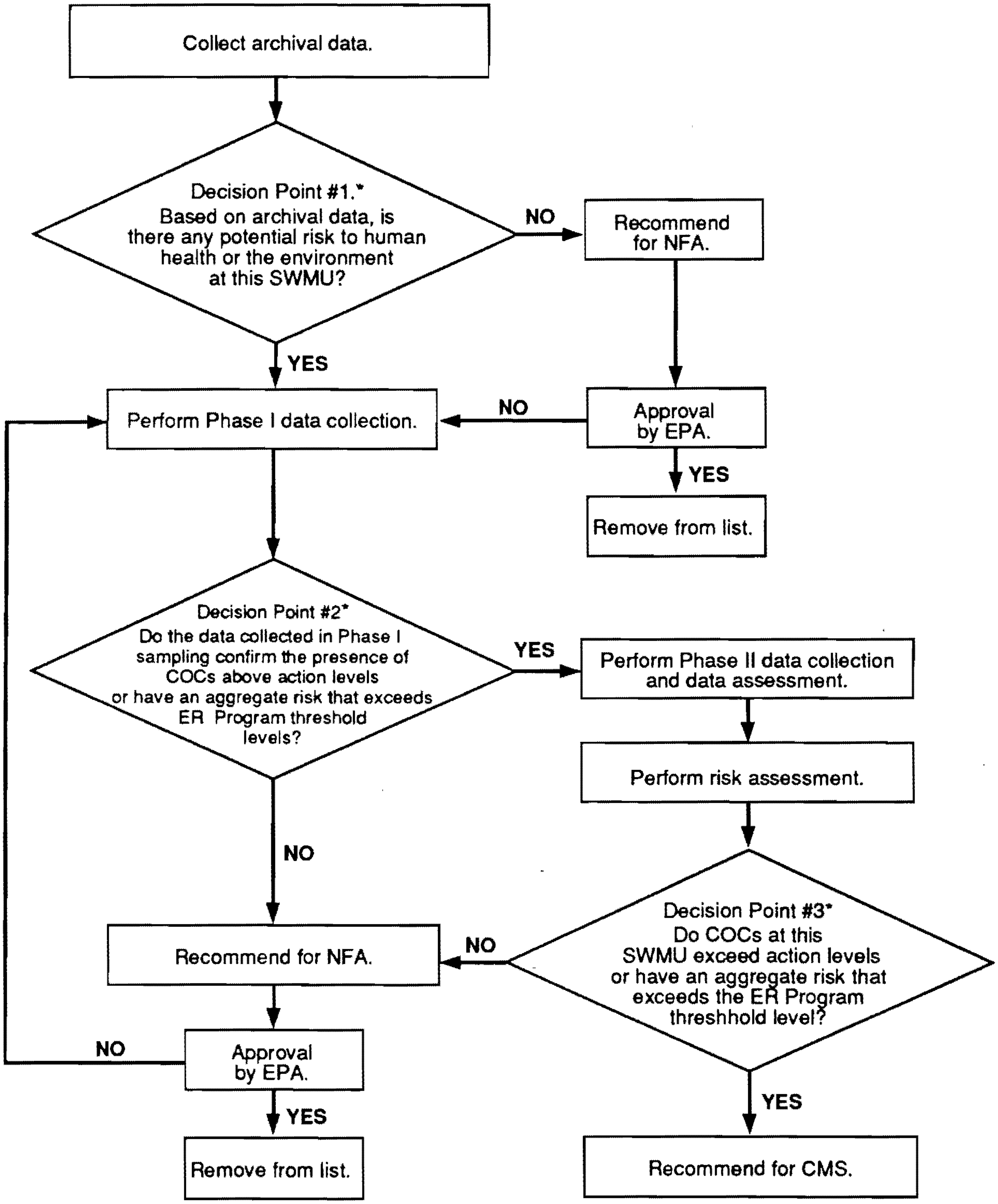
The basic technical approach is summarized as follows.

- Archival data are gathered from available sources to establish a basic understanding of the processes and events that produced each SWMU and the contaminants of concern (COCs) that may be present at each SWMU.
- The archival data are evaluated to identify those SWMUs for which no potential hazard exists so that the number of sites undergoing field investigation can be reduced. SWMUs can be recommended for NFA on the basis of archival data. Phase I field investigations are carried out where needed to determine the presence or absence of COCs.
- Quantitative risk assessment will be conducted for each site based on Phase I data to determine which SWMUs need further characterization and which, at this point, may be recommended for NFA. For SWMUs requiring further study, Phase I data are used to help design Phase II sampling and analysis plans.
- Phase II field investigations are conducted to initiate subsurface sampling and to more fully characterize the nature and extent of contamination indicated after Phase I sampling.
- An RFI report is compiled that contains data analysis using results gained from the site investigation. SWMUs are recommended for CMS when the analytical or risk assessment results exceed certain values; the remaining SWMUs are recommended for NFA. Recommendations of NFA will be supported by appropriate criteria, which are discussed in the following text. At any stage of the RFI, a voluntary corrective action (VCA) may also occur.

The technical approach and decision process used in this work plan are discussed in the following sections.

1.8.2 OU 1078 Decision Process

All SWMUs within OU 1078 are evaluated using the three-step decision process illustrated in Figure 1.8-1. Terms used in this figure are defined in Table 1.8-1. The diamonds in the figure represent a decision point for each SWMU or SWMU aggregate under consideration. Each question can be answered only by "yes" or "no." The process is designed to identify those SWMUs that can be recommended for NFA as early in the process as possible. Upon completion of Phase I or II investigations, those SWMUs that cannot be recommended for NFA may become candidates for a CMS. Candidate SWMUs for VCA/opportunity-available action (OAA) will be identified at anytime within the corrective action process. The methods for identifying and handling VCA/OAA candidate SWMUs are developed later in the work plan.



* SWMUs may be screened for (VCA) at any of these decision points.

Figure 1.8-1. Three -step decision process for SWMU characterization phases.

TABLE 1.8-1

TERM DEFINITIONS

Archival data are available information collected from published and unpublished records pertaining to the history or processes that have resulted in a SWMU. Records can include communication such as reports, memoranda, letters, notes, calculations, or photographs. Verbal communication can be considered as archival data. Archival data have different degrees of data quality.

Potential risk is a judgmental determination of potential exposure from COCs at a SWMU and is arrived at solely on the basis of archival data. A potential risk is based on the likelihood that a release may have occurred at a SWMU and may have entered a potential migration pathway leading to receptors. No potential risk is associated with the SWMU if any of the three criteria for NFA in Table 1.8-2 are met.

Contaminants of concern are organic, inorganic, or radioactive constituents that may cause or contribute a threat to human health or the environment because of their quantity, concentration, or physical/chemical characteristics. COCs may consist of one or more constituents regulated by RCRA or CERCLA or of radioactive elements/daughter products.

Phase I is the initial surface sampling phase of site assessment work intended to collect adequate information to confirm the presence of COCs above action levels in the surface environment. Information collected during Phase I sampling and analysis will be used for risk assessment and to determine if Phase II sampling is necessary or if NFA is warranted for the SWMU.

Phase II is the second sampling phase of site assessment at SWMUs potentially having COCs and is determined on the basis of archival or Phase I surface sampling investigations. Phase II sampling and analysis will include the subsurface sampling and attempt to delineate the nature and extent of contamination on the surface and in the subsurface. Data collected in this phase will be used for risk assessment, NFA nomination, and CMS, as indicated.

Human health or environment pertains specifically to the health and environment of the general public and on-site investigators or construction workers.

1.8.3 Decision Point 1:

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

The function of Decision Point 1 is to differentiate between SWMUs that clearly do not pose a potential risk to receptors and those that will require further investigations. This decision must be made on the basis of qualitative archival data and requires professional judgment on the part of the decision makers. A "yes" decision indicates that the SWMU under consideration poses some potential risk or that the available data are insufficient to deny the possible existence of risk. All such SWMUs are recommended for further consideration at Decision Point 2. A "no" decision indicates that the SWMU poses no potential risk and should be recommended for NFA. Because of the judgmental nature of this decision, a recommendation of NFA cannot be made unless the available documentation and/or site inspections clearly show that a SWMU has been improperly designated, release of COCs has not occurred, the site has been adequately remediated, or, if a release is documented, the release is physically prohibited from posing a risk to receptors. Each recommendation of NFA must be justified by one or more of the criteria listed in Table 1.8-2.

Evaluation at Decision Point 1 divides OU 1078 SWMUs into two sets: one set consists of SWMUs recommended for NFA and the other set consists of SWMUs that must be evaluated at Decision Point 2. Because the first decision is made on the basis of archival data, all SWMUs were evaluated at Decision Point 1 during the preparation of this work plan. The 21 SWMUs recommended for NFA at Decision Point 1 and the rationale used for the basis of such recommendations are presented in Section 2.5.

1.8.4 Phase I Sampling

All potential surface contaminated SWMUs not designated for NFA at Decision Point 1 and requiring surface soil or water sampling will undergo Phase I sampling. The phased approach to site characterization used in the OU 1078 work plan is consistent with EPA and IWP guidelines (LANL 1991, 0553). The technical approach uses a phased field investigation to document the presence or absence of surface COCs at a site. Quality data will be used to perform health-based risk assessment.

Phase I sampling will be performed at surface SWMUs in which contamination is suspected but not confirmed by archival data. Phase I sampling points will be selected based on the likelihood that the sampling point will yield confirmatory results or will be selected by statistical methods. As analytical results become available, sampling and analysis plans may be revised to acquire the additional data needed. In some cases, acquired data may indicate less stringent sampling or the need for fewer analytical analyses.

TABLE 1.8-2

CRITERIA USED FOR A RECOMMENDATION OF NFA AT DECISION POINT 1

The SWMU was never the location of hazardous or radioactive waste disposal.
The SWMU is physically situated such that a release to the environment and exposure to receptors is highly unlikely.
Available data indicate that the SWMU has undergone characterization or cleanup and that COCs are not present in concentrations that exceed health-risk-based action levels.

In this manner, Phase I is an iterative, flexible process and sequential sampling is standard. Statistical analyses based on Phase I data will serve as input for Decision Point 2.

1.8.5 Decision Point 2:

Do the data collected in Phase I sampling confirm a health-based risk at this SWMU?

Decision Point 2 is designed to identify SWMUs that do not contain COCs above Subpart S action levels (EPA 1990, 0432). These will be recommended for NFA. For those SWMUs where COCs are above action levels, Phase I data will be used in a health-based risk assessment.

A "yes" answer at Decision Point 2 indicates that the presence of COCs at the SWMU will be confirmed and that the health-based risk measure will be greater than the ER Program risk guidance to be published in a future IWP. The SWMU must then be evaluated at Decision Point 3. A "no" answer indicates that the absence of COCs and/or an acceptable health-based risk measure at the SWMU has been confirmed and justifies a recommendation for NFA.

1.8.6 Phase II Sampling

The purpose of Phase II sampling is to develop a more complete picture of the nature and extent of contamination at a site and to undertake any subsurface sampling that may be required. Phase II is an iterative process for most sites; real-time data will be used to track the progress of the investigation against the DQOs for this phase. As data becomes available, Phase II sampling plans will be reviewed against objectives for completeness and suitability and will be revised, as appropriate. The data set resulting from Phase II will serve as the data inputs to the subsequent risk assessment process.

1.8.7 Risk Assessment Process

Because health-based risk assessment is integral to the Laboratory RCRA process, OU 1078 will incorporate an assessment of risk for all SWMUs that undergo Phase I and Phase II investigation (a preliminary discussion of dose assessment for OU 1078 is discussed in Chapter 4). This assessment will incorporate the total data set for each SWMU, as obtained through archival review and Phase I and/or Phase II sampling activities. The risk assessment methodology for OU 1078 will reflect the guidance set out in Subpart S, 40 CFR 264. The ER Program is currently developing baseline risk assessment scenarios and criteria that will be presented in the 1992 version of the IWP. This approach will be developed in adequate time for data analysis. The risk assessment results will serve as input to Decision Points 2 and 3.

1.8.8 Decision Point 3:

Do COCs at this SWMU pose a risk above the ER Program threshold value?

Decision Point 3 is the final step in the decision process. SWMUs that have undergone field investigation will be recommended for a CMS or NFA. Decision Point 3 allows an evaluation of the entire set of data available for each SWMU. Statistically estimated concentrations of COCs at each SWMU aggregate will be compared against the action levels for those COCs. The risk calculated from the COCs will be compared against acceptable risk values determined by the ER Program office and approved by EPA. A recommendation of NFA at this point in the decision process will be justified for a SWMU if either of the above criteria are met.

A CMS (or an alternative response action) is required for SWMUs at which any COC is present at a level that exceeds the risk-based action level specified in either 40 CFR 264, Subpart S, or a future version of the IWP. A CMS or a corrective action may not always be necessary for a SWMU when COCs are detected in concentrations that exceed Subpart S action levels. If further site-specific risk assessment indicates that human health and the environment are not at risk (e.g., if there is no plausible pathway from source to potential receptors), then NFA may be appropriate. The ER Program office will be publishing criteria to calculate site-specific risk.

1.9 Data Quality Objectives

There are three stages in the decision process at which data must be collected. The first stage involves the collection of pertinent archival information. This information serves as data input for Decision Points 1 and 2. The data required to make a decision at Decision Point 2 are collected during Phase I sampling, the second stage of data collection. The data needs for Decision Point 3 determine the scope of Phase II sampling, the third stage of data collection.

Because these decisions must be technically sound and legally defensible, an attempt has been made to collect as much reliable archival information about each site as possible. The DQO process has been applied to the development of the sampling plans. The DQO process is a seven-step process developed by the EPA for planning effective and efficient data collection programs that will ensure the appropriate type, quantity, and quality of data are collected (EPA 1987, 0086). Quality environmental data are needed to make defensible environmental decisions.

The DQO process is a valuable tool because

- it provides a logical, iterative structure for study planning and encourages focusing on critical questions;
- it provides a focused method to determine data needs;
- it helps data users plan for uncertainty; and
- it facilitates communication among the technical team members and assures a cost-effective sampling effort.

The DQO process is found in Appendix H of the 1991 IWP. Sampling and analysis plans and concomitant SOPs are presented in Chapter 7.

1.9.1 Phase I DQOs

DQOs for Phase I sampling and analysis plans have been developed using the process described below and are utilized in the sampling plans.

1.9.1.1 Problem Statement

Some COCs are suspected at most of TA-1 SWMUs, but their presence has not been confirmed and no data are available on their concentrations or specific locations. Environmental samples must be collected and analyzed to confirm the presence or absence of COCs at the site.

1.9.1.2 Question to be Answered

Do the data from Phase I sampling confirm the presence of COCs at this SWMU? This question and its two possible answers are discussed in Section 1.8.5

1.9.1.3 Decision Inputs/Data Needs

Two sets of decision inputs (data needs) that are necessary to support the decisions made at Decision Point 2 have been identified. These sets include

- the information necessary to design an adequate Phase I sampling and analysis plan and
- the field and analytical data that will be collected during the sampling program.

The first set includes information that must be gathered before development of the sampling plan. The second set includes the concentrations of COCs at the site as determined by field and laboratory analyses of samples collected. Design of the sampling and analysis plan hinges on two important questions.

- What COCs are suspected at the site?
- Where are the highest concentrations of these COCs most likely to occur?

Consideration of these questions will help determine the locations and depths of samples to be collected and what analyses should be run for those samples.

1.9.1.4 Problem Domain

The problem domain includes potential receptors (local area residents and biota), spatial boundaries (the area of a release and spatial limits of contaminant migration), and temporal constraints (the time frame over which risk is to be calculated).

1.9.1.5 Decision Rule/Logic Statement

Decision Point 2 will be based on the following rule.

> If the average concentration of any COC in an exposure unit (see Chapter 4) does not exceed action levels for that constituent or if the SWMU aggregate site-specific risk is not above the ER Program threshold value, the SWMU will be recommended for NFA. Otherwise, the SWMU will undergo further study.

1.9.1.6 Uncertainty Constraints

Uncertainty in estimates must be incorporated in action decisions. Decisions in the OU 1078 work plan will be based on statistic plus uncertainty, where uncertainty is twice the estimated standard error of statistic (i.e., a 80–95% confidence level based on the one-sided Chebyshev's inequality) (Ross 1984, 0725).

1.9.2 Phase II DQOs

In this work plan, DQOs for Phase II sampling and analysis plans have been developed only for the Industrial Waste Line SWMU aggregate. Phase II DQOs will be developed as needed for other SWMUs and will be presented in technical and phase memoranda.

1.9.2.1 Problem Statement

Even though the presence of COCs above action levels in some SWMUs may be confirmed by data collected during Phase I sampling, the nature and three-dimensional extent of contamination may still be unknown. Environmental samples must be collected and analyzed to define the nature and extent of contamination so that the health-based risk posed by the COCs can be assessed within acceptable uncertainties.

1.9.2.2 Question to be Answered

Do COCs at this SWMU exceed action levels or have an aggregate risk above the ER Program threshold value? This question and its two possible answers are discussed in Section 1.8.8.

1.9.2.3 Decision Inputs/Data Needs

The purpose of Phase II sampling is to initiate subsurface sampling and to obtain additional data needed to support the decision made at Decision Point 3. To calculate a health-based risk assessment, the nature and extent of contamination at the site must be adequately characterized. Therefore, two sets of decision inputs must be defined during Phase II sampling. These sets include

- the spatial extent of the areal contamination in three dimensions and
- the concentrations of all COCs present at various locations and depths.

To develop a sampling and analysis plan that will obtain necessary data, archival data and data collected during Phase I sampling and analysis investigations must be considered. Before an adequate Phase II sampling and analysis plan can be designed, the following decision inputs must be considered.

- What COCs are known to be present at the site?
- Which area(s) is(are) likely to have maximum concentrations of COCs?
- Is there suspected subsurface contamination?

Consideration of these questions will help to determine the locations and depths at which samples should be collected and the types of analyses that should be run on each sample. Data needs for each SWMU aggregate known to require Phase II sampling (e.g., industrial waste line) were developed and are presented in the individual sampling plans.

1.9.2.4 Problem Domain

The problem domain includes potential receptors (local area residents and biota), spatial boundaries (the area of a release and spatial limits of contaminant migration), and temporal constraints (the time frame over which risk is to be calculated).

1.9.2.5 Decision Rule/Logic Statement

If no COC found in this Phase II sampling exceeds its action level calculated over an exposure unit and the risk value for all COCs does not exceed the ER Program threshold value, the SWMU aggregate will be recommended for NFA. Otherwise, the SWMU will be recommended for CMS.

1.9.2.6 Uncertainty Constraints

Statistically based sampling plans will provide test statistics that fit within error constraints to be established by the ER Program in a future iteration of the IWP.

1.10 Field and Analytical Data Quality Requirements

Data quality requirements for field and analytical data collected at OU 1078 are governed by the need to make defensible, risk-based decisions for each SWMU. The information collected will be based on professional judgment, required EPA protocol, statistical requirements, and overall data objectives for the project. The two-phased site assessment approach proposed for OU 1078 is a logical means of obtaining the goals of the RFI. This section will discuss data quality requirements concerning analytical levels, analytical methods, PARCC (precision, accuracy, representativeness, completeness, and comparability) parameters, and field data quality requirements.

1.10.1 Analytical Levels

The determination of analytical levels for field and laboratory tasks is required to set data quality standards for the project. Analytical levels are divided into four distinct categories as depicted in Table 1.10-1. Levels I and II are associated with on-site portable field instrumentation or tests that can yield real-time data. Levels III and IV data are acquired with mobile or facility laboratory protocol. Additional documentation will accompany this higher-quality, defensible data. Investigations at OU 1078 will be performed according to a combination of analytical levels to meet the specific project needs.

TABLE 1.10-1

SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES

Data Uses	Analytical Level	Type of Analysis	Limitations	Data Quality
Site characterization Monitoring during implementation Health and safety Sample packaging/ transportation	Level I	Total organic/inorganic vapor detection using portable instruments; radiological screening instruments; field test kits/screening instruments	High detection limits	If instruments are calibrated and data are interpreted correctly, can provide indication of potential contamination
Site characterization Evaluation of alternatives Engineering design Monitoring during implementation Risk assessment (possibly)	Level II	Variety of organics by gas chromotography(GC); inorganics by atomic absorption (AA); X-ray fluoresence (XRF); tentative ID; analyte-specific; gross alpha, beta, and gamma	Qualitative ID; Relatively high detection limits; screening only	Dependent on QA/ quality control (QC) steps employed; data typically reported in activity or concentration ranges
Risk assessment Site characterization Evaluation of alternatives Engineering design Monitoring during implementation	Level III	Organics/inorganics using EPA procedures/ analyte-specific; RCRA characteristic tests	Can provide data of same quality as Level IV; tentative ID in some cases; nonstandard	Similar detection limits to contract laboratory program (CLP); less rigorous QA/QC
Risk assessment Evaluation of alternatives Engineering design Site characterization	Level IV	EPA-CLP procedures; Hazardous substance list organics/ inorganics by GC/mass spectrometer (MS); AA, ICAP; low ppb detection level	Limited identification of non-HSL parameters; some time may be required for validation of packages	Goal is data of known QA/QC; rigorous QA/QC; strict sample documentation

1.10.1.1 Phase I Analytical Levels

Phase I investigations will be performed under analytical Levels I, II, and III. Level I and II data will be collected as part of a field-screening program to allow for qualitative and semiquantitative real-time evaluations of site contaminant levels. Level I field screening will include several portable field instrumentation or field test kits that can continually or periodically give information on various constituents. Level I observations are also used as a critical part of the site health and safety plan and for evaluation of samples to determine proper shipping procedures. Table 1.10-2 provides additional details concerning the instrumentation and methods for each analytical level.

Level II activities will include the use of field survey methods and portable field laboratories (Table 1.10-2). Field surveys (e.g., PHOSWICH) include the use of surface radiological measurements to assist in the location of sample points. Mobile analytical laboratories can provide quantitative information on samples that can be used to support field strategy decisions.

TABLE 1.10-2

INSTRUMENTATION AND METHODS FOR PROPOSED ANALYTICAL LEVELS

LEVEL I: FIELD SCREENING

Portable Instruments	Field Test/Methods/Kits
PHOSWICH Meter	
FIDLER Meter	OVA Headspace Test
Geiger-Müller Counter	HNU Headspace Test
Micro R Meter	Handby Kit
Organic Vapor Analyzer (OVA)	Draeger Tubes
Photoionization Detector	Hazcat Kits
Explosimeter	Lab in a Bag^{TM}
Oxygen Level Indicator	Chloride Test Kits (soil)
pH, Temperature, Conductivity Meter	HachKits^{TM}

LEVEL II: FIELD SURVEYS/INSTRUMENTATION

Mobile Analytical Lab (limited QA documentation)

Radiological Screening Laboratory

LEVEL III/IV: LABORATORY METHODS/INSTRUMENTATION

EPA protocol for soil, air, and water analysis for semivolatile organic compounds and metals using Los Alamos, off-site, or mobile laboratories (EPA 1986, 0291).

Instrumentation typically includes GC, GC/ MS, inductively coupled plasma atomic emission spectroscopy (ICAP), AA

Level III will be implemented during Phase I activities to obtain quality analytical data from field mobile laboratories or from facility or contract laboratories that can support any decisions made for each SWMU aggregate. This data must be of sufficient quality to support a recommendation of NFA or to calculate baseline risk assessment. Under Level III, QA/QC and sample documentation procedures will be followed (as discussed in Annex II). Laboratory protocol for sample analysis will be performed using EPA's test methods for evaluating solid waste (EPA 1986, 0291) for organic compounds and metals. Tests for radionuclides and miscellaneous analytes will be performed by other analytical methods outlined in the IWP (LANL 1991, 0553).

1.10.1.2 Phase II Analytical Levels

Phase II analytical level requirements will be similar to those used in Phase I (Levels I, II, and III). In rare cases, Level IV data will be required.

1.10.2 Analytical Methods and PARCC Parameters

Analytical methods selected for the analysis of soil, water, or air samples collected at OU 1078 for the ER Program follow standard laboratory protocol recognized by the EPA. The analytical methods include several techniques that will screen for hundreds of individual analytes. Testing for semivolatile organic compounds and metals will be performed using EPA's test methods for evaluating solid waste (EPA 1986, 0291). Analyses for radionuclides and miscellaneous analytes will be performed under other acceptable analytical methods. Table 1.10-3 summarizes the analytical methods that will be used.

Tables V.3 through V.12 and IX.1 (Appendix T of the 1991 IWP) in the Laboratory's Generic Quality Assurance Project Plan (QAPjP) contain additional information concerning these analytical methods. The QAPjP lists the individual constituents analyzed under each method, the corresponding chemical abstract service numbers, and the practical quantitation and detection limits for each constituent.

PARCC parameters are analytical and sampling QA goals established to ensure that quality data are generated. A thorough discussion of the PARCC parameters for the Laboratory ER Program is presented in Section 5.0 of the Generic QAPjP.

1.10.3 SOPs For Field Investigations and Health and Safety

Numerous field activities have an impact on the overall data quality for an environmental restoration program. The activities that have a direct effect on data quality include equipment calibration schedules and procedures, sample method selection and technique, sample containers, preservatives, sample holding times, the number or type of QC samples, sample documentation, and equipment decontamination. The ER Program is developing SOPs for all field activities in the RFI. To ensure that data quality is maintained in the field, specific details for each of these activities are included in the SOP Manual for the ER Program (LANL 1992, 0688). A list of ER and HS-5 (LANL Health and Safety Division, Group 5) SOPs applicable to field activities for the OU 1078 RFI appears in Table 1.10-4.

TABLE 1.10-3

SUMMARY OF ANALYTICAL METHODS FOR THE ANALYSIS OF SAMPLES COLLECTED AT OU 1078

EPA SW-846 Method 8270*
Semivolatile Organic Compounds

EPA SW-846 Method 6010*
Metals by Inductively Coupled Plasma Atomic Emission Spectroscopy

EPA SW-846 Method 7000*
Metals by Atomic Absorption

EPA SW-846 Method 7470*
Mercury

EPA Method 418.1*
Total Petroleum Hydrocarbons

Radionuclides - LANL or DOE Method[a]
Gross Alpha
Gross Beta
Gamma Spectrometry
Americium-241
Cesium-137
Isotopic Plutonium (^{238}Pu, ^{239}Pu, ^{240}Pu)
Isotopic Thorium (^{228}Th, ^{230}Th, ^{232}Th)
Total Uranium
Isotopic Uranium (^{234}U , ^{235}U, ^{238}U)
Radium-226
Strontium/Yttrium-90
Tritium

Miscellaneous Analytes to be Determined[a]
*(EPA 1986, 0291)
[a]Refer to Laboratory ER QAPjP for additional information.

TABLE 1.10-4

SOPS APPLICABLE TO OU 1078 FIELD ACTIVITIES

General

- General Instructions for Field Investigations
- Sample Containers and Preservation
- Handling, Packaging, and Shipping of Samples
- Sample Control and Field Documentation
- Field Quality Control Samples
- Management of RFI-Generated Waste

Health and Safety in the Field

- Personal Protective Equipment
- Respirators
- Pre-Entry Briefings for Site Personnel
- Pre-Entry Briefings for Site Visitors
- Safety Meetings and Inspections
- Heat and Cold Stress and Natural Hazards
- General Equipment Decontamination
- Accident/Incident Reporting
- Radiation Protection
- Training and Medical Surveillance

Reconnaissance/Field Survey

- Geomorphic Characterization
- PHOSWICH Determination of Low-Energy Gamma Radiation
- FIDLER Determination of Low-Energy Gamma Radiation

Drilling, Excavating, Sampling, and Logging

- Drilling Methods and Drill Site Management
- Excavating Methods

Field Screening Techniques

- Portable GC/MC for Field Screening Organics
- X-Ray Fluorescence for Field Screening of Metals
- Gross Alpha Activity on Soil
- Gross Beta Activity on Soil
- Gross Gamma Activity on Soil

Sampling Techniques

- Spade and Scoop Method for Collecting Soil Samples
- Hand-Auger and Thin-Wall Tube Sampler
- Stainless Steel Surface Soil Sampler
- Surface Water Sampling
- Sediment Material Collection
- Coliwasa Sampler for Liquids and Slurries
- Trier Sampler for Sludges and Moist Powders or Granules
- Weighted Bottle Samples for Liquids and Slurries in Tanks
- Draeger Tubes
- Split Spoon Sampling for Auger Drilling

REFERENCES

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory Report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

DOE (US Department of Energy), October 1987. "Phase I: Installation Assessment, Los Alamos National Laboratory," Volumes 1 and 2, (draft), Comprehensive Environmental Assessment and Response Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1987, 0264)

DOE (US Department of Energy) September 26, 1988. "Radioactive Waste Management," DOE Order 5820.2A, Washington, DC. (DOE 1988, 0074)

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), November 1986. "Test Methods for Evaluating Solid Wastes; Physical/Chemical Methods," SW-846, Third Edition, Washington, DC. (EPA 1986, 0291)

EPA (US Environmental Protection Agency), March 1987. "Data Quality Objectives for Remedial Response Activities, Development Process," EPA 540/G-87/003, OSWER Directive No. 9355.0-7B, prepared by CDM Federal Programs Corporation, Washington, DC. (EPA 1987, 0086)

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 VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, 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, February 1991. "Solid Waste Management Unit Descriptions for the TA-1 Work Plan, Project No. 301215.08.01, " Los Alamos, New Mexico. (International Technology Corporation 1991, 09-0003)

LANL (Los Alamos National Laboratory), November 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-90-3825, Los Alamos, New Mexico. (LANL 1990, 0144)

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)

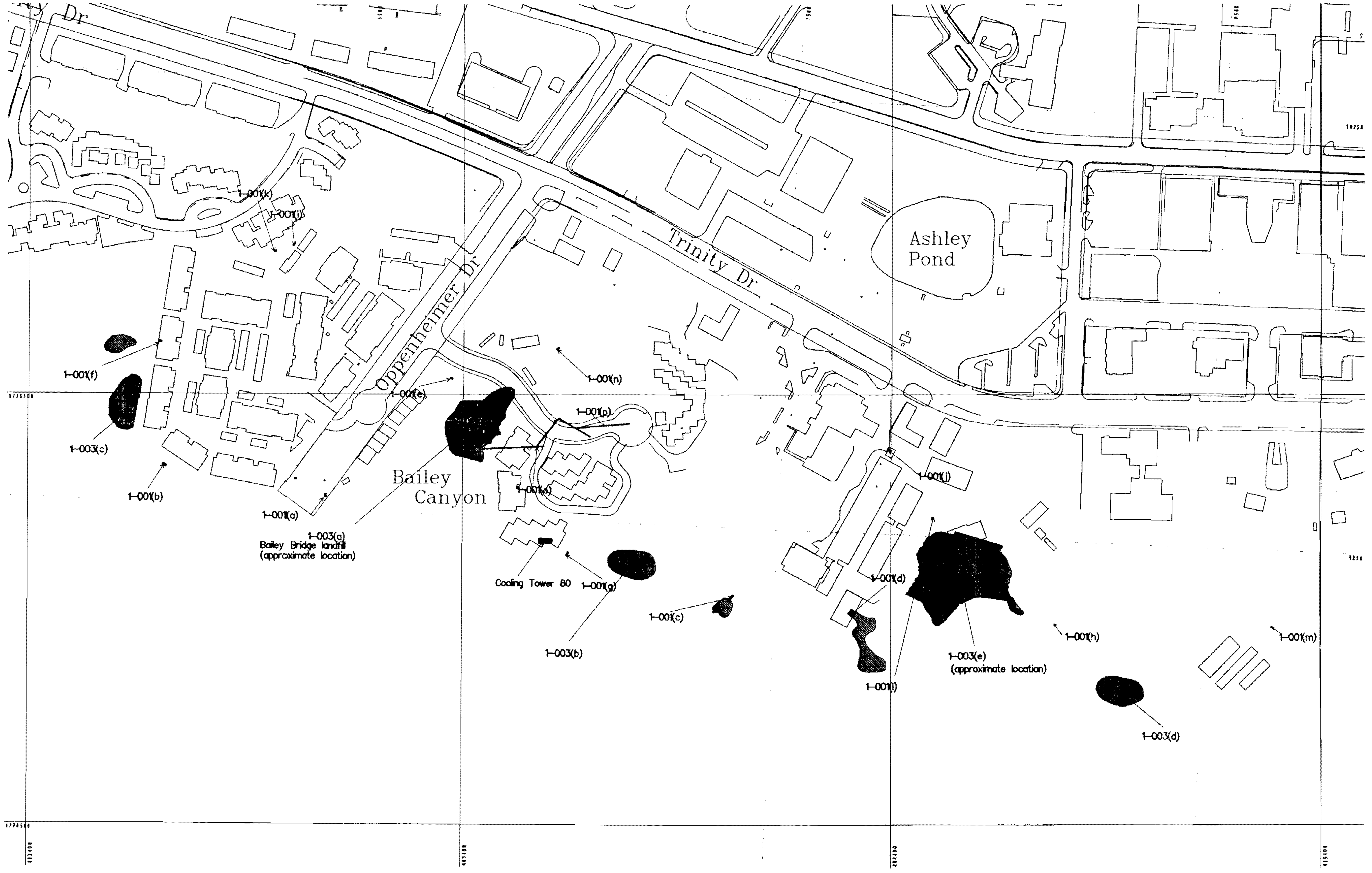
LANL (Los Alamos National Laboratory), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory Report LA-UR-91-3310, Los Alamos, New Mexico. (LANL 1991, 0553)

LANL (Los Alamos National Laboratory), March 16, 1992. "Environmental Restoration Standard Operating Procedures," Vols. I and II, Los Alamos, New Mexico. (LANL 1992, 0688)

NMEID (New Mexico Environmental Improvement Division) November 8, 1989. "Hazardous Waste Facility Permit," Permit No. NM0890010515-1 issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective February 19, 1990, Santa Fe, New Mexico. (NMEID 1989, 0595)

Ross, S., 1984. A First Course in Probability, Second Edition, Macmillan Publishing Company, New York, New York. (Ross 1984, 0725)

OU-1078 - Map A Locations of Septic Tanks, Sanitary Sewer Lines O and P, and Hillside Surface Disposal Sites



LEGEND

- Acid (Industrial) Waste Line (SWMU 1-002)
- Outfall (SWMU 1-006)
- Potential Release Site
- Sanitary Sewer (SWMU 1-001)
- Storm Drain (SWMU 1-006)
- Acid Manhole (SWMU 1-002)
- Cistern
- Drum Storage Area
- Excavation Pit
- Incinerator
- Landfill and Surface Dump
- Sanitary Sewer Manhole
- Septic Tank (SWMU 1-001)
- Suspected Subsurface Soil Contamination Area
- Surface Disposal Area

NORTH, NM State Plane

Grid provides NMSP coordinates, in feet

Grid interval, in feet: 1000

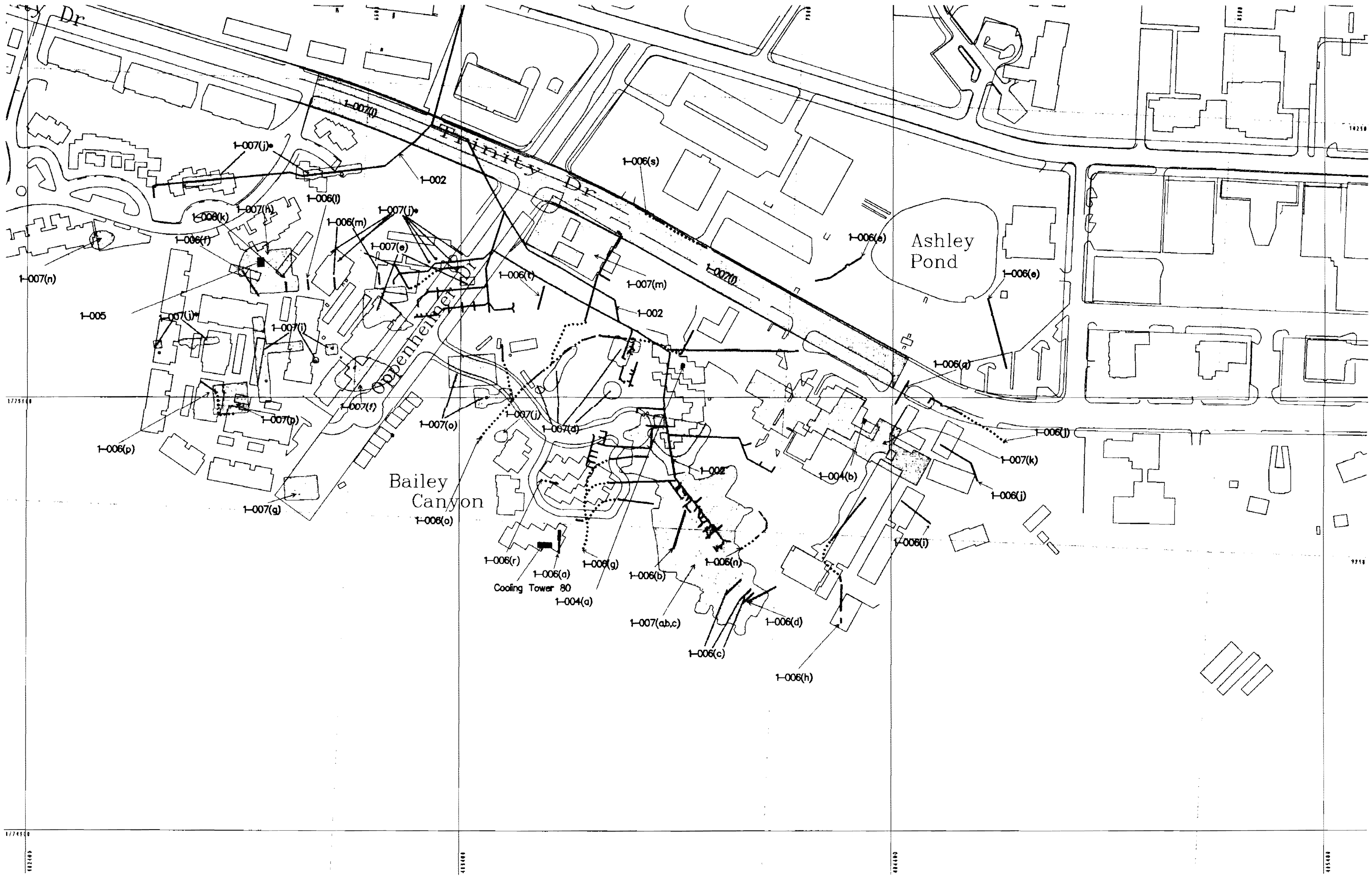
0 100 200 300 FEET ON GROUND

NOTICE: Information on this map is provisional and has not been checked for accuracy

University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD Facility for Information Management, Analysis and Display

Produced by: Marcia Jones
Date: 92-03-09

OU-1078 - Map B Location of Acid (Industrial) Waste Line, Suspected Subsurface Soil Contamination, Incinerators, and Building and Storm Runoff Drains



LEGEND

- Acid (Industrial) Waste Line (SWMU 1-002)
- Outfall (SWMU 1-006)
- Potential Release Site
- Sanitary Sewer (SWMU 1-001)
- Storm Drain (SWMU 1-006)
- Acid Manhole (SWMU 1-002)
- Cistern
- Drum Storage Area
- Excavation Pit
- Incinerator
- Landfill and Surface Dump
- Sanitary Sewer Manhole
- Septic Tank (SWMU 1-001)
- Suspected Subsurface Soil Contamination Area
- Surface Disposal Area

1-007(j)* - miscellaneous small swmus

1-002 - Acid waste line has been completely excavated and removed from TA-1 OU

NORTH, NM State Plane

Grid provides NMSP coordinates, in feet

Grid interval, in feet: 1000

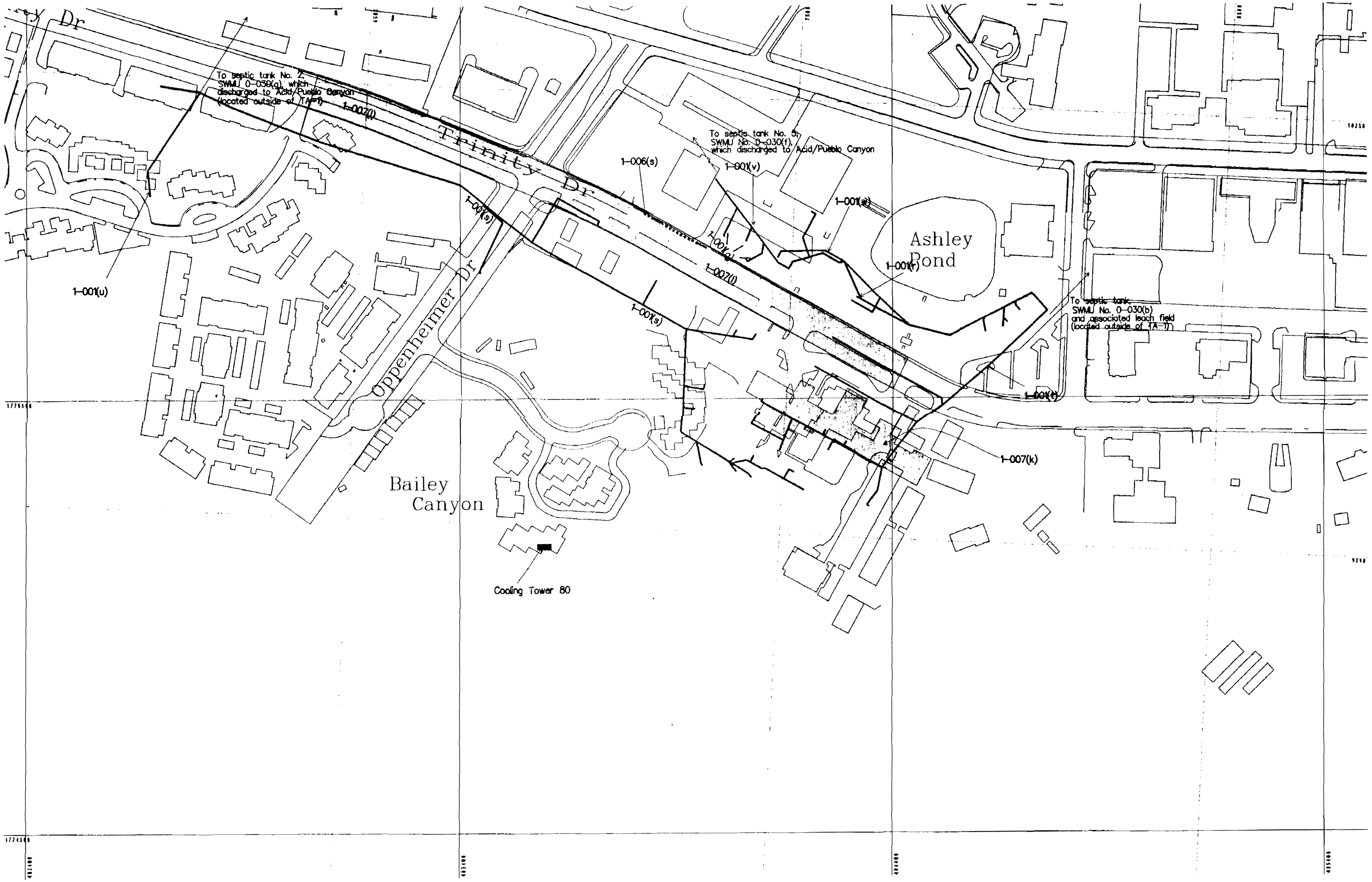
0 100 200 300 FEET ON GROUND

NOTICE: Information on this map is provisional and has not been checked for accuracy

University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD Facility for Information Management, Analysis and Display

Produced by: Marcia Jones
Date: 92-03-09

OU-1078 - Map C Location of SWMUs Proposed for Opportunity-Available Sampling



LEGEND

- Acid (Industrial) Waste Line (SWMU 1-002)
- Outfall (SWMU 1-006)
- Potential Release Site
- Sanitary Sewer (SWMU 1-001)
- Storm Drain (SWMU 1-006)
- Acid Manhole (SWMU 1-002)
- Cistern
- Drum Storage Area
- Excavation Pit
- Incinerator
- Landfill and Surface Dump
- Sanitary Sewer Manhole
- Septic Tank (SWMU 1-001)
- Suspected Subsurface Soil Contamination Area
- Surface Disposal Area

NORTH, NM State Plane

Grid previous NMSP coordinates, in feet

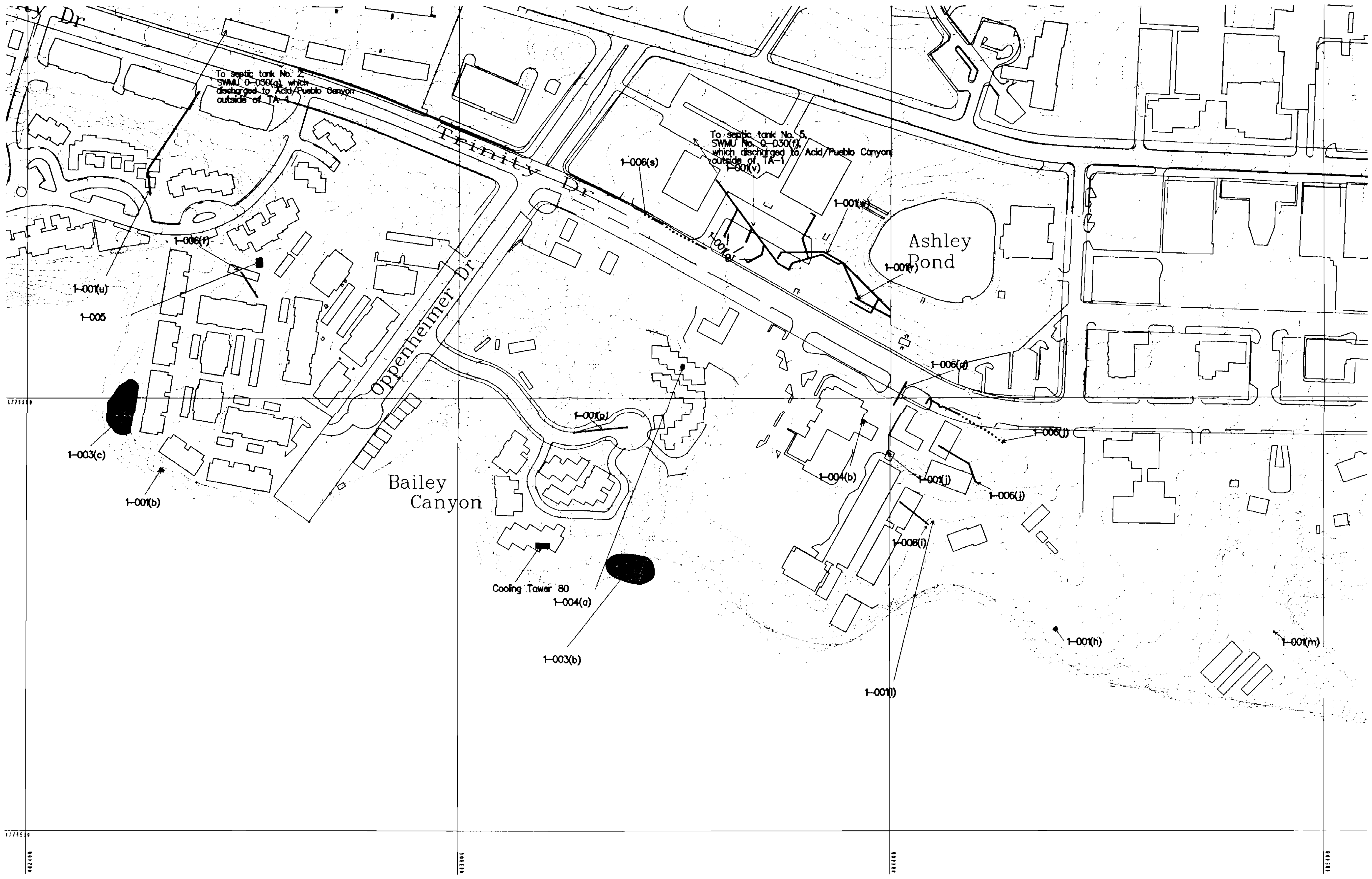
Grid interval, in feet: 1000

0 100 200 300 FEET ON GROUND

NOTICE: Information on this map is provisional and has not been checked for accuracy

University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD Facility for Information Management, Analysis and Display
Produced by: Marcia Jones
Date: 92-03-09

OU-1078 - Map D Location of SWMUs Proposed for No Further Action



LEGEND

- Acid (Industrial) Waste Line (SWMU 1-002)
- Outfall (SWMU 1-006)
- Potential Release Site
- Sanitary Sewer (SWMU 1-001)
- Storm Drain (SWMU 1-006)
- Acid Manhole (SWMU 1-002)
- Cistern
- Drum Storage Area
- Excavation Pit
- Incinerator
- Landfill and Surface Dump
- Sanitary Sewer Manhole
- Septic Tank (SWMU 1-001)
- Suspected Subsurface Soil Contamination Area
- Surface Disposal Area

NORTH, NM State Plane

Grid provides NMSP coordinates, in feet

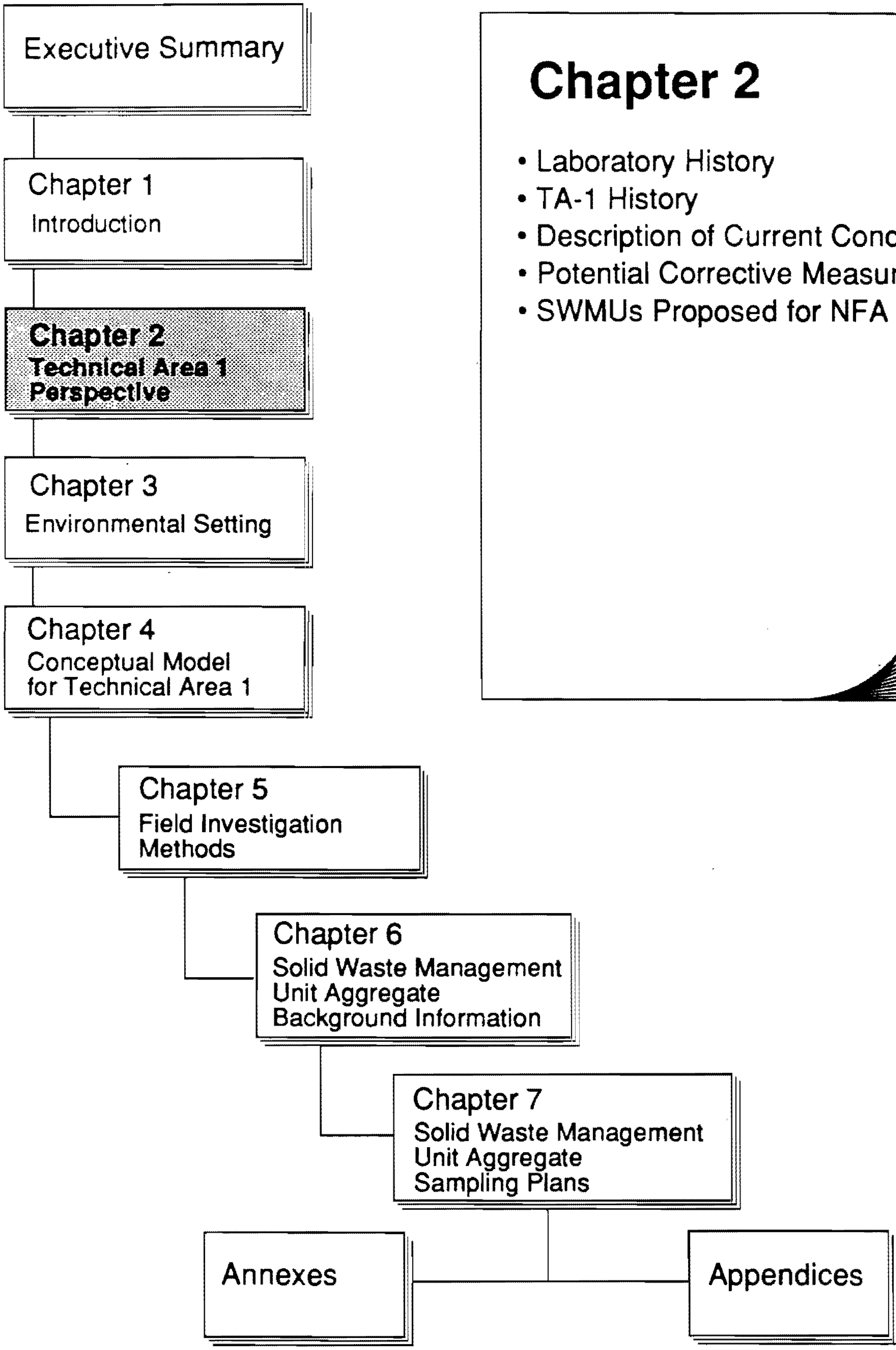
Grid interval, in feet: 1000

0 100 200 300 FEET ON GROUND

NOTICE: Information on this map is provisional and has not been checked for accuracy

University of California
Los Alamos National Laboratory
Earth & Environmental Sciences Division
FIMAD Facility for Information Management, Analysis and Display

Produced by: Marcia Jones
Date: 92-04-20



Chapter 2

- Laboratory History
- TA-1 History
- Description of Current Conditions
- Potential Corrective Measures
- SWMUs Proposed for NFA

2.0 TECHNICAL AREA 1 PERSPECTIVE

2.1 Laboratory History

During America's participation in World War II (1941–1945), it became apparent to US strategists that the successful development of a nuclear fission device was imperative. The creation of such a device, capable of releasing incredible amounts of energy in a controlled and timely manner, could be directed toward the evolution of an effective nuclear fission bomb that might ultimately be used in the war. This effort was initiated by many prominent American scientists who believed that Germany was already developing such a bomb (Rhodes 1986,0664).

Once the US became directly involved in the war, military visionaries decided to implement a project that actively pursued the development of a nuclear fission bomb. Recruiting first-rate, innovative scientists and engineers was imperative to the success of the project. In 1942, an eminent nuclear physicist, J. Robert Oppenheimer, was selected to head a developmental laboratory, aid in the enlistment of qualified scientists, and direct the research effort on the highly experimental project.

Oppenheimer was familiar with northern New Mexico and had visited the Los Alamos Ranch School. The school, which was located on the mesa above Los Alamos Canyon, had been founded in 1918 by Ashley Pond, a prominent Detroit businessman (Figure 2.1-1). The location of the school matched all the initial physical criteria necessary for building a secret laboratory. It was located in the sparsely populated wilderness of New Mexico, making the site ideal for secrecy and safety. For this reason, Oppenheimer and other influential persons proposed Los Alamos as the site for the bomb development project. The existing school structures would ultimately provide immediate housing for the first scientists and administrators arriving at Los Alamos to participate in Project Y under the US Army Corps of Engineers' Manhattan Engineer District. Because much of the land immediately surrounding the school had already been cleared for irrigated agriculture and recreational activities, significant acreage was immediately available for the construction of the many additional buildings that would be required for the implementation of Project Y (Rhodes 1986, 0664; Hawkins 1983, 0663).

On December 7, 1942, school officials were notified by the War Department that the school would be taken over by the federal government. On January 1, 1943, the University of California (UC) was selected to operate the new laboratory facility under a formal, nonprofit contract with the Manhattan Engineer District of the Army Corps of Engineers headed by General Leslie Groves (Rhodes 1986, 0664).

During this early transition period, approximately 1500 scientists, construction workers, and support staff arrived at Los Alamos. To accommodate these scientists and engineers, new buildings housing laboratories and offices were constructed south of Ashley Pond. Apartments, dormitories, and temporary dwellings to house the scientists, their families, and thousands of military and support staff (Figure 2.1-2) were hastily built (LASL 1986, 0691). The site of what was probably the most secret project the United States had ever undertaken was fenced with barbed wire and patrolled by armed guards on horseback and in jeeps (Hawkins 1983, 0663).

Before the early period of the Laboratory's establishment, the theoretical basis of nuclear fission weaponry was already understood (Condon 1943, 0692). The problems remaining unsolved were the manufacture of sufficient quantities of fissionable material for weapon production (undertaken by facilities at Oak Ridge, Tennessee, and Hanford, Washington) and the actual design of the weapon (i.e., the development of a method by which fissionable material could be exploded efficiently and at precisely the right time). This latter problem became the prime wartime focus of the Laboratory.

Two distinct phases distinguished these early efforts at the Laboratory. One phase involved physical, chemical, and metallurgical research on plutonium and uranium while the second focused on engineering ordnance design. These efforts generated both radioactive and hazardous wastes. This early work, as well as subsequent experiments and tests conducted over the ensuing 22 years, has resulted in the Technical Area 1 (TA-1) solid waste management units (SWMUs) that are addressed in this document.

2.2 TA-1 History

2.2.1 Operational History

The effort toward the development of a nuclear weapon was initiated on March 15, 1943, and culminated 28 months later on July 16, 1945, with the explosion of the first nuclear device (Fat Man) at Trinity Site in the deserts of southern New Mexico (Rhodes 1986, 0664).

As early research and development work progressed, additional buildings were constructed to the south and southwest of Ashley Pond. In general, buildings in which radioactive materials were investigated or processed were located close to the rim of Los Alamos Canyon; buildings housing personnel, administrative offices, and the theoretical division offices were located around the perimeter of Ashley Pond (Figure 2.2-1). Many radioactive materials were handled at TA-1. These included ^{238}U, ^{235}U, ^{239}Pu, ^{3}H, ^{244}Cm, ^{210}Po, ^{232}Th, ^{226}Ra, ^{137}Cs, ^{90}Sr, ^{241}Am, ^{140}Ba, ^{140}La, ^{103}Ru, ^{106}Ru, ^{60}Co, and ^{14}C. Many of these radionuclides were used only in minute quantities and should not be considered as potential contaminants of concern. Many nonradioactive chemicals and/or hazardous substances were also used in laboratory research and development activities. These other elements or compounds included (but were not limited

Figure 2.1-1. Los Alamos Ranch School graduation at Fuller Lodge in 1942.

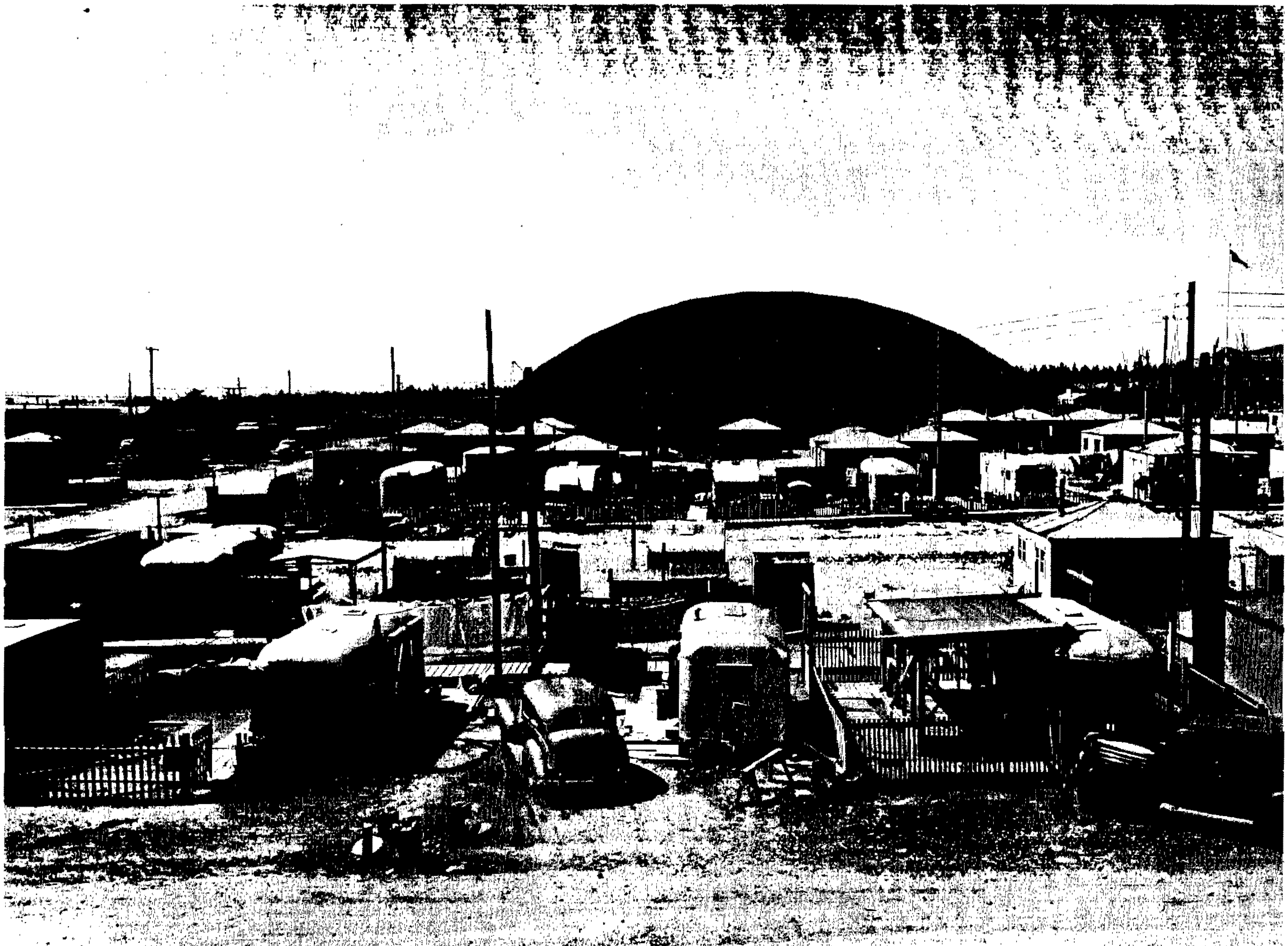


Figure 2.1-2. Los Alamos town site residential area in 1947.

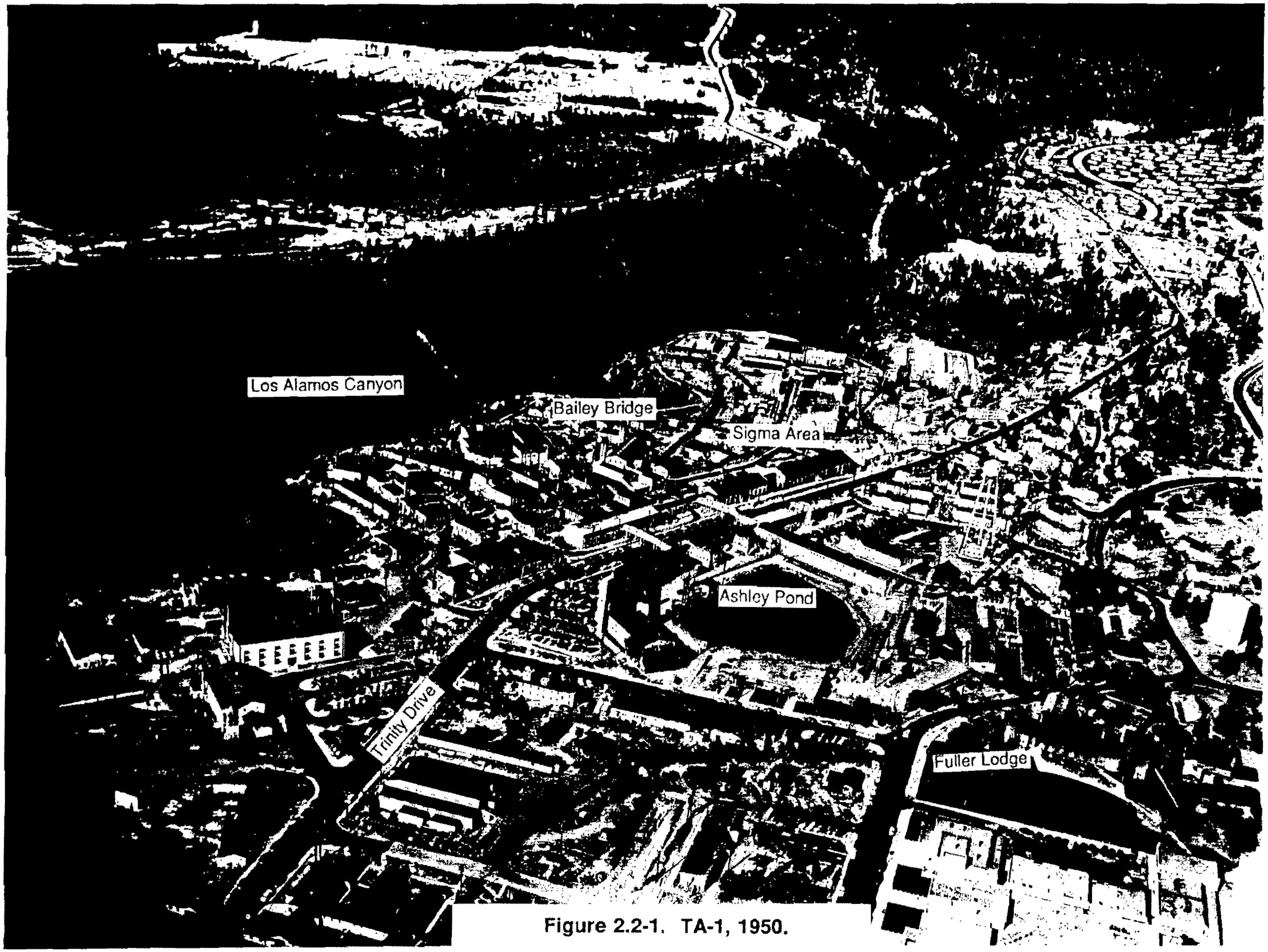


Figure 2.2-1. TA-1, 1950.

to) deuterium, lithium hydride, beryllium, metallic mercury, iodine, tributyl phosphate, organic solvents (e.g., ethyl ether, toluene, methyl isobutyl ketone, carbon tetrachloride and trichloroethylene), asbestos, copper, lead, inorganic acids (e.g., nitric, hydrochloric, sulfuric, perchloric, hydrofluoric, and orthophosphoric acids), and high explosives (e.g., trinitrotoluene, nitrocellulose, RDX, HMX and Baratol). It is not critical to have a precise knowledge of every chemical ever used at TA-1 because, during the sampling and analysis phase of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI), a particular analysis suite will include elements and compounds mentioned above, as well as numerous compounds not referenced.

2.2.2 Hazardous and Radioactive Chemical Generation

Basic chemical operations occurring at TA-1 included chemical laboratory wet chemistry experimentation and wet and dry chemistry processing, including purification and recovery processes for uranium and plutonium (Christensen and Maraman 1969, 0037). TA-1 also housed several physical operations, such as casting, machining, powder metallurgy, and metallurgical and solid materials procedures for shaping metals (radioactive as well as nonradioactive) and high explosives. These activities generated various hazardous and radioactive wastes.

Additionally, standard health protection measures commonly practiced in the early years of the Laboratory most likely produced further radioactive or hazardous waste. Routine protective procedures, such as room air filtration for dust control of hazardous and radioactive particulate matter (including beryllium or plutonium) and the use of lead for shielding radioactivity, generated what now are classified as mixed wastes.

Several operations at Los Alamos yielded both radioactive and hazardous wastes. For example, at Hanford, Washington, plutonium manufacturing procedures from 1944 through early 1945 were fairly primitive and could produce only a very limited quantity of this element in an impure form. It was necessary to purify this manmade element before definitive chemical or physical experiments could be conducted (Christensen and Maraman 1969, 0037). Additionally, the small mass (approximately 5 mg) of those early ^{239}Pu arrivals and the difficulty encountered in recovering small amounts of this element from solution made plutonium a very scarce commodity, especially in the early years of the Manhattan Project. The extreme scarcity of plutonium promoted recycling of the element to the greatest extent practicable. Before another experiment could be initiated on a quantity of plutonium, the plutonium had to undergo tedious recovery and purification processes. Recovery and purification became the standard end result of all early experimentation and processing procedures (Christensen and Maraman 1969, 0037). Many of these purification and recovery operations occurred on a very small scale and generated very little radioactive waste. These early experiments, recovery, and purification operations occurred at TA-1 in D Building (Figure 2.2-2) from February 1944 to August 1945 (Christensen and Maraman 1969, 0037). It was anticipated that facilities at TA-1 would be unable to process larger quantities of uranium and plutonium, so a new processing plant was constructed at DP site (TA-21, OU 1106) (Figure 1.6-1). In September of 1945, all plutonium-processing and recovery operations, with the exception of secondary recovery, were relocated to DP site. Large quantities of weapon-grade plutonium were never processed at TA-1 (Hawkins 1983, 0663).

Experiments testing radioactive metals with the intent of finding an optimal initiator for a nuclear device were also conducted at TA-1. In the early weapons, polonium, with a half-life of 138 days, proved to be an ideal initiator, and numerous experiments were done on this metal. Once World War II ended, Laboratory efforts focused on perfecting efficient fission bombs and investigating the efficacy of the super or fusion bomb. At this time, experimental work on tritium (an isotope of hydrogen) was accelerated at TA-1 with the intent of using it in a fusion bomb (Rhodes 1986, 0664).

2.2.3 Early Los Alamos National Laboratory Waste Management Procedures

The waste management practices during the early years of the Los Alamos National Laboratory (LANL or the Laboratory) were in accordance with standard practices of the time. The Laboratory attempted to keep radioactively contaminated wastes separated from sanitary liquid wastes by dedicating separate disposal lines for the collection of industrial liquid wastes. An industrial waste line led from TA-1 to Acid Canyon, a small branch of Pueblo Canyon (the first canyon to the north of TA-1). The industrial waste discharge into Acid Canyon was untreated until 1951 when the TA-45 (OU 1079) treatment plant was built (Figure 2.2-3) (Ferenbaugh et al. 1982, 0662).

TA-1 sanitary waste was collected by three sanitary systems (Foldout Map C). All these sanitary lines discharged at points located outside of the TA-1 operable unit (OU) and collectively served the western, northern, and eastern sectors of TA-1. Sanitary waste collected from the western sector was discharged into Acid Canyon and the upper reaches of Pueblo Canyon (SWMU 0-003g, OU 1071). The northern sanitary waste line system discharged liquid sanitary waste into Acid Canyon at a release point (SWMU 0-003f, OU 1071) near the industrial waste line outfall. The eastern sanitary waste line system conveyed waste to a septic tank leach field (SWMU 0-003b, OU 1071) located to the east of TA-1. Additionally, individual sanitary waste (septic) tanks served several of the outlying TA-1 buildings (Foldout Map A) (International Technology Corporation 1990, 09-0003).

Nonradioactive solid waste was burned in two incinerators located near TA-1's G and Q Buildings (Foldout Map B) (International Technology Corporation 1990, 09-0003). At least one incinerator located

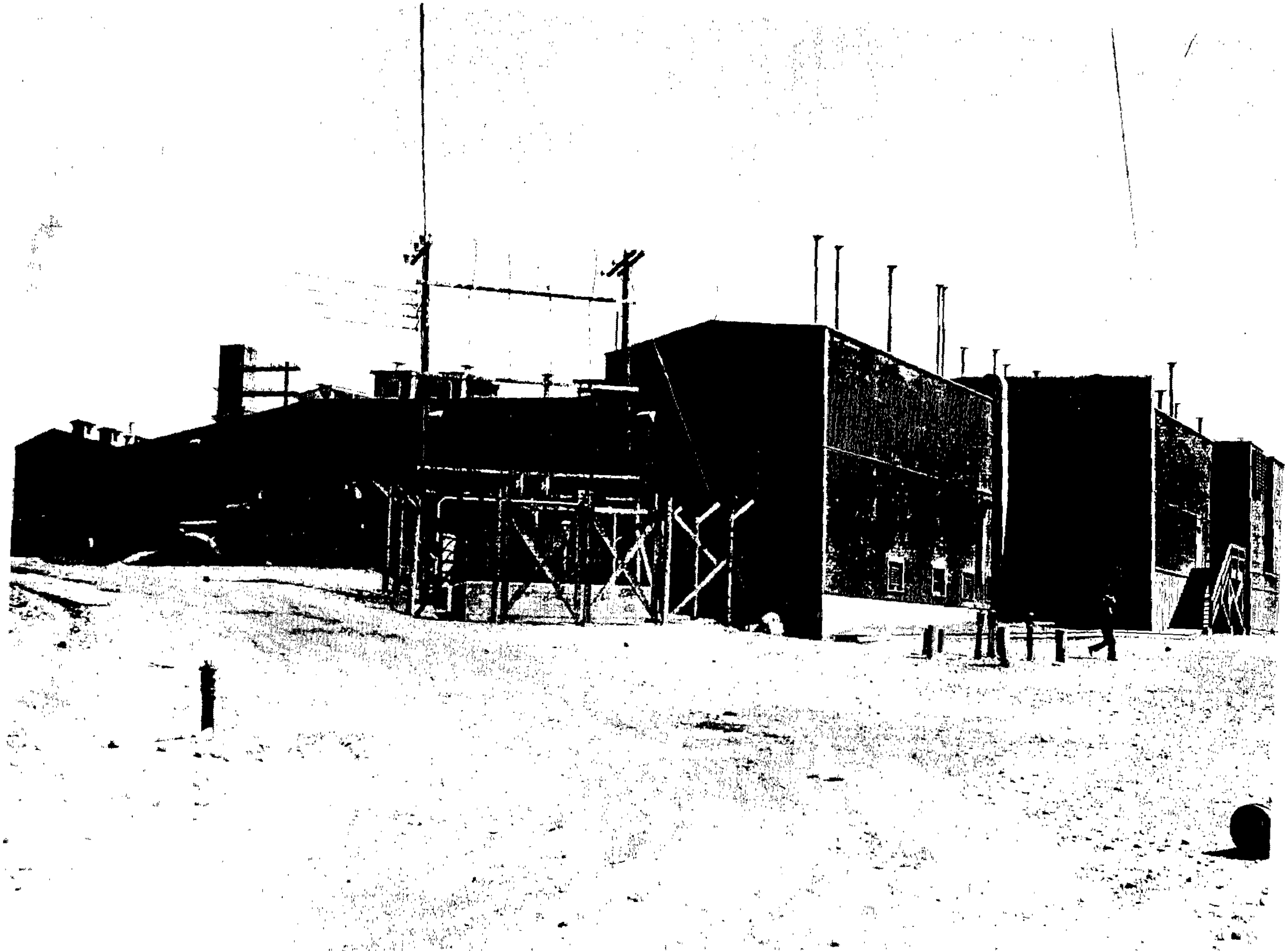


Figure 2.2-2. D Building, TA-1.

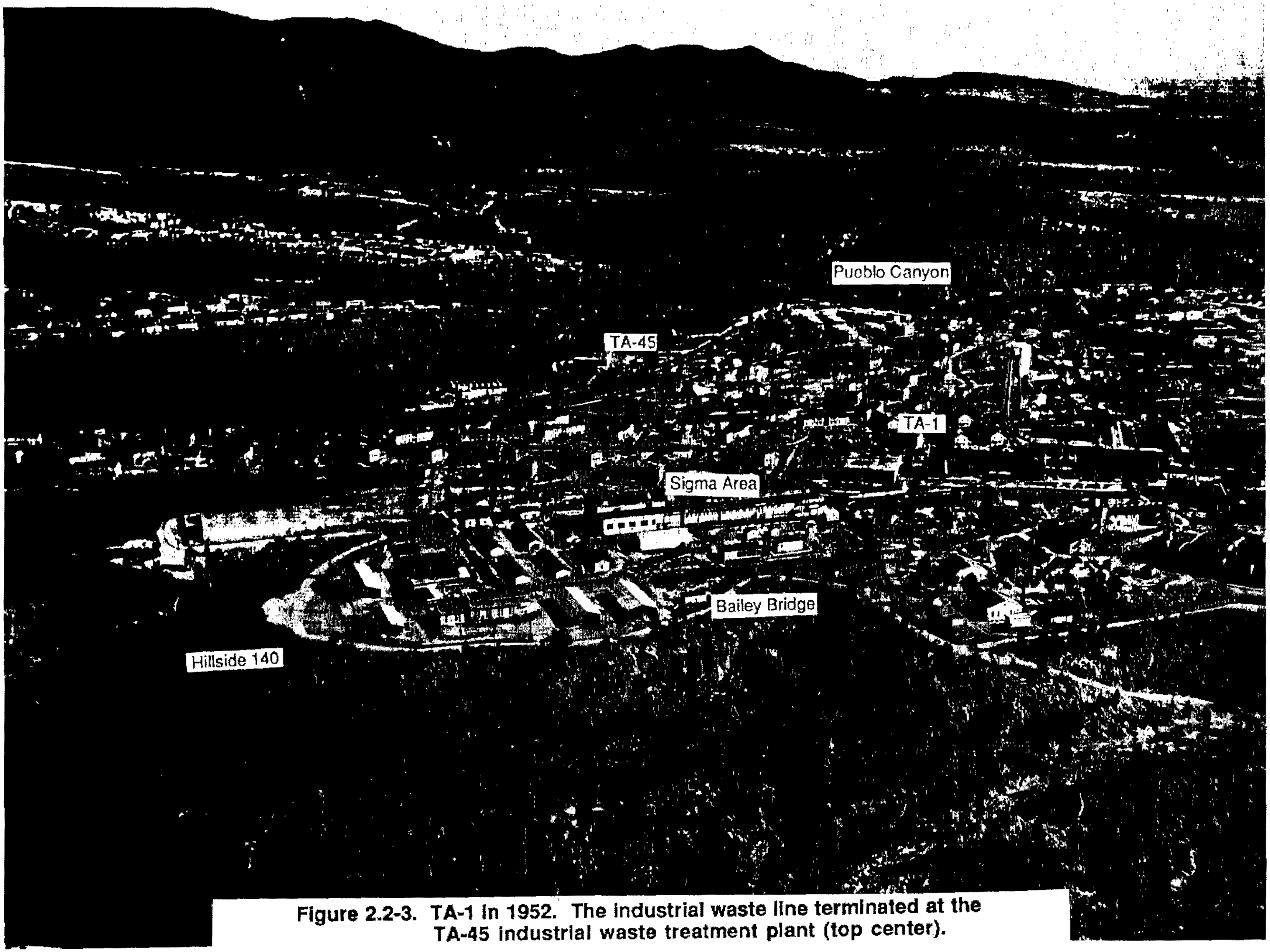


Figure 2.2-3. TA-1 in 1952. The industrial waste line terminated at the TA-45 industrial waste treatment plant (top center).

outside the TA-1 OU was used for combustion of TA-1 nonradioactive solid wastes. Noncombustible, nonradioactive solid wastes were transported and removed to a landfill located outside of TA-1, near the the present-day Los Alamos Airport (SWMU 73-001a, OU 1071). There is no record of any radioactive solid waste landfill on the mesa top within the perimeter of TA-1. During the decommissioning and demolition phases of TA-1, some building debris was discarded over the mesa rim onto the Los Alamos Canyon hillsides in at least two locations: Bailey's Canyon, a small drainage of Los Alamos Canyon, and the hillside located directly east of the present-day Los Alamos Inn. Bailey's Canyon is the only surface disposal site currently identified as containing debris that might possibly be contaminated with low levels of radioactivity. The hillside surface disposal site located in the central portion of TA-1 below Cooling Tower 80 (Foldout Map A) and the hillside surface disposal site located west of Bailey's Canyon are candidates for no further action (NFA) (see Section 2.5). A fifth surface disposal site, the Can Dump Site, may undergo a voluntary corrective action (VCA) early in this RFI.

2.2.4 Decommissioning and Decontamination of TA-1

2.2.4.1 Eastern Sector of TA-1

TA-1 operations were gradually relocated to new technical areas. Phased decommissioning and decontamination activities began at TA-1 in 1953 and continued through 1976 (Ahlquist et al. 1977, 0016). The eastern portion of TA-1 was the first sector to be phased out. Structures that were razed during the 1953–1959 demolition and decontamination effort included D, D-2, E, G, Gamma, H, M, ML, O, P, Q, R, S, T, U, V, W, Z; and A Buildings and Boiler House No. 2. Structures with residual radioactive contamination were removed to Material Disposal Area (MDA) C located outside TA-1 at TA-50 (OU 1147). In some cases, combustible portions of buildings were burned at TA-54 (OU 1148), Area G (DOE 1987, 0264).

A September 15, 1959, memorandum from Buckland (1959, 09-0001) stated that the removal of the industrial waste line and contaminated concrete pads on which buildings had rested had begun. This work occurred from January 14 to September 9, 1959. All sections of the industrial waste line from the eastern sector were excavated and removed to an unspecified disposal area outside TA-1.

2.2.4.2 Western Sector of TA-1

Decommissioning and decontamination of the western portion of TA-1 was completed by December 1, 1965 (Ahlquist et al. 1977, 0016). All building superstructures were demolished and removed. Contaminated cement flooring was excavated, but uncontaminated slabs and building foundations were monitored and left in place. Uncontaminated foundations were principally those of shops, warehouses, and the foundry and sheet metal shop located at the far western end of TA-1. Uranium-contaminated cement building debris with activity in excess of 2500 counts/min was transported to an unspecified disposal area outside of TA-1. Cement debris reading 2500 counts/min or less was removed to Bailey's Canyon. According to a February 16, 1973, memorandum from Buckland (1973,09-0008), hundreds of truckloads of debris were deposited into this canyon and then covered with soil. Most of the concrete was uncontaminated or exhibited activity well below 2500 counts/min (all activity attributed to normal and/or enriched uranium contamination) (Buckland 1973, 09-0008).

Sections of the industrial waste line in the western portion of TA-1 were removed in 1964 and 1965. This included all sections extending north from TA-1 to the Acid Canyon outfall located at TA-45 (OU 1079). Surveys of radioactivity in pipes (before removal) indicated levels ranging from 2000–15 000 counts/min for alpha and 0.2 mR/hr for beta/gamma (Meyer 1965, 09-0009). By September 28, 1965, removal of the industrial waste line was reported to be complete, including the abandoned line that ran under the concrete slab south of C Building (Foldout Map B) (Buckland 1973, 09-0008). Figure 2.2-4 depicts TA-1 as it looked at the end of the decommissioning and decontamination effort.

2.2.4.3 Additional Decontamination of TA-1, 1974–1976

In 1974–1976, areas near the former location of the industrial waste line became the focus of exploratory efforts to find possible areas of radiological soil contamination. The principal area of focus was the vicinity of D Building, TA-1's plutonium chemistry and metallurgical building (Foldout Map C). This sector, located in the eastern portion of TA-1, was found to contain a wide expanse of residual radioactive contamination. Contaminated soil and rock in these areas were removed to depths of up to 15 ft. Total volume of material removed in the immediate area of D Building was approximately 6150 yd^3 (Ahlquist et al. 1977, 0016). To level the ground after excavation, clean fill was brought in from construction activities at TA-53 and TA-55.

A second location contaminated by the former industrial waste line was the vicinity of H Building. Records indicate that fluids from the industrial waste line had overflowed and surfaced there (Kingsley 1946, 09-0005). This incident prompted the 1974–1976 exploratory sampling of this area. Gross alpha activity (primarily Pu) reached levels as high as 200 pCi/g in sediment samples. Increasing levels of contamination were detected through several phases of excavation and removal, each leading closer to the location of the former industrial waste line north of H Building. Two sections of highly contaminated, concrete-encased pipe that had served as lateral connections to the industrial waste line were located and removed (Ahlquist et al. 1977, 0016).

Figure 2.2-4. TA-1 after decommissioning of all buildings in 1974.

Because of contamination detected at D and H Buildings, a second excavation was conducted around the industrial waste line in 1974–1976. Subsequently, a trench running from D Building to Trinity Drive (just north of Sigma Building) was excavated and decontaminated. Gross alpha activity (as high as 120 pCi/g) was detected in soil in some sections of the trench. Three contaminated manholes, or portions of these manholes, were also removed. An approximate total of 1441 yd^3 of contaminated soil was removed from the industrial waste line trench during this portion of the 1974–1976 decontamination operation (Ahlquist et al. 1977, 0016).

Additional investigation of the western portion of TA-1 was undertaken during the 1974–1976 survey. Explorations took place near the location of J-2 Building, which had been used for radiochemistry research on mixed fission products associated with weapons debris. A section of the J-2 Building industrial waste line was located and a 121-ft section of contaminated pipe was removed. Additionally, an area of surface contamination attributed to ^{137}Cs was found at the approximate location of a known leak that had occurred in the industrial waste line running from J-2 Building toward Trinity Drive. All surrounding contaminated soil was removed. A total of approximately 5765 yd^3 of contaminated material was removed from the excavation area near the J-2 Building (Ahlquist et al. 1977, 0016).

2.3 Description of Current Conditions

Since decommissioning and decontamination activities ended in 1976 with property transfer to the county and private parties, construction in the TA-1 area of the Los Alamos townsite has been constant. Residential buildings have clustered at the western portion of the area, while commercial and municipal buildings have filled the areas along both sides of Trinity Drive (Figure 2.3-1). All residential buildings are multiple-unit dwellings consisting of privately owned condominiums or rented townhouses. Landscaping has been completed around residential units, and sidewalks, parking areas, and roads were constructed to access residential areas. In general, commercial properties have more paving (for parking) and less landscaping than residential buildings. The town of Los Alamos has stocked Ashley Pond with fish and ducks and developed the area surrounding the pond into a public park with lawns, picnic tables, and art works. The Los Alamos Community Center (formerly the Laboratory Communications Center), located east of Ashley Pond, is the only building remaining from TA-1. All other TA-1 buildings have been demolished or dismantled and removed, as described above (Section 2.2.4).

In 1989, after most of the current development of the TA-1 site had taken place, the New Mexico Environmental Improvement Division, currently named the New Mexico Environment Department (NMED), issued a RCRA operating permit to the Department of Energy (DOE) and UC allowing LANL's operation as a hazardous waste treatment, transfer, storage, and disposal facility. In 1990, the US Environmental

Protection Agency (EPA) issued a Hazardous & Solid Waste Amendments module to this permit with the stipulation that corrective action investigations be taken at any Laboratory SWMUs (including those not within DOE property boundaries) suspected of containing areas of contamination "regardless of the time at which the waste was placed in such unit." The EPA further identified and prioritized certain Laboratory SWMUs to be investigated first. TA-1 SWMUs designated for priority investigation were identified by their proximity to former Laboratory buildings in which the storage or handling of radioactive or hazardous materials was known or suspected to have occurred or by their proximity to industrial or sanitary waste lines that may have carried radioactive and chemical waste. The TA-1 SWMUs are only suspected of still retaining residual contamination. All SWMUs discussed in the OU 1078 work plan are associated with former TA-1 structures or conveyances and have no relationship to current townsite structures.

Many areas where TA-1 SWMUs are located were sampled for radioactivity during the decommissioning and decontamination activities of the mid-1970s. Although the sampled areas were considered clean at the time, no sampling was done to determine if hazardous nonradioactive chemical constituents were present in remaining soil. The OU 1078 work plan addresses existing information for TA-1 SWMUs and presents methodology for obtaining additional data required to make a baseline risk assessment and determine if any corrective measures are needed to remediate any SWMUs that may pose unacceptable risk.

2.4 Potential Corrective Measures

As early as possible in the RCRA corrective action process, it is important to identify measures that the Laboratory might be required to take toward remediation of a SWMU (or SWMU aggregate) should the RFI indicate an unacceptable risk to the public. By early identification of potential corrective measures, the RFI can be tailored to collect only that data needed to make decisions on a corrective response should one be needed. If a SWMU is a health risk, it is advantageous to consider potential corrective measures for that SWMU as early in the RFI as possible. Section 2.4.1 establishes the preliminary guidelines for both residual hazardous chemicals and radioactivity in soil that will be one basis for making decisions on potential corrective measures. Section 2.4.2 focuses on potential response actions for TA-1 SWMUs, and Section 2.5 identifies those TA-1 SWMUs that have been nominated for NFA.

2.4.1 Guidelines for Determining Residual Radiological and Chemical Constituents in TA-1 Media

The Environmental Restoration (ER) Program is currently developing soil cleanup guidelines that will be presented in future versions of the Installation Work Plan (IWP). Guidelines for residual radioactivity and hazardous constituents remaining in soil at TA-1 SWMUs will be proposed to achieve a risk-based

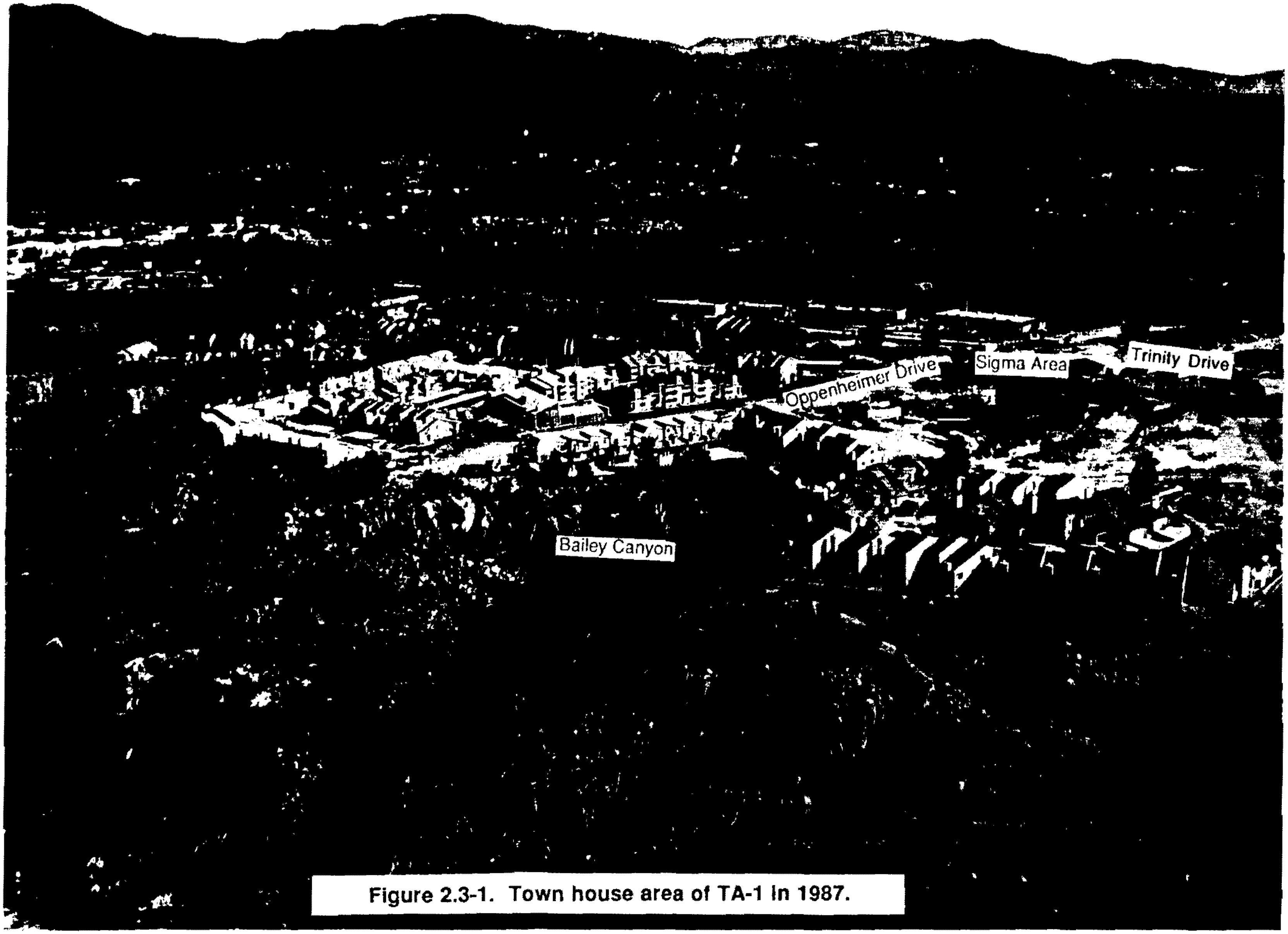


Figure 2.3-1. Town house area of TA-1 in 1987.

cleanup and follow the principle of as low as reasonably achievable. This principle is defined by the DOE as reduction of residual radioactivity to lowest levels given existing technical and economic constraints (DOE 1987, 0264). To determine corrective measures, the LANL ER Program office is developing decision analysis methodology.

Upper-limit soil radioactivity concentration guides (20-pCi/g gross alpha or gross beta) are used in the development of the sampling plans used in this RFI. The 20-pCi/g guideline is based on the gross alpha and beta detection limits for field laboratory instruments. At this time, it is not meant to be a health-based guideline, but only serves as an aid to sampling and submittal of samples for laboratory analyses. Soil that contains contaminants with activities that exceed the 20-pCi/g gross alpha or beta guideline will be removed for disposal. Final cleanup guidelines will be developed and applied as recommended by the EPA, the NMED, and DOE.

In accordance with the Comprehensive Environmental Assessment and Response Program, applicable or relevant and appropriate requirements (ARARs) will be identified in the IWP. ARARs, promulgated under environmental and public health laws, address nonradioactive hazardous chemical constituents that may be present in TA-1 SWMUs. The chemical-specific ARARs will be identified as early as possible in this site investigation in order to become a planning tool that may be useful in identifying remedial alternatives.

Until more information is available about type and concentration of contaminants at the SWMUs being investigated, identification of potential ARARs is premature. Full tabulation of potential location-, contaminant-, and action-specific requirements will be provided in future technical reports as adequate SWMU information is obtained through the RFI process.

Guidelines for action levels of hazardous chemical constituents in soil are needed to identify sampling locations and referrals for NFA, as well as cleanup priorities and corrective measures. If these action levels are exceeded, a corrective measures study may be initiated according to proposed RCRA Subpart S rules (EPA 1990, 0432). However, action levels are site specific and it is possible that they may be exceeded at certain SWMUs if site-specific risk calculations indicate acceptable risk. Action levels for many of the possible chemical contaminants that may be in TA-1 SWMUs are derived by the EPA and contained in the Subpart S rules, but action levels may also be calculated through methodologies other than EPA regulations.

Final action and cleanup levels or guidelines for radioactive constituents that may be in the soil of TA-1 SWMUs will be recommended by the DOE, the EPA, and the NMED.

2.4.2 Identification of Potential Corrective Measures

Section 3.5.2.3 of the IWP (LANL 1991, 0553) details the Laboratory's RFI approach. Field investigations generate data that will be used to determine whether a Corrective Measures Study (CMS) is necessary and support the performance of a CMS or the design and implementation of a corrective measure. The staged, iterative, investigative approach being employed for the RFI at TA-1 (as detailed in Section 1.8) encourages identification of key data needs as early as possible and at each stage in the process to ensure that data collection is always directed toward providing information relevant to selection of a remedial action. The NFA alternative is a viable corrective option at the three decision points in the RFI process. This section provides a preliminary development and screening of potential technologies and alternatives for TA-1 SWMUs, although detailed screening analysis cannot be performed until additional data are collected. Potential remedial alternatives for corrective action will be re-evaluated following site risk assessment or site characterization sampling.

The following general corrective action alternatives are believed technically feasible and appropriate for use at TA-1 SWMUs.

- NFA
- institutional controls (monitoring, restricted access, deed restriction, or notification)
- cap-in-place
- stabilization-in-place (with containment such as capping)
- removal and treatment
- removal and disposal (at RCRA mixed waste or radioactive waste landfill or treatment as needed)

This section focuses on the most likely corrective measures for TA-1 SWMU aggregates. As additional data are collected during the RFI, applicable remedial action technologies will be re-evaluated for each SWMU aggregate. In the future, TA-1 mesa tops may be used for residences and the hillsides for recreation. These two future-use scenarios preclude no-action measures, such as institutional controls or long-term monitoring. For example, except under limited circumstances, a restricted access fence should not be proposed if the area is designated for residential or recreational purposes in the future.

2.4.2.1 No Further Action

The NFA alternative may be applicable if archival data or field investigation results indicate any of the following conditions at a SWMU.

- the site is incorrectly classified as a SWMU
- no contaminants have ever been present
- past actions have been sufficient to remediate the area
- laboratory analysis documents that Subpart S action levels are not exceeded on soil
- risk assessment demonstrates that the extent of contamination and the associated exposure pathways result in acceptable risk using the risk assessment methodology and action levels to be published in the IWP

The NFA alternative with no field investigation will apply to many TA-1 SWMUs that were previously decontaminated (Ahlquist et al. 1977, 0016) or were designated as SWMUs before available archival data was examined. For example, if surface soil contamination is below action levels or poses no risk to human health and the environment, NFA may be the alternative selected for certain SWMUs. If risk assessment for a SWMU indicates subsurface units pose either no risk or an acceptable risk, the NFA alternative may apply to that SWMU. The SWMUs in TA-1 nominated for NFA and the rationale for nomination are presented in Section 2.5. The decision analysis process used to make these NFA selections was presented in Section 1.8.

2.4.2.2 Institutional Controls

If field investigation results indicate that contaminants are present in concentrations above regulatory action levels or that waste is left in place at a given site, institutional control measures (such as fencing or restrictions) may be a viable alternative. However, because of the impermanence of these measures, institutional controls are not a corrective measure favored by EPA. Institutional controls are not being considered for any TA-1 SWMUs because, in the future, the areas will be used for residential and recreational purposes, and institutional controls are not designed to actively protect the public.

2.4.2.3 Capping-in-Place

Capping-in-place entails placing a horizontal, low-permeability cover over an area of surficial or below-ground contamination. Engineered caps are designed to reduce infiltration, biointrusion, radioactive or organic chemical emissions, surface run-off, and erosion; to physically isolate contaminants from the above-ground environment; and to prevent direct contact by man or biota. The LANL ER capping pilot study is discussed in greater detail in the IWP, Appendix P (LANL 1991, 0553).

The capping technology developed at the Laboratory (1991 IWP, Appendix P) provides a response action potentially applicable to the TA-1 environment, particularly at SWMUs with previous shallow land burial (e.g., buried waste lines) or at SWMUs where construction debris was used as fill on the mesa top and on the hillsides.

Additional containment alternatives such as vertical barriers, bottom sealing, or surface management technologies may be applicable at TA-1 SWMUs. However, additional site characterization data for individual SWMUs and better definition of potential migration pathways are required to determine whether these alternatives are appropriate and merit further consideration. The capping alternative is not favored for TA-1 SWMUs because the future residential and recreational land-use scenario precludes any solutions except permanent cleanup solutions.

2.4.2.4 Treatment-in-Place and Removal and Treatment Technologies

Numerous technologies involving treatment of soil or water, either *in situ* or combined with removal, are general response actions. Examples of *in situ* contaminated soil treatment technologies potentially applicable to the TA-1 OU are immobilization, soil flushing, vapor extraction, vitrification, and biological treatment. Based on available data, groundwater treatment technologies are not applicable or required at TA-1 because there are no aquifers underlying the TA-1 mesa-top location at depths less than 1200 ft.

Insufficient SWMU data are available to determine which of these technologies are applicable at TA-1. For example, treatment may be required at SWMUs where contamination prevails at depth. As appropriate, treatment technologies will be evaluated during the CMS. Laboratory, bench-scale, and pilot-scale tests will be used as needed to confirm feasibilities of treatment technologies.

2.4.2.5 Removal and Disposal

Removal actions are paired with either treatment and/or disposal. Removal and disposal with minimal site characterization is applicable for SWMUs that are inactive small units, such as fragments of pipe, contaminated soil, and construction or other types of debris. After examining existing data, it appears that removal is a possible remedial alternative for the majority of TA-1 SWMUs that may require corrective action. Because the future-use scenario involves human activity (residential and recreational), permanent solutions, such as removal and disposal, are warranted. Although this corrective measure is not favored by EPA because it is not conducive to waste minimization, removal and disposal must be considered for the majority of SWMUs requiring corrective action. At TA-1, major efforts have already been undertaken to locate and remove all septic tanks, all sections of the industrial waste lines, and contaminated soil. If the public is to have unrestricted access to TA-1, residual, risk-causing, subsurface contaminants must not be easily exposed (e.g., by erosion) now or at any future time (as defined in a subsequent iteration of the IWP).

2.4.3 Potential Corrective Measures for TA-1 SWMU Categories

The potential application to each TA-1 SWMU of the corrective measures discussed above is presented in this section. The purposes of this preliminary identification are to support the investigation plan for the RFI and to provide a general framework for the eventual design and implementation of the most appropriate corrective measures should they prove necessary at any stage of the corrective action process.

Preliminary identification of potential corrective measures for TA-1 SWMU categories is based on present conditions and existing environmental data at each SWMU. Because the available information for most SWMUs is limited, identification was accomplished based on professional engineering judgement and experience. The results are summarized below.

2.4.3.1 Sanitary (Septic) Waste Systems

The 23 sanitary waste system SWMUs in TA-1 occur in 11 of the 16 SWMU aggregates discussed in Chapter 6. The sanitary waste system included 14 septic tanks and 9 sanitary waste drain lines. The septic tanks have all been excavated and removed. Their classification as SWMUs is related only to their former locations.

The NFA alternative (Section 2.5) is proposed as a viable option for several of these SWMUs (both septic tanks and drain lines) because it is believed that these septic tanks and drain lines were incorrectly identified as SWMUs and afford no present-day risk. In some cases, additional preliminary data will be gathered to support this contention. The cap-in-place corrective measure was eliminated for TA-1 sanitary waste system SWMUs because of the difficulty in constructing and maintaining a cap on steep slopes and the impracticality of capping over potential line sources, such as drain lines.

Should any residual contamination be found at a sanitary waste system SWMU, removal and disposal, treatment-in-place, or a combination of the two alternatives would be applicable, depending on the level of contaminant concentration.

2.4.3.2 Industrial Waste Line

The industrial waste line formerly served TA-1 by carrying process waste and laboratory liquid waste. Corrective measures taken so far include removal and disposal of all sections of the industrial waste line and contaminated soil found in the vicinity of the industrial waste line. Excavated industrial waste line trenches should be free of radioactive contamination, but previous decontamination efforts conducted no analyses for hazardous chemicals. The NFA alternative is considered feasible because heavy metals and organic compounds were most likely removed during excavation and removal of sections of the waste line (see Appendix A). In addition, natural biodegradation of many residual organic compounds has taken place. The cap-in-place measure was eliminated for the industrial waste line SWMU because of the difficulties in constructing and maintaining a cap on steep slopes and over long distances.

Should any residual contaminants exceeding action levels be found along the industrial waste line SWMU, removal and disposal would be the most viable alternative. A preliminary decision has been made to remove any radiologically contaminated soil exceeding a gross alpha or beta activity of 20 pCi/g from the industrial waste line trench during field sampling.

2.4.3.3 Landfill and Surface Disposal Sites

The Bailey's Canyon Landfill and four debris disposal areas are situated on the canyon hillsides. No known hazardous or radioactive releases have occurred from these units; however, one of these hillside disposal areas (Bailey's Canyon) contains concrete potentially contaminated with low levels of uranium. The NFA alternative is being considered for two of these surface disposal sites (1-003b and 1-003c) because preliminary field investigations have indicated the presence of very little or no debris at these locations.

Cap-in-place (where the slope is not too steep), removal and disposal, and institutional controls are the three corrective measure alternatives that appear viable (at this time) for the Bailey's Canyon Landfill and the Surface Disposal Site Southeast of Los Alamos Inn. SWMU 1-003 (d) (Can Dump Site) may be small enough that a VCA involving removal and disposal will be proposed for this SWMU early in the RFI.

2.4.3.4 Incinerators

TA-1 contained two solid waste incinerators that were decommissioned and removed in 1958 and 1959. There were no known releases of hazardous or radioactive materials associated with these incinerators. Based on current information, the NFA measure is appropriate for these two SWMUs. It is not likely that other measures will be viable because the incinerator locations are physically inaccessible.

2.4.3.5 Bench-Scale Incinerator

A small bench-scale incinerator was located in TA-1-68 Building (TU-1 Building). Because this incinerator was used to recover enriched uranium, it is likely that a radioactive release occurred at this SWMU. However, the building (TU-1) housing the incinerator and thousands of cubic yards of soil surrounding the building have been removed and disposed. For this reason, the incinerator has been proposed for NFA.

2.4.3.6 Storm Run-off/Building Drain Lines and Outfalls

Twenty storm run-off and building drain lines were identified under SWMU Category 1-006. These drain lines served many buildings in TA-1 and discharged to outfalls in Los Alamos Canyon or in the vicinity of the buildings that they served. None of these drain lines and their associated discharge points are in place and their location is no longer evident. The NFA alternative has been chosen for many of these drain lines. Removal and disposal is the other favored alternative.

2.4.3.7 Suspected Subsurface Soil Contamination Beneath and Adjacent to Former Buildings and Pipelines

There are 16 SWMUs designated as suspected subsurface soil contamination units. These subsurface soil contamination SWMUs were identified by locating the soil cleanup areas described in the Ahlquist report. It is possible that residual hazardous and radioactive constituents remain in these areas, which currently may lie beneath fill, paved roads, or buildings. For SWMUs situated under these physical barriers, the cap-in-place alternative is viable and already in place; whereas for subsurface soil contamination accessible from the surface, the removal and disposal alternative may be the most viable one.

2.5 SWMUs Proposed For NFA

Available information for all 68 SWMUs in TA-1 has been reviewed. Twenty-one of these SWMUs (Foldout Map D, Table 2.5-1) are candidates for NFA for reasons stated below (see Section 1.8 for decision-making process used to nominate NFA SWMUs). However, until the EPA concurs that these SWMUs need no further investigation, they will continue to be included as components of the SWMU aggregates discussed in Chapters 6 and 7.

2.5.1 SWMU No. 1-001b—Septic Tank 135

Septic Tank 135 was designed to receive sanitary waste and was located at the far southwestern corner of TA-1 at the edge of Los Alamos Canyon (Foldout Map D). The buildings served by this septic tank

TABLE 2.5-1

SWMUs PROPOSED FOR NFA

SWMU No.	Source Buildings or Entity
1-001b	Septic Tank 135
1-001h	Septic Tank 142
1-001j	Septic Tank 149
1-001l	Septic Tank 269
1-001m	Septic Tank 275
1-001p	Sanitary waste line from Q to ML Buildings
1-001q	Sanitary waste line from P and PX Buildings
1-001r	Sanitary waste line from E Building
1-001u	Sanitary waste line from J-2 Building
1-001v	Sanitary waste line from P Building to Manhole 195
1-001w	Sanitary waste line from P and AP Building
1-003b	Surface disposal site east of Bailey's Canyon
1-003c	Surface disposal site west of Bailey's Canyon
1-004a	Incinerator 146
1-004b	Incinerator 147
1-005	Bench-scale incinerator
1-006f	Storm drain from northwest corner of Warehouse 4
1-006i	Storm drain from R and S-1 Buildings
1-006j	Storm drain from S Building
1-006q	Storm drain from southeast of T Building
1-006s	Storm drain from northwest of P Building

were M-1 and possibly the nonferrous metal foundry (FP Building). Septic Tank 135 was not considered to be radioactively contaminated in 1964 when it was decommissioned (Buckland 1964,09-0002). M-1 Building was used for machining lithium and possibly ^{238}U. Because both these materials are pyrophoric in small-particle form (dust, chips, turnings), only a minimum amount of material would have been stored in the building. The foundry was used to cast nonferrous metals, such as copper, tin, and zinc. Most likely, metallurgical processes at the foundry would not be a source of radioactivity. Any hazardous organic chemicals commonly used in foundry operations would have evaporated, dissipated, or biodegraded by this time.

During demolition in 1965, M-1 and FP Buildings were determined to be radioactively uncontaminated. After demolition, their cement building pads were left in place according to the standard procedure followed by the Laboratory for uncontaminated buildings. M-1 Building was removed by the Bureau of Indian Affairs for subsequent off-site use.

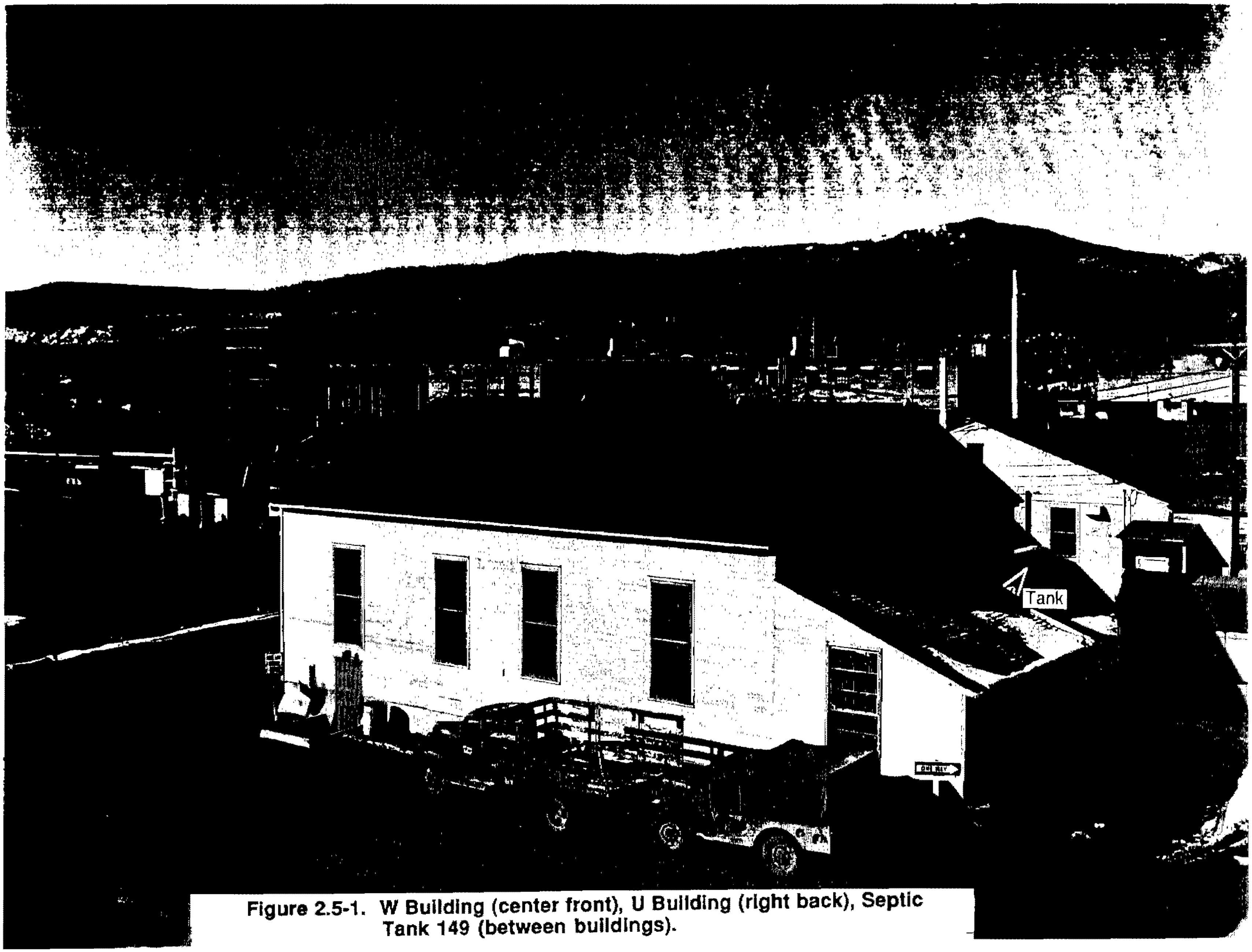


Figure 2.5-1. W Building (center front), U Building (right back), Septic Tank 149 (between buildings).

Septic Tank 135 was not put into operation until 1949. By that time, the Laboratory was more aware of potential environmental hazards resulting from discharges into adjacent canyons.

Septic Tank 135 and its contents were sampled during the 1976 decontamination effort. Ahlquist found no indication of radioactive contamination. Because there is no indication that wet chemistry experimentation or processing occurred in the M-1 or FP Buildings (Ahlquist et al. 1977, 0016), it is doubtful that acids and heavy-metal solutions were discharged into Septic Tank 135. Finally, had any organic chemical discharges from Septic Tank 135 occurred, they would have been small in volume and their residuals would not be found on the hillside 25–30 years after operations ceased at these two buildings. For these reasons, it is highly likely that Septic Tank 135 is not a public health risk and should be a candidate for NFA.

2.5.2 SWMU No. 1-001h—Septic Tank 142

Septic Tank 142 was also designed to receive sanitary waste and was located at the far eastern end of TA-1 near what is currently the US West Communications Building. This area was occupied by the Zia Company (a LANL contractor) complex of service buildings, including paint, carpenter, furniture, and sign shops. No radioactive materials were used at these shops, which were all located outside the TA-1 security fence. Building 118 served as a latrine for Zia shop personnel. A drain line ran from Building 118 to Septic Tank 142 and subsequently into Los Alamos Canyon.

Septic Tank 142 was removed in 1976 (Ahlquist et al. 1977, 0016). At that time the tank and its sludge were tested for radioactivity and none was detected. Because this septic tank was physically separated from shops and warehouses and received only sanitary waste, it is doubtful that any radioactive or hazardous contamination ever reported to this septic tank or to the hillside below it. Septic Tank 142 poses no public health risk and is a candidate for NFA.

2.5.3 SWMU No. 1-001j—Septic Tank 149

Septic Tank 149 was located on the north side of and between U and W Buildings. Although reported as a septic tank in the SWMU Report (LANL 1990, 0145), this steel cylindrical tank was clearly a storage tank holding unknown fluids. A photograph of U and W Buildings clearly shows the above-ground tank (Figure 2.5-1). This tank was eventually moved to TA-3, indicating the integrity of the tank. There is no documented evidence of leaks or discharges from this tank while it was located at TA-1. For these reasons, Septic Tank 149 is not a public health risk and is a candidate for NFA.

2.5.4 SWMU No. 1-001l—Septic Tank 269

Septic Tank 269 served S-1 Building from 1943 to 1954, providing for disposal of sanitary waste. S-1 Building, located outside the security fence at the far northeastern corner of TA-1, initially functioned as a four-bay service garage and later as a storehouse. Documentation of radioactive materials in this building does not exist; nor is it likely that any radioactive materials were present. It is doubtful that hazardous metals would be used in a garage nor is there documentation of any major liquid spills (including organic compounds) having occurred there. Because S-1 Building functioned as a garage, inadvertent spills of small quantities of petroleum products would have occurred. It is possible that small amounts of petroleum products were flushed into Septic Tank 269, then discharged into Los Alamos Canyon. During the 37 years since the building's removal (1954), physical and biological processes would have disseminated or metabolized these petroleum products.

Septic Tank 269's location and discharge point currently are covered by fill and a paved parking lot. It is not a health risk, and there is no potential for any discharge of contaminants from it. Septic Tank 269 is nominated for NFA.

2.5.5 SWMU No. 1-001m—Septic Tank 275

Septic Tank 275 was designed to receive sanitary waste and was located outside the TA-1 security fence at the rim of the mesa to the east of Septic Tank 142. This tank served Warehouse 13 and possibly Warehouse 18 and discharged directly into Los Alamos Canyon. Septic Tank 275 was used only from 1944 to 1946; the last discharge from it occurred approximately 45 years ago. Warehouses 13 and 18 were located outside TA-1's security fence and there is no record of any radioactive constituent storage or use in these warehouses. It is unknown whether heavy metals or organic chemicals were discharged into Septic Tank 275, but, because it was designated for sanitary waste, it is doubtful that hazardous chemicals were discharged into this tank. Ahlquist did not find Septic Tank 275 in 1976 (Ahlquist et al. 1977, 0016) and stated that the area had been graded to an elevation lower than the elevation recorded for Septic Tank 275. It is likely that Septic Tank 275 had been removed in a previous construction action.

In the 45 years since discharges from Septic Tank 275 ceased, it is doubtful that any quantities of organic chemicals discharged from it could still be found on the hillside below. It is unlikely that radioactive material would have been stored in unsecured warehouses located outside the confines of the security fence, nor would metal-bearing solutions have been discharged from the buildings into the tanks. Septic Tank 275 presents a minimal health risk and is a candidate for NFA.

2.5.6 SWMU No. 1-001q—Sanitary Waste Line From P and PX Buildings

P and PX Buildings date from the earliest days of the Manhattan Project. P Building was located outside TA-1's security fence and housed personnel offices. No record of association with radioactive or hazardous constituents exists for P Building. PX Building was the early Laboratory's military post commercial exchange—the grocery and dry goods commissary for the post's personnel. Three sanitary waste lines extended from the PX and connected into the main sanitary waste line. It is doubtful that hazardous or radioactive constituents were used in the PX or discharged into the segment of the sanitary waste system leading from the PX. SWMU No. 1-001q is a candidate for NFA.

2.5.7 SWMU No. 1-001r—Sanitary Waste Line From E Building

SWMU No. 1-001r served E Building, which was located adjacent to and southwest of Ashley Pond outside TA-1's security fence. E Building was completed in July 1944 and was used only as office space for administrative staff and theoretical physicists (Ahlquist et al. 1977, 0016; Kennedy 1987, 09-0007). It is highly unlikely that radioactive or hazardous materials were ever used in E Building and that SWMU No. 1-001r carried any radioactive or hazardous constituents. For this reason, this sanitary waste line is not a health risk and is a candidate for NFA.

2.5.8 SWMU No. 1-001u—Sanitary Waste Line From J-2 Building

SWMU No. 1-001u carried sanitary waste from J-2 Building at the west end of TA-1 to the western sanitary waste collection system (SWMU No. 1-001s). This line extended from the eastern part of J-2 Building. When J-2 Building was demolished in 1956, the sanitary waste line was tested and found free of radioactive contamination. In 1976, Ahlquist's investigation located SWMU No. 1-001u (Ahlquist et al. 1977, 0016) and determined that it was not radioactively contaminated. Because it was uncontaminated, the line was left in place. By the time J-2 Building was constructed (1949), the Laboratory had become aware of the dangers involved in disposing of radioactive waste having even low levels of contamination. For this reason, hazardous and radioactive waste were disposed of through the industrial waste line rather than the sanitary waste line. This buried waste line is not a health risk and is a candidate for NFA.

2.5.9 SWMU No. 1-001v—Sanitary Waste Line From P Building to Manhole 195

SWMU No. 1-001v extended from P Building to Manhole 195 and served P Building, which housed the early Laboratory's personnel offices. It is very unlikely that radioactive and hazardous chemicals were handled or processed in P Building. There is no reason to believe that radioactive or hazardous materials would have been discharged into this sanitary waste line. Therefore, SWMU No. 1-001v is not a health risk and is a candidate for NFA.

2.5.10 SWMU No. 1-001w—Sanitary Waste Line From P and AP Buildings

SWMU No. 1-001w served P Building and AP Building. Both buildings were located outside TA-1's security fence and were solely used as personnel and administration buildings. It is doubtful that hazardous chemicals and radioactive materials were used in these buildings. It is unlikely that any discharges of a hazardous nature would have been released into this section of the sanitary waste line, minimizing the health risk from this sanitary waste line. This sanitary waste line is a candidate for NFA.

2.5.11 SWMU No. 1-003b—Surface Disposal Site East of Bailey's Canyon

There is no record that any radioactive debris was ever discarded on this hillside. An on-foot examination of the site found fragments of iron pipe, small pieces of concrete, and the partial chassis of an old vehicle. It is doubtful that any of these items would have contained radioactive or hazardous chemical constituents. There are no substantial reasons to designate this area as a SWMU and it is a candidate for NFA.

2.5.12 SWMU No. 1-003c—Surface Disposal Site West of Bailey's Canyon

The surface disposal site located south of the outfall for Septic Tank 140 and northwest of the outfall for Septic Tank 135 has been designated as a SWMU. There is no record of any disposal of radioactive debris in this area; there is no reason this area should be designated as a SWMU. Weston (DOE 1988, 09-0006) did not observe any debris in this area during a 1988 site visit. An EM-8 on-site inspection of this area also found no debris. This SWMU is a candidate for NFA.

2.5.13 SWMU No. 1-004a—Incinerator 146

Incinerator 146 was one of two incinerators located within TA-1 and used for combustion of nonradioactive trash generated at TA-1. It was built in 1947 and located between G and H Buildings. Incinerator 146 was used for 10 years and then removed (LANL 1990, 0145). This small incinerator (3.5 x 3.0 x 2.5 ft.) was gas fired and was housed in a 6-foot-high sheet metal structure.

There is no indication that radioactive waste material was burned in Incinerator 146. Because Incinerator 146 was gas fired, any organic material would most likely have been subject to complete combustion. During the 34 years since Incinerator 146 was used, any organic material emitted during incomplete combustion would have been destroyed by biological processes or disseminated by anthropogenic and physical processes. Most heavy-metal residues would have been reduced to ash, which was undoubtedly disposed of outside the TA-1 area (no waste disposal areas exist within the TA-1 OU). Only massive amounts of heavy-metal emissions could have manifested themselves as hot spots around the incinerator. It is extremely unlikely that hot spots could have been produced by an incinerator as small as Incinerator 146. Residuals from Incinerator 146 are not a health risk; this SWMU is a candidate for NFA.

2.5.14 SWMU No. 1-004b—Incinerator 147

Incinerator 147 is the second of two identical incinerators located within TA-1 and used for combustion of nonradioactive material generated at TA-1. Incinerator 147 was located on the north side of TA-1's U Building. This incinerator was removed at the same time as Incinerator 146. This location is currently beneath the paved area near the front of the Los Alamos Inn. Incinerator 147 has exactly the same function and history as previously described for Incinerator 146.

Incinerator 146 and Incinerator 147 were inspected in 1957 (Buckland 1957, 09-0004) and both were found to be "free of any radioactive contamination that is dangerous to health." It is 34 years since the incinerators ceased operation and unlikely that any residual contamination remains in either area. There is no pathway for dissemination of any possible hazardous constituents to potential human receptors. Incinerator 147 is not a health risk and is a candidate for NFA.

2.5.15 SWMU No. 1-005—Bench-Scale Incinerator

A bench-scale incinerator was located in the TU-1 Building at the western end of TA-1. The TU-1 Building was built in 1948 to store enriched uranium and to house a small incinerator used for recovery of uranium (presumably ^{235}U) from combustible materials, such as rags and papers (LANL 1990, 0145). Ash produced by combustion was treated by a uranium recovery process and the barren ash residues were disposed. In 1964 the TU-1 Building was dismantled and removed to a contaminated disposal area (Area G) and burned (Ahlquist et al. 1977, 0016). No mention of the disposition of the incinerator was made. However, it is likely that this small incinerator was buried in an MDA, such as Area C at TA-50 (OU 1147) or moved to another laboratory location. The fact that this incinerator was used for uranium recovery is not reason enough to consider it a SWMU. The purpose of the incinerator was not to create waste but rather to recover precious amounts of enriched uranium. Only small quantities of uranium would have been involved. In Ahlquist's (1977, 0016) 1974–1976 cleanup effort, 3682 yd^3 of soil were removed from the location of the former TU-1 Building and transported to Area G at TA-54 (OU 1148). The area surrounding the TU and TU-1 Buildings has been designated SWMU No. 1-007h, which is included in the J-2/TU Area SWMU Aggregate and will be investigated as such. This incinerator should not be regarded as a separate SWMU and is a candidate for NFA.

2.5.16 SWMU No. 1-006f—Storm Drain From Northwest Corner of Warehouse 4

SWMU No. 1-006f consists of the storm drain that served the northwest corner of Warehouse 4 in the western sector of TA-1 and discharged just southwest of the TU-1 Building. Warehouse 4 was used only for storage and there is no indication that any radioactive or hazardous constituents were stored there. Therefore, it is unlikely that the SWMU No. 1-006f storm drain would have carried any chemical or radioactive constituents. Its discharge point was near TU-1 Building where radioactive soil contamination resulted from operations in the TU or TU-1 Buildings. The area around the TU-1 Building was excavated (see Section 2.5.15). Because it is doubtful that discharges from this storm drain would have been contaminated and the area into which this storm drain discharged (TU-1 Building vicinity) has been excavated, refilled, and is already a designated SWMU; there is no reason for the storm drain itself to be retained as a SWMU. This SWMU is a candidate for NFA.

2.5.17 SWMU No. 1-006i—TA-1-50 and TA-1-54 Storm Drains

The SWMU No. 1-006i storm drain served the northeastern side of R Building and the southwestern side of S-1 Building, neither of which had any record of radioactive constituent use (Ahlquist et al. 1977, 0016). The R Building contained assorted shops and the S-1 Building housed a four-bay garage for vehicle maintenance.

SWMU No. 1-006i's point of discharge lies under several feet of soil and other fill material and is located at very nearly the same location as Septic Tank 269's point of discharge. The area of discharge from this storm drain is being investigated as part of the Surface Disposal Site Southeast of Los Alamos Inn, SWMU Aggregate H. SWMU No. 1-006i storm drain is a candidate for NFA .

2.5.18 SWMU No. 1-006j—TA-1-53 Storm Drain and Outfall

SWMU No. 1-006j is comprised of two storm drains that served TA-1's S Building (TA-1-53). One followed the north side of the building; the other followed the south side of the building. Both storm drains discharged into the drainage east of Los Alamos Inn. S Building functioned as a general stock warehouse. Radioactive or hazardous constituents are not documented as having been handled there.

Because oil drums were stored along the south side of the building, the most likely contaminant source from S Building would have been run-off of any oil spilled or washed from the surface of the oil drums. S Building was removed 32 years ago and it is highly unlikely that any traces of contaminants from S Building could still be found. Residual contaminants are unlikely because of the tremendous amounts of fill brought into the drainage below this outfall as well as physical forces, including evaporation, photolysis, movement by water, and biological degradation, that would have minimized any organic chemicals discharged long ago. NFA should be taken for SWMU No. 1-006j.

2.5.19 SWMU No. 1-006q—TA-1-64 Storm Drain and Outfall

The SWMU No. 1-006q storm drain served the area southeast of T Building (TA-1-64), continued northeast, and discharged into TA-1's main east/west thoroughfare (currently Trinity Drive). T Building, which housed the Theoretical Division, was one of the first structures built at Los Alamos during the Manhattan Project. There was no known hazardous or radioactive constituent storage in T Building nor is it likely that any would have been stored in Theoretical Division Offices.

Storm drainage from this building, therefore, would not be expected to have carried any contaminants. There is no pathway for a potential contaminant to cause a health risk. SWMU No.1-006q is a candidate for NFA.

2.5.20 SWMU No. 1-006s—TA-1-46 Storm Drain and Outfall

The SWMU No. 1-006s open storm drain served the northwest side of P Building (TA-1-46), which was located southwest of Ashley Pond outside TA-1's security fence. P Building was used for personnel and general office space. SWMU No. 1-006s discharged along TA-1's main east/west thoroughfare (currently Trinity Drive).

SWMU No. 1-006s is being nominated for NFA for the same reasons as SWMU No. 1-006q (see Section 2.5.19). Its origination, P Building, has no record of storage for radioactive or hazardous constituents and the storm drain discharged into TA-1's main east/west thoroughfare (currently Trinity Drive). It is doubtful that SWMU No. 1-006s poses any health risk and is a candidate for NFA.

2.5.21 1-001p—Sanitary Waste Line

SWMU 1-001p was mistakenly identified as a sanitary waste line in the International Technology Corporation SWMU Description Report (International Technology Corporation 1991, 09-0003). An engineering drawing correctly identifies the conveyance between the Q and ML buildings as a steam tunnel. The steam tunnel (LASL 1947, 09-0010) originated at Boiler House No. 2. For this reason, SWMU 1-001p is recommended for NFA.

REFERENCES

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory report LA-6887, Los Alamos, New Mexico, 1977. (Ahlquist et al. 1977, 0016)

Buckland, C., December 6, 1957. "Final Health Clearance of Various Buildings in TA-1 Located South of Trinity Drive," Los Alamos Scientific Laboratory memorandum from C. Buckland to S.E. Russo, Los Alamos, New Mexico. (Buckland 1957, 09-0004)

Buckland, C., September 15, 1959. "Final Radioactive Contamination Health Clearance of the Eastern Sector of TA-1 South of Trinity Drive and the J-2 Area," Los Alamos Scientific Laboratory memorandum from C. Buckland to Joe Hill, Los Alamos, New Mexico. (Buckland 1959, 09-0001)

Buckland, C., April 21, 1964. "Final Radioactive Survey of Certain Structures in TA-1," Los Alamos Scientific Laboratory memorandum from C. Buckland to S.E. Russo, Los Alamos, New Mexico. (Buckland 1964, 09-0002)

Buckland, C., February 16, 1973. "Summary of Records Search for Radioactivity Remaining in TA-1, Acid Waste Lines, TA-10, TA-45, and Acid Canyon Below TA-45," Los Alamos Scientific Laboratory memorandum from C. Buckland to D. D. Meyer, Los Alamos, New Mexico. (Buckland 1973, 09-0008)

Christensen, E. L., and W. J. Maraman, April 1969. "Plutonium Processing at the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory report LA-3542, Los Alamos, New Mexico. (Christensen and Maraman 1969, 0037)

Condon, E. U., Comp., April, 1943. "Los Alamos Primer," Los Alamos Scientific Laboratory report LA 1, Los Alamos, New Mexico. (Condon 1943, 0692)

DOE (US Department of Energy), October 1987. "Phase I: Installation Assessment, Los Alamos National Laboratory," Volumes 1 and 2, (draft), Comprehensive Environmental Assessment and Response Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1987, 0264)

DOE (US Department of Energy), September 1988. "Remedial Investigation Plan: Task 11, Technical Area 1," Environmental Restoration Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1988, 09-0006)

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)

Ferenbaugh, R., T. Buhl, A. Stoker, and W. Hansen, August 1982. "Environmental Analysis of Acid/Middle Pueblo Canyon, Los Alamos, New Mexico," Los Alamos National Laboratory report LA-9409-MS, Los Alamos, New Mexico. (Ferenbaugh 1982, 0662)

Hawkins, D., 1983. Project Y: The Los Alamos Story Part 1. Toward Trinity, Tomash Publishers, Los Angeles, California. (Hawkins 1983, 0663)

International Technology Corporation, February 1991. "Solid Waste Management Unit Descriptions for the TA-1 Work Plan," Project No. 301215.08.01, Los Alamos, New Mexico. (International Technology Corporation 1991, 09-0003)

Kennedy, W. R., January 26, 1987. "Summary of Environmental Data, 1943-1969," Los Alamos National Laboratory memorandum from W. R. Kennedy to R. W. Vocke, Los Alamos, New Mexico. (Kennedy 1987, 09-0007)

Kingsley, W. L., June 19, 1946. "Overflowed Sewer," Personal communication from W. L. Kingsley to J. F. Tribby, Los Alamos, New Mexico. (Kingsley 1946, 09-0005)

LANL (Los Alamos National Laboratory), May 1981. "Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Site of a Former Radioactive Liquid Waste Treatment Plant (TA-45) and Effluent-Receiving Areas of Acid, Pueblo, and Los Alamos Canyons, Los Alamos, New Mexico," Los Alamos National Laboratory report LA-8890-ENV (DOE/EV-0005/30), Los Alamos, New Mexico. (LANL 1981, 0141)

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)

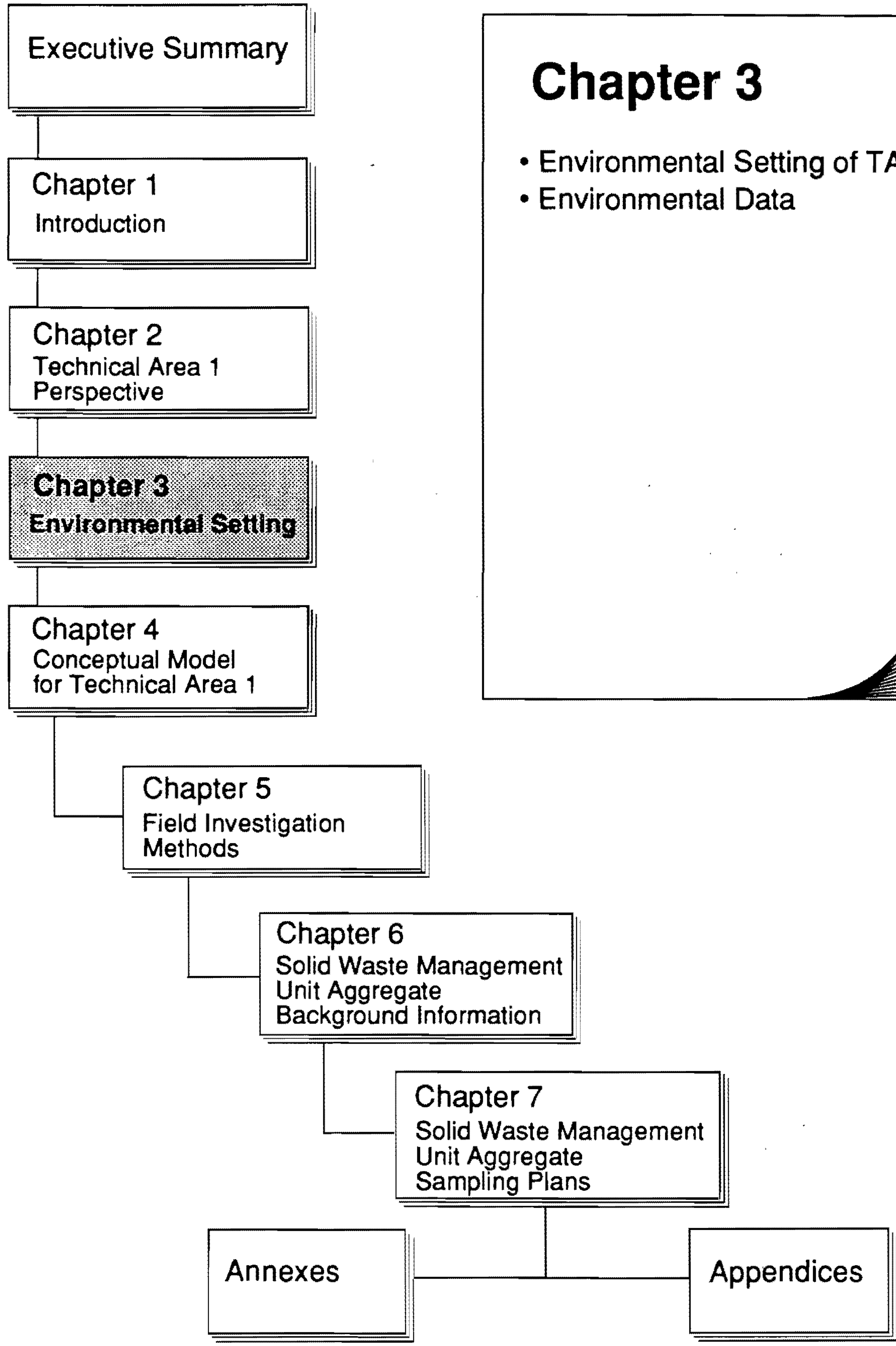
LANL (Los Alamos National Laboratory), November 1991. "Installation Work Plan for Environmental Restoration," Revision 1, Los Alamos National Laboratory report LA-UR-91-3310, Los Alamos, New Mexico. (LANL 1991, 0553)

LASL (Los Alamos Scientific Laboratory), April 1947. Drawing EWG-R27, Los Alamos, New Mexico. (LASL 1947, 09-0010)

LASL (Los Alamos Scientific Laboratory), July 1986. "Los Alamos, Beginning of an Era 1943–1945," Los Alamos Scientific Laboratory reprint LASL-79-78, Los Alamos, New Mexico. (LASL 1986, 0691)

Meyer, D. D., March 1, 1965. "Recommendations for Disposal of Contaminated Sewer Line, TA-1, TA-3, and TA-45," Los Alamos Scientific Laboratory memorandum from D. D. Meyer to S. E. Russo, Los Alamos, New Mexico. (Meyer 1965, 09-0009)

Rhodes, R. 1986. The Making of the Atomic Bomb, Simon & Schuster, New York, New York. (Rhodes 1986, 0664)



Chapter 3

- Environmental Setting of TA-1
- Environmental Data

3.0 ENVIRONMENTAL SETTING

Chapter 3 describes the Technical Area 1 (TA-1) environment as it exists today. It characterizes the environmental setting of TA-1 and identifies available information that may be used to assess the presence, pathways, mobility, and importance of various potential contaminants in the TA-1 environment. The Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) sampling plans presented in Chapter 7 are based, in part, on the understanding developed here. Additional information on the Los Alamos National Laboratory's (LANL's or the Laboratory's) environmental setting is available in the installation work plan (IWP) (LANL 1991, 0553).

Chapter 3 has two sections. The first section contains descriptive information about the climate, soil, geology, and hydrology at TA-1. The second section presents data on surface and ground water quality, air quality, external penetrating radiation, and soil chemical and radiological constituents collected near the TA-1 environment. These data may indicate the possibility that contaminants may have migrated outside of Operable Unit (OU) 1078.

3.1 Environmental Setting of TA-1

The environmental setting of the Laboratory is described in Chapter 2 of the IWP (LANL 1991, 0553). The following discussions of the environmental setting of TA-1 focus only on the detailed situation affecting viable migration pathways at this OU. In this chapter, reference is made to information given in the IWP with additional detail provided, as appropriate.

3.1.1 Geographic Setting

The geographic setting of the Laboratory is described in Section 2.1 of the IWP. The elevation of OU 1078 is approximately 7300 ft. OU 1078 is located on the western portion of the Pajarito Plateau, approximately one-third of the distance between the Jemez Mountains to the west and White Rock Canyon to the east (Figure 3.1-1). The bedrock formation underlying the entire OU is composed of an 800-ft volcanic ash deposit (Bandelier Tuff). The regional aquifer lies approximately 1250 ft below the surface of the mesa.

OU 1078 is sited on the northern edge of Los Alamos Canyon (Figure 1.6-1) and comprises private, Los Alamos County, and Department of Energy (DOE) lands. It is defined as the area between approximately 1774714-1776511 northing and 482075-485731 easting (New Mexico state plane coordinate system). TA-1 has both mesa-top and canyon wall areas. The mesa-top portion of TA-1 is situated outside the Laboratory's boundary; the walls and floor of Los Alamos Canyon lie within the Laboratory's boundary. A

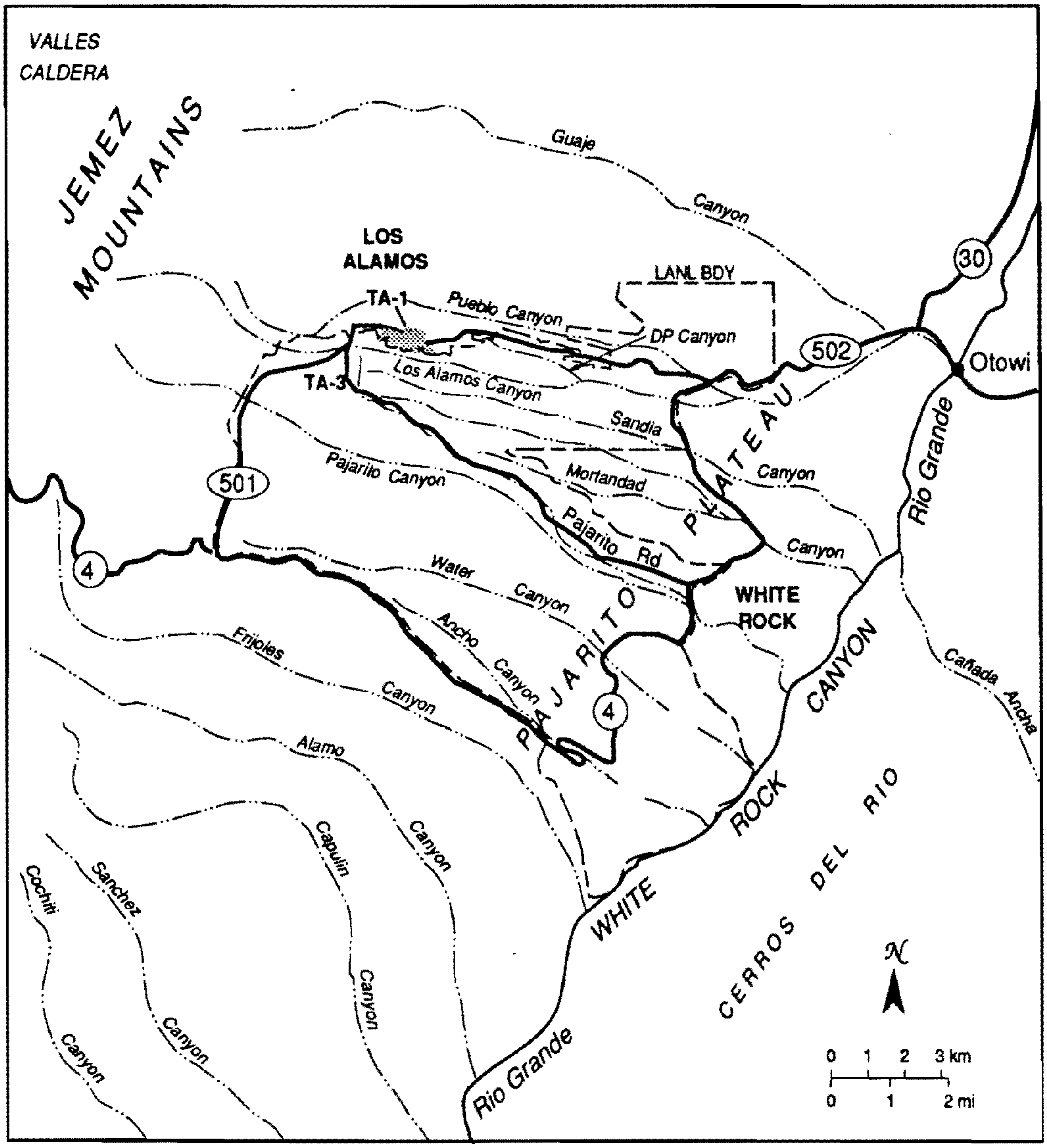


Figure 3.1-1. Location of TA-1 on the Pajarito Plateau.

portion of the Los Alamos townsite's eastern sector, located to the north and south sides of Trinity Drive, currently encompasses a major portion of the approximately 50-acre mesa-top area formerly occupied by TA-1. Thirty hillside acres along the north wall of Los Alamos Canyon compose the remainder of the OU 1078 (Figure 3.1-2).

3.1.2 Climate

Los Alamos County has a semiarid, temperate mountain climate. The climate of the county, including frequency analyses of extreme precipitation events, is discussed in detail in Bowen (1990, 0033) and summarized in Section 2.5.3 of the IWP.

Wind speed and direction are measured at five stations around the Laboratory. The East Gate monitoring station is 2.0 mi. east of TA-1. Wind speeds in 1988 were less than 5.5 mph 38% of the time and greater than 11 mph 21% of the time. Strong winds occur predominantly in the spring. The prevalent wind direction is from the south-southwest implying that deposition patterns for wind-borne contaminants would be more prominent to the north-northeast of OU 1078.

Los Alamos precipitation is typical of a semiarid climate. It receives a normal annual precipitation, including rainfall and water-equivalent snowfall, of 18 in. As is characteristic for semiarid climatic regions, actual precipitation from year to year varies considerably. Annual precipitation extremes range from 6.80 to 30.34 in. over a 69-year period (Bowen 1990, 0033). Forty percent of annual precipitation occurs as brief, intense thunderstorms during July and August. Significant run-off of surface water often occurs during summer storm events. Snowfall averages 51 in. annually (ESG 1989, 0308). The prevalence of short, intense precipitation events at the OU 1078 could cause surface erosion and run-off transport of soil, which may affect any existing surficial contaminants.

3.1.3 Soils

Mesa-Top Soils. Section 2.6.2.3 of the IWP discusses the soils of the Pajarito Plateau. Soils in the vicinity of TA-1 are loamy, mixed, frigid Lithic Ustorthent (Pogna series) (Nyhan et al. 1978, 0161). In general, the Pogna series consists of shallow well-drained soils that formed in material weathered from tuff on gently to strongly sloping mesa tops. Typically, these soils are a light brownish gray, fine, sandy loam over tuff bedrock. The available water capacity of these moderately permeable soils is low, and the effective rooting depth is relatively shallow (8–20 in.). Run-off and water erosion are moderate.

During the 1970s decommissioning and decontamination of TA-1 (Section 2.2.4), large amounts of contaminated soil (19 650 yd3) were removed to material disposal areas (MDAs) outside of TA-1. Clean soil from TA-53 and TA-55 (under construction during 1974–1976) was used to fill the excavated areas. Soils

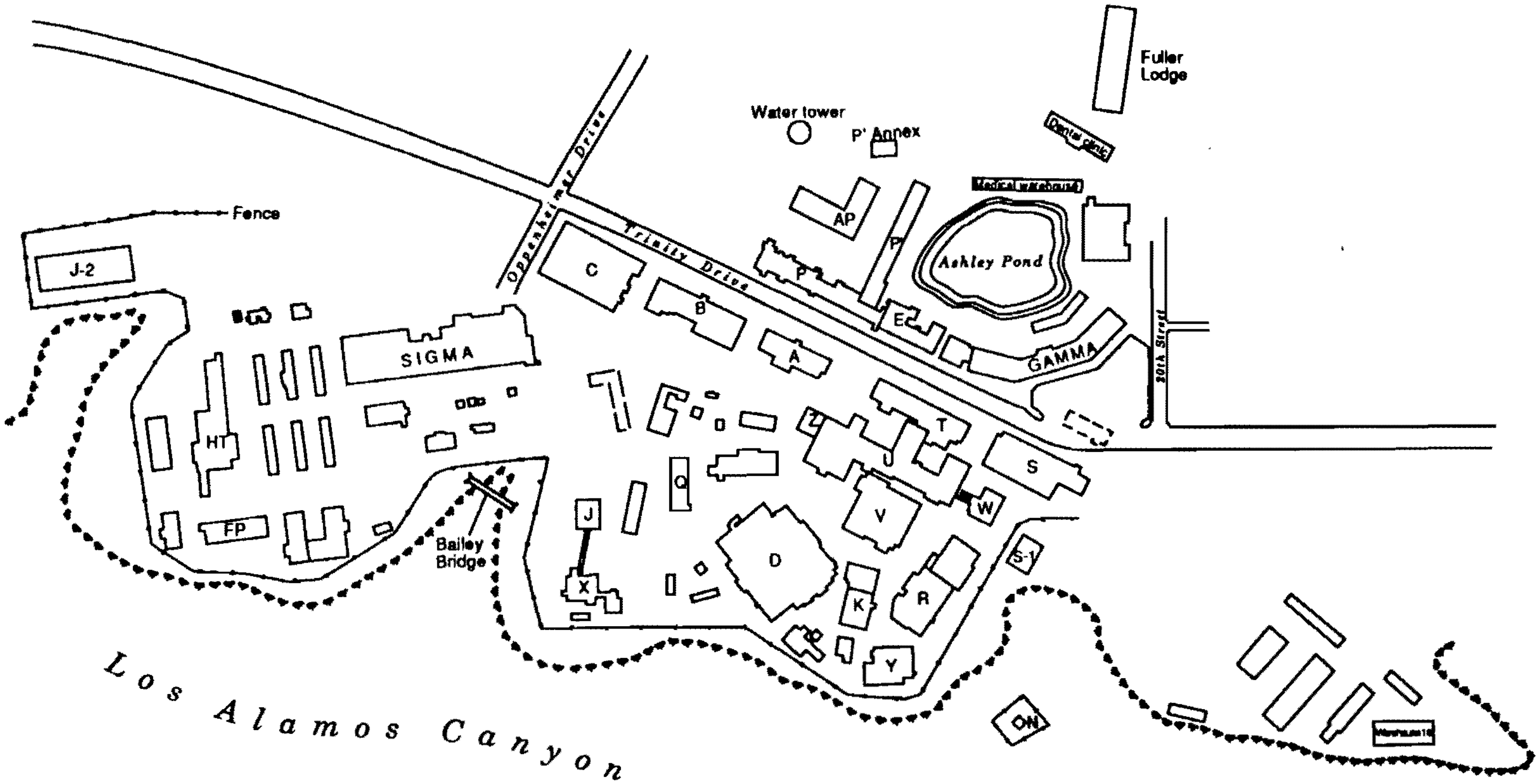


Figure 3.1-2 TA-1, circa 1943-1954.

from TA-53 were identified by Nyhan et al. (1978, 0161) as consisting of tuff rock outcrop (65%), very shallow undeveloped soil (5%), Hackroy sandy loam (5%), and narrow escarpments (25%). Soils from TA-55 were identified as belonging to the Carjo series. These soils are described as a grayish brown loam or a very fine sandy loam at surface depths. At greater depths (4–16 in.), the soils from TA-55 consist of a brown and/or reddish brown clay loam.

A majority of the natural surface soil of the TA-1 mesa top has been altered by anthropogenic activities. Excavation and fill, paved roads, parking lots, parks, landscaped yards, and buildings have considerably changed the natural soil landscape.

Canyon Walls and Canyon Floor Soils. The slopes between the mesa tops and canyon floors are generally steep rock outcrops, consisting of approximately 90% exposed bedrock and patches of shallow, early development soils. South-facing canyon walls (also referred to as hillsides in this document) below TA-1 are very steep and have relatively little soil or vegetation (Nyhan et al. 1978, 0161).

A portion of the lower-elevation, south-facing wall of Los Alamos Canyon is mapped as unnamed soils of the Typic Ustorthents-Rock Outcrop Complex, formed on colluvial material mantling the lower slope. The Typic Ustorthents are deep, well-drained soils. The surface layers of the Typic Ustorthents are generally a pale brown stony or gravelly sandy loam approximately 2 in. thick. The substratum may be as deep as 59 in. and generally consists of a very pale brown, or light gray, gravelly, loamy sand or sand (Nyhan et al. 1978, 0161).

Colluvial material occasionally mantles the lower slope of the mesa. Occasionally a gradient break in the slope occurs at the contact of stratographic units within the tuff, creating local soil-covered benches. Benches will be important sampling areas for the OU 1078 RFI.

3.1.4 Surface Water Hydrology

The floor of Los Alamos Canyon, located directly south of the OU 1078 area and outside its boundaries, has an ephemeral stream for most of the year. The stream is dependent on annual precipitation and releases from the upstream Los Alamos Reservoir.

Run-off and infiltration are the significant aspects of surface water hydrology at TA-1. Run-off may cause potential TA-1 contaminants to move into surface waters, become concentrated in drainages, and deposit downstream. It is expected that, during the 27 years since the last technical building was demolished at TA-1, significant removal of contaminants from TA-1 by surface water run-off has occurred. Surface water infiltration may cause potential TA-1 contaminants to be transported into subsurface soils, the vadose zone, and alluvial aquifers located on the floor of Los Alamos Canyon. Surface hydrology aspects of immediate relevance include

- areas and paths of surface water run-off, sediment transport rates, and sediment deposition areas;
- soil erosion rates relevant to future exposure of presently covered residual contamination; and
- locations and sizes of areas of disturbed and undisturbed surface soils in drainages.

3.1.4.1 Surface Water Run-off

During summer thunderstorms and spring snowmelt, run-off flows into the ephemeral stream in Los Alamos Canyon below TA-1. Summer storm run-off reaches a maximum discharge in less than 2 hours and generally lasts less than 24 hours. This high discharge rate can transport large masses of suspended and bed sediments for considerable distances, possibly the entire stream length. The run-off flow in the stream on the floor of Los Alamos Canyon is of secondary interest to OU 1078 because the canyon floor lies within the bounds of OU 1049 and is outside the purview of the OU 1078 work plan.

Surface run-off from the TA-1 mesa top enters Los Alamos Canyon by way of several primary drainages. Because of extensive residential and commercial mesa-top development, current mesa-top run-off carries much less sediment load than past mesa-top run-off. However, the current volume of liquid run-off per event would be expected to be higher than in the past because of lower water retention on the mesa top. Although mesa-top development has decreased area-wide erosion to the mesa top itself, it may have increased erosion to the canyon wall areas.

Sediment transport by surface water run-off is dependent upon soil properties and water velocity. Contaminants that may have been released onto mesa-top and hillside soils may chemically bind to and be transported with soil particles. The silt-clay fraction of soil often enhances contaminant retention because of the mineralogy and the higher specific surface area of the small clay particles. Once detached from soil, silt-clay sediments are readily transported in suspension, making surface water run-off an efficient contaminant transport mode. Movement with sediment is the primary mode of surface water transport in the semiarid ecosystem of Los Alamos for insoluble contaminants such as uranium and plutonium (Hakonson and Nyhan 1980, 0117; Hakonson et al. 1979, 0119; Hakonson et al. 1981, 0121).

3.1.4.2 Surface Water Infiltration

Undoubtedly, many small-volume liquid discharges of contaminants to soil occurred at TA-1 during its active years. Laboratory studies summarized in Chapter 2 of the IWP indicate that infiltration of surface water into the tuff bedrock is not a significant mechanism for the movement of contaminants on the mesa tops occupied by Laboratory facilities. These studies show that even the prolonged presence of a water source on the mesa top (which is not the case at TA-1) produces only a limited transfer of moisture to or through the tuff. The strong evaporative potential associated with the semiarid climate paired with transpiration in vegetated areas leads to rapid removal of water from soil and upper tuff. The IWP documents the following surface water infiltration studies (LANL 1991, 0553).

- Section 2.6.3.1.2, Movement of Fluids Through Tuff, notes that much infiltrating water is quickly lost through evapotranspiration, that a natural clay layer in native soil profiles may form an infiltration barrier, and that clay filling of joints and fractures in the tuff may inhibit infiltration.
- Section 2.6.3.3.1, Pit Infiltration Studies, describes a study in which a continuous supply of water to a pit dug in soil above the natural clay layer did not significantly increase the moisture content of the underlying tuff.
- Section 2.6.3.4.2, Fracture Orientation Patterns, describes jointing and fracturing of the tuff and notes that many joints are filled with caliche, brown clay, or limonitic material that can block flow along fractures.
- Section 2.6.3.4.3, Moisture Studies, indicates that little precipitation passes through undisturbed soil profiles, whereas a greater amount of infiltration penetrates to the tuff in areas where the soil has been disturbed. Moisture from a single storm event can penetrate as deep as 6.5 ft through disturbed fill, but is subsequently rapidly depleted by evaporation. Seasonal moisture fluctuations were detected in the bedrock tuff and in fill to depths of 13 ft. A downward moisture flux can be identified at that depth in fill but not in the tuff bedrock.
- Section 2.6.3.4.6, Vadose Zone Studies, indicates that precipitation moisture does not penetrate deeper than 10 to 22 ft into tuff.

In summary, Laboratory studies indicate that relatively little water has infiltrated into the underlying tuff at TA-1 because of low infiltration rates and high evapotranspiration rates.

3.1.5 Alluvial Aquifers

The surface water run-off pathway leads to the alluvial aquifers as a reservoir for one potentially contaminated media, the shallow ground water. Although TA-1 does not contain any alluvial aquifers, some exist on the canyon floor (OU 1049). Detection of contaminated alluvial aquifers in Los Alamos Canyon between TA-1 and TA-21 may indicate the impact prior surface water releases have had on contaminant migration.

3.1.6 Geology

The geologic setting of the Pajarito Plateau is described in Section 2.6.2 of the IWP. As illustrated in Figure 3.1-3, TA-1 is situated on the Bandelier Tuff, which includes (from top to bottom) the Tshirege (Figure 3.1-4), Cerro Toledo, Otowi, and Guaje members. These units are composed of volcanic ash flows and ash falls. Depending on the nature of the deposit, the rock varies from loose pumice to hard, highly

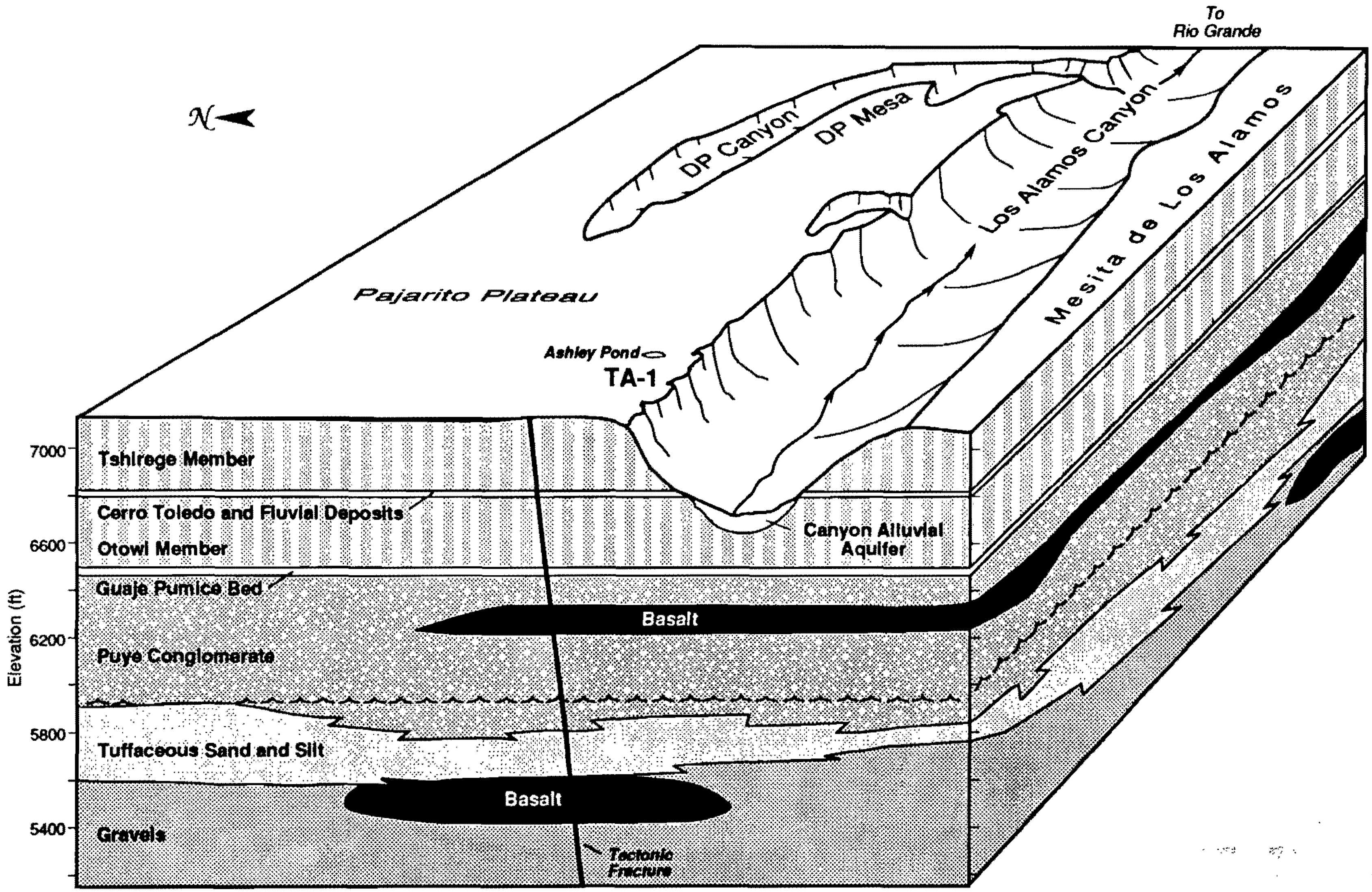


Figure 3.1-3. Generalized geologic block diagram of the Pajarito Plateau.

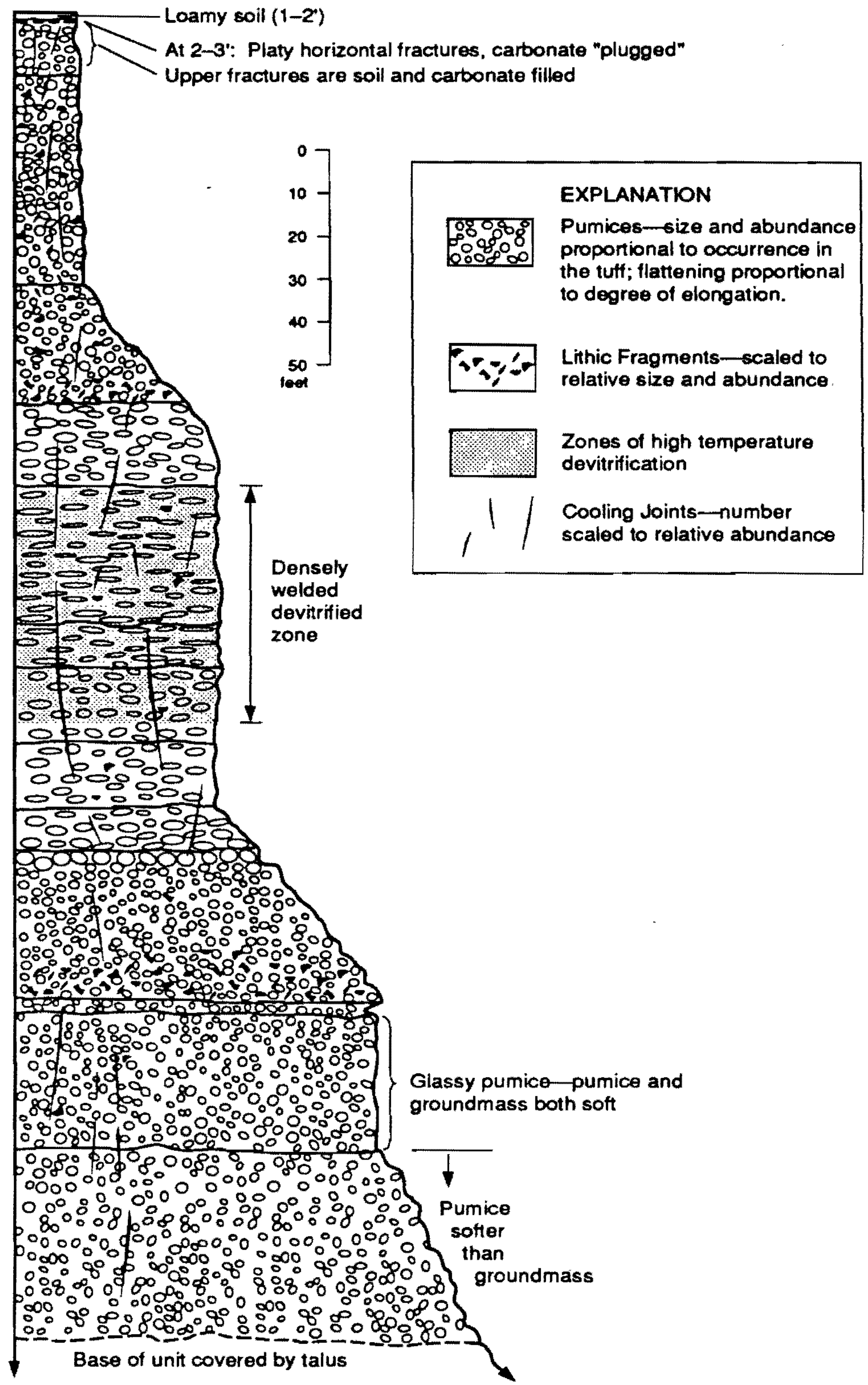


Fig. 3.1-4. Schematic stratigraphic section showing the lithology of the Tshirege Member of the Bandelier Tuff in Los Alamos Canyon.

welded tuff. Degrees of welding vary within the individual units depending on the local conditions of deposit and cooling. Volcanic ash deposits are underlaid by the sediments of the Santa Fe group (Puye and Tesuque Formations) and basalt flows (basaltic rocks of Chino Mesa).

Knowledge of the geology beneath the OU-1078 is important because it has been established that this type of geologic setting provides substantial impedance to contaminant migration by hydraulic flow (Section 3.1.4.2). There are approximately 1250 ft of volcanic and sedimentary materials (the Santa Fe group) between any potential contaminant-bearing units at the surface of TA-1 and the surface of the regional aquifer (Figure 3.1-5).

Stratigraphy. General geological stratigraphy for the Laboratory is discussed in Section 2.6.2.2 of the IWP. The stratigraphy of the upper rock units (tuff) at TA-1 can be observed directly in excellent exposures of outcrops on canyon walls and slopes to the south of TA-1.

Faulting. Section 2.6.2.4 of the IWP discusses faulting activity for the area of the Laboratory. The Pajarito Plateau is within the Espanola Basin of the Rio Grande rift. The western edge of the Pajarito Plateau is marked by the Pajarito fault system, which also forms the western margin of the Espanola Basin. The Pajarito fault system has had Holocene movement and historic seismicity (Gardner and House 1987, 0110).

3.1.7 Vadose Zone Hydrology

The hydrology of the unsaturated zone of the Pajarito Plateau is discussed in Section 2.6.3 of the IWP. It includes discussions of the hydrogeologic properties of the tuff and the limited movement of fluids through the tuff and describes related studies that have been conducted at the Laboratory (Section 3.1.4.2). The summary of the studies provides strong support for the concept that the unsaturated zone of the Bandelier Tuff provides substantial impedance to the movement of liquid in the subsurface (Section 3.1.4.2).

An understanding of the vadose zone at TA-1 is important because it is the primary barrier to any movement of liquids and vapors potentially originating from SWMUs. For a depth of more than 1200 ft, the subsurface hydrology is dominated by unsaturated flow conditions. The top of the saturated zone of the regional aquifer occurs approximately 1250 ft below the surface of the mesa. Hydrologic characterization of the Bandelier Tuff has concentrated on the upper 100 ft of tuff throughout most of the Laboratory (Abrahams 1963, 0012; Abeele et al. 1981, 0009; Kearl et al. 1986, 0135). The properties of the Bandelier Tuff underlying TA-1 are expected to be similar to the properties of the Bandelier Tuff beneath TA-21, where tuff pilot studies are being conducted under the OU 1106 RFI. The following subsections present some information useful in assessing movement of water and vapors in the unsaturated zone below TA-1.

3.1.7.1 Properties of Tuff

Hydrogeologic properties of tuff such as porosity, permeability, moisture content, hydraulic conductivity, and moisture characteristic curves are parameters required for hydrogeological modeling of vadose zone contaminant movement. Most available data are for Laboratory studies on crushed Bandelier Tuff (Abeele 1984, 0002; Abeele et al.1986, 0229); no data on OU 1078 *in situ* properties are available. These types of data are being acquired by Environmental Restoration (ER) Program framework studies currently in progress at the Laboratory.

Porosity. The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges from 30 to 60% by volume, generally decreasing for more highly welded tuff (Section 2.6.3.1.1 of the IWP).

Permeability. Permeability relates to the movement of a fluid through porous or fractured media. Permeability varies for each cooling unit of the Bandelier Tuff. Values for the Tshirege Member of the Bandelier Tuff at TA-54, located southeast of TA-1, were determined using *in situ* vacuum and water injection tests. Laboratory analyses of cores range from 0.1 to 0.6 darcies (Kearl et al. 1986, 0135; Stoker and McLin 1990, 09-0012).

Moisture Content. The moisture content of native tuff below the mesa tops is low (generally less than 5% by volume) throughout the profile (Section 2.6.3.1.1 of the IWP). Previous studies at the nearby TA-21 MDAs (where large-volume mesa-top discharges of liquid have occurred) have shown that moisture content changes little below 40 ft (Abrahams 1963, 0012; Christenson and Thomas 1962, 0039). At TA-21 the specific retention of moisture in tuff ranges from 18 to 38% by volume, indicating a considerable tuff capacity for holding moisture (Purtymun et al. 1990, 0215). Recent work by Stoker et al. (1991, 0715) at Mortandad Canyon, 2.5 miles southeast of TA-1, suggests that moisture content in tuff beneath canyon floors is higher than beneath mesa tops but is still less than saturation.

Hydraulic Conductivity. Hydraulic conductivity is the term used to quantify the permeability of the medium. It is largely dependent on the porosity of the medium as well as the conductive properties of the fluid flowing through the medium. Saturated tuff has a hydraulic conductivity of approximately 0.02 cm/hr for welded tuff and 1.12 cm/hr for nonwelded tuff (Section 2.6.3.1.1 of the IWP) (Purtymun et al. 1989, 0214). Laboratory saturated hydraulic conductivity measurements from cores at TA-21 MDAs T and V range from 0.16 to 1.10 cm/hr (Abrahams 1963, 0012; Nyhan et al. 1984, 0167). *In situ* hydraulic conductivity studies at TA-54, approximately 3.6 mi. southeast of TA-1, yielded values ranging from 1.63 to 4.44 cm/hr using air injection and vacuum tests respectively (Kearl et al. 1986, 0135).

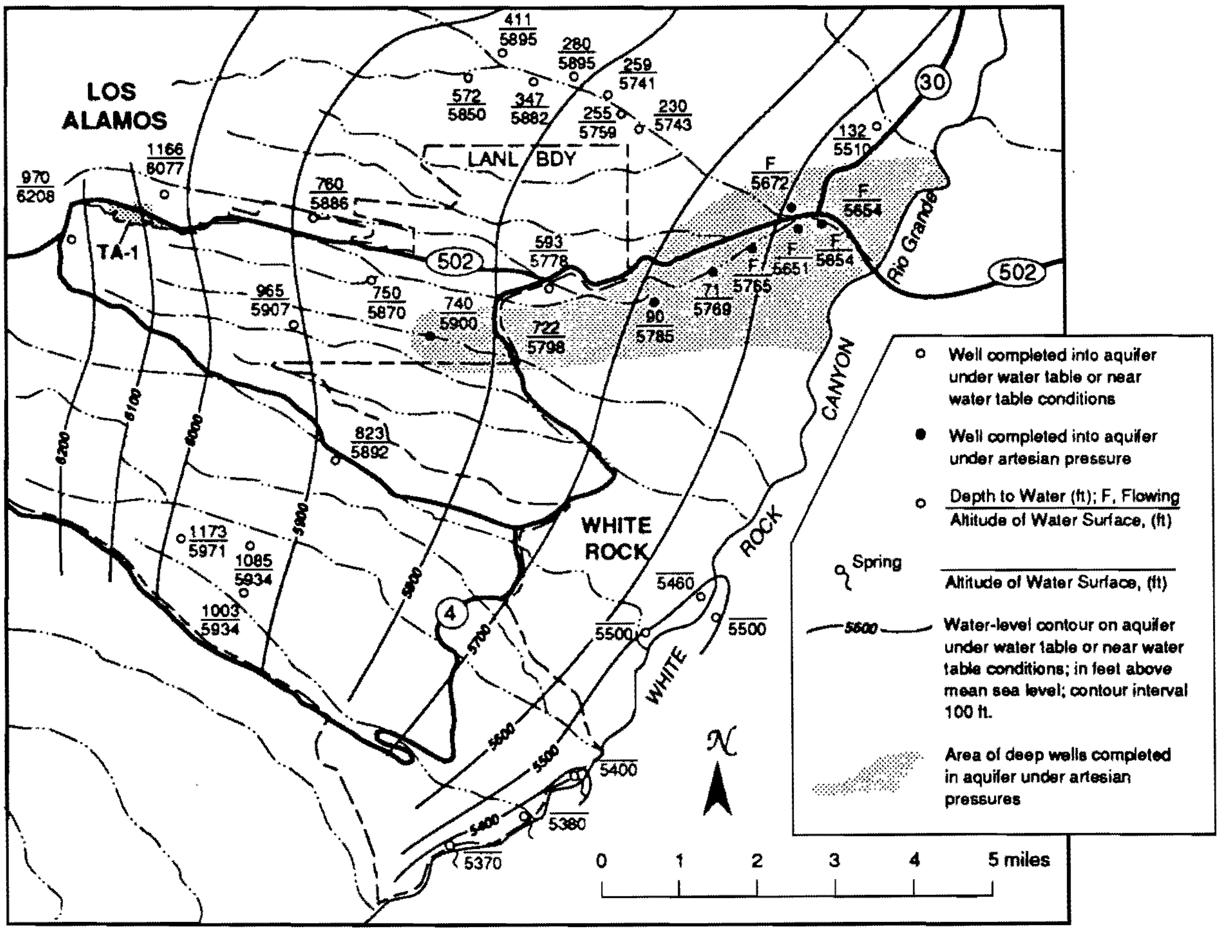


Fig. 3.1-5 Generalized contours above main aquifer (Purtymun and Johansen 1974).

The hydraulic conductivity of unsaturated tuff varies with moisture content and has values two to five orders of magnitude lower than saturated tuff (Purtymun et al. 1989, 0214). All 800 ft of the tuff underlying TA-1 should be unsaturated.

Injection Well Study. Hydrologic characteristics of Bandelier Tuff are presented in a recent report documenting an injection well study (Purtymun et al. 1989, 0214). Purtymun determined that a moderately welded tuff with an effective porosity of approximately 38% by volume has moisture movement by diffusion at moisture content above 6–12% by volume, by capillary forces in the range of approximately 13–24% by volume, and by gravity for 24–38% moisture by volume. During the injection well tests, it was discovered that considerable pressure was required to continuously inject water. The tuff near the injection well became saturated, but farther out from the well the three slower unsaturated flow mechanisms dominated and resisted the rapid movement of fluid that was possible only in the saturated zone. Further, it was found that when injection ceased, the zone of saturation was gradually depleted as unsaturated flow mechanisms removed the fluid. With time, the system stabilized at low moisture content where further moisture movement was minimal.

Two aspects of this description are important. First, unsaturated tuff effectively resists rapid influx or percolation of water (Abeele et al. 1981, 0009; Weir and Purtymun 1962, 0228). This barrier phenomenon may supplement the clay layer barrier in the lower soil profile as an explanation of the observed low precipitation infiltration rates. Second, even when accepted by the tuff, fluids are not rapidly transmitted downward. Their mobility is retarded, and fluids are dispersed in the tuff near their point of infiltration.

3.1.8 Saturated Zone Hydrology

Section 2.6.6 of the IWP describes the main aquifer beneath the Pajarito Plateau. The surface of the aquifer lies in the Santa Fe group well below the base of the Bandelier Tuff. Figure 3.1-5 shows the regional aquifer surface contours (Purtymun and Johansen 1974, 0199). The depth to the top of the the aquifer beneath TA-1 is not precisely known but is estimated to be approximately 1250 ft. Regional directional flow of the aquifer is from west to east and is expected to be the same beneath TA-1.

No evidence of any Laboratory-related contaminant has ever been detected in water samples collected from the main aquifer. Sampling of the main aquifer in immediate proximity to TA-1 has not been done. Because there is no evidence of subsurface migration of water through the more than 1200 ft of overlying vadose zone, there is no compelling reason to drill wells to accomplish regional aquifer sampling directly below TA-1.

Ground water modeling is being undertaken as part of the ER framework studies and will not be done independently at the OU 1078 as part of this RFI.

3.2 Environmental Data

This section summarizes the environmental data available for the OU 1078 environment. The Laboratory environmental surveillance programs include stations that are in proximity to Laboratory facilities and monitor the effect of releases close to the source. Data from stations near TA-1 are presented here to determine the presence of any potential contaminants that might have originated from TA-1.

Data are collected from on-site stations shown in Figures 3.2-1 and 3.2-2. These data represent the best available information to describe possible contaminant contribution attributable to the OU 1078 as well as unimpacted natural conditions in the vicinity of the Laboratory.

3.2.1 Surface Water

Surface water run-off from precipitation events has undoubtedly moved some radioactive contaminants from mesa-top operations (including those at TA-1) into the canyons below. Table 3.2-1 gives data for plutonium in solution (and in transported sediments) during snowmelt run-off at GS-2 Station in Los Alamos Canyon approximately 2 miles below the confluence with DP Canyon (Figure 3.2-1). The plutonium in solution, however, is in the same range as background levels reported in deep ground water wells (Purtymun et al. 1990, 0215; ESG 1989, 0308).

It is suspected that TA-1 chemical contaminants may have infiltrated into the shallow aquifer of Los Alamos Canyon. A broad suite of chemical analyses were taken in 1986 (Purtymun and Stoker 1988, 0205) from six ground water locations in Los Alamos Canyon. No contaminants were present above detection limits.

3.2.2 Ground Water

The main aquifer beneath the Laboratory is routinely sampled in both the supply and distribution systems. Water quality is dependent on well depth, lithology of the aquifer adjacent to the well, and yield from beds within the aquifer. No radionuclides for which the main aquifer has been tested have been detected above the Environmental Protection Agency (EPA) maximum concentration levels (ESG 1989, 0308).

Seven ground water sampling locations in Los Alamos Canyon are shown in Figure 3.2-2. Six of these (the LAO series) sample the alluvial aquifer in the canyon and the seventh (Test Well 3) samples ground water in the Puye Formation at 750 to 815 ft below the canyon floor. Table 3.2-2 summarizes data on radionuclides in water from the six wells during the five-year period of 1984 through 1988. All radionuclides are within the range of background levels as defined by samples from the main aquifer (Test Well 3, Figure 3.2-2). In the alluvial aquifer, the levels of ^{137}Cs and ^{238}Pu are within the range of background

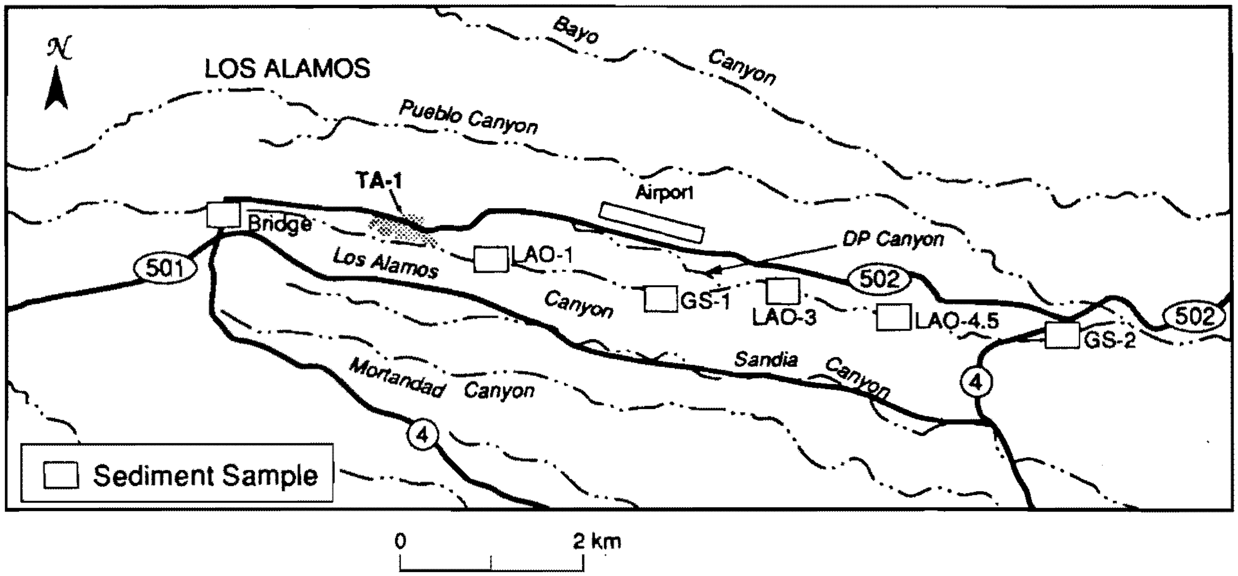


Fig. 3.2-1. Sediment sampling locations in Los Alamos Canyon.

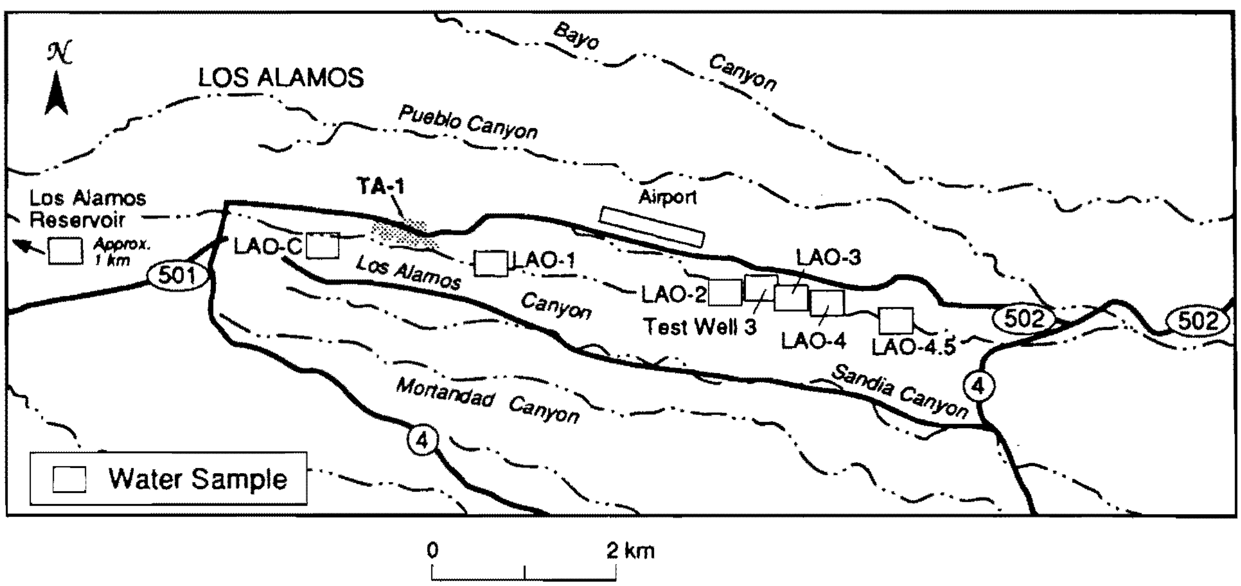


Fig. 3.2-2. Surface and groundwater sampling locations in Los Alamos Canyon.

at all sampling locations. Uranium is also in the range of background, except at LAO-2 downstream of TA-1 and TA-21, where the total uranium concentration may be slightly elevated. From LAO-2 downstream through the remaining wells sampled, $^{239/240}Pu$ is slightly above the range of background in water.

TABLE 3.2-1

PLUTONIUM IN RUN-OFF WATER, SUSPENDED SEDIMENTS, AND BED SEDIMENTS IN LOS ALAMOS CANYON BELOW DP CANYON (STATION GS-2)

Year	TOTAL PLUTONIUM Solution (pCi/L)	Suspended Sediments (pCi/g)	Bed Sediments (pCi/g)
1975*	0.03	1.16	0.18
1979*	0.01	4.56	0.40
1980*	0.01	5.37	0.17
1982*	0.05	11.1	0.31
1983*	0.01	4.97	0.24
1985*	0.03	5.47	0.82
1986*	0.01	1.84	0.29
1987**	0.021	2.05	---
1988***	0.004	3.32	---

*(Purtymun et al. 1990, 0215).
**(ESG 1988, 0308) ^{238}Pu and $^{239/240}Pu$ concentrations were summed to give total plutonium.
***(ESG 1989, 0308) ^{238}Pu and $^{239/240}Pu$ concentrations were summed to give total plutonium.

The main aquifer below the Laboratory has been tested for several chemical constituents none of which have been found to be above EPA drinking water standards (ESG 1989, 0308).

3.2.3 Soil and Sediment

This section describes concentrations of radionuclides and trace elements in soil and stream sediments near TA-1 and in Los Alamos Canyon.

Laboratory-wide sampling data for sediments have been shown to be very similar to Laboratory sampling data in soil with the exception of ^{137}Cs (Chapter 2 of the IWP). This may indicate that a distinction between soil and sediment samples is unnecessary for ephemeral drainages where the sediments are eroded soil materials that are not continually washed by flowing water.

Data on radionuclide concentrations in TA-1 soil were collected by Ahlquist et al. (1977, 0016) during the 1975–1976 decontamination and decommissioning efforts. That data is presented in detail in Chapter 4 where radiological dose estimations are made.

TABLE 3.2-2

RADIONUCLIDE CONCENTRATIONS IN THE ALLUVIAL AQUIFER AND THE MAIN AQUIFER BENEATH LOS ALAMOS CANYON

Site	Tritium pCi/mL	^{137}Cs pCi/L	^{238}Pu pCi/L	$^{239/240}$Pu pCi/L	Total U µg/L
Alluvial Aquifer					
LAO-C	0.4 ± 0.8	34.3 ± 36.1	0.006 ± 0.010	0.002 ± 0.009	1.0 ± 0.8
LAO-1	6.8 ± 8.0	0.0 ± 44.1	-0.000 ± 0.008	0.009 ± 0.012	1.1 ± 0.5
LAO-2	7.3 ± 11.4	33.6 ± 44.8	0.010 ± 0.009	0.069 ± 0.076	5.1 ± 9.5
LAO-3	8.2 ± 12.1	-24.7 ± 42.8	0.009 ± 0.014	0.037 ± 0.052	2.2 ± 1.4
LAO-4	3.9 ± 4.5	30.9 ± 65.5	0.022 ± 0.033	0.051 ± 0.054	1.4 ± 1.2
LAO-4.5	4.3 ± 5.4	5.2 ± 65.3	0.006 ± 0.013	0.049 ± 0.053	1.6 ± 1.1
Main Aquifer					
TW-3	0.3 ± 1.2	10.0 ± 25.4	0.006 ± 0.013	0.010 ± 0.018	1.1 ± 1.1
EPA MCL (primary std.)	20.	200.	15.	15.	

Table 3.2-1 presents sediment data on the plutonium concentrations in Los Alamos Canyon during run-off events over the course of the nine-year period of 1975 and 1979 through 1988. Table 3.2-3 presents the results of analyses for several radionuclides in sediments collected when the channel was not flowing from 1984 through 1988. Samples were collected at six locations in Los Alamos Canyon. The data are also presented in Figures 3.2-3 and 3.2-4; concentrations are plotted as a function of the sampling location in the canyon. The data indicate background levels of radionuclide content of sediments at the bridge location farthest upstream in Los Alamos Canyon. At the LAO-1 station, a slight increase is seen in some radionuclides in the sediments. Tritium, strontium-90, and uranium are within the range of background for the length of Los Alamos Canyon, but cesium-137, plutonium-238, -239, -240, and americium-241 are above background levels just downstream of TA-1 (Figures 3.2-3 and 3.2-4).

No data are available for hazardous organic chemicals that may occur in soil or sediments on the Pajarito Plateau. For this document, it is assumed that any naturally occurring hazardous organic compounds are below the detection limit of analytical techniques specified for the analysis of samples (Chapter 5 and Annex II). However at TA-1, it is expected that some soil samples will exhibit the presence of semivolatile organic compounds, such as polynuclear aromatic compounds (PNAs). PNAs are constituents of the asphalt roads that formerly crossed TA-1. If asphalt chunks or particles are evident in soil samples, low concentrations of some PNAs will undoubtedly be detected. This is documented in several ER interim action reconnaissance sampling tasks accomplished by the EM-8 group in 1990 (Fresquez 1990, 09-0011).

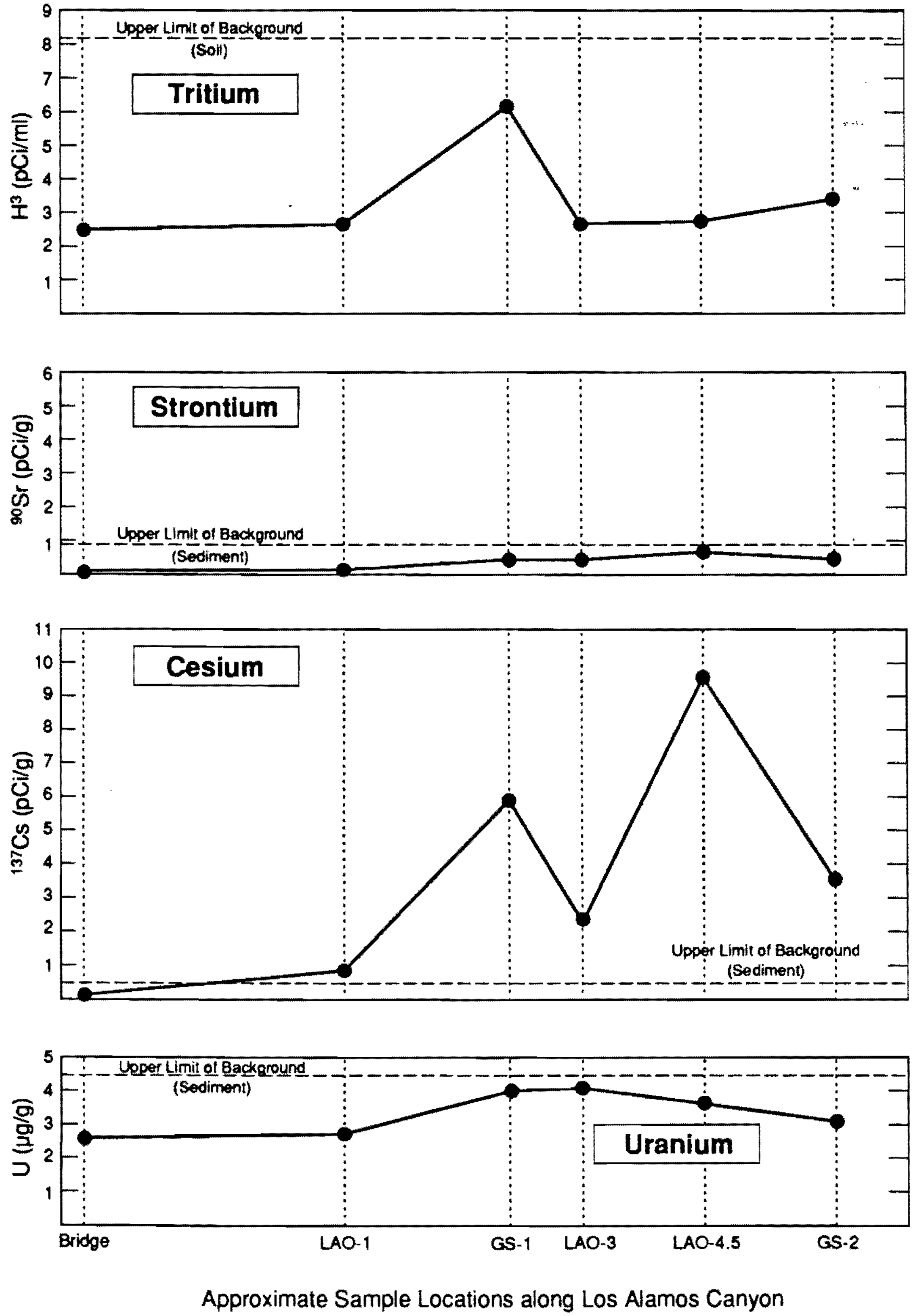


Figure 3.2-3. Graphs showing concentrations of tritium, strontium, cesium and uranium in samples along Los Alamos Canyon.

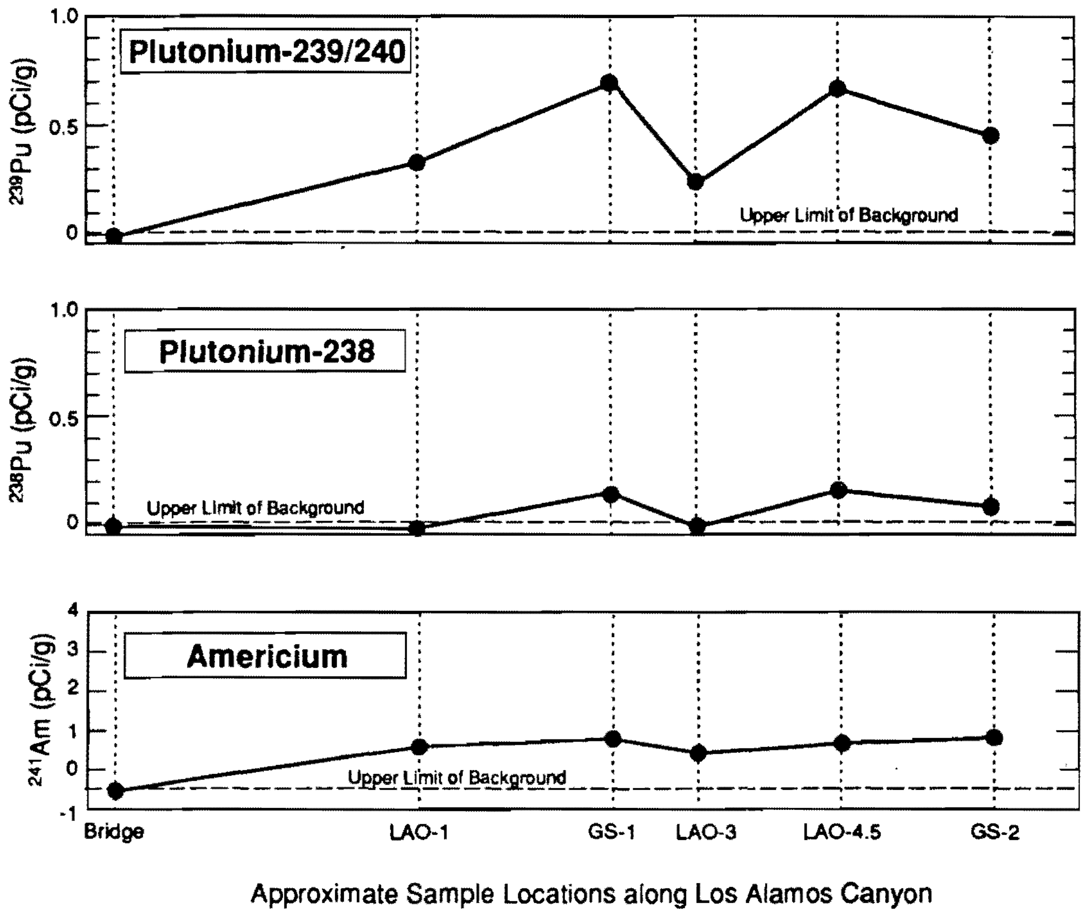


Figure 3.2-4. Graphs showing concentrations of plutonium-238, -239/240, and americium in samples along Los Alamos Canyon.

3.2.4 Air

Some measurements are available on radionuclide concentrations in air at TA-1. Data focus on radionuclides. Figure 3.2-5 identifies six air sampling locations in the vicinity of TA-1. On-site Laboratory monitoring includes a thermoluminescent dosimeter station located at the center of TA-1 behind the Shell Service Station at the corner of Trinity and Oppenheimer Drives. Table 3.2-4 summarizes the air monitoring data from these six stations and three regional stations (regional data have been added for comparison purposes) (Figure 3.2-5) for the five-year period from 1984 through 1988. Samples were collected and analyzed monthly for tritium and quarterly for total uranium and $^{239/240}Pu$.

For data on radioactivity, levels measured must be greater than two standard deviations above background or regional levels to be considered above detection limit. By this standard, air sampling stations in the vicinity of TA-1 have not measured tritium levels above regional levels. In any case, it is very unlikely that TA-1 would be the source of any airborne contribution of tritium decades after operational activities

TABLE 3.2-3

RADIONUCLIDE CONCENTRATIONS IN SEDIMENTS OF LOS ALAMOS CANYON, 1984–1988[a]

Location	Tritium[b,d] (pCi/mL)	^{90}Sr[c,e] (pCi/g)	^{137}Cs[e] (pCi/g)	U[e] (μg/g)	^{238}Pu[e] (pCi/g)	$^{239/240}Pu$[e] (pCi/g)	^{241}Am[f] (pCi/g)
Los Alamos Canyon							
At bridge	2.4 ± 0.8	0.1 ± 0.2	0.2 ± 0.2	2.6 ± 1.1	0.000 ± 0.001	0.009 ± 0.015	-0.289 ± 0.658
LAO-1	2.6 ± 0.8	0.2 ± 0.2	0.8 ± 0.8	2.8 ± 0.9	0.006 ± 0.009	0.317 ± 0.166	0.433 ± 0.812
GS-1	5.2 ± 1.2	0.5 ± 0.3	5.9 ± 5.5	4.0 ± 1.3	0.141 ± 0.107	0.695 ± 0.274	0.753 ± 0.880
LAO-3	2.6 ± 0.8	0.5 ± 0.4	2.3 ± 2.7	4.1 ± 4.5	0.030 ± 0.030	0.241 ± 0.126	0.394 ± 0.655
LAO-4.5	2.7 ± 0.8	0.7 ± 0.4	9.6 ± 10.6	3.7 ± 1.1	0.134 ± 0.113	0.689 ± 0.558	0.575 ± 2.054
At State Road 4	3.4 ± 0.8	0.5 ± 0.2	3.6 ± 3.0	3.1 ± 1.2	0.080 ± 0.038	0.426 ± 0.260	0.816 ± 0.837

[a]ESG (1985–1989).
[b]Data from one year (1984) only.
[c]Data from four years (1984–1986, 1988).
[d]Measurement ± counting uncertainty.
[e]Mean of measurements ± standard deviation (x ± s).
[f]Data for four years (1984–1987).

ceased. It is known that elevated levels of tritium in soil at TA-21 (OU 1106 located just southeast of TA-1) exist and are present in the permitted liquid effluent from TA-21's sewage treatment plant. TA-21 is one possible source of any airborne tritium measured on the Pajarito Plateau.

For $^{239/240}Pu$, the results from the perimeter stations in the vicinity of TA-1 are comparable to those from regional stations. Total uranium measurements for all stations were within the range expected for background concentrations of uranium in air. Annual average concentrations of these radioactive materials are less than 0.1% of DOE-derived air concentration guides for uncontrolled areas. Concentration guides are included in Table 3.2-4.

Because the Los Alamos area is remote from major sources of air pollution, such as large metropolitan areas, air monitoring for nonradioactive contaminants, such as organic compounds, has not been conducted.

TABLE 3.2-4

AIRBORNE RADIOACTIVITY IN THE VICINITY OF TA-1*

Air Monitoring Station	Tritium pCi/m³	$^{239/240}Pu$ pCi/m³ ($10^{-18}\mu Ci/mL$)	Total U pg/m³
Regional			
Espanola	4.7 ± 2.8	1.0 ± 0.8	75.8 ± 47.4
Pojoaque	6.4 ± 3.7	0.3 ± 0.5	96.7 ± 43.7
Santa Fe	3.2 ± 2.6	1.0 ± 0.6	54.8 ± 41.0
`x ± s	4.8 ± 3.3	0.8 ± 0.7	75.8 ± 47.3
Nearby Perimeter Stations			
6 East Gate	12.4 ± 7.5	1.3 ± 0.5	37.7 ± 6.6
8 LA Airport	11.4 ± 4.6	2.1 ± 1.8	60.0 ± 28.2
9 Bayo STP	4.4 ± 1.5	1.1 ± 0.8	43.9 ± 37.3
10 Shell Station	11.0 ± 2.0	2.6 ± 1.1	45.6 ± 4.4
`x ± s	9.7 ± 5.6	1.8 ± 1.3	46.9 ± 25.7
`x ± s w/o Bayo	11.2 ± 5.5	2.0 ± 1.3	52.6 ± 26.0
On-site Stations near TA-1			
15 TA-21	26.5 ± 16.5	1.0 ± 0.4	45.8 ± 11.5
17 TA-53	13.9 ± 5.4	0.9 ± 0.7	35.6 ± 11.0
DOE Air Concentration Guides	$1x10^5$	$1x10^4$	$1x10^5$

*ESG (1985–1989).

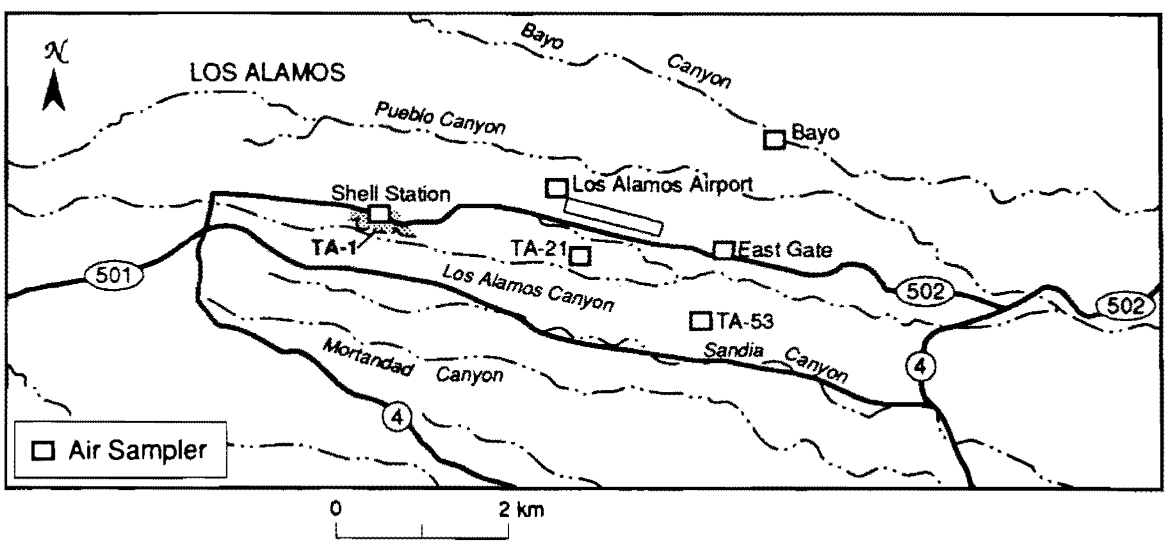


Figure 3.2-5. Air sampling locations potentially susceptible to TA-1 emissions.

REFERENCES

Abeele, W. V., March 1984. "Hydraulic Testing of Crushed Bandelier Tuff," Los Alamos National Laboratory report LA-10037-MS, Los Alamos, New Mexico. (Abeele 1984, 0002)

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)

Abeele, W. V., H. R. Fuentes, and J. Hosch 1986. "Characterization of Soil Moisture Characteristic Curves in the 30 to 1000 k Pa Tension Range for Bandelier Tuff in Waste Disposal Areas G and L, Technical Area 54, Los Alamos National Laboratory," report prepared for Environmental Surveillance Group, HSE-8, Los Alamos National Laboratory, Los Alamos, New Mexico. (Abeele et al. 1986, 0229)

Abrahams, J., February 1963, "Geologic and Hydrologic Environment of Radioactive Waste Disposal Sites at Los Alamos, New Mexico," US Department of the Interior geological survey, Albuquerque, New Mexico. (Abrahams 1963, 0012)

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

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

Christenson, C. W. , and R. G. Thomas, March 1962. "Movement of Plutonium Through Los Alamos Tuff," in *Ground Disposal of Radioactive Wastes, Second Conference Proceedings*, No. TID-7628, prepared by The Johns Hopkins University, Baltimore, Maryland. pp. 248-281. (Christenson and Thomas 1962, 0039)

ESG, June 1989. Environmental Surveillance at Los Alamos During 1988, Los Alamos National Laboratory report LA-11628-ENV, Los Alamos, New Mexico. (ESG 1989, 0308)

Fresquez, P., December 18, 1990. "Results of an Environmental Restoration Interim Action (ERIA) Reconnaissance Survey at a Site Where a Drum Storage Facility Will be Built at TA-55," Los Alamos National Laboratory memorandum from P. Fresquez to J. Krueger, Los Alamos, New Mexico. (Fresquez 1990, 09-0011)

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)

Hakonson, T. E., G. C. White, E. S. Gladney, and M. Dreicer, April 1979. "The Comparative Distribution of Stable Mercury, Cesium-137, and Plutonium in an Intermittent Stream at Los Alamos," in Environmental Surveillance at Los Alamos During 1978, Los Alamos Scientific Laboratory report LA-7800-ENV, Los Alamos, New Mexico. (Hakonson et al. 1979, 0119)

Hakonson, T. E., and J. W. Nyhan 1980. "Ecological Relationships of Plutonium in Southwest Ecosystems," in Transuranic Elements in the Environment, W. C. Hanson (Ed.), DOE/TIC 22800, Technical Information Center, Springfield, Virginia, pp. 402-419. (Hakonson and Nyhan 1980, 0117)

Hakonson, T. E., R. L. Watters, and W. C. Hanson 1981. "The Transport of Plutonium in Terrestrial Ecosystems," *Health Physics*, Vol. 40, pp. 63-69. (Hakonson et al. 1981, 0121)

Kearl, P. M., J. J. Dexter, and M. Kautsky, March 1986. "Vadose Zone Characterization of Technical Area 54, Waste Disposal Areas G and L, Los Alamos National Laboratory, New Mexico, Report 3: Preliminary Assessment of the Hydrogeologic System," Report GJ-44, Bendix Field Engineering Corporation, Grand Junction, Colorado. (Kearl et al. 1986, 0135)

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)

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., G. L. DePoorter, B. J. Drennon, J. R. Simanton, and G. R. Foster 1984. "Erosion of Earth Covers Used in Shallow Land Burial at Los Alamos, New Mexico," *Journal of Environmental Quality*, Vol. 13, No. 3, pp. 361–366. (Nyhan et al. 1984, 0167)

Purtymun, W. D., and S. Johansen, 1974. "General Geohydrology of the Pajarito Plateau," in New Mexico Geological Society Guidebook, 25th Field Conference, held at Ghost Ranch, New Mexico, pp. 347-349. (Purtymun and Johansen 1974, 0199)

Purtymun, W. D., and A. K. Stoker, August 1988. "Water Supply at Los Alamos: Current Status of Wells and Future Water Supply," Los Alamos National Laboratory report LA-11332-MS, Los Alamos, New Mexico. (Purtymun and Stoker 1988, 0205)

Purtymun, W. D., E. A. Enyart, and S. G. McLin, August 1989. "Hydrologic Characteristics of the Bandelier Tuff as Determined Through an Injection Well System," Los Alamos National Laboratory report LA-11511-MS, Los Alamos, New Mexico. (Purtymun et al. 1989, 0214)

Purtymun, W. D., R. Peters, and M. N. Maes, July 1990. "Transport of Plutonium in Snowmelt Run-Off," Los Alamos National Laboratory report LA-11795-MS, Los Alamos, New Mexico. (Purtymun et al. 1990, 0215)

Stoker, A., and S. McLin, June 19, 1990. "Review of Installation Work Plan Section (HSE-DO/ER:131," Los Alamos National Laboratory memorandum HSE-8:90-538 from A. Stoker and S. McLin to M. Devaurs, Los Alamos, New Mexico. (Stoker and McLin 1990, 09-0012)

Stoker, A. K., W. D. Purtymun, S. G. McLin, and M. N. Maes, May 1991. "Extent of Saturation in Mortandad Canyon," Los Alamos National Laboratory report LA-UR-91-1660, Los Alamos, New Mexico. (Stoker et al. 1991, 0715)

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

Chapter 1
Introduction

Chapter 2
Technical Area 1
Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model
for Technical Area 1

Chapter 5
Field Investigation
Methods

Chapter 6
Solid Waste Management
Unit Aggregate
Background Information

Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans

Annexes

Appendices

Chapter 4

- Environmental Pathways
- Identification of Potential Receptors
- Conceptual Site Model
- Dose Estimation Procedures
- Preliminary Dose Estimation
- Prioritization of OU 1078 SWMU Aggregates
- Cultural and Biological Resources

4.0 CONCEPTUAL MODEL FOR TECHNICAL AREA 1

Chapter 4 completes the current understanding of the Operable Unit (OU) 1078 environment through the development of a model that describes the pathways and transport mechanisms that may allow residual contaminants to reach human receptors. The conceptual model is used with soil sampling data in a preliminary dose estimation to prioritize solid waste management units (SWMUs) for field investigation and sampling.

Chapter 4 develops the preliminary dose estimation.

- Section 4.1, Environmental Pathways, describes important migration and exposure pathways of potential contaminants from OU 1078 SWMUs.
- Section 4.2, Identification of Potential Human Receptors, is an evaluation of targets affected by releases along each pathway.
- Section 4.3, Conceptual Site Model, summarizes pathways and receptors at OU 1078.
- Section 4.4, Dose Estimation Procedures, presents assumptions and models used to estimate dose preliminarily.
- Section 4.5, Preliminary Dose Estimation, describes how existing soil sample data are used to estimate radiological dose to Technical Area-1 residents.
- Section 4.6, Prioritization of OU 1078 SWMU Aggregates, contains an ordering of the SWMU aggregates by level of concern.
- Section 4.7, Cultural and Biological Resources, presents information needed to assess impacts resulting from contaminants that may be present in SWMUs. Impact to human health is not included.

Based on information in Sections 4.1 through 4.5, the SWMU aggregates are prioritized so that those of highest concern can be investigated first. Dose estimations were calculated to indicate the magnitude of reasonable maximum exposure for the pathways applicable to TA-1. Use of historical monitoring data can only estimate current exposure concentrations; these data will be modified to reflect more accurate exposure conditions after sampling data is acquired. The field sampling plans, designed to verify information presented in this chapter and gather data relevant to conduct a baseline risk assessment, are provided in Chapter 7.

4.1 Environmental Pathways

This section identifies relevant environmental pathways for any existing contaminants that may be associated with SWMUs at OU 1078. Section 4.1.1 defines four categories of SWMUs and discusses the contaminant release mechanisms and migration pathways for each category.

Section 4.1.2 describes the viable environmental endpoints of the important migration mechanisms identified in Section 4.1.1.

4.1.1 Migration Mechanisms

OU 1078 SWMUs are listed in Chapter 1 (Table 1.6-1). When assessing potential environmental pathways, it is important to note that each SWMU is located on the mesa-top, on the canyon wall, or on both mesa top and canyon wall. Substantial remediation efforts were directed at mesa-top SWMUs and construction activity has covered the majority of the SWMUs with roads, structures, and clean fill. The mesa top and canyon wall differ greatly in their geological characteristics, land-use scenarios, and extent of human activity. For sampling plans and dose estimation analyses, the mesa-top and canyon wall classifications lead to two conceptual models. When defining types of release mechanisms from potential sources of residual contamination, SWMUs fall into the following release categories.

- Surface contamination areas on mesa tops
- Subsurface liquid releases on mesa tops
- Solid waste disposal on canyon walls
- Liquid releases on canyon walls

The descriptions in Table 4.1-1 serve as simple models for each release category of SWMU and identify the nature of the waste (either soil or debris), some typical SWMUs, and principle contaminant migration pathways.

Three viable contaminant migration pathways have been identified for SWMU release categories. These are summarized in Section 4.1-2, where the media representing the environmental endpoints of the migration pathway are identified.

TABLE 4.1-1

MAJOR CONTAMINANT RELEASE AND TRANSPORT MECHANISMS FOR TYPICAL SWMUs

Waste	Representative SWMUs	Description	Release/Transport Mechanisms	
			Primary	Other
I. Surface Contamination Areas on Mesa Tops				
Contaminated surface soil; present contaminant sources are deposited on, mixed with, or sorbed on surface soil	Building remnants, buried structures, surface disposals, and some drainage channels	Includes SWMUs comprised primarily of contaminated surface soil resulting from contaminated building structures, solid waste spills, and inadvertent surface liquid waste leaks or spills of limited volume; surface soil in vicinity of former TA-1 buildings may be contaminated from past operations (spills, overflows, stack emissions, windblown dust releases, and similar processes)	Surface erosion by precipitation run-off; dispersal of contaminated soil by wind; external exposure to or direct contact with contaminated soil	Transport into deeper (subsurface) soil or sediments resulting from infiltration of precipitation
II. Subsurface Liquid Releases on Mesa Tops				
Resulted from shallow liquid releases of small volumes or low contaminant concentrations; present contaminant is surface and near-surface soil	Sanitary waste systems, industrial waste line, and certain drain lines and outfalls	Past releases from SWMUs resulted from leaks of buried septic tanks and waste lines and will be diffusely located, relatively shallow in depth, and unlikely to have high concentrations of contaminants	Erosion and wind dispersal of contaminated surface soil; storm water run-off erosion of contaminated surface soil; erosive exposure of contaminated subsurface soil, followed by wind and water erosion	Precipitation infiltration and liquid or vapor migration in the vadose zone

TABLE 4.1-1 (continued)

Waste	Representative SWMUs	Description	Release/Transport Mechanisms	
			Primary	Other
III. Solid Waste Disposals on Canyon Walls				
Solid waste placed onto canyon walls	Bailey Bridge disposal area and the surface disposal area on the eastern edge of TA-1's canyon wall (Can Dump Site)	Characterized redominantly by exposed rubble or other solid waste and soil that were bulldozed or disposed over the canyon wall after demolition of TA-1 buildings	Erosion and wind dispersal of contaminated surface soil; storm water run-off erosion of contaminated rubble and soil; direct contact with contaminated rubble and soil	Precipitation infiltration and mobilization of otherwise-contaminated contaminants; erosive exposure of contaminated subsurface soil, followed by wind and water erosion
IV. Liquid Releases on Canyon Walls				
Resulted from liquid releases over the canyon walls from mesa-top drain line outfalls; present contaminant source is surface and near-surface tuff and soil on canyon walls	Hillside 137 outfall, Hillside 138 outfall, and Hillside 140 outfall	Liquid releases occurred directly over the edge of Los Alamos Canyon during the years of TA-1 operation; releases include liquid wastes from laundry facilities, sanitary waste lines, cooling tower drains, and storm drains; soil and tuff outcrops at the site of outfalls, along the canyon wall drainage patterns, and on bench areas on the hillside may be contaminated	Erosion and wind dispersal of contaminated surface soil, storm water run-off erosion of contaminated surface soil; erosive exposure of contaminated subsurface soil, followed by wind erosion	Precipitation infiltration and liquid migration in the vadose zone; erosive exposure because of mass wasting of surface soil and tuff outcrops

4.1.2 Pathways to Human Receptors

Potential human exposure to residual contaminants may result from the migratory pathways that are relevant to OU 1078. These pathways are

- atmospheric dispersion,
- surface water run-off, and
- erosion.

The pathways are summarized in Table 4.1-2 and Figure 4.1-1 and discussed in detail in the following sections.

It has been concluded that no pathway exists for the migration of contaminants to ground water beneath the Bandelier Tuff. Laboratory studies described in Section 3.1.7 support the assessment that some migration into the tuff may have occurred 30 years ago when small amounts of liquid wastes were originally released. Such migration would soon stop because of the lack of significant recharge and effects of evapotranspiration (Purtymun et al. 1989, 0214). Those studies indicated that infiltration of natural precipitation cannot provide enough water to sustain movement of contaminants downward. Therefore, ground water is not considered a viable pathway for dissemination of contaminants at OU 1078.

TABLE 4.1-2

SUMMARY OF MAJOR MIGRATORY PATHWAYS AND ENVIRONMENTAL ENDPOINTS OF INTEREST

Migratory Pathways	Environmental Endpoint of Interest
A. Wind entrainment and dispersal of surface soil	1. Contaminants deposited on surface soil 2. Contaminants in air
B. Surface water run-off carrying soil/sediment in suspension, contaminants in solution	1. Contaminants deposited in drainage sediments 2. Contaminants released to surface waters 3. Contaminated surface water infiltrating canyon side soil, tuff, and rubble
C. Erosive exposure of subsurface contaminated soil	1. Feeds wind dispersal (A) and surface water run-off (B)

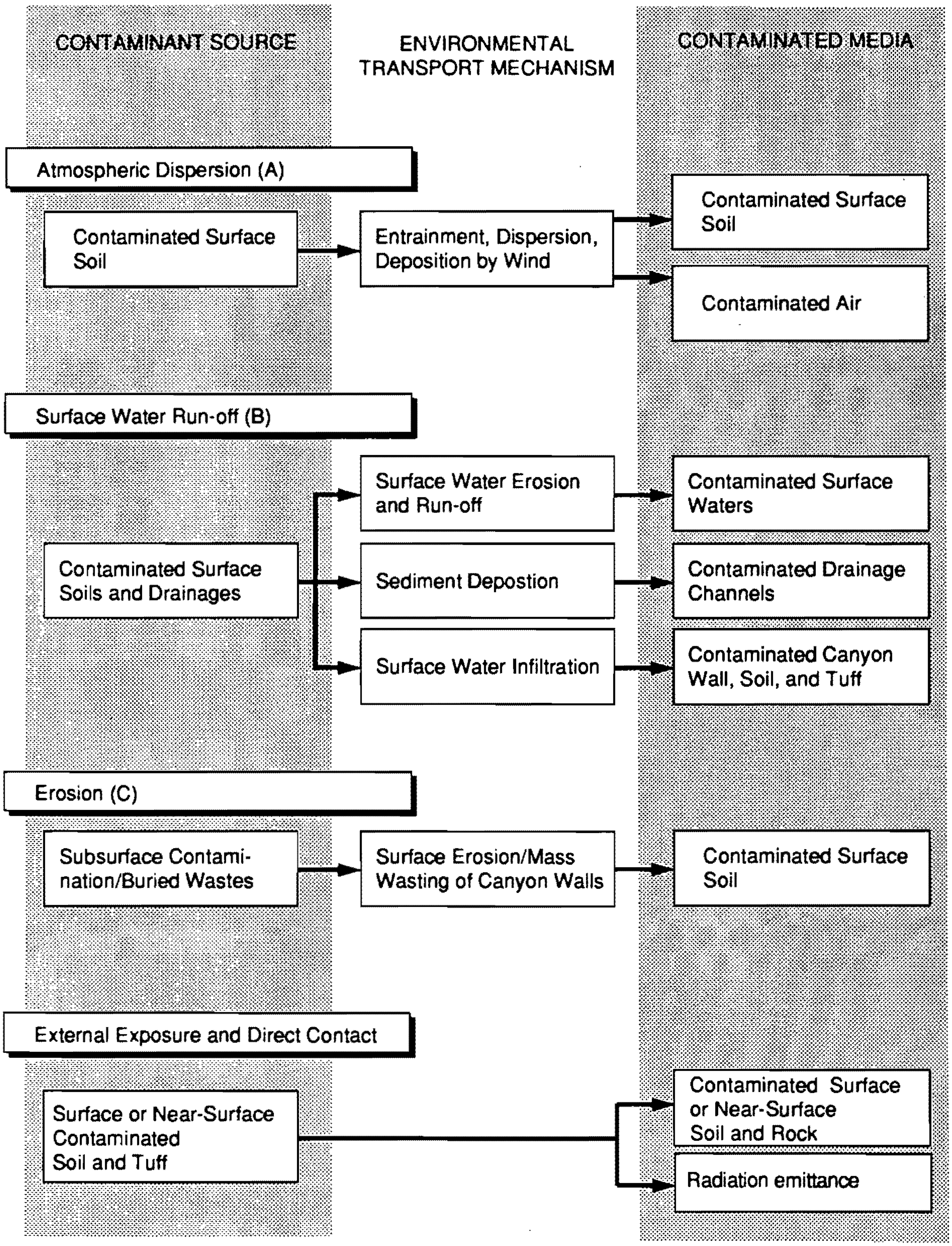


Figure 4.1-1. Diagram of major contaminant migration pathways.

4.1.2.1 Atmospheric Dispersion Pathway

Atmospheric dispersion pathways include wind entrainment of contaminated soil (resuspension) and releases of volatile organic compounds and tritium, or tritiated compounds, from within the soil profile. It is anticipated that tritium compounds are a minor contamination problem 32 years after the last use of tritium or its compounds occurred at TA-1. The half-life of tritium is 12 years; thus, almost 3 half-lives for tritium have passed and only 15% of the original tritium would still be in existence. In addition, tritium is extremely mobile and this mechanism would also decrease any initial localized concentrations. Important variables affecting resuspension and soil gas releases include wind speed, direction and stability class, vegetative cover, soil physical properties, soil moisture content, and soil heat flux (Travis 1975, 0420; Abeele and Nyhan 1987, 0008).

Mesa-top surface soil at TA-1 was contaminated by intentional or inadvertent release of solid or liquid wastes. Surface soil is a source of any residual contaminants suspended and redeposited through airborne dispersion. Most soil contamination events on the mesa top occurred almost 40 years ago. As a result of subsequent decontamination and decommissioning activities in the 1960s and 1970s, any remaining contaminated soil now may be under several feet of clean fill. Anthropogenic activities, such as construction, gardening, and children playing, serve as release mechanisms for mesa-top subsurface soil.

Canyon wall contamination is also the result of past disposal activities, but chemical releases onto the hillside areas would have been deposited onto soil relatively undisturbed by human activities. Demolition debris, possibly contaminated, was disposed over the edge of the mesa rim during decommissioning of former TA-1 buildings. Therefore, radionuclides and chemical constituents could have contaminated bedrock, soil on small hillside bench areas, or could still be present as exposed rubble. The atmospheric dispersion pathway for contaminant release on canyon walls is resuspension of exposed soil and rubble surface dusts.

The release of common laboratory solvents and other organic compounds were documented at some SWMU locations. Few data are available to document subsurface distribution of contaminants that could be released in gas phase from the soil. However, substantial evaporation and biodegradation, particularly in the semiarid climate of Los Alamos, would have eliminated much of the organic contaminants from the soil in the intervening 30–40 years since TA-1 was in full operation. Most importantly, recent paving and building have decreased the area of soil surface and diminished this migratory pathway.

4.1.2.2 Surface Water Run-off Pathway

The precipitation climate of the Pajarito Plateau (Section 3.1.2) is characterized by snowfall with intermittent snowmelt in the winter and high-intensity, short-duration rainfall events in the summer. These factors often result in significant surface water run-off and soil erosion. The release mechanism for the run-off pathway is erosion of contaminated surface soil or tuff. Environmental dispersal of contaminants by the run-off pathway has three major components.

- Movement of mesa-top soil to canyon wall soil and tuff
- Contamination of the shallow soil zones in the flat bench areas on the canyon walls
- Contamination of surface waters off site

4.1.2.3 Erosion Pathway

On the Pajarito Plateau, potential long-term exposure of subsurface contaminated soil or buried wastes is dependent on two major mechanisms:

- loss of surface soil cover by wind and water erosion and
- mass wasting of canyon walls.

These mechanisms might expose any potentially contaminated surface soil or wastes from the canyon side. Once exposed, constituents could be dispersed into the environment by atmospheric dispersion or surface water run-off. Mass wasting, or cliff retreat, of canyon walls (another dispersive process) is a very long-term process. Many 600- to 800-year-old prehistoric Indian cave dwellings continue to exist in the mesa walls of the Pajarito Plateau indicating the time scale for mass wasting.

4.2 Identification of Potential Human Receptors

This section identifies populations representing receptors for any residual contaminants potentially associated with SWMUs at OU 1078. Several subjects are addressed.

- Local human populations are identified.
- Potential exposure routes are determined.
- Pathway-specific receptors are considered.
- Present and future land-use patterns are discussed.

4.2.1 Local Populations

The current residents of OU 1078, in particular, children playing or families who garden, are defined as the most susceptible population group in mesa-top areas. As introduced above, the town of Los Alamos is centered on OU 1078 and consists of both residential and commercial properties. Local residents, comprised generally of young families with small children or the elderly, have access to open areas in the form of yards or common recreational space. All residential units within OU 1078 are either rented townhouses or privately owned condominium units. Units, consisting of several subdivisions, have common grassed areas ranging from approximately 200 square feet to 1 acre. Approximately seventy units, mostly canyon lots, have front and back yards ranging in area from 50 to 200 square feet (Den-Baars 1991, 09-0046).

The mesa-top area is also the site of numerous commercial and local government activities. More than 440 business and municipal employees work at offices adjacent to or in OU 1078 (Den-Baars 1991, 09-0046). The public areas of Ashley Pond and Pond Park, on the north side of Trinity Drive, are included in OU 1078.

The canyon wall or hillside portion of OU 1078 is owned by the Department of Emergy (DOE) and is fenced at the mesa rim to deter access to the canyon. The fence follows the mesa rim on the east side of OU 1078 from the US West Communications Building and extends west to Hillside 140. Access to the canyon walls is not prevented from below. Thus, the hillside area is used by an occasional hiker through the canyon. If the canyon wall should ever be released to the county, recreational users would be expected to increase. More importantly, children from mesa-top residences would have free access to the steep canyon walls and frequent playing among the boulders and soil would be expected.

The town of Los Alamos surrounds OU 1078. These residents are not at the most risk of exposure to any residual contaminants that may be present at OU 1078 and will not be included in the preliminary dose estimates. Residents located outside the immediate area will not be addressed in this work plan.

4.2.2 Land Use

Current residential and commercial land use on the mesa top is expected to continue and presents the most important land-use scenario of concern for possible human exposure to radioactive and hazardous materials that may be present. The neighboring canyon area of OU 1078 is currently under DOE/Laboratory control. Outside the immediate vicinity of OU 1078, land-use patterns can be expected to remain within constraints imposed by the environment: little large-scale agriculture is anticipated, home gardens are typical, residences are primarily in developed mesa-top areas, and low-intensity cattle grazing occurs only in the lower reaches of the canyons on Indian pueblo land several miles to the east and out of OU 1078.

If future land use is considered, a scenario of increased construction and habitation of residences with larger yard and garden areas is possible on the mesa top. It is highly improbable that residents will ever raise their own livestock. Another population of concern for exposure at the site is construction workers. Workers would be in the area for eight hours a day, for several months at a time, and may be exposed dermally to both surface and subsurface soil and to dust raised during construction activities. Construction workers are not assumed to be at highest risk for exposure on the mesa top, but if future construction occurs where contamination is determined to be present, some routes of exposure may be higher for this group of individuals than for permanent residents.

4.2.3 Routes of Exposure

Under current land-use patterns in OU 1078, the mesa-top and canyon wall areas have separate receptors and pathways of concern. For each contaminated medium identified in Section 4.1, routes of exposure for potential receptors have been identified (Figure 4.2-1). For mesa tops and canyon walls, airborne dusts may be inhaled. External penetrating radiation may enter a receptor by whole body exposure as well as by inhalation or ingestion. Some hazardous chemical constituents, if present, may be absorbed through the receptor's skin. For contaminated soil, ingestion has been cited as the potential route of exposure (accidental ingestion of soil by adults and intentional ingestion by children). Ingestion of water is listed as a potential exposure route on the canyon wall only for collected surface water, although the potential for such ingestion is considered small. No human exposure routes for potential contaminants in subsurface soil and rock have been identified; only deep rooted plants have access to such contaminants, but future construction activities may expose any existing contaminants at depth.

Identification of any existing contaminants being transported in specific environmental pathways may be refined with the collection of initial environmental samples. In addition, exposure or migration pathways for hazardous chemical contaminants are assumed to follow pathways of radionuclides found at the same site. A detailed discussion of this proposition is presented in Appendix A .

4.2.4 Pathways Affecting Potential Receptors

For each potentially contaminated medium and relevant route of exposure, all possible human receptors have been identified in Table 4.2-1. The most probable receptors are on-site townhouse residents, on-

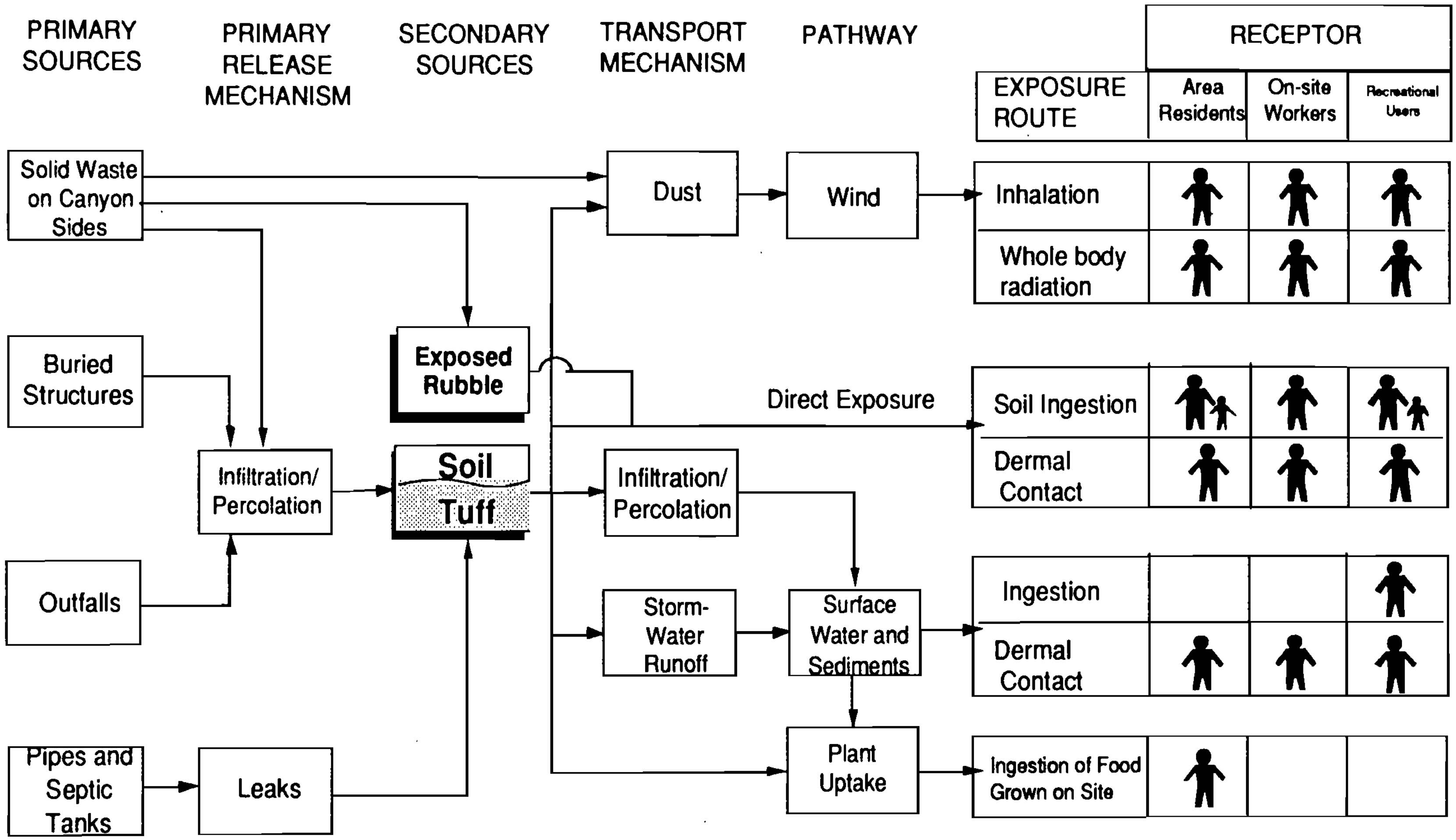


Figure 4.2-1. Conceptual Site Model for Mesa Top and Canyon Walls of TA-1.

TABLE 4.2-1

EXPOSURE ROUTES FOR POTENTIAL RECEPTORS.

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Comments
Current on-site residents: adults and children	•Inhalation of re-entrained dusts	Some excavated material in yard & garden activities
	•External radiation exposure	
	•Direct contact with soil or surfaces	
	•Ingestion of soil	Child will be main receptor
	•Direct contact with storm water run-off	Highly unlikely route of exposure
	•Ingestion of food grown on site	
Current on-site commercial businesses	•Inhalation of re-entrained dusts	May not be a relevant population; direct contact with soil unlikely
	•External radiation exposure	
	•Ingestion of or direct contact with soil	
	•Direct contact with storm water run-off	
Recreational users of canyon wall	•Inhalation of re-entrained dusts	Child playing or hikers in the canyon
	•Direct contact with exposed rubble or other manmade solid material	
	•External radiation exposure	
	•Direct contact with soil	
	•Ingestion of soil	More likely with children
	•Ingestion of storm water run-off or ponding	
	•Direct contact with storm water run-off	
Future on-site construction workers	•Inhalation of re-entrained dusts	
	•External radiation exposure	
	•Ingestion of or direct contact with soil	
	•Direct contact with storm water run-off	

TABLE 4.2-1(continued)

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Comments
Current off-site residents of Los Alamos or White Rock	•Inhalation of re-entrained dusts	Some residents are quite close to site
	•External radiation exposure	
	•Direct contact with soil contaminated by storm water run-off	The result of a migratory pathway: off-site contamination
	•Ingestion of soil	More likely with children
	•Direct contact with storm water run-off	Highly unlikely route of exposure
	•Ingestion of food grown on contaminated soil	
On-site burrowing and vegetation-eating animals		Separate ecological risk assessment

site commercial businesspersons, future construction workers, and recreational users of the canyon wall. Further discussion will be limited to these populations because, as mentioned in Section 4.2.1, OU 1078 is the site of much human activity. For residual contaminants associated with mesa-top SWMUs, the human populations exposed to airborne dusts and potentially contaminated surface soil include both area residents and on-site workers. For the canyon wall SWMUs, exposed human populations are recreational users of the area and construction workers, should cleanup be required on the canyon walls. Direct contact of or external penetrating radiation, resulting from potentially contaminated soil on the mesa tops and exposed rubble on the canyon walls, is the third major pathway for human exposure at OU 1078. Mesa-top residents who consume a large portion of their diet from vegetables grown on site have been identified as the population most susceptible to exposure to potential contamination because of dermal contact with soil and consumption of vegetables grown in soil. No human receptors could be identified for contaminants retained in subsurface rock and soil, should any exist. Because no seeps or springs are present on OU 1078 canyon walls, direct ingestion of surface waters is an improbable route of exposure and is limited to persons hiking along or playing within a drainage.

Should contaminants be found in SWMUs, biota will be identified as potential receptors. Terrestrial biota are predominant because of the climate and the ephemeral nature of flow in drainages. Plants are the only potential receptor for contaminants potentially present in subsurface soil and rock. Small mammals, birds, reptiles, and insects are common terrestrial fauna throughout the area, particularly on the canyon walls. For the OU 1078 work plan, more data are needed on existence of potential contaminants and area biota before it can be included in a total risk assessment of the site. Such data would include a

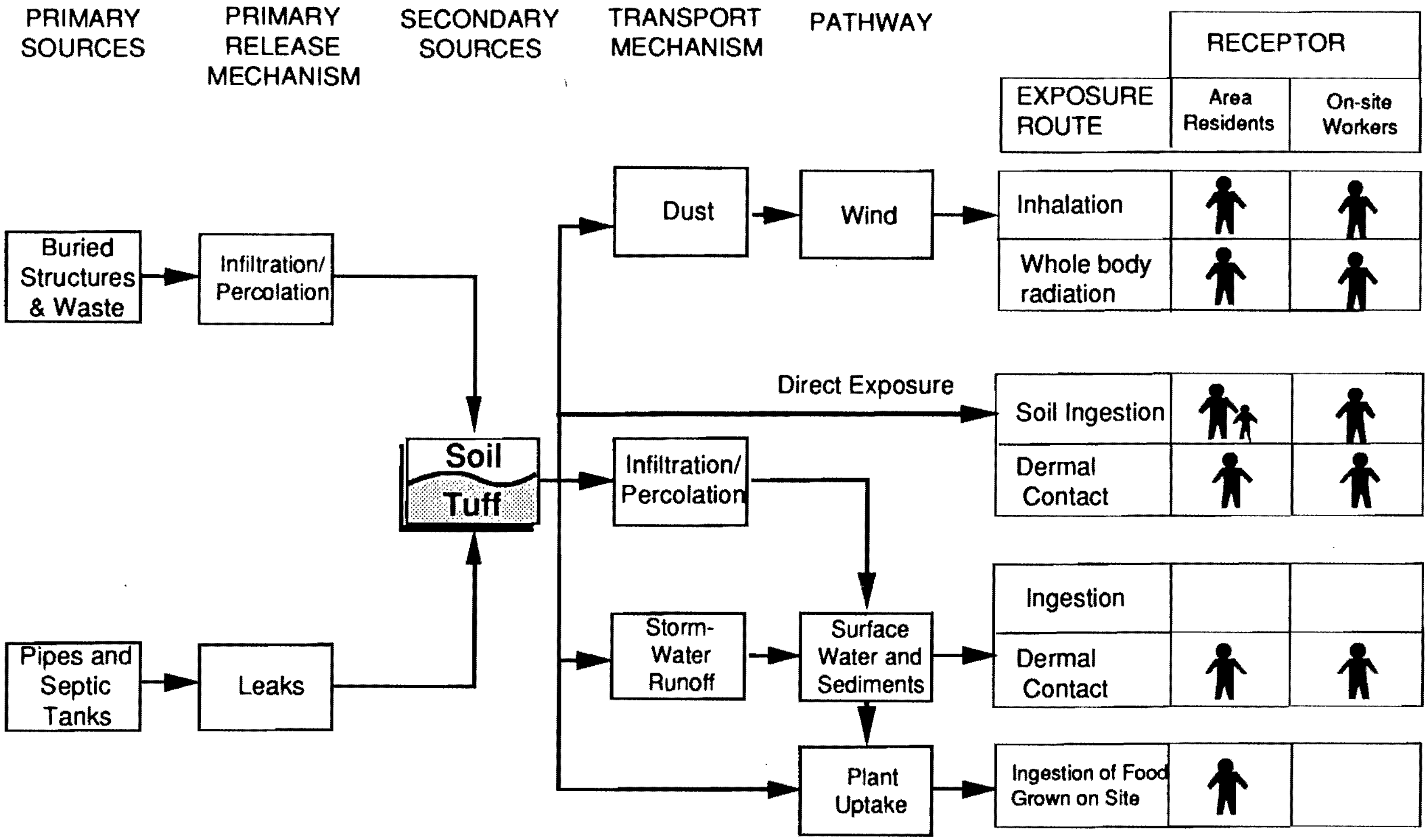


Figure 4.3-1. Conceptual Site Model for Mesa Top.

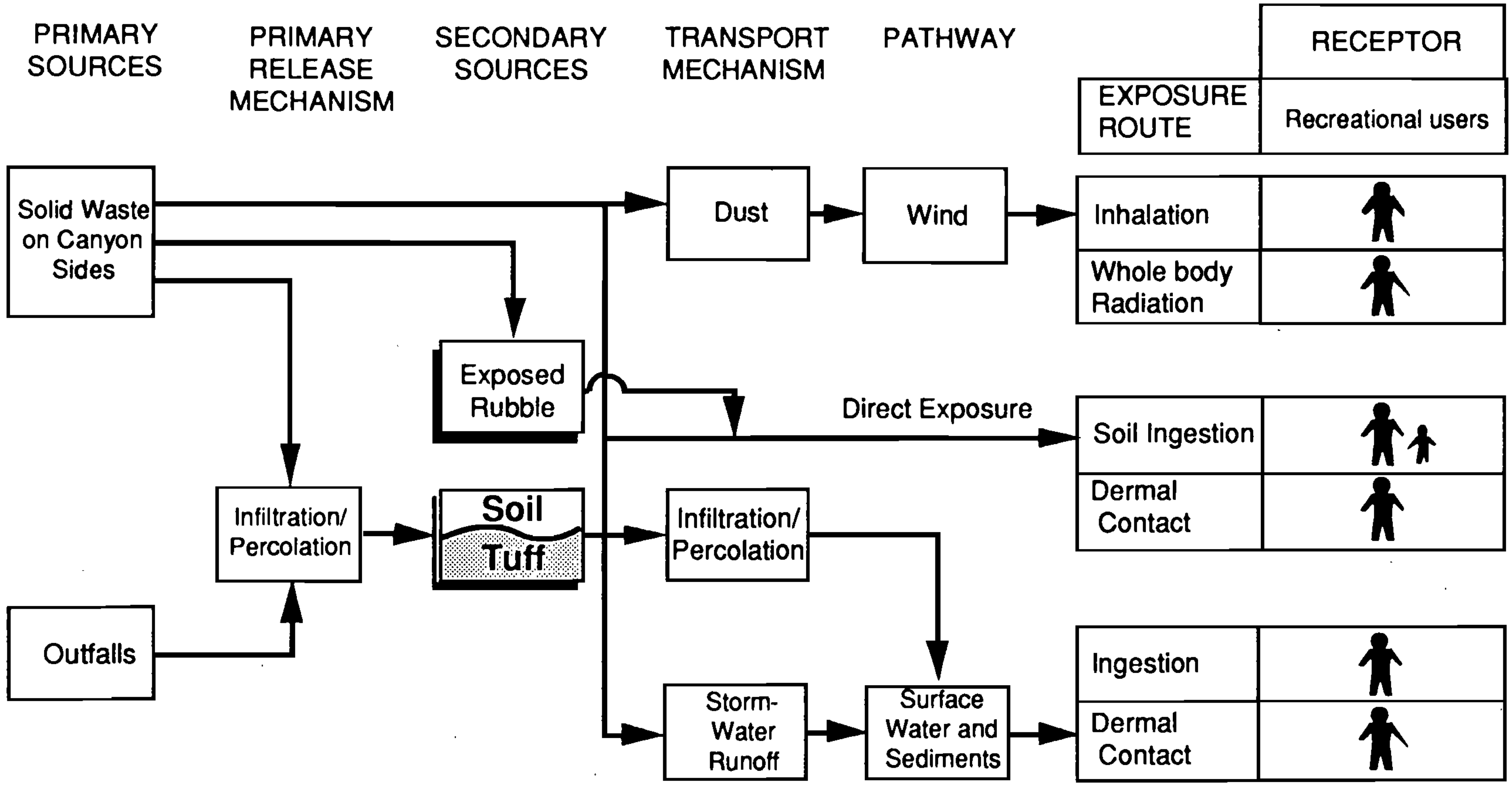


Figure 4.3-2. Conceptual Site Model for Canyon Walls.

TABLE 4.3-1

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concept/Hypotheses
Atmospheric Dispersion	
Particulate dispersion	• Entrainment is limited to contaminants in surface soil. • Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, as well as atmospheric conditions. • Atmospheric conditions affecting entrainment, dispersal, and deposition include wind speed, direction, stability class, and precipitation.
Surface Water Run-off	
Surface water	• Precipitation that does not infiltrate will become surface run-off. • Surface run-off 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. • Contaminant transport by surface run-off can occur in solution, sorbed to suspended sediments, or as mass movement of heavier bed sediments. • Surface run-off may carry contaminants beyond the OU 1078 boundary. • Contaminated surface run-off may infiltrate the canyon bottom alluvium.
Sediments	• Surface soil erosion and sediment transport is a function of run-off intensity and soil properties. • Contaminants dispersed on the soil surface can be collected by surface water run-off and concentrated in sedimentation areas in drainages. • Erosion of drainage channels can extend the area of contaminant dispersal in the drainage way.
Alluvial aquifers	• Surface run-off discharged to the canyons may infiltrate into sediments of channel alluvium. • Flow in the alluvial aquifer under saturated conditions will be down channel.
Infiltration	• Infiltration into surface soil depends on the rate of precipitation or snowmelt, antecedent soil water status, depth of soil, and soil hydraulic properties.

TABLE 4.3-1 (concluded)

Pathway/Mechanism	Concepts/Hypotheses
	• 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.
Erosion	
Soil Erosion	• The erosion of surface soil is dependent on soil properties, vegetative cover, slope and aspect, exposure to the force of the wind, and precipitation intensity and frequency. • Erosion may be controlled by natural or manmade surface features. • Depositional areas as well as erosional areas exist, and erosive loss of soil may not occur in all locations.
Mass Wasting	• The loss of rock from the canyon walls is a discontinuous, observable process. • The rate of the process is extremely slow.
Plant Uptake	
Plant Uptake	• Contaminants can be moved into the food cycle by root uptake of surface water and soil nutrients.
External Exposure	
External Penetrating 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.
Direct Contact	
Dermal Exposure	• Some hazardous chemical constituents will absorb through the skin when in contact with contaminated surfaces of soil, tuff, or rubble.

baseline biological survey of flora and fauna (Section 4.7), transport mechanisms through soil to flora, and confirmed presence of contaminants in exposed soil on canyon walls.

4.3 Conceptual Site Model

To assist in characterizing potential contaminants of concern at OU 1078, a conceptual site model has been developed. The conceptual model identifies the scenario for estimating exposure to an individual maximally exposed at the area and uses the residential land-use scenario (Section 4.4.1). The conceptual model for contaminant release, migration, and viable routes of exposure is presented in Figure 4.2-1. The diagram differentiates exposure routes for the mesa top from those for canyon walls (Figures 4.3-1 and 4.3-2). Viable pathways included in the model are based on present knowledge of the SWMU types. Pathway descriptions include primary release mechanisms, environmental migration processes, and resulting contaminated media for each pathway (expanded upon in Table 4.3-1). Exposure routes and receptors for each potentially contaminated media were described in Section 4.2. Because the entire mesa-top area could be used for residences in the future, all exposure media and routes for the current residents will be applicable for the future resident scenarios for the mesa top.

A preliminary radiological dose estimation of mesa-top SWMUs has been carried out, based on data collected from decontamination and decommissioning activities that occurred at TA-1 in 1974–1976 (Section 2.2.4). These initial radiological dose estimates identify potential SWMUs of concern and provide a basis for prioritization of those SWMUs. The radiological dose estimation approach is summarized in the following section. Data acquired from planned field investigations will allow a more comprehensive evaluation of conditions and dose at OU 1078, particularly on the undisturbed canyon walls, and provide for an analysis of risk due to any residual contaminants detected at OU 1078. Field investigations will also verify the value of the historical monitoring data used to estimate dose.

Under the current land-use patterns of the mesa top, the major receptor of concern is the family that gardens and harvests vegetables for their own consumption. On-site worker exposure will not be evaluated at this time because their exposure is estimated to be less than the resident exposure; however, the risk of a probable exposure situation to on-site workers will be calculated subsequent to acquiring sampling results in the RFI report. (The safety of the site investigation personnel during the RFI is evaluated in accordance with the Health and Safety Plan, Annex III.) The major receptor on the canyon walls is likely to be the recreational user, that is, the child playing on the soil and rocks or the casual hiker.

In both scenarios, the primary exposure pathways of concern are surface water run-off and sediment transport; external penetrating radiation or dermal contact to hazardous constituents; and wind re-entrainment and dispersal of surface soil. Unsaturated zone transport (in both liquid and vapor phases) and the ground water pathway are not of concern, based on paucity of source terms, tuff characteristics, the great depth of the main aquifer system, and the lack of a viable pathway for contaminants to move to ground water.

Inhalation, ingestion, and dermal contact of potentially contaminated soil and tuff through recreational use or gardening are primary potential exposure mechanisms. Wind entrainment of soil-borne contaminants can be a pathway for widespread dispersal of contaminants. Dispersal is limited to surficial deposits and soil and debris exposed by erosion processes. Run-off, soil erosion, and subsequent movement and fate of the water and transported contaminants in the OU 1078 environment are important contaminant migration components. Erosive exposure processes are long-term release mechanisms serving to expose previously contained contaminants to the environment or to provide access of water to previously protected soil.

Through the TA-21 (OU 1106) site investigation, pilot studies, and remediation efforts, site characterization data applicable to OU 1078 will be collected. Because TA-21 is not accessible to the general public, more extensive geologic and hydrologic investigations are planned at this site. In addition, because TA-21 and TA-1 are located on the same mesa, data collected at TA-21 can be used for further refinement of the TA-1 conceptual model, either to support the current model or to define another model. Further, the ER Program is currently developing regional framework studies. Results of these studies will be integrated into the development of the TA-1 conceptual model.

4.4 Dose Estimation Procedures

The considerations described above set the groundwork for radiological dose estimates that will be used to prioritize the need for investigation and sampling of SWMUs. To conduct such estimations, several assumptions must be made and site-specific parameters estimated. These assumptions and parameters, presented in the rest of this chapter, include

- identification of the maximally exposed individual,
- assumptions needed to allow us to use soil sampling data taken 15 years ago,
- an estimation of the radionuclide contaminants present at the points of exposure, and
- geologic and hydrologic parameters and pathway conversion factors.

Section 4.5 presents a preliminary dose estimate that can be used to characterize SWMUs and prioritize sampling needs. One important component necessary for the RFI report baseline risk assessment is a method for combining radiological and chemical risk estimates to allow comparable decisions based on risks from both types of contaminants. The development of such a model is incomplete at this time and beyond the scope of the current OU 1078 work plan.

4.4.1 Exposure Scenarios

Many of the parameters that determine the dose of a radionuclide or chemical to which an individual is exposed are determined by exposure scenarios, that is patterns of human activity that determine exposure to a contaminant. When estimating human health risk from SWMUs, it is important to select a scenario that estimates exposure to the maximally exposed individual at the site. As identified in Section 4.2.1 and Section 4.2.2 maximally exposed individuals and exposure scenarios will be distinct for the mesa top and the canyon wall.

Lifetime residents at OU 1078 who ingest soil as children, garden, and consume fruits and vegetables grown on their land are expected to receive the highest predicted dose from any contaminant or combination of contaminants potentially present on the mesa top. This scenario, termed the residential scenario, accounts for exposures throughout the lifetime of the resident. The residential scenario is highly probable for OU 1078 because much of OU 1078 is occupied by privately owned townhouses or condominiums. Although land available for gardening is quite limited at present, it is conceivable that in the future some of the mesa top might be used for larger family units. An exposure unit of 5000 ft^2 has been selected to define the area used by a residential scenario (Neptune et al. 1990, 0748).

As discussed in Section 4.2.4 exposure pathways to the mesa-top resident are (1) inhalation of contaminated dust; (2) ingestion of fruits or vegetables grown in contaminated soil; (3) direct dermal contact with contaminated soil and debris; (4) external exposure to radiation; and (5) ingestion of contaminated soil. Nonviable pathways include routine ingestion of drinking water drawn from on-site sources, ingestion of meat or milk from livestock raised on site, and ingestion of aquatic foods raised in an on-site pond.

The canyon wall is inaccessible for human habitation and is likely to be used only for recreational activities. The maximally exposed individual has been identified as the child who plays on the hillside or the casual hiker. This scenario can be termed a recreational scenario with emphasis on a child. An exposure unit of one acre is a likely space in which a child might roam on the hillside. An important factor in calculating risk by way of a recreational scenario is the relatively small amount of on-site time spent at the activity. Pathways for exposure, as discussed in Section 4.2.4, include (1) direct dermal contact with contaminated soil and debris; (2) inhalation of re-entrained dusts; (3) external exposure to radiation; and (4) ingestion of contaminated soil. Exposure through consumption of vegetables, meat, milk, or drinking water are nonviable pathways in the recreational scenario. Many of the site-specific parameters needed to calculate exposure on the canyon walls are unknown at this time. Therefore, radiological dose estimates for the recreational scenario on the canyon walls will not be developed further in the current version of this work plan. The canyon wall baseline risk assessment will be presented in the OU 1078 RFI report.

4.4.2 Assumptions for Radiological Dose Estimation

To devise methodology for preliminary dose estimation for OU 1078, the following basic assumptions are made. Prioritizing investigation of SWMUs near residents of the Los Alamos townsite area is of primary importance. Because the preliminary dose analysis uses soil sampling data from the 1974–1976 site decontamination and decommissioning, preliminary dose estimation procedures will focus on the mesa-top exposure scenario. The dose calculated will be the result of residual radioactivity. Risk due to hazardous chemical constituents that may be present at SWMUs will be calculated after results from soil samples indicate the presence of chemicals of concern. Risk assessment assumptions that are specific to canyon walls will be developed after sampling data on the canyon walls has been acquired. These assumptions are listed below.

- The area of exposure, or the exposure unit, for the mesa top equals 5000 ft^2, which is estimated to be the average size of a residential home with a small yard.
- Contamination causing present-day risk would be on the surface. This is a very conservative assumption, and a study of dose versus the extent of cover material is presented.
- Radionuclide sampling data taken upon completion of decommissioning and decontamination activities of the mid-1970s (Ahlquist et al. 1977, 0016) can be used to estimate levels of any residual radioactive contamination today.
- The mesa-top ground surface at OU 1078 has been homogenized because of anthropogenic activities such as construction, landscaping, and physical forces, such as wind and rain. Thus, former surface hot spots of contamination have been diluted, and the prevalence of surface hot spot contamination has been reduced.
- At each site, the level of contamination, measured in gross alpha activity, is assigned to one radionuclide. The radionuclide chosen is the most pervasive and most persistent radionuclide expected at the site, making this a conservative assumption.
- The highest mean value of the sampling data for each site (calculated for an exposure unit) is used to represent the level of contamination at that site.
- Soil samples that had reported concentration levels less than the detection limit (in the 1974 sampling) of 20 pCi/g for gross alpha counts are assigned a value of 10 pCi/g, or one-half the detection limit, in the calculation of mean activity per exposure unit. This is only one method of several that could be used to treat nondetects.
- Residents receive drinking water from off-site uncontaminated, underground sources.

TABLE 4.4-1

PARAMETERS FOR OU 1078 MESA-TOP PRELIMINARY DOSE ESTIMATION

Parameter Description	Parameter Value	Source
Pathway Conversion Factors	**Adult, Child (if different)**	
Inhalation rate	7297 m^3/yr, 5869 m^3/yr	EPA 1991, 0746 EPA 1989, 0297
Mass loading for inhalation	0.0002 g/m^3	NMEID 1990, 0704
Dilution length for airborne dust, inhalation	3.0 m	Gilbert et al. 1989, 0754
Occupancy factor, inhalation	.45	Calculated
Occupancy and shielding factor, external gamma, based on exposure frequency	.60	Calculated
Fruit, vegetable, and grain consumption	124 kg/yr, 62.4 kg/yr	EPA 1991, 0746
Leafy vegetable consumption	36 kg/yr, 29 kg/yr	Clement Associates 1988, 0745
Soil ingestion rate	36.5 g/yr, 73 kg/yr	EPA 1991, 0746
Mass loading for foliar deposition	0.0001 g/m^3	Gilbert et al. 1989, 0754
Depth of soil mixing layer	.15 m	Clement Associates 1988, 0745
Depth of roots	.9 m	Site Data
Exposure Frequency		
Fraction of time spent indoors	.50	Calculated
Fraction of time spent outdoors, on site	.25	Calculated
Contaminated Site Assumptions		
Area of contaminated zone	464 m^2	Site data
Thickness of contaminated zone	1.0 m	Site data
Length parallel to aquifer flow	21.5 m	Calculated
Time since placement of material	30 yr	Site data
Cover depth	0.0 m (assume contaminants on the surface)	
Climatic Parameters		
Evapotranspiration coefficient	.6	*
Precipitation	0.4 m/yr	*
Irrigation	8.0 m/yr	Site data
Irrigation mode	overhead	Site data
Run-off coefficient	.52	Site data
Irrigation fraction from ground water	0	Site data
Geologic Strata		
Contaminated Zone		
Soil density	1.6 g/cm^3	*
Erosion rate	0.001 m/yr	*
Total porosity	0.4	*
Effective porosity	0.2	*
Hydraulic conductivity	50.0 m/yr	*
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754
Saturated Zone		
Soil density	1.6 g/cm^3	*
Total porosity	0.3	*
Effective porosity	0.3	*
Hydraulic conductivity	270.0 m/yr	*
Hydraulic gradient	0.02	*
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754

TABLE 4.4-1 (concluded)

Parameter Description	Parameter Value	Source
Water table drop rate	0.3 m/yr	*
Model: (nondispersion or mass balance)	Nondispersion	Gilbert et al. 1989, 0754
Unsaturated Zone 1		
Thickness	260 m	DOE 1979, 0051
Soil density	1.6 g/cm^3	DOE 1979, 0051
Total porosity	0.5	DOE 1979, 0051
Effective porosity	0.4	DOE 1979, 0051
Hydraulic conductivity	30.0 m/yr	DOE 1979, 0051
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754
Unsaturated Zone 2		
Thickness	100 m	DOE 1979, 0051
Soil density	1.6 g/cm^3	DOE 1979, 0051
Total porosity	0.4	DOE 1979, 0051
Effective porosity	0.2	DOE 1979, 0051
Hydraulic conductivity	37.0 m/yr	DOE 1979, 0051
Soil-specific b parameter	5.3	Gilbert et al. 1989, 0754

* These values from Purtymun and Stoker (1988, 0205) and Abeele et al. (1981, 0009).

4.4.3 Description of Models

4.4.3.1 Radiological Dose

DOE Order 5400.5 has approved the use of a standardized computer code, developed by Argonne National Laboratory (Gilbert et al. 1989, 0754) to calculate dose, as committed effective dose equivalents (CEDE) to a maximally exposed population group. The code, Residual Radioactive Materials (RESRAD), applies site-specific parameters for each effective pathway in a chosen exposure scenario. For OU 1078, the choice of the residential scenario leads to activation or deactivation of pathways discussed above. The RESRAD code requires some site-specific input parameters to assess relative importance of exposure pathways for the residential scenario. OU 1078 input parameters are presented in Table 4.4-1. Many parameters (e.g., inhalation, dietary and nondietary pathways, and soil ingestion) are default values recommended by the EPA (EPA 1989, 0304; EPA 1991, 0746; Clement Associates 1988, 0745). These default values are considered conservative estimates. Site-specific climatic values, such as precipitation, irrigation, run-off coefficient, wind speed, and erosion rate are used. Hydrologic parameters for OU 1078's three geologic strata, the contaminated, saturated, and unsaturated zones, are also site specific. The ground water pathway is not a viable route of exposure. Climatic and hydrologic parameters peripherally affect other pathways, such as uptake of radioactive contaminants by root systems.

Once site-specific parameters have been entered into the RESRAD code, the program computes a radiological dose (CEDE) in mrem/yr from a known concentration of a single radioisotope or a combination of radionuclides. Radionuclide concentrations can be entered as soil concentration (pCi/g), concentration in water (pCi/l), or both. For OU 1078, single radionuclide concentrations are estimated from soil sampling data collected in 1976. In computing the total dose (CEDE) to a maximally exposed individual, RESRAD considers the radionuclide decay products' contribution. The dose conversion factors for radiation exposure by inhalation, ingestion, and external radiation were taken from DOE reports (DOE 1988, 0266; DOE 1988, 0265); similar values (for inhalation and ingestion) are given in an EPA report (EPA 1988, 0297). The use of RESRAD for a preliminary dose estimation for the mesa top is presented below in Section 4.5.

4.4.3.2 Toxicological Dose

Toxicological dose will be included in baseline risk assessment calculations for potential health effects of residual hazardous constituents at OU 1078, should any be detected. The LANL ER Program is developing a program-wide approach to risk assessment for all OUs. A discussion of calculating toxicological risk for OU 1078 is outside the scope of the current version of the OU 1078 work plan. The models and approach will follow ER Program guidance.

4.5 Preliminary Dose Estimation

The 1974–1976 decontamination and decommissioning activities at TA-1 focused on removal of radionuclide contamination. Therefore, the soil sampling data available to calculate radiological dose is gross alpha activity. Most SWMUs have data for gross alpha activities; however, quantitative isotopic concentrations are restricted to select sites. The Ahlquist report (Ahlquist et al. 1977, 0016) documents a linear correlation between gross alpha activity and radionuclide concentration on soil. Based on historic documentation of TA-1 waste practices, research activities, and operational procedures, each SWMU aggregate can be associated with a primary discrete radioactive contaminant and gross alpha concentrations can be assumed to have resulted from that radionuclide.

In the 1974–1976 radiological survey and cleanup, contaminated areas were excavated until radiation levels in remaining soil or sediments measured as low as practicably achievable (generally less than 25 pCi/g gross alpha or beta above background) (Ahlquist et al. 1977, 0016). Contaminated soil was taken to the Laboratory's low-level disposal facility at Area G. After excavated areas were determined to be uncontaminated, they were backfilled with clean fill material.

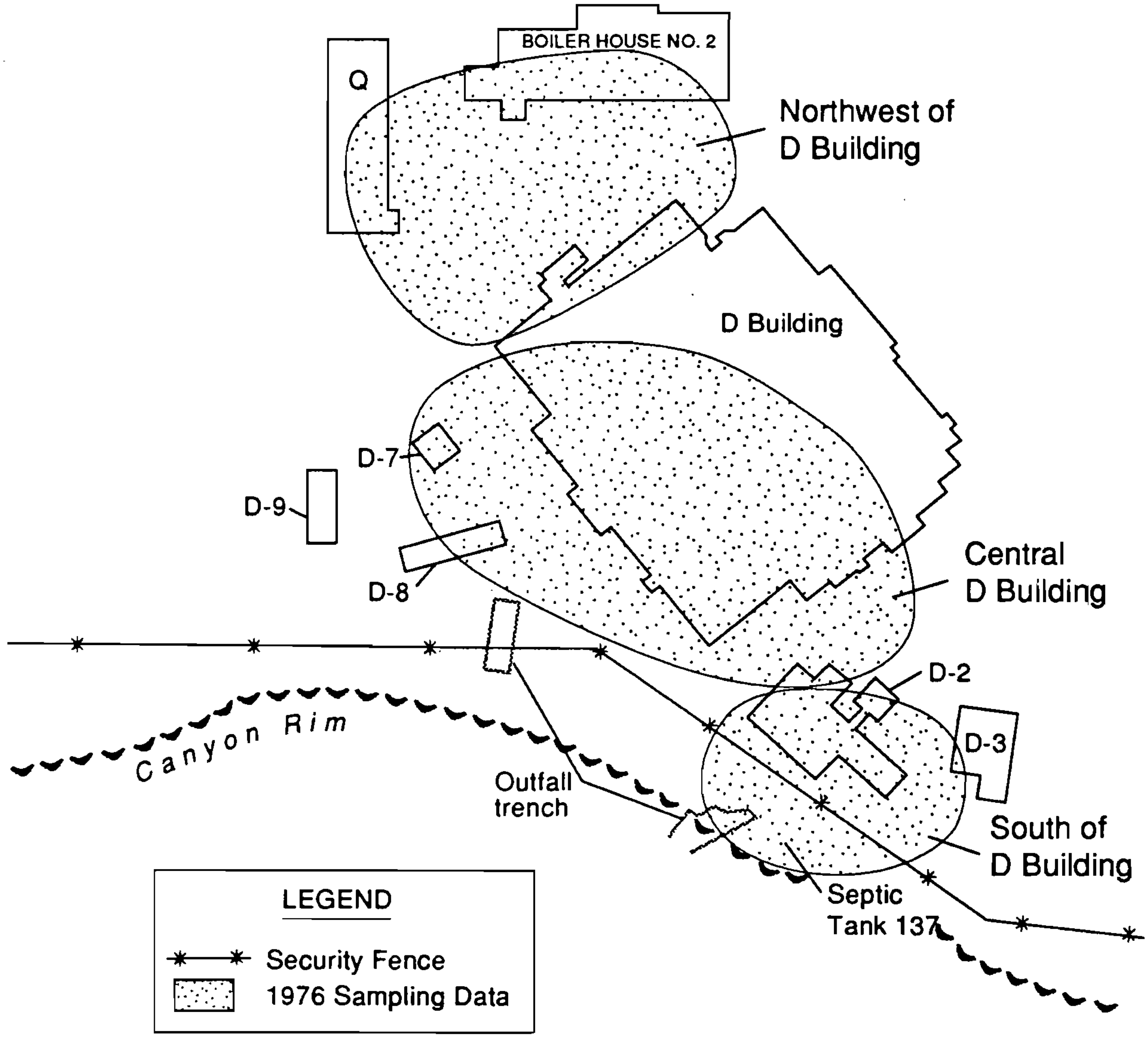


Figure 4.5-1a. Location of 1976 sampling within SWMU aggregate Hillside 137.

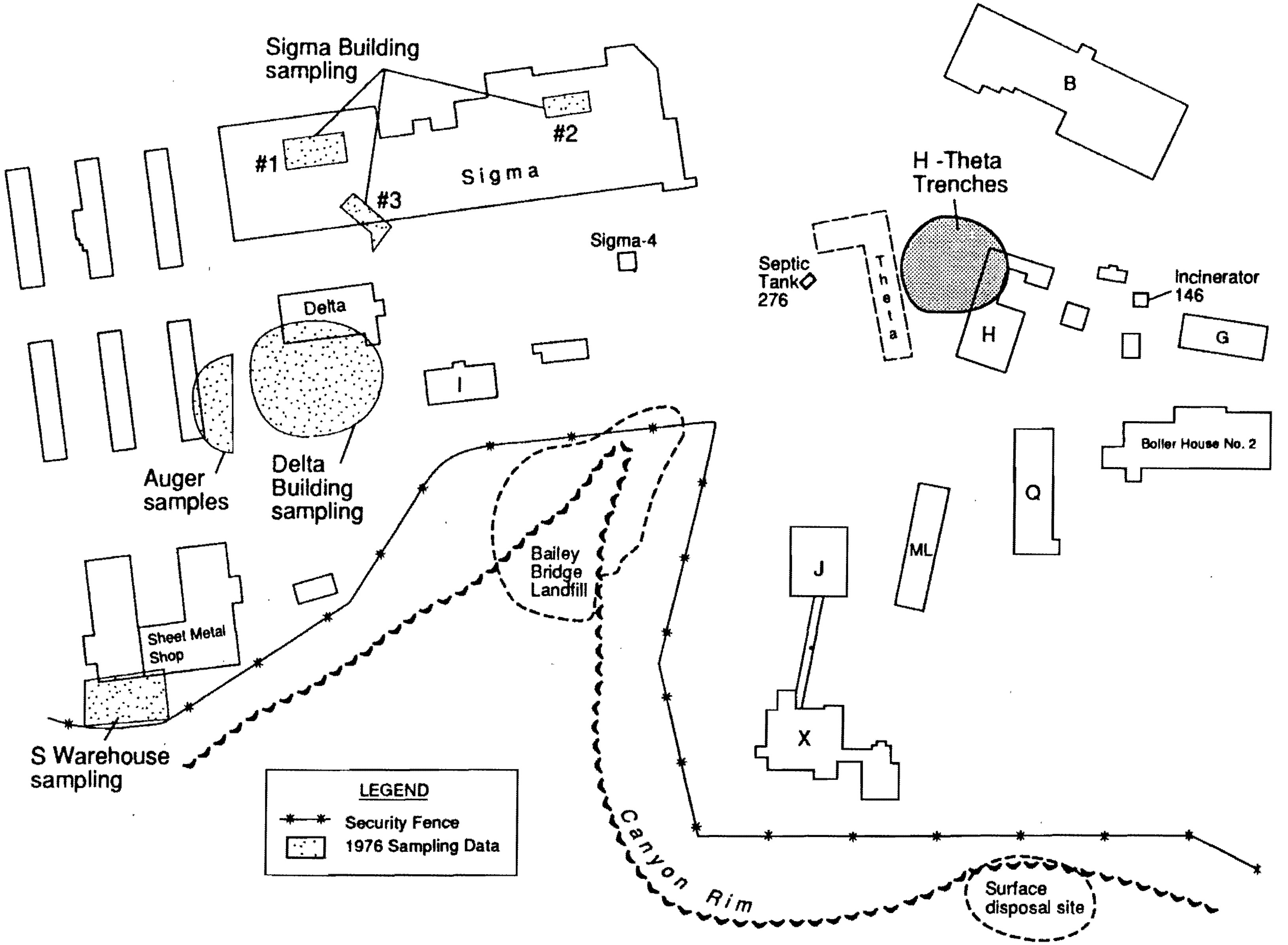


Figure 4.5-1b. Location of 1976 sampling within SWMU aggregates Bailey Bridge and Sigma Building Vicinitiy.

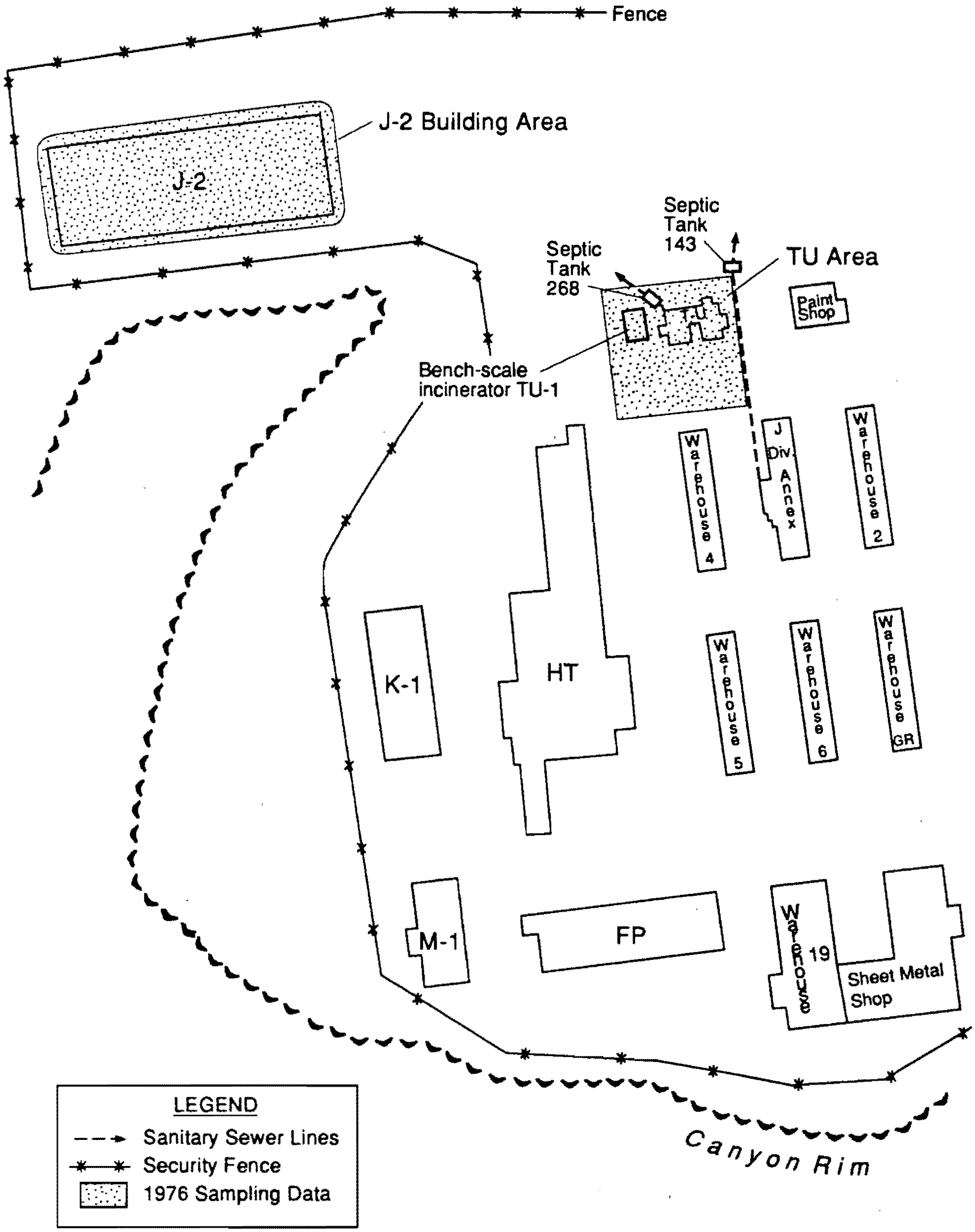


Figure 4.5-1c. 1976 Sampling data within SWMU aggregate J-2 / TU area.

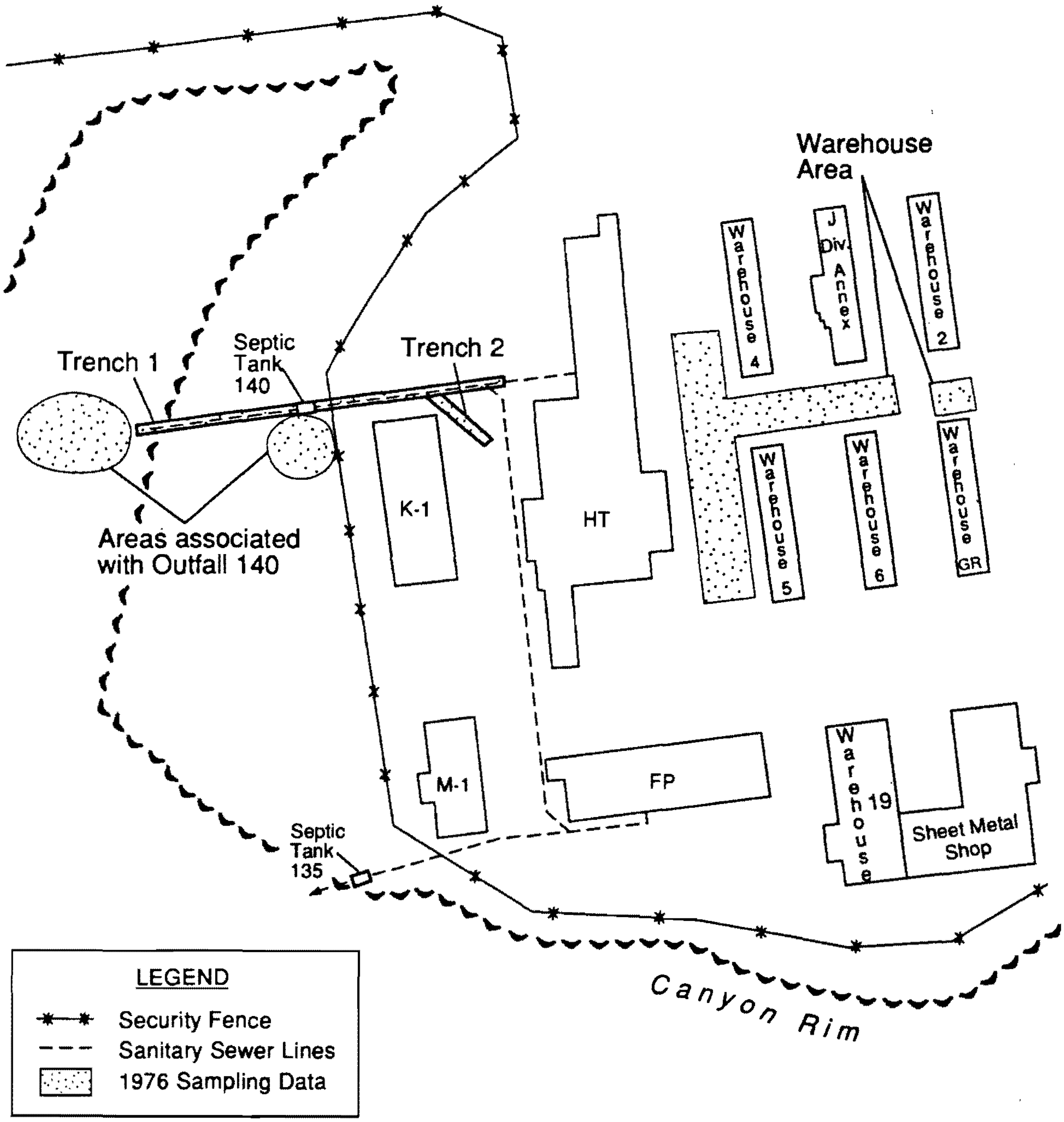


Figure 4.5-1d. Location of 1976 sampling within SWMU aggregate Hillside 140.

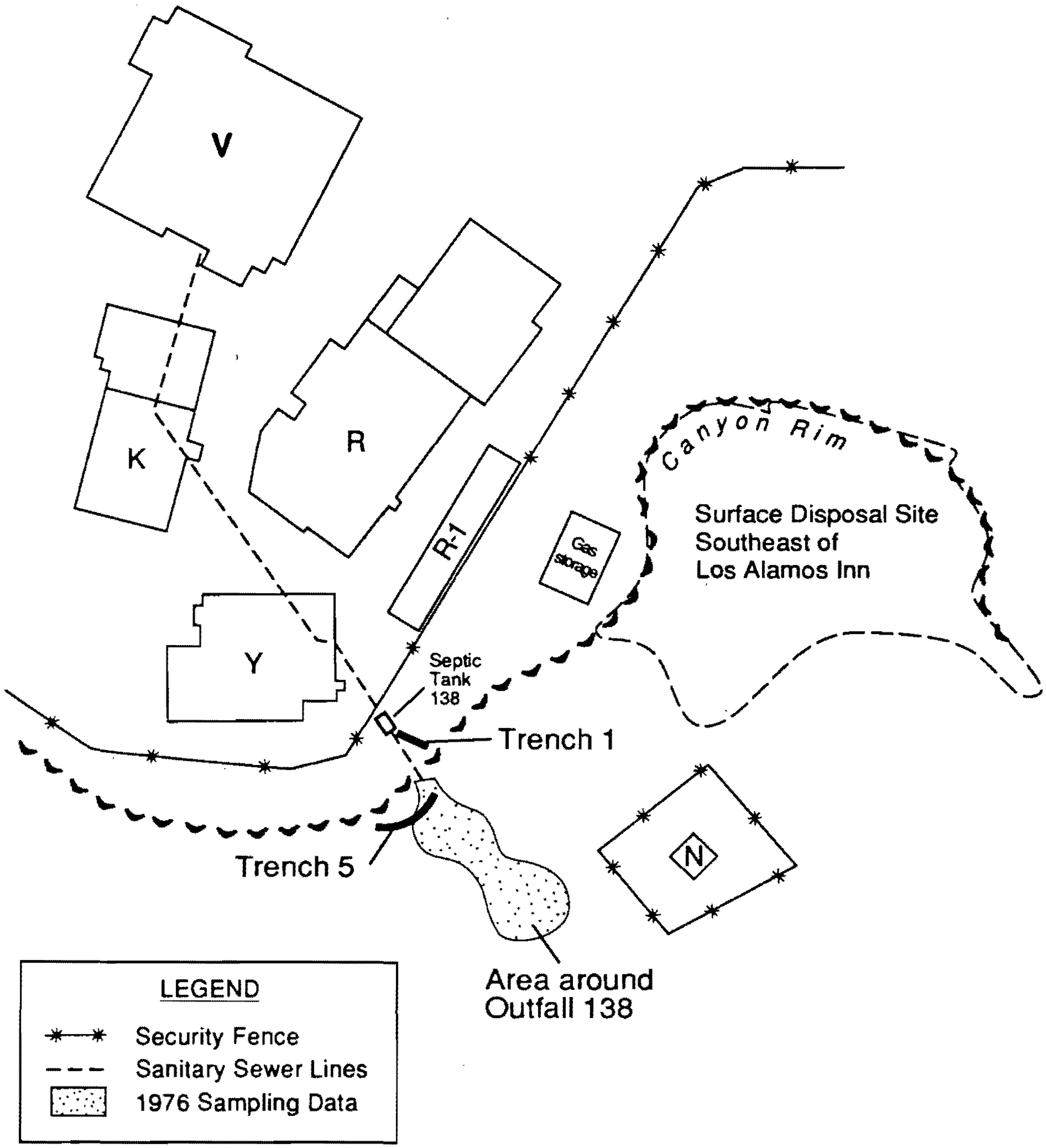


Figure 4.5-1e. Location of 1976 sampling within SWMU aggregate Hillside 138.

TABLE 4.5-1

OU 1078 SAMPLING POINTS AND DOSE ESTIMATES USING MESA-TOP PARAMETERS*

SWMU Description	Number of Sampling Points	Number of samples >20 pCi/g	Mean GROSS ALPHA (pCi/g)	TOTAL DOSE† (mrem/yr)
Hillside 137 Aggregate				**Adult/Child**
D-2 Building clean, 1976	59	30	35.9	14, 13 ^{239}Pu
NW of D Building, surface	21	4	15.9	6, 6 ^{239}Pu
NW of D Building, 1m	21	7	19.1	8, 7 ^{239}Pu
S of D Building	160	50	27.2	11, 10 ^{239}Pu
Center of D Building	421	125	23.7 range 11.9 to 28.4	9, 9 ^{239}Pu
Bailey Bridge Aggregate				
H-Theta Area	53	12	21.7	11, 11 ^{235}U
H-Theta Area	59	7	23.5	12, 12 ^{235}U
S Warehouse	11	3	20.9	11, 10 ^{235}U
Sigma Building Vicinity				
Sigma Building	35	2	11.4	6, 6 ^{235}U
Delta Building	7	3	28.7	15, 14 ^{235}U
J-2/TU Area				
TU Area	27	1	11.1	6, 6 ^{235}U
J-2 Building area	22	2	12.6	7, 6 ^{235}U
Hillside 140 ‡				
Warehouse area	59	2	10.8	6, 5 ^{235}U
Outfall 140	9	6	67.7	35, 34 ^{235}U
Outfall 140, E/W trench	36	3	12.1	6, 6 ^{235}U
Outfall 140, NW/SE Trench	10	1	11.6	6, 6 ^{235}U
Outfall 140, Pit	10	1	11.7	6, 6 ^{235}U

TABLE 4.5-1 (concluded)

SWMU Description	Number of Sampling Points	Number of samples >20 pCi/g	Mean GROSS ALPHA (pCi/g)	TOTAL DOSE† (mrem/yr)
Hillside 138 Aggregate‡				**Adult/Child**
Outfall 138 area	45	26	796.9	311, 295 ^{239}Pu
Trench 1	13	9	16.9	7, 6 ^{239}Pu
Trench 5	16	1	12.5	5, 5 ^{239}Pu
Tank 138	8	4	34.0	13, 13 ^{239}Pu

*The calculations estimate surface dose although the data used are from subsurface measurements.
†Dose is calculated by the RESRAD computer code and assumes that gross alpha levels are due to either ^{239}Pu or ^{235}U.
‡These sampling locations are strictly hillsides outside of the current security fence except the warehouse area of Hillside 140 ; therefore, the areas were not cleaned up in the 1970s decontamination activities. Nevertheless, the sampling data is available s corresponding doses have been calculated here using the mesa-top exposure scenarios and parameters.

The 1974–1976 sampling data collected by Ahlquist (Ahlquist et al. 1977, 0016) can be associated with SWMU aggregates for the purpose of calculating radiological dose. Gross alpha values used here are those from samples collected after the 1976 cleanup effort. The shaded areas in Figures 4.5-1a–e indicate the location of the 1976 sampling data within current SWMU aggregates; trenches are not depicted with a high degree of certainty. The sampling points in the figures are not to scale; the figures have been created solely to depict the relation between sampling points and former TA-1 buildings. Some SWMUs aggregates have no sampling data from the 1975–1976 decommissioning activities that can be associated with their locations. Those aggregates (E and H through P) have individual sampling plans designed for them (Chapter 7).

Table 4.5-1 presents mean gross alpha activity (in pCi/g) for 1976 data and describes sample locations corresponding to former TA-1 buildings and current SWMU aggregates. The table also includes information on the number of soil samples having detectable levels of alpha radiation (above the 20 pCi/g detection limit). In order to compute mean gross alpha levels for each area, data points below the limit of detection were ascribed a value of 10 pCi/g, or one-half the detection limit.

In an attempt to determine any effect that shape and size of an exposure unit might have on contaminant concentration within a sampling set, different exposure units were characterized statistically using various shapes to calculate activity per unit area. Sampling data means for exposure units shaped as squares, rectangles, wedges, and circles of 5000 and 3000 ft^2 were compared and their distributions plotted. It was found that the means for the different shapes did not vary significantly. The 5000 ft^2 circular-areas generally had the smallest mean and mean variance and were normally distributed. Exposure units of 5000 ft^2 will be used to calculate dose (CEDE) on the mesa top; 5000 ft^2 circles have been used to calcu-

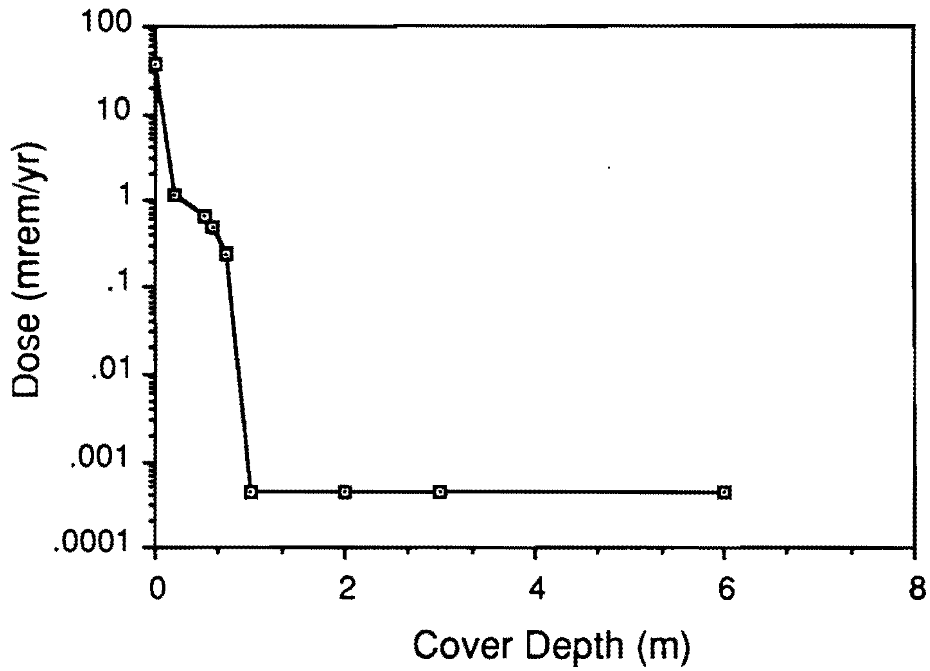


Figure 4.5-2 Log of dose versus cover depth for a dose of 38 mrem/yr with no cover.

late means. As an example, Table 4.5-1 denotes the mean gross alpha value calculated for each sampling data set grouped by SWMU aggregate. Many soil samples were taken over an area larger than 5000 ft^2 in the center of D Building. We have reported the overall activity mean of the area, 23.7 pCi/g, and the range of means calculated for 29 randomly determined 5000 ft^2 circular areas. The low value of the range, 11.9 pCi/g, indicates a random circle that encompassed only 4 of 54 data points above detection limit; the high value of the range, 28.4 pCi/g, had 26 of 57 soil samples above 20 pCi/g gross alpha.

The RESRAD code has been used to calculate maximum dose (CEDE in mrem/yr) for each set of OU 1078 sampling means; the results are presented in Table 4.5-1. For each SWMU area, the gross alpha data are entirely applied as ^{239}Pu or as ^{235}U (both alpha emitters), depending upon the principal radioisotope contaminant expected for the SWMU aggregate. This assumption is conservative because the radionuclide chosen is one most likely to be present and most persistent in the environment. An assumption has been made that doses calculated from 1976 sampling data are representative of residual radioactivity on the ground surface today. This assumption is extremely conservative because clean fill was put into this area, and the ground sampled in 1976 may be buried under 0.2–5 m of soil. If this is the case, dose values to a maximally exposed individual would be considerably lower under present-day conditions. The protection against alpha radiation offered by various depths of soil cover is presented in Figure 4.5-2. A hypothetical dose of 38 mrem/yr with no cover drops one and one-half orders of magnitude with 0.2 m of cover and approaches zero with 1 m of cover material.

The conservative projected dose (CEDE) estimates for the mesa-top SWMU areas range from 6 to 15 mrem/yr for adults and 5 to 14 mrem/yr for children. These doses result from sampling data means that ranged from 10.8 to 28.7 pCi/g gross alpha levels. The dose estimates for the child are somewhat lower than those for the adult residents. An analysis of the contribution of each exposure pathway to the maximum dose can partially explain these results. Pathway component analysis of the RESRAD calculations indicate that 88–97% of the maximum dose estimates are through dust inhalation and external radiation exposure and 3–16% through plant and soil ingestion. Because the major exposure route for radionuclide dose is inhalation, the child, who has a lower inhalation rate, would be expected to have lower maximum dose because of residual radiation at this site (NMEID 1990, 0704). However, it would be expected that soil ingestion would play a larger role in dose calculations for a child for hazardous chemical constituents, should any be present.

The data support a need for verification of the 1976 sampling data and for formal treatment of available and collected data. The results of our preliminary dose calculations have been used to prioritize SWMU aggregate areas on the mesa top and hillsides for field investigation. If possible, the 1976 data will be used to supplement data collected during the RFI.

Several assumptions made when using the RESRAD code have led to conservative estimates of maximum dose. Those assumptions include the following: (1) soil samples taken in 1976 represent the levels present in soil today; (2) gross alpha counts are on the surface; (3) all gross alpha counts have been assigned to the most probable, worst case radionuclide at each site; and (4) mesa-top residents would be exposed through all pathways chosen, including a large amount of their diet taken from food-grown on site.

As mentioned above, preliminary dose estimates presented here are based on soil sampling data collected in the mid-1970s. Although much soil was removed from the TA-1 area (more than 19 000 yd^3), radionuclides were the only contaminants for which soil samples were investigated. To test whether the preliminary dose estimates represent true incremental doses to current residents of OU 1078, verification sampling will be conducted. Some sampling will be of a confirmatory nature (radionuclide analyses on

TABLE 4.6-1

PRIORITIZED LIST OF OU 1078 SWMU AGGREGATES

Aggregate Letter	Aggregate Title	Sampling Plan	Reason for Listing
A	Sigma Building	Mesa top	• Surrounded by residents, soil sampling levels above detection
B	Bailey Bridge	Mesa top, hillsides	• Very close to residents, suspected contamination on debris
C	Hillside 140	Hillsides	• Close to residents, high alpha readings on hillside
D	J-2/TU Area	Mesa top, hillsides	• Close to residents, high alpha readings before cleanup
E	Cooling Tower 80	Mesa top, hillsides	• Close to residents
F	Hillside 138	Hillsides	• Hillside site, close to doctor's office
G	Hillside 137	Mesa top, hillsides	• Site not directly near residents
H	Surface Disposal SE of LA Inn	Hillsides	• Site far from people
I	Can Dump Site	Hillsides	• Do not expect hazardous contaminants
J	Ashley Pond	Ashley Pond	• Public use area
K	Industrial waste disposal line	Industrial waste disposal line	• Nature of historical use
L	Eastern Sanitary Waste Line	Opportunity-as-available	• Nature of use, do not expect contaminants
M	Northern Sanitary Waste Line	Opportunity-as-available	• Nature of use, do not expect contaminants
N	Western Sanitary Waste Line	Opportunity-as-available	• Nature of use, do not expect contaminants
O	Subsurface contamination at UW	Opportunity-as-available	• Do not expect hazardous contaminants
P	Soil contamination under Trinity Drive	Opportunity-as-available	• Paved over

samples taken in areas where past soil sampling data indicated residual radioactivity). In addition, many samples will be analyzed for metals and semivolatile organic compounds to certify that the OU 1078 area does not pose an unacceptable health risk to any inhabitants. The sampling plans are presented in Chapter 7.

4.6 Prioritization of OU 1078 SWMU Aggregates

The preliminary dose estimates presented in Section 4.5 have been used primarily to prioritize SWMU aggregates located on the mesa top so that those of highest concern can be investigated first. The prioritization of aggregates will be used to implement the sampling plans that are developed in Chapter 7. Proximity to population and historical information on the nature of possible contaminants have also been used to prioritize the aggregates. Distance from aggregates to residents was the most important consideration used in the prioritization; those aggregates closest to residents have been rated highest. Hillside aggregates have been prioritized based on proximity to population and gross alpha sampling data. Table 4.6-1 orders OU 1078 aggregates from those of most concern to those of least concern and includes information used to judge the level of importance to OU 1078 sampling plans. Table 4.6-1 also identifies the type of sampling plan proposed in the current RFI work plan that corresponds to each SWMU aggregate. Sampling efforts in the field will begin with those sites of most concern in the summer of 1992.

4.7 Cultural and Biological Resources

4.7.1 Biological Summary

During 1991, field surveys for OU 1078 (site characterization) were conducted by the Biological Resource Evaluations Team of the Environmental Protection Group (EM-8) to provide National Environmental Protection Act (NEPA) documentation for OU 1078. The available NEPA documentation is found in Appendix B of this work plan. Site characterization requires surface and subsurface sampling within the OU and Los Alamos Canyon. Further information concerning biological field surveys for OU 1078 is contained in the report, Biological Assessment for Environmental Restoration Program, Operable Unit 1078 (Appendix B). The biological assessment will contain specific information on survey methodology, results, and mitigation measures. This assessment will also contain information that may aid in defining ecological pathways and vegetation restoration.

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

The purpose of the field surveys was threefold. The first was to determine the presence of critical habitat for any state or federal sensitive, threatened, or endangered plant or animal species within OU 1078 boundaries. Secondly, surveys were conducted to determine the presence of any ecologically sensitive areas, such as floodplains or wetlands; the extent of these areas; and their general characteristics. The third purpose was to provide additional plant and wildlife data concerning habitat types within the OU.

Results and Mitigations. Database searches indicated that species of possible concern for OU 1078 were the

- peregrine falcon (*Falco peregrinus*, federally endangered);
- spotted bat (*Euderma maculatum*, state endangered);
- Jemez Mountains salamander (*Plethodon neomexicanus*, state endangered and federally protected under a memorandum of agreement);
- Mexican spotted owl (*Strix occidentalis lucida*, federal candidate);
- pine marten (*Martes americana*, state endangered); and
- wood lily (*Lilium philadelphicum var. andium*, state endangered).

Threatened and Endangered Species. Based on the habitat evaluation and previous OU 1078 data, no species listed in the this plan appear to have potential for occurrence at OU 1078.

Wetlands/Floodplains. There are no wetlands located within OU 1078. Potential floodplains are found within the canyon systems outside of OU 1078. Although present, these floodplains will not be adversely impacted by the proposed action and therefore no mitigation measures are necessary.

Impacts to nonsensitive plant species should be avoided when possible. Because off-road driving is especially harmful to plants and soil crust, vehicular travel should be restricted to existing roads whenever possible. If off-road travel is required, EM-8 should be contacted to monitor the activity. Revegetation may be required at some sites. A list of native plants suitable for OU 1078 revegetation is contained in the final report, Biological Assessment for Environmental Restoration Program, Operable Unit 1078, Appendix B.

4.7.2 Cultural Resources

Two archaeological sites have been located on the OU 1078 hillsides. No soil sampling is planned at either of these two locations. Further documentation of the locations can be found in Appendix B.

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)

Abeele, W. V., and J. W. Nyhan 1987. "Emanation and Dispersal of Tritiated Water from Disposal Shafts," *Nuclear and Chemical Waste Management*, Vol. 7, pp. 217-226. (Abeele and Nyhan 1987, 0008)

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory Report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

Clement Associates, Inc., June 1988. "Multi-Pathway Health Risk Assessment Input Parameters Guidance Document," prepared for the South Coast Air Quality Management District under Contract #8798, El Monte, California. (Clement Associates 1988, 0745)

Den-Baars, P. S., Ocotober 31, 1991, "TA-1 Risk Assessment," International Technology Corporation letter from P. S. Den-Baars to A. Dorries, Project No. 301215.08.03.08, Los Alamos, New Mexico. (Den-Baars 1991, 09-0046)

DOE (US Department of Energy), December 1979. "Final Environmental Impact Statement: Los Alamos Scientific Laboratory Site, New Mexico," DOE/EIS-0018, Washington, DC. (DOE 1979, 0051)

DOE (US Department of Energy), July 1988. "Internal Dose Conversion Factors for Calculation of Dose to the Public," DOE/EH-0071, Washington, DC. (DOE 1988, 0266)

DOE (US Department of Energy), July 1988. "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," DOE/EH-0070.DOE (US Department of Energy), September 13, 1988. (DOE 1988, 0265)

EPA (US Environmental Protection Agency), September 1988. "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, Federal Guidance Report 11," EPA-520/1-88-020, Washington, DC. (EPA 1988, 0297)

EPA (US Environmental Protection Agency), July 1989. "Exposure Factors Handbook," EPA/600/8-89/043, Washington, DC. (EPA 1989, 0304)

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

Gilbert T.L., Yu C., Yuan Y.C., Zielen A.J., Jusko M.J., and A. Wallo, June 1989. "A Manual for Implementing Residual Radioactive Material Guidelines," ANL/ES-160, DOE/CH/8901,Argonne National Laboratory Argonne, IL. (Gilbert et al. 1989, 0745)

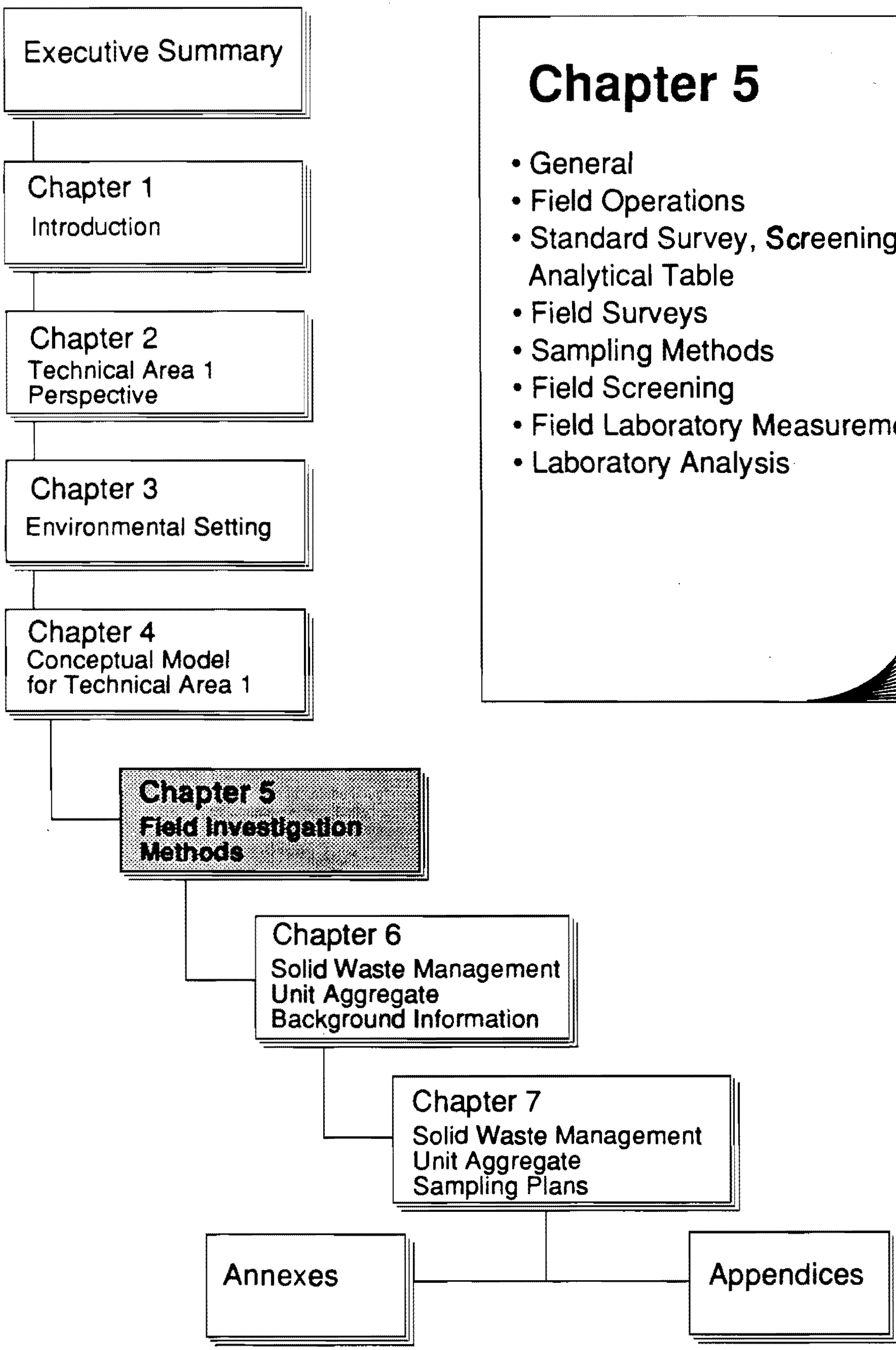
Neptune, D., E. P. Brantly, M. J. Messner, and D.I. Michael, May 1990. "Quantitative Decision Making in Superfund: A Data Quality Objectives Case Study," in *Journal of Hazardous Materials Control*, May/June 1990. (Neptune et al. 1990, 0748)

NMEID (New Mexico Environmental Improvement Division) 1990. "Air Quality Bureau Annual Report 1985–1988," EID/AIR-90/1, Santa Fe, New Mexico. (NMEID 1990, 0704)

Purtymun, W. D., and A. K. Stoker, August 1988. "Water Supply at Los Alamos: Current Status of Wells and Future Water Supply," Los Alamos National Laboratory Report LA-11332-MS, Los Alamos, New Mexico. (Purtymun and Stoker 1988, 0205)

Purtymun, W. D., E. A. Enyart, and S. G. McLin, August 1989. "Hydrologic Characteristics of the Bandelier Tuff as Determined Through an Injection Well System," Los Alamos National Laboratory Report LA-11511-MS, Los Alamos, New Mexico. (Purtymun et al. 1989, 0214)

Travis, J. R., month 1975. "A Model for Predicting the Redistribution of Particulate Contaminants from Soil Surfaces," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. (Travis 1975, 0420)



Chapter 5

- General
- Field Operations
- Standard Survey, Screening, and Analytical Table
- Field Surveys
- Sampling Methods
- Field Screening
- Field Laboratory Measurements
- Laboratory Analysis

5.0 FIELD INVESTIGATION METHODS

5.1 General

This chapter identifies and describes aspects of the phased field investigation process common among Technical Area 1 (TA-1) solid waste management units (SWMUs). Information that is identical for each aggregate-specific field sampling plan is consolidated to reduce repetition.

The following general assumptions and decisions have been made to guide all of the SWMU aggregate field sampling investigations presented in Chapter 7.

- Releases of radioactive materials may have occurred without simultaneous release of hazardous constituents.
- The release of hazardous constituents at some SWMUs may not have been associated with the release of radioactive materials, but years of human activities and action by physical forces would have diluted this isolation effect.
- Field radiological surveys and field screening of samples will be used to identify any existing gross contamination and to serve as Level I data.
- Field laboratory analyses (if available) will be used to more quickly provide Level II/III data to help guide field operations.
- Analytical laboratory analysis will complete the sampling planned at each phase of site investigation.

This chapter includes discussions of several Laboratory-wide aspects of Los Alamos National Laboratory (LANL or the Laboratory) field sampling implementation not covered in the SWMU aggregate-specific field sampling plans of Chapter 7. These aspects include the following standard activities for supporting field operations (Section 5.2).

- Health and safety aspects of field operations
- Laboratory-required preliminary activities and support procedures
- Documentation of locations to be sampled
- Sample handling and laboratory coordination procedures
- Equipment decontamination procedures
- Management of wastes generated by sampling activities

A complete list of environmental restoration (ER) standard operating procedures (SOPs) to be used at the Operable Unit (OU 1078) is found in Table 1.10-4.

The primary focus of this chapter is on field investigation methods. It provides further OU-specific information and builds on the field sampling methods section (Section 3.5.3) of the Laboratory's installation work plan (IWP) (LANL 1990, 0144). The methods presented here are options in the IWP. In addition, this chapter references the Laboratory's ER SOPs for field operations (LANL 1992, 0411); some of these SOPs are currently in preparation. Each of the brief descriptions given here refers to applicable ER SOPs for detailed methodology. However, some field procedures (e.g., concrete debris sampling) currently have no associated ER SOP. This chapter describes the following methods (Sections 5.4–5.8).

- Sampling methods
- Field survey methods to identify contaminants *in situ* (Level I)
- Field sample screening methods to be used at or near the point of sample collection (Level I/II)
- Field laboratory measurement methods to provide rapid quantitative or semiquantitative sample analyses Level II/III)
- Analytical laboratory methods (Level III/IV)

The method descriptions presented here are simple, brief, and provide limited specific information describing the application of the method. Specific information on each method (such as sampling location) is provided by the SWMU aggregate-specific field sampling plans presented in Chapter 7. The brief method descriptions presented here do not reduce the importance of the Quality Assurance Project Plan (Annex II) and the governing ER SOPs.

5.2 Field Operations

Several field investigations may be conducted concurrently. Figure 5.2-1 identifies the organizational structure for the OU 1078 field investigation team. The field team manager will be responsible for field work scheduling, field engineering, waste mangement, and field public relations activities. The field team leader will be responsible for specific sampling activities, including sampling methodology, sample identification and handling, and chain-of-custody procedures. The field team leader will also serve as the site safety officer whose duties will overlap with HS-1 and HS-5 monitors who will also be on site. The field team(s) may share various operations, such as the field laboratory, equipment decontamination, and radioactive health monitoring. If a field laboratory is available, it will used it to perform any field analyses (radionuclides, metals, and semivolatile organic compounds) required by the field sampling plans in Chapter 7. The OU 1078 field team will also deliver soil samples to the EM-8 count lab for gross alpha, beta, and gamma activity counting. Field laboratory analysis, if used, will occur predominantly in Phase II sampling. This field laboratory will be independently managed to ensure rigorous quality assurance (QA) and quality control.

5.2.1 Health and Safety

Annex III presents the Health and Safety Project Plan for all field activities within the TA-1 OU. Annex III gives SWMU aggregate-specific information regarding known or suspected contaminants and suggests personnel protection levels required for various activities. In general, most activities at TA-1 will require Level D protection. As appropriate, samples acquired under this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) will be screened immediately after collection to identify any potential gross radioactive or hazardous constituent contamination that could threaten the health and safety of field personnel. The techniques listed in Section 5.6 will be used for this task. In particular, gross alpha and gross gamma radiation surveys and organic vapor surveys will be standard procedure when suitable. Because of the length of time that has passed since TA-1 has had active operations, volatile organic compounds are not expected to be found during surface, or Phase I, sampling. If appropriate, open excavations and borehole headspace will also be monitored using organic vapor instruments and combustible gas and oxygen detectors. The following SOPs are applicable; all deviations from SOPs will be recorded in field documentation.

- Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
- Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector
- Health and Safety Monitoring of Combustible Gas Levels

5.2.2 Cultural and Biological Resource Evaluations

As part of the Laboratory's environment, safety, and health (ES&H) questionnaire process and in conjunction with field work, cultural and biological resource evaluations (included as Appendix B) have been performed for those areas of TA-1 where the surface is to be disturbed, vegetation removed, or invasive sampling performed. The Department of Energy (DOE) Environmental and Cultural Resources Checklist for categorical exclusion has been completed and is being reviewed by the appropriate Laboratory and DOE groups.

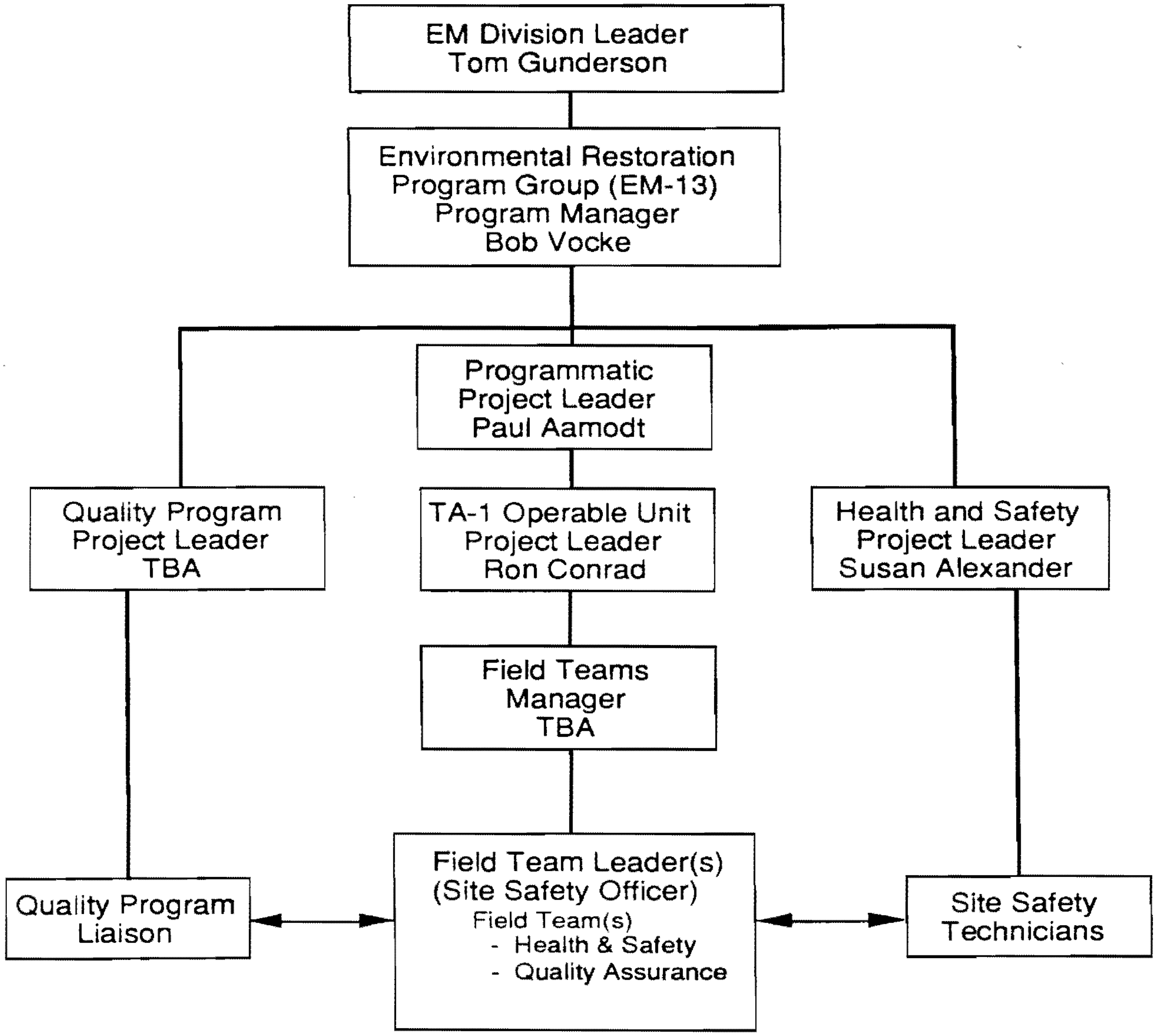


Figure 5.2-1. TA-1 OU field work organization chart, showing health and safety and quality assurance responsibility.

5.2.3 Support Services

Laboratory support groups, such as ENG-3, and contractors, such as Johnson Control, will provide physical services during the field investigation. Laboratory and contractor task procurement procedures will be used. Services provided by these groups may include land surveying, hand trenching, hand augering, excavating with backhoes and front-end loaders, moving pallets of drummed auger cuttings and decontamination solutions, posting signs and other warning notices around the perimeter of the working area, and any other tasks that may be required by the TA-1 OU project leader (PL).

5.2.4 Excavation Permits

As part of the ES&H questionnaire process, excavation permits are required by the Laboratory before any excavation, drilling, or other invasive activity below 18 in. is begun. Acquisition of these permits will be coordinated with EM-3 and Johnson Controls. Acquisition of excavation permits will be scheduled, as appropriate, for each phase of field work. Excavation permits are not required for activities involving surface sampling only. All areas intended for excavation, drilling, or sampling deeper than 18 in. will be marked in the field for formal utility clearance before the work is begun.

5.2.5 Sample Control and Documentation

The IWP (Section 3.5.5) and Annex IV provide guidance for sample handling (LANL 1990, 0144). The ER Program SOPs provide the following sample packaging, handling, chain of custody, and documentation procedures (LANL 1992, 0411).

- General Instructions for Field Investigations
- Sample Containers and Preservation
- Guide to Handling, Packaging, and Shipping of Samples
- Sample Control and Field Documentation

5.2.6 Sample Coordination

The ER Program has established the EM-9 sample coordination facility to provide consistency for all investigations in handling collected samples and in assigning contract analytical laboratories. The system is detailed in Section 3.5.5 and Appendix N of the IWP (LANL 1990, 0144). The applicable SOP is Sample Control and Field Documentation.

5.2.7 Quality Assurance Samples

Several types of field QA samples will be collected during field investigations. Annex II defines each kind of QA sample and gives its purpose. The field sampling plans in Chapter 7 specify collection frequency for each type of field QA sample. The appropriate SOP is Field Quality Control Samples.

5.2.8 Equipment Decontamination

Decontamination is a QA measure and a safety precaution. It prevents cross contamination among samples and maintains a safe and clean working environment. Sampling tools may be decontaminated in the field by washing, rinsing, and drying. The effectiveness of the decontamination process is documented periodically by submitting rinsate blanks for laboratory analysis. Heavy machinery, vehicles, auger flights, and coring tools used in borehole drilling and sampling are steam cleaned before each new sampling event. Decontamination fluids, including steam-cleaning fluids, are considered hazardous wastes and will be collected and contained for proper disposal. The applicable SOP is General Equipment Decontamination.

5.2.9 Waste Management

This discussion is based on Section 3.5.4 and Appendix B of the IWP (LANL 1990, 0144). Wastes produced during characterization sampling activities may include borehole auger cuttings, excess sample soil excavated from trenching, decontamination and steam-cleaning fluids, and disposable materials, such as wipes, protective clothing, and spoiled sample bottles. At TA-1, the following waste categories may be encountered: nonhazardous solid waste, hazardous waste, low-level radioactive waste, and mixed waste. The applicable SOP, Management of RFI-Generated Waste, describes requirements for segregating, containing, characterizing, treating, and disposing of each type and category of waste. The ER regulatory compliance technical team leader will be consulted concerning proper procedures to effect waste disposal.

5.3 Standard Survey, Screening, and Analytical Table

In all sampling plans of the OU 1078 work plan, a standard table has been used to identify field operations, sample analytical requirements, and specialty samples (e.g., duplicates). Table 5.3-1, an example of this standard table, contains measurement or analysis identification columns and columns that identify samples and sampling methods.

5.3.1 Samples and Sampling Methods

The four columns on the left side of Table 5.3-1 indicate the type of sampling or activity to be conducted, the sampling location, the depth interval (as appropriate), and the sample identification number. Certain table and sampling plan details may require modification should the observational approach warrant field modifications. Sampling methods or activities identified in the first column are defined in Section 5.5.

5.3.2 Survey, Screening, and Analysis Methods

The terms below define types of measurement for the OU 1078 work plan.

> **Field Surveys** (or surveys). Direct reading or recording instruments are used to scan the land surface to make measurements of *in situ* conditions. Typically, surveys provide Level I data. Gamma radioactivity (PHOSWICH readings) is a common target of field surveys. Land surveys are included in this category.
>
> **Field Sample Screening**. Instrumental observations are applied to samples at or near the point of collection to measure the presence of contaminants or determine other properties of the sample. Field screening provides Level I or Level II data. Gross alpha radioactivity and organic vapors are common targets of field screening.
>
> **Field Laboratory Measurements**. These sample analysis methods require minimal sample preparation and use bench-top analysis equipment. They measure contaminants or other sample properties at lower detection limits and with better precision than can be obtained with field screening techniques. Depending on the testing technique used, Levels I, II or III data may be produced. Gamma spectrometry on dried soil samples placed in a fixed, shielded geometry (Petri dish) is a typical example.
>
> **Laboratory Analysis** (or analytical laboratory analysis). This category represents the ultimate analysis for which samples are collected, preserved, and sealed. Level III or IV data are usually expected and are generally provided by off-site analytical laboratories.

These four categories of measurement are shown in Table 5.3-1. For the different categories, several measurement techniques are identified in vertical columns. These will be the most common techniques used for the majority of TA-1 SWMU aggregates. The measurement techniques in each vertical column are identified in Section 5.4, Section 5.6, Section 5.7, and Section 5.8.

The generic logic flow diagram in Figure 5.3-1 presents the interaction among the four categories of measurement during field investigations. The exact logic flow and categories of measurements implemented in an individual field investigation may vary from the generic logic flow presented in Figure 5.3-1. However, the structure that controls interaction between measurement types is uniformly applied in all field

Table 5.3-1 Screening and Analysis for Phase I Investigations at OU 1078 (TA-1).

SWMU Aggregate:______________________

Subarea:______________________

Date:______________________

Field Team Leader:______________________

Sample Type	Sampling Location	Interval	ER Sample Identification	Field Surveys and Screening						Field Laboratory Measurements					Laboratory Analysis										
				Low-energy gamma (PHOSWICH)	FIDLER	Beta / Gamma	Alpha	Organic vapor		Gross alpha	Gross beta	Gross gamma	X-ray fluorescence		Gamma Spectrometry (^{137}Cs)	Total uranium	Isotopic plutonium	Semivolatiles (SW 8270)	Metals (SW 6010)						
Surface Soil Sample	1	0.0 - 6.0 in.																							
	2	0.0 - 6.0 in.																							
	3	0.0 - 6.0 in.																							
	4	0.0 - 6.0 in.																							
	5	0.0 - 6.0 in.																							
	6	0.0 - 6.0 in.																							
	7	0.0 - 6.0 in.																							
	8	0.0 - 6.0 in.																							
	9	0.0 - 6.0 in.																							
	10	0.0 - 6.0 in.																							
	11	0.0 - 6.0 in.																							
	12	0.0 - 6.0 in.																							
	13	0.0 - 6.0 in.																							
	14	0.0 - 6.0 in.																							
	15	0.0 - 6.0 in.																							
	16	0.0 - 6.0 in.																							
	17	0.0 - 6.0 in.																							
	18	0.0 - 6.0 in.																							
	19	0.0 - 6.0 in.																							
	20	0.0 - 6.0 in.																							
	21	0.0 - 6.0 in.																							
	22	0.0 - 6.0 in.																							
	23	0.0 - 6.0 in.																							
	24	0.0 - 6.0 in.																							

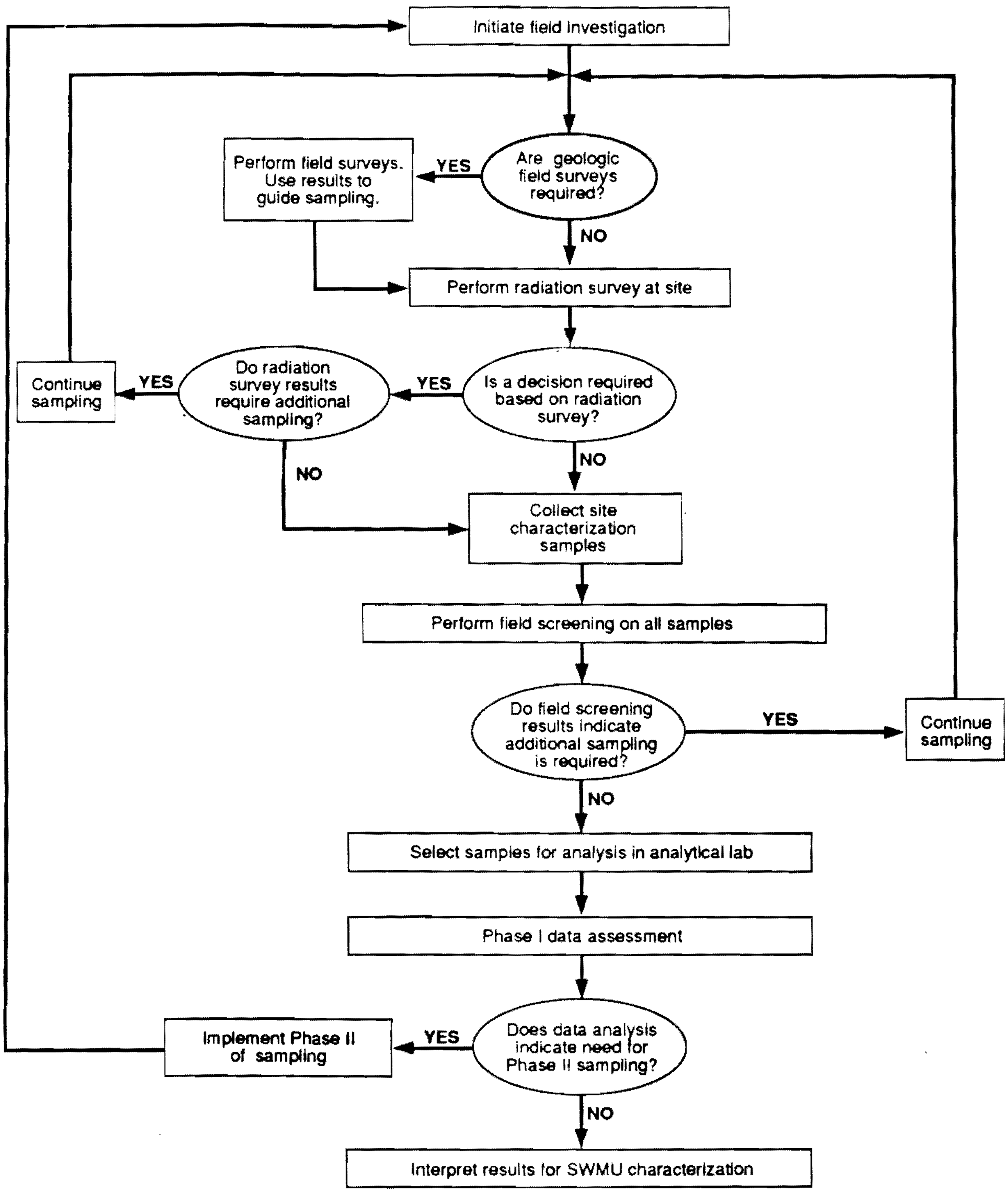


Figure 5.3-1. Logic flow diagram for field investigations.

investigations. Logic flow diagrams (either generic and/or individual) for each SWMU aggregate field investigation will be presented in each of the SWMU aggregate sampling plans in Chapter 7.

5.3.2.1 Use of the Standard Screening and Analysis Table

Table 5.3-1 serves two major purposes. First, it clearly and concisely summarizes the information associated with collected samples. It gives locations; indicates sampling methods and depth interval; identifies major survey, screening, and analysis measurements for each sample (as detailed in Chapter 7); explicitly identifies the collection and analysis of field QA samples; and gives a representation of any options in a sampling plan. Second, the table provides the detail needed to estimate investigation costs.

The following three types of sample selections are used to complete Table 5.3-1. The selection should be marked at the intersection of the sample row and the analysis column.

- **X.** Planned sample screening and analysis should be marked with an X.
- **E.** An E should be used to mark an example selection of samples. This is used for cases in which a plan allows an option or provides guidance to field personnel for selecting particular samples to be submitted for analysis. The particular samples selected in the field may differ from those indicated by an E, but the actual number selected should not differ radically from the number originally indicated. If a sample marked E is associated with a field QA sampling requirement, the QA requirement will be applied to the actual sample selected.
- **C.** A C should be used to mark sample analyses that are provided by the plan as a contingency against foreseeable uncertainties that may be encountered in the field.

5.3.2.2 The Full Suite of Analyses

At many SWMU aggregates insufficient current information necessitates sampling for a wide spectrum of possible contaminants. In many cases, the analytical suite is simply specified as a full suite of analyses. In the context of the OU 1078 work plan, a full suite indicates that the following list of analyses will be requested for a sample.

- Gamma spectrometry (including ^{137}Cs)
- Total uranium
- Isotopic plutonium
- Semivolatile organic compounds (SW 8270) (EPA 1986, 0291)
- Metals (SW 6010) (EPA 1986, 0291)

The full suite has been developed using available information on source terms and data collected during the 1976 TA-1 decontamination (Ahlquist et al. 1977, 0016). Although many other radionuclides were present at TA-1, their release is not a certainty. Additionally, most radionuclides were available in such small amounts that if a release had occurred, its extent of contamination would be minimal. Many radionuclides for which there is evidence of releases (e.g., ^{210}Po) would have decayed to harmless products by today. Volatile organic compounds will not be analyzed in Phase I samples because physical and biological forces operating since TA-1 was extant would certainly have reduced any volatile organics to minimal levels.

5.3.2.3 Additional Analyses

For certain SWMU aggregates, additional laboratory analyses (e.g., isotopic thorium, ^{241}Am) may be appropriate. These additional analyses will be performed on samples as detailed in Section 5.8. Blank columns are provided in Table 5.3-1 for listing any additional analyses that may be required at particular SWMU aggregates.

5.4 Field Surveys

Field surveys were previously defined in Section 5.3.2. These are primarily surveys of the land surface performed on foot using direct-reading recording instruments. For this document, these surveys include low-energy, gamma-radiation surveys, such as those performed with PHOSWICH or FIDLER meters. For convenience, land engineering surveys to identify and mark specific site locations are included as field surveys. Field survey data may be used to identify the presence of contaminants by using nondestructive methods. Certain individual sampling plans require that radiological field survey techniques be used to identify locations for judgmental sampling or as a preliminary assessment at areas where contaminants are not expected or would be homogeneously distributed. While negative results from field surveys are not conclusive evidence of the absence of contaminants, positive results obtained at an early stage can allow timely redirecting of a sampling plan.

5.4.1 Radiological Surveys

5.4.1.1 Gross Gamma Survey

Several suitable instruments are available for these surveys: Micro-R meters, NaI detectors of various sizes with rate meters or scalers, and Geiger-Müller detectors. The preferred instruments are Micro-R meters with the ability to measure to 5 μR/hr and 2-in. by 2-in. NaI detectors with rate meters capable of displaying 100 counts/min. Some discrete- or continuous-measurement recording instruments are also available with the same detectors. Surveys are conducted by carrying the instrument at waist height, walking slowly, and observing and recording the rate meter response. Measurements may also be made at the ground surface to determine if localized contamination is present. The applicable SOP is Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector.

5.4.1.2 Low-Energy Gamma Survey

Two instruments are commonly used for low-energy gamma surveys, the FIDLER and the PHOSWICH. Both are adequate for detection of low-energy photons such as the 60-keV gamma emission from ^{241}Am, low-energy gamma, or x-rays that accompany the alpha decay of most heavy radionuclides, including uranium, thorium, and plutonium. Either instrument or a suitable substitute may be used for the OU 1078 work plan. Discrete- and continuous-measurement models are available. Surveys are conducted by walking, carrying the instrument close to the ground surface, and observing the rate meter or scaler. By counting for a finite period of time, such as 100 seconds, measurements may also be made directly at the ground surface to determine if localized contamination is present. The applicable SOPs are Standard Procedure PHOSWICH Calibration, Quality Control, Detection Limits, and Field Use and Standard Procedure FIDLER Calibration, Quality Control, Detection Limits, and Field Use.

5.4.2 Land Surveys

Land surveys will be used for three purposes: (1) to document most sampling locations, (2) to locate either former or buried structures, and (3) to map disposed construction debris, land surface contours, and field features. Sampling location surveying will be conducted for most sampling and not identified as a task in the analytical table. In all cases, the precision requirements for the surveys are identical: ±1-ft horizontal and ±0.1-ft vertical. The conventional survey procedures used are documented by Laboratory Engineering Division personnel in their standard operating procedures.

5.4.3 Geomorphic Mapping

A significant amount of field or geomorphic mapping will be required at TA-1 to assist in the location of certain sampling points. In order to sample those hillside areas judged most likely to contain potential contamination, several of the individual sampling plans in Chapter 7 require the identification of hillside watercourses or drainages. Preliminary field work at the TA-1 hillside SWMU aggregates (such as Hillsides 137 and 138) indicates that an expert field geologist will be required to document present-day precipitation run-off channels. The geologist will also correlate present-day drainage channels to the historic channels that would have carried fluids from the TA-1 outfall locations into the lower gradient area at the floor of Los Alamos Canyon. To assist in correlating current drainage channels to historic drainage channels, the geologist will use field mapping, aerial photographs, topographic maps, and other archival information.

Several SWMU aggregate drainages and channels are well defined from the rim to the floor of the canyon (e.g., Bailey Bridge aggregate). Other hillside aggregates will require mapping, as described above. Field maps allow the best use of professional judgment for placing representative sampling locations or establishing the placement of a systematic sampling grid. Representative sampling locations must provide adequate coverage to assess dissemination of potential contaminants over the hillsides below TA-1. Correct use of well-documented judgmental sampling points will allow less reliance on nonjudgmental or random sampling regimens. The applicable SOP is Geomorphic Characterization.

5.5 Sampling Methods

5.5.1 Introduction

For the field sampling plans used in Phase I of the OU 1078 work plan, a set of specific sampling methods has been selected, and the details of their use and application in the field have been carefully defined. For example, a surface soil sample in this document is specifically defined as representing a 0- to 6-in. layer of soil collected by a hand scoop (Section 5.5.2.1), and a vertical borehole core sample is a 3- or 5-ft core interval taken with a hand auger or a split-barrel sampler of a particular length and diameter (Section 5.5.3). During the sampling process, an unexpected situation may require a change in the location or depth of a sample from that specified in a sampling plan. In such situations, the field team leader and OUPL will determine the new location or depth of the sample.

Essential details for each method to be used at TA-1 are identified below. However, to completely understand the method, one must refer to the applicable ER SOP or individual field sampling plan for additional information (e.g., nominal or target depth for a borehole).

5.5.2 Soil Sampling Methods

5.5.2.1 Surface Soil Samples

Surface soil samples are defined as samples taken from the first 6 in. of soil using a stainless steel, Teflon-coated, or otherwise inert plastic scoop. Instruments plated with chrome or other potentially contaminating materials are not acceptable for collecting this type of soil sample. Samples will be taken to a full 6-in. depth and the sides of the hole will be cut vertically to ensure that equal volumes of soil are sampled over the full 6-in. depth. The applicable SOP is Spade and Scoop Method for Collection of Soil Samples.

5.5.2.2 Near-Surface Soil Samples

The spade and scoop method will be used to obtain near-surface soil samples from depths of up to 30 in. Spades, shovels, scoops, or hand augers will be used to remove surface material to the required depth. Once the required depth is obtained, a stainless steel, Teflon-coated, or otherwise inert plastic scoop will be used to collect the sample. Devices plated with chrome or other potentially contaminating materials are not acceptable for soil sample collection of this type. Sample collectors must be careful to take the sample to the full depth specified in the SWMU aggregate-specific sampling plan and to cut the sides of the hole vertically to ensure equal volumes of soil are sampled over the full depth. The standard sample thickness of 6 in. may be changed should an appropriate situation arise (e.g., encountering a tree root or bedrock). The applicable SOP is Spade and Scoop Method for Collection of Soil Samples.

5.5.2.3 Undisturbed Surface Soil Samples

Undisturbed surface soil samples will be gathered from the first 6 in. of soil using the ring sampler method. This method involves driving a 4-in.-diameter stainless steel tube (ring sampler) vertically into the area to be sampled. The soil around the ring sampler is then excavated and the tube removed. An undisturbed core sample is obtained by pushing the soil from the ring sampler. Because of the small amount of undeveloped surface area at TA-1, undisturbed soil samples will rarely be taken. The applicable SOP is Stainless Steel Surface Soil Sampler.

5.5.2.4 Deposition-Layer Soil Samples

Deposition-layer samples will not be collected at TA-1. TA-1 has been nonoperational for over 25 years, and the majority of the surface soil at TA-1 has been severely altered by physical processes (wind, water, sun) and by various anthropogenic activities resulting from the residential and commercial development of the area. Any residue of airborne emissions from TA-1's operational period or from atmospheric fallout would long since have been removed or grossly altered by a combination of wind erosion, water erosion, and anthropogenic activity.

5.5.2.5 Manual Shallow Core Samples

Small-volume subsurface soil samples can be recovered from depths up to 10 ft with a hand auger or with a thin-wall tube sampler. The thin-wall tube sampler provides a less-disturbed sample than that obtained with a hand auger. However, when it is not possible to force the thin-wall tube sampler through certain soil sediments or tuff, sampling with a hand auger may be used. Neither the hand auger or the thin-wall sampler is practical for digging below 10 ft. The applicable SOP is Hand Auger and Thin-Wall Tube Sampler.

5.5.3 Borehole Core Sampling Methods

Split-barrel core subsurface sampling will be accomplished using a hollow-stem auger drill rig. Soil samples will be collected using a split-barrel stainless steel sampler. A nominal depth for each borehole will be given in Phase II sampling plans that specify drilling activity. The borehole will be sampled to at least this nominal depth. If contamination is detected by field screening methods or field laboratory measurements in the last core interval above the nominal depth, specified drilling will continue until contamination levels measure that of background in the successive sample interval. This criterion will be used to determine when to stop drilling boreholes and as a means of ensuring that the maximum information on contaminant depth is acquired. Phase II sampling plans specify analytical plans for cores down to the nominal depth. The pattern set by the analytical plan will be followed for the complete depth of the borehole, as determined by the criterion for stopping just described. However, during the sampling process, an unforeseen situation may require a change in the depth of sample from that specified in the sampling plan. In such situations, the field team leader and OUPL will determine the new depth of sample. The applicable SOP is ASTM Method for Sampling with a Split Spoon.

5.5.3.1 Shallow Boreholes

Several of TA-1's sampling plans will call for shallow core Phase II samples to be collected to investigate subsurface migration of contaminants where potential for deep migration is low. This shallow borehole method is intended for boreholes no deeper than 30 ft. For ease of setup and rapid drilling, the use of a lightweight drilling rig may be preferred for all shallow boreholes. The criterion for stopping described in Section 5.5.3 will also be used for these boreholes, and the applicable SOP is Drilling Methods and Drill Site Management.

5.5.4 Trenching

In the OU 1078 work plan, trenching is proposed for several purposes: to identify the location of buried structures before drilling, to expose buried structures or backfilled trenches for sampling, and to expose deeper soil for visual observation or sampling. Hand trenching may be performed for shallow depth sampling or for use in areas inaccessible to heavy equipment. Backhoes or other appropriate equipment capable of excavating to a depth of 15 ft may be used in areas accessible to heavy equipment. The width and type of the bucket are based on soil conditions and type of exposure needed and will be determined by the equipment operator. The trench must be wide enough for soil sampling, field surveying, and screening operations to be performed safely. When a trench of 4 ft or deeper is needed, the OSHA standard for shoring and sloping (29 CFR 1926.650) will be followed (OSHA 1991, 0367). Because the tuff at TA-1 is stable rock, shoring and sloping will generally not be required when tuff is trenched, but each trench will be inspected by a competent engineer or by health and safety personnel to ensure that no sign of a potential cave-in exists. The maximum depth of a trench will generally be 15 ft. The applicable SOP is Excavating Methods.

5.5.5 Surface Water Sampling Methods

A Geotech Model 0700 peristaltic pump or its equivalent will be used as one of two methods for collecting surface water samples. The Geotech Model 0700 simplifies representative sample collection and reduces the possibility of sample contamination. In this method, surface water samples can be filtered and collected directly with minimal elapsed time. This method also allows samples to be collected without filtering if, for instance, total heavy metals are to be analyzed.

An alternate method is to collect surface water as grab samples. In this method, a beaker, flask, or some other transfer device is dipped into the water surface to retrieve the sample. The water sample can also be collected directly by dipping the sample container into the water and filling it. Ashley Pond is the only area of TA-1 for which surface water samples will be collected. The applicable SOP is Surface Water Sampling.

5.5.6 Sludge Sampling Methods

Sludge from the bottom of Ashley Pond will be collected by either of two methods. The first method employs a thief sampler dragged along specified locations at the bottom of the pond. The second method involves collecting grab samples by dipping a weighted stainless steel beaker or other inert transfer device attached to a PVC pipe or metal rod into the pond sludge, filling the transfer device, and transferring the sludge to a stainless steel bucket. Sample containers are then filled from the sludge in the bucket. The applicable SOPs are Trier Sampler for Sludges and Moist Powders and Granules and Weighted Bottle Sampler for Liquids and Slurries in Tanks.

5.5.7 Concrete Debris Sampling Methods

Concrete debris sampling will be conducted at several hillside disposal areas. The process includes land surveying and mapping of debris components; field screening for radioactivity and metals; and, if necessary, invasive sampling and laboratory analysis of debris (for a more complete description of concrete debris sampling, see Chapter 7).

5.6 Field Screening

Field screening was previously defined in Section 5.3.2. Screening measurements are applied at the point of sample collection, in borehole headspace, and in excavations to identify gross contamination and to assess conditions affecting the health and safety of field personnel. Screening for personnel health and safety is detailed in Annex III, Health and Safety Plan, of the OU 1078 work plan. The individual sampling plans in Chapter 7 may not explicitly identify sample screening techniques; however, the standard analytical table for each investigation will show the methods to be used. In general, every sample taken at TA-1 will be field screened for gamma and alpha radioactivity, and all excavations and boreholes will be monitored for combustible gases and organic vapors.

Certain individual sampling plans may also use sample screening information explicitly as Level I data for making decisions regarding further sampling (such as determining whether a hot spot exists) or for selecting sample analysis options.

5.6.1 Radioactive Screening

5.6.1.1 Gross Gamma

A hand-held NaI detector probe and rate meter will be used to screen samples in the field for gamma radioactivity. The detector is held close to the sample or core and identifies elevated concentrations of certain radionuclides by registering a rate meter reading above instrument background levels. Quantification of the response is difficult. Therefore, this field screen method will only be used as a gross indicator of potential contamination. The applicable SOP is Gross Gamma Activity in Soil.

5.6.1.2 Gross Alpha

A hand-held alpha scintillation detector and a rate meter will be used to screen samples in the field for gross alpha contamination. The detector is held close enough to establish contact with the sample, core, or ground surface. Its lower detection range is approximately 100–200 pCi/g for a damp soil sample. The instrument cannot identify specific radionuclides. The applicable SOP is Gross Alpha Activity in Soil.

5.6.2 Nonradioactive Screening

5.6.2.1 Organic Vapor Detectors

Organic vapor detectors will be used to screen boreholes or confined spaces at the point of entry and borehole cores and soil samples at the point of collection. Two purposes are addressed by this method: personnel safety will be monitored and gross organic compound contamination will be flagged. Two types of detectors, the Model PI 101 Photoionization Detector (PID) and the Foxboro Model OVA-128 (FID), will be used to detect a wide range of vapors. Equivalent instruments may be substituted.

The PID is a general survey instrument capable of detecting real-time concentrations of many complex organic, as well as some inorganic, compounds in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish among detectable compounds in a mixture of gases. The applicable SOP is Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

The FID is a flame ionization detector that can be used as a general screening instrument for detecting the presence of many organic compounds. Calibrated to a gas of known composition, it responds to an unknown gas relative to its response for the known gas. The applicable SOP is Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector.

5.6.2.2 Combustible Gas/Oxygen Detector

A Gastech Model 1314 or its equivalent will be used to determine the potential for combustion or explosion of unknown atmospheres during drilling and intrusive activities. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit or lower flammability limit. The Gastech Model 1314 also contains an oxygen detector to determine atmospheres that are deficient or enriched in oxygen. For health and safety purposes, the CGI will be used (if appropriate) to monitor atmospheres during some intrusive activities. The applicable SOP is Health and Safety Monitoring of Combustible Gas Levels.

5.6.2.3 X-Ray Fluorescence Probe For Metals

X-ray fluorescence (XRF) is a technique for analyzing metals in solids. The instrument consists of a source for sample excitation (x-ray tube), a detector or proportional counter, a sample chamber, and an energy analyzer. The XRF instrument will be used for detection of metals on solid surfaces. Dried soil or crushed debris samples are placed in a sample chamber, excited, and counted for finite time periods (such as 400 seconds). Detection limits for metals in soil must be low enough to ascertain whether action levels for metals on soil or debris will be exceeded. Even if metal action-level detection limits cannot be achieved in field instruments, gross concentrations of metals may be detected. This will be valuable information for soil or debris assessment. There is no ER SOP for XRF; calibration and field procedures recommended by the instrument manufacturer will be followed.

5.7 Field Laboratory Measurements

The scope and nature of field laboratory measurements for supporting investigations at TA-1 are defined in Section 5.3. If the field laboratory is available, it will provide fast turnaround analysis of samples for a limited number of analytical methods. Field laboratory measurements may determine whether to move from a Phase I to a Phase II investigation. The techniques used in the field laboratory give primarily Level II data, although some yield Level I or near Level III data, as noted for a particular analysis method below. Field laboratory methods provide better quality information and lower detection limits than can be obtained with field screening. In many cases, they provide a type of information that cannot be obtained with field screening techniques. Uses of field laboratory results vary among individual sampling plans. However, the following major uses dominate.

> **Guidance to Field Operations.** The use of field laboratory results as guidance to field operations provides fast turnaround results to help direct the course of field work. This use of the field laboratory can increase the efficiency of field operations, such as when laboratory measurements are used to determine when to cease drilling a borehole in a contaminated zone. For instance, if metals on soil exceed Subpart S action levels (EPA 1990, 0432), drilling to greater depth will be required.
>
> **Judgmental Sample Selection.** The use of field laboratory results in judgmental sample selection provides a means of focusing analytical efforts on samples best suited toward achieving investigation objectives. Depending on the specific goals of the investigation, samples can be chosen based on selected characteristics. For example, those with no detectable contaminants are selected to assess the edge of an area of surface contamination; those with the highest levels are selected to identify contaminants during source characterization. Knowledge-based sample selection can enhance the effectiveness of the investigation. An example would be sample selection for full suite analysis based on gross alpha or beta activity greater than 20 pCi/g.

Analytical Sample Load Reduction. Field laboratory results provide the ability to quickly and inexpensively assess large numbers of samples for easily detectable contaminants. A broad base of lower-quality measurements will provide some assurance that the few high-quality measurements are representative and sufficient for decision making. This can effectively reduce the number of samples that must be submitted to an analytical laboratory for costly analysis. For example, gross alpha and beta measurements are relatively quick and inexpensive. Taking many measurements of this type in soil may yield more valuable information than running full suite analysis on very few samples.

In the majority of the individual field sampling plans, the selection of samples for submission to the analytical laboratory will be made on the basis of field laboratory results (gross alpha or beta). The criteria to be used for making this selection depend on the focus and goals of the particular investigation; however, two guidelines have been delineated as follows.

When the primary goal of the investigation is to identify contaminants by characterizing them at the source, samples selected for submission to an analytical laboratory should principally be those in which the presence of contaminants was detected in the field laboratory (e.g., soil samples with gross alpha or beta activity greater than 20 pCi/g).

If the main goal is to determine the extent or absence of contamination, the selection should be made from the samples at the edges of and immediately outside a contaminated zone. These areas would be respectively defined by those samples having low contaminant concentrations, as determined in the field laboratory, and by those with results below the detection limits of field laboratory instruments. In these cases, samples submitted to the field laboratory will be chosen randomly.

The individual sampling plans in Chapter 7 specify the approximate number of samples to be submitted to the analytical laboratory. Some situations may complicate the application of these criteria. Certain unforeseen field situations (in particular, hillside sampling) may require that the field team leader and OUPL modify the number of samples from the number specified in the sampling plan.

5.7.1 Radiological Field Laboratory Measurements

Potential release of contaminants at SWMUs in TA-1 may have included radionuclides. Because radionuclides are relatively easy to detect even at very low levels in a field laboratory, the OU 1078 work plan proposes using field laboratory radiological measurements to guide decision making in the field. For example, field laboratory measurements might be used to determine whether to obtain additional samples in a subsurface investigation and to guide the selection of particular samples for submission to the analytical laboratory.

5.7.1.1 Gross Alpha

Measurements of gross alpha radioactivity can be used to assess the presence of plutonium, uranium, americium, and thorium in soil samples, although identification of individual radionuclides is not possible with this technique. For example, alpha particle emissions from ^{239}Pu are indistinguishable in gross alpha measurements from those of ^{241}Am. A typical method for measuring gross alpha radiation uses dried soil samples in a fixed geometry (Petri dish or planchet) to detect alpha-emitting radionuclides with activities as low as 20 pCi/g. After the soil is dried, it is typically measured for 5 minutes to 24 hours using large-area ZnS alpha scintillation detectors or gas proportional counters with scalers. A Ludlum Model 2200 with a Model 43-10 alpha scintillation detector or its equivalent is appropriate. These Level II measurements can be used to guide field operations or to guide sample selection for the analytical laboratory based on defined levels of activity such as 20 pCi/g. The applicable SOP is Screening Soil Samples for Alpha Emitters.

5.7.1.2 Gross Beta

A measurement procedure similar to that for gross alpha activity on soil will be implemented for gross beta measurement of beta emitters such as ^{90}Sr and ^{137}Cs. Samples will be dried, homogenized, placed in a Petri dish, and counted for finite time periods (5 min. to 24 hrs). A Ludlum Model 2200 and an appropriate beta detector and scaler or a gas proportional counter are used for counting soil or other dried solids. The applicable SOP is Screening Soil or Debris for Beta Emitters.

5.7.1.3 Gamma Spectrometry

Gamma radiation spectrometry can be used to quantify particular radionuclides present in soil samples such as ^{137}Cs, ^{60}Co,^{234}U, ^{235}U, and ^{238}U. Additionally, 59-keV gamma activity from ^{241}Am can be detected. Such identification is important for guiding field work, judging the selection of samples for laboratory analysis, or analyzing for ^{137}Cs. The use of PC-based, multichannel analyzers (MCAs) and NaI or germanium photon detectors in a field laboratory setting can produce rapid turnaround analysis with Level II or Level III quality. A Canberra MCA with a Ludlum 44-10 NaI detector or equivalent instrument is acceptable. Dried soil samples in fixed geometries (Petri dishes) can be analyzed in approximately 20 to 30 min. with detection limits of approximately 5 pCi/g for radionuclides such as ^{137}Cs. The applicable SOP is Use of Gamma Spectrometry Systems as a Screen for Gamma Ray-Emmitting Radionuclides in Soil Samples.

5.7.2 Organic Chemical Field Laboratory Measurements

5.7.2.1 Volatile Organic Compounds

Rapid turnaround analysis for volatile organic compounds with Level II or Level III quality may, in rare cases, be needed to guide TA-1 field operations, primarily drilling or trenching. An instrument with the ability to distinguish between various organic compounds is preferable. The Laboratory's transportable purge-and-trap Gas Chromatograph/Mass Spectrometer can provide qualitative and quantitative analyses of most volatile organic compounds with boiling points below 200°C and exhibiting low or slight solubility in water. Volatile water-soluble compounds can also be detected under certain conditions. Contractors will also be able to provide this same type of Level II/Level III quality field instrumentation. The applicable SOP is Portable Gas Chromatography for Field Screening of Volatile Organic Compounds. Generally, it is not anticipated that volatile organic compound analysis will be used at TA-1.

5.8 Laboratory Analysis

Contract laboratory analyses will yield the highest quality data (Level III/IV) to be collected in the OU 1078 RFI. As described in Section 5.2.6, samples to be submitted to an analytical laboratory will be coordinated, handled, and tracked by the ER Program Sample Coordination Facility located in the Laboratory's EM-9 installation at TA-59. Before individual samples can be brought into the EM-9 receiving laboratory, they must be screened for gross alpha, beta, and gamma activity.

Certain portions of individual sampling plans rely heavily on Level III/IV analytical data to support their objectives. Most plans rely heavily on Level I/II data for field guidance but use the higher-quality results from an analytical laboratory for documenting the absence or presence of contaminants at the TA-1 OU and for calculating baseline risk assessments. As discussed in Section 5.3, the standard survey, screening, and analysis table identifies the analyses to be performed on each sample. The common full suite of analyses is discussed below.

> **Gamma Spectrometry.** Several Radionuclides may be quantified by using gamma spectrometry to measure photon emission. Analysis of ^{137}Cs will be performed by utilizing this technique. Gamma spectral analysis is performed on a sample aliquot placed in a special geometry container. The instrument's detector is calibrated to the geometry of the cell. The container is placed in a "well" surrounding the detector and counted for a specific period of time. Gamma activity per aliquot is measured.
>
> **Total Uranium.** Analysis is conducted by Laboratory EM-9 methods that follow sample digestion using US Environmental Protection Agency (EPA) Method 3050 (EPA 1986, 0291).

Isotopic Plutonium. Radiochemical separation of plutonium from soil is followed by alpha spectrometry to quantify each isotope of plutonium. If special counting techniques with modern detectors and software are developed to provide plutonium isotopic data in soil and sediment at low activity levels, these will be substituted for radiochemistry, as appropriate.

Semivolatiles. Semivolatile organic compounds are quantified using EPA Method SW 8270 (EPA 1986, 0291). The standard list of analytes and quantification limits is given in Annex II.

Metals. Total metals are quantified using EPA Method SW 6010 (EPA 1986, 0291). The standard list of analytes and quantification limits is given in Annex II.

Four additional analyses that are not part of the common full suite of analyses may be specified in certain individual plans.

Toxicity Characteristic Leaching Procedure (TCLP). The TCLP method is an EPA testing technique for determining whether a waste is a RCRA waste. It is used specifically for hazardous metals and hazardous volatile organic compounds. The standard list of analytes and quantification limits is given in Annex II.

Isotopic Thorium. Radiochemical separation of thorium from soil is followed by alpha spectrometry to quantify each isotope of thorium.

Tritium. Soil moisture is distilled from soil or vegetation. Low-energy beta emission from tritium is measured by liquid scintillation techniques.

Strontium-90. Radiochemical separation of strontium-90 is performed by using multiple selective precipitation and is followed by gas proportional detectors.

REFERENCES

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory report LA-6887, Los Alamos, New Mexico, 1977. (Ahlquist et al. 1977, 0016)

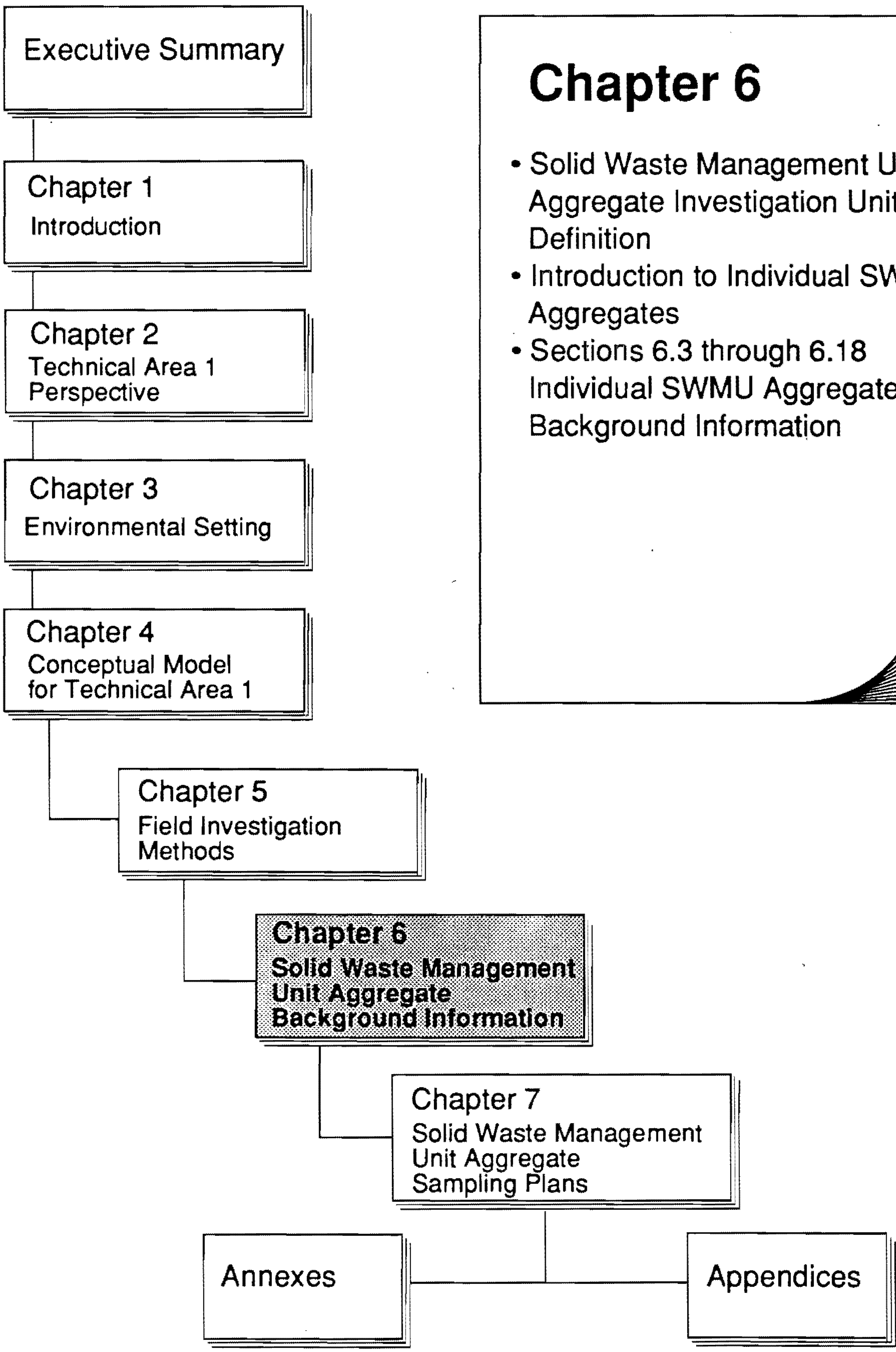
EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40 Parts 264, 265, 270, and 271, Federal Register, Vol. 55. (EPA 1990, 0432)

EPA (US Environmental Protection Agency), November 1986. "Test Methods for Evaluating Solid Wastes; Physical/Chemical Methods," SW-846, Third Edition, Washington, DC. (EPA 1986, 0291)

LANL (Los Alamos National Laboratory), November 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory report LA-UR-90-3825, Los Alamos, New Mexico. (LANL 1990, 0144)

LANL (Los Alamos National Laboratory), May 1991. "Environmental Restoration Standard Operating Procedures," Vols. I, II, and III, Los Alamos, New Mexico. (LANL 1992, 0411)

OSHA (Occupational Safety and Health Administration) July 1, 1991. "OSHA Construction Standards," 29 CFR 1926 (OSHA 1991, 0367)



Chapter 6

- Solid Waste Management Unit Aggregate Investigation Unit Definition
- Introduction to Individual SWMU Aggregates
- Sections 6.3 through 6.18 Individual SWMU Aggregate Background Information

6.0 SOLID WASTE MANAGEMENT UNIT AGGREGATE BACKGROUND INFORMATION

6.1 The Solid Waste Management Unit Aggregate

In order to streamline the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan, the 68 individual solid waste management units (SWMUs) at Operable Unit (OU) 1078 have been combined into aggregates. A SWMU aggregate can consist of an individual SWMU or two or more geographically related SWMUs that have the same conceptual model (Section 4.3) and receptors. Combining geographically and conceptually comparable SWMUs, where appropriate, avoids repetitive modeling, evaluation of migration pathways, and redundant sampling plans. A second criterion used for combining SWMUs into sampling aggregates is by common drainage areas. For instance, Bailey Bridge Canyon is the drainage into which run-off from the majority of the central portion of Technical Area (TA) 1 flowed. A few SWMUs in this aggregate (Aggregate B) are some distance from the canyon (e.g., TA-146 incinerator and Septic Tank 276); however, any run-off carrying contaminants from these SWMU locations would eventually report to Bailey's Canyon.

Three of OU 1078's SWMU aggregates consist of a single SWMU. These SWMU aggregates (Aggregate J, Ashley Pond; Aggregate K, industrial waste line; and Aggregate 0, suspected subsurface soil contamination under U, W, and Z Buildings) are unique and require distinct sampling plans. The industrial (acid) waste line Phase II sampling plan involves the construction of trenches for subsurface sampling and, should removal of contaminated soils prove necessary, combines sampling with contaminant removal action. Ashley Pond is the only SWMU aggregate at OU 1078 for which water sampling will be conducted. The suspected subsurface soil contamination SWMU comprising U, W, and Z Buildings is unique because it is located principally beneath Los Alamos Inn property. The OU 1078 work plan proposes opportunity-available sampling for this SWMU. Opportunity-available sampling will occur at five subsurface SWMUs that are presently inaccessible (because they lie beneath buildings, roads, and other manmade structures) to normal sampling procedures. Construction activities intersecting these SWMUs will initiate opportunity-available sampling.

6.2 Introduction to Individual SWMU Aggregates

The sections below present background information for each SWMU aggregate. Background information includes descriptions of buildings as sources, rationale for determining which building process was the source of a SWMU, spills and discharges associated with particular buildings or processes, and any decontamination effort that might have taken place at a SWMU to mitigate past discharges of deleterious materials. Decontamination efforts frequently reference disposal at material disposal areas (MDAs), all

MDAs are located outside the boundaries of OU 1078. SWMU aggregates are discussed in the order of potential radioactive dose, as developed in Chapter 4. The purpose of this prioritization is to expeditiously pursue field investigation of those SWMU aggregates that potentially have the most impact on the Los Alamos townsite community.

The field sampling plans for OU 1078's 16 SWMU aggregates are presented in Chapter 7. These sampling plans use the background information developed here and incorporate the data quality objectives approach to establish data needs and to design the methodology for acquiring data.

6.3 Sigma Building Vicinity, SWMU Aggregate A

•TA-1-56, -74 Storm Drain and Outfall	SWMU 1-006 (m)
•TA-1-5 Storm Drain and Outfall	SWMU 1-006 (t)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (d)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (e)
•Suspected Subsurface Soil Contamination (two sites)	SWMU 1-007 (j)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (m)

Note: Sub-SWMU numbers for SWMUs 1-006 (m, t) and 1-007 (d, e, j, m) were derived from the February 1991 IT TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report.

6.3.1 Physical Description of the Site

The Sigma Building SWMU aggregate is located on the OU 1078 mesa top south of Trinity Drive and extends eastward from the Sigma Building to C Building and then south of C Building to H Building (Figure 6.3-1). The area is currently occupied by residences, commercial establishments, and an undeveloped area located behind the Shell Service Station. The buildings associated with this aggregate include Sigma Building, Warehouse 2, C Building, H Building, Theta Building, and Sigma Huts 1–4. The data from this SWMU aggregate will be used, in part, for verification of the preliminary mesa-top dose assessment presented in Chapter 4. This aggregate is depicted in Figure 6.3-1.

6.3.2 Historical Use of the Site

The buildings composing the Sigma SWMU aggregate were among the first built during the early days of the Manhattan Project. These buildings were gradually vacated during the 1940s through the 1960s as

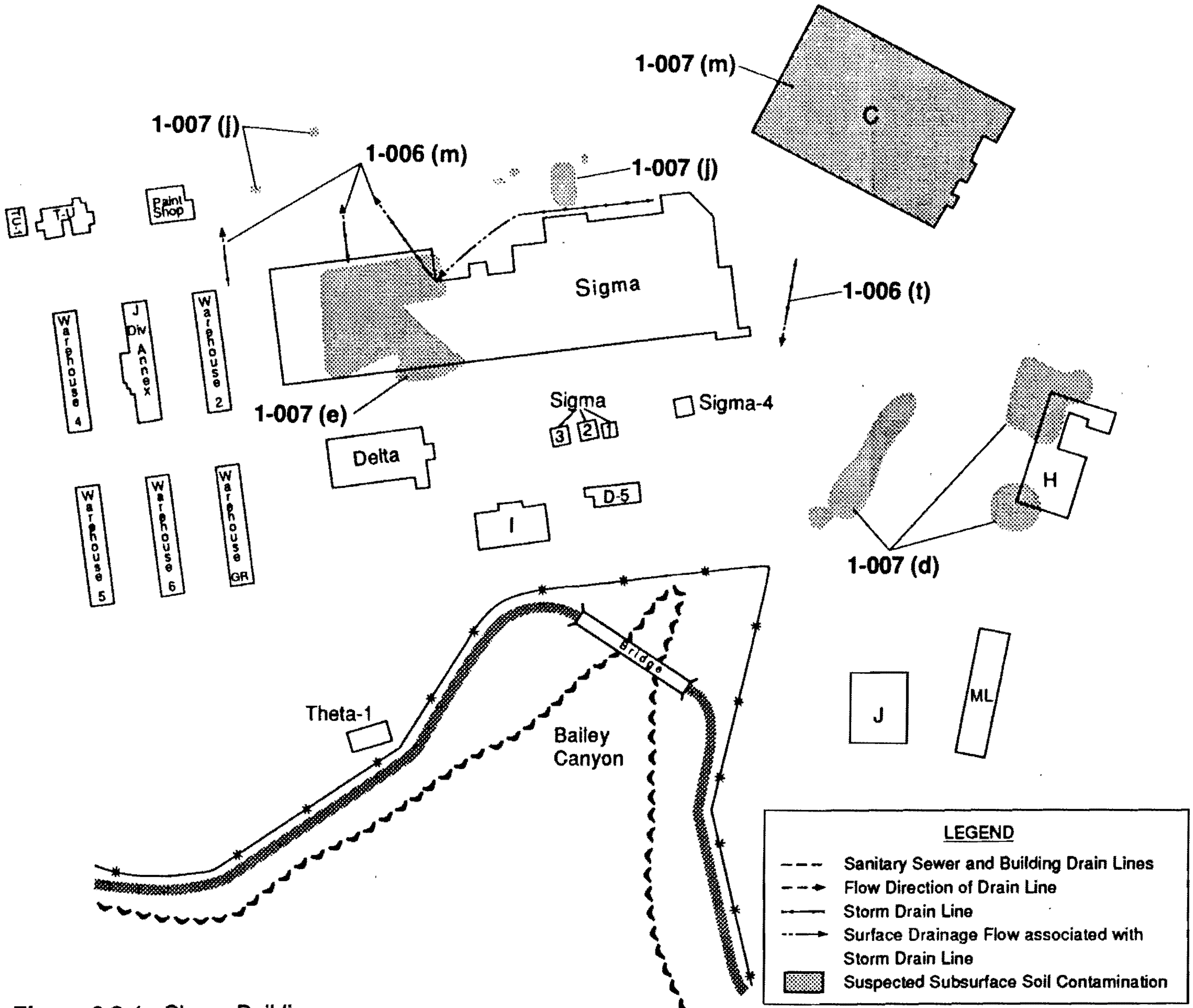


Figure 6.3-1. Sigma Building area.

new facilities south of Los Alamos Canyon became available. In general, as each building was vacated, the building and its adjacent lands were radiologically surveyed. Most of the radioactively contaminated demolition debris was disposed in Laboratory MDAs located outside the bounds of TA-1. The TA-1 land surface was then tested for radioactive contamination; if any was found, the soil was removed and clean soil was used for backfill. The majority of the plumbing associated with these buildings was removed and the soil surrounding the lines was monitored for radioactive contamination. If any was found, the contaminated soil was also excavated (Blackwell 1971, 09-0016).

The Sigma Building was used for plutonium, uranium and thorium machining, casting, and powder metallurgy. In the early years of the Laboratory, the Sigma Building was one of the principal sources of plutonium in waste water that was discharged through the industrial waste line (SWMU 1-002, Chapter 7) to Pueblo Canyon (Hinch 1945, 09-0015).

Several documented occurrences of radioactive contamination took place in Sigma Building (H-Division 1952, 0757; H-Division 1954, 0759; H-Division 1955, 0482; H-Division 1960, 0678). Sigma Building was demolished in December 1965. Components of the building were found to be moderately contaminated, so building debris and concrete with radioactivity greater than 2500 counts/min were disposed at a Laboratory MDA located outside of TA-1. The remaining concrete with surface radioactivity less than 2500 counts/min was taken to Bailey's Canyon where it was disposed and later covered with soil (Ahlquist et al. 1977, 0016).

The 1974–1976 survey effort identified spots of uranium contamination on pipe shards and in soil located within the footprint of the former Sigma Building (Ahlquist 1975, 09-0017; Ahlquist et al. 1977, 0016). In addition, several areas of contamination were found north of the Sigma Building. One area was below a storm drain pipe outside the former fence boundary. Because of the pipe shards, which probably originated from the breakup of laterals to the industrial waste line during demolition, exploration trenches were dug to determine whether the laterals from the Sigma and main industrial waste lines had actually been removed (they had been). During the trenching operations, contaminated soil and corrugated metal pipe were found (apparently part of a storm drain) (Ahlquist et al. 1977, 0016). Contaminated materials were removed to MDA G.

H Building was constructed for radiochemical and radioactive tracer processing. Radioactive isotopes including ^{210}Po, ^{140}Ba, and ^{140}La were used and stored in the building. Reports indicate that drain lines from sinks in H Building had high beta radiation levels (actual levels were not stated) as a result of ^{90}Sr contamination (Blackwell 1957, 09-0018). Radioactivity was detected in the drain lines at 45 mrem/hr during the building's demolition in 1957 (Pederson 1957, 09-0019).

Theta Building was completed in January 1945 and functioned as a warehouse. It had no known history of radioactivity.

Surface soils between the H and Theta Buildings and west of Theta Building [SWMU 1-007(d)] had confirmed soil contamination in 1946 because of an industrial waste line overflow. After the overflow, all the contaminated soil that was possible to remove was taken away to one of the Laboratory's MDAs (Ahlquist et al. 1977, 0016).

Because of the history of contamination in this area, an intensive investigation of the area was completed during the 1974–1976 survey (Ahlquist et al. 1977, 0016). Gross alpha activity (primarily plutonium) at levels of ~200 pCi/g was measured during excavation in the area of the former industrial waste line. Two contaminated lateral connections from H Building to the main line were removed along with approximately 610 yds^3 of contaminated soil. The excavation trench extended from the area of H and Theta Buildings toward the former location of Bailey Bridge (Ahlquist et al. 1977, 0016).

An area of subsurface soil contamination [SWMU 1-007(e)] was also found adjacent to the former Sigma Building footprint during the 1974–1976 survey. Radiochemical analyses of soil samples confirmed that the predominant contaminant was uranium. Excavation of three small areas within the original Sigma Building footprint resulted. Approximately 196 yds^3 of soil were removed from the vicinity of Sigma Building (Ahlquist et al. 1977, 0016).

Two other small areas of surface contamination, both identified under SWMU 1-007(j), were found north and northwest of the former Sigma Building during the 1974–1976 survey. The suspected contaminant was uranium (Ahlquist et al. 1977, 0016). These small areas of contamination were removed by hand shoveling soil into plastic bags.

Three storm drains [SWMU 1-006(m)] drained areas around the Sigma Building and had outfalls north of Sigma Building. Cooling Tower TA-1-57 was located just south of Sigma Building but was not documented as being contaminated.

The four Sigma huts were constructed for storage, presumably in 1944 when Sigma Building was built. The only hazardous material known to have been stored in these buildings was beryllium (H-Division January 1955, 0760). All four Sigma huts were removed in 1955 (Ahlquist et al. 1977, 0016).

C Building was primarily used to machine uranium (Ahlquist et al. 1977, 0016; Hawkins 1983, 0663). Before its removal in 1964, C Building was found free of contamination with the exception of the large concrete foundation pad which was subsequently demolished and disposed at a Laboratory MDA in 1965 (Ahlquist et al. 1977, 0016; LANL undated, 0402). The footprint of C Building has been designated as SWMU 1-007 (m).

An area near C Building was drained by a storm drain line [SWMU 1-006(t)] that had an outfall near the southeast corner of Sigma Building. There is no record of contamination in this area from sampling conducted during the 1974–1976 radiological survey.

6.3.3 Summary of Existing Data

Table 6.3-1 summarizes potential contaminants for the Sigma Building SWMU aggregate.

TABLE 6.3-1

Sigma Building SWMU Aggregate Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-006(m)	^{239}Pu, ^{235}U, ^{238}U, Thorium, Toluene, Solvents, Metals	Ahlquist et al. 1977, 0016 Hinch 1945, 09-0015; Jette1946, 09-0044; LANL 1987, 09-0013
1-006(t)	^{239}Pu, ^{235}U, ^{238}U, Thorium	Ahlquist et al. 1977, 0016
1-007(d)	^{239}Pu, ^{235}U, ^{238}U, Fission Products	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-007(e)	^{239}Pu, ^{235}U, ^{238}U, Thorium, Toluene, Solvents, Metals	Ahlquist et al. 1977, 0016 Hinch 1945, 09-0015; LANL 1987, 09-0013
1-007(j)	^{238}U	Ahlquist et al. 1977, 0016
1-007(m)	Uranium, Plutonium	Ahlquist et al. 1977, 0016 Hinch 1945, 09-0015; Jette 1946, 09-0044

During the 1974–1976 survey and decontamination, trenching was initiated to confirm removal of the industrial waste lines. Trenching activities south of the Exxon Service Station on Trinity Drive unearthed an 8-in.-diameter cast iron pipe which emitted gasoline fumes (Ahlquist et al. 1977, 0016). Apparently, a leaking pump from an underground gasoline storage tank at the station permitted gasoline to migrate into an abandoned line that may be the SWMU 1-006(t) storm drain system. Eventually the line was cut and removed to the Exxon property line (currently the Shell Service Station) where it was plugged with concrete.

Table 6.3-2 (DOE 1988, 09-0006) presents sampling results from the 1974–1976 radiological survey of the Sigma area. The maximum gross alpha measured for the radionuclides found and the postremediation maximum gross alpha activities for the remediated soils are included in the table.

To date, hazardous chemical sampling conducted in the Sigma Building SWMU aggregate is limited to

TABLE 6.3-2

1974–1976 Radiological Survey Results
Sigma Building

Area of Contamination	Maximum Gross Alpha (pCi/g) Found	Remaining	Principal Contaminant
Acid sewer connections (H-Theta area)	310	36	Plutonium
Surface drainage areas from H-Theta area	74	<20	Plutonium
Vicinity of Sigma building:			
Trench 2	350	<20	Uranium
Area 1	13000	<20	Uranium
Area 2	--	28	Uranium
Area 3	46	42	Uranium

the southwest corner of the Sigma Building area. In 1987, the Sigma area was investigated as a component of a verification sampling conducted by the Department of Energy (DOE). Surface samples were taken in various locations in the Sigma area. Two boreholes were also made and samples were taken on the surface, at the soil-tuff interface, and three feet down into the tuff. Radionuclides, metals, and organic chemicals were analyzed. No constituent was found above background level (LANL 1987, 09-0045). It is expected that during the excavation activities that occurred during all phases of demolition and decontamination, hazardous chemicals in the underlying soil, if present, would have been physically removed along with the radionuclide contaminated soils.

6.4 Bailey Bridge, SWMU Aggregate B

•Septic Tank 134	SWMU 1-001 (a)
•Septic Tank 139	SWMU 1-001 (e)
•Septic Tank 276	SWMU 1-001 (n)
•Sanitary Waste Line from Buildings J and ML	SWMU 1-001 (o)
•Sanitary Waste Line from Buildings Q and ML	*SWMU 1-001 (p)
•Bailey Bridge Landfill	SWMU 1-003
•TA-1-146 Incinerator	*SWMU 1-004 (a)
•TA-1-1, -2, -5, -26, -61 Storm Drain and Outfall	SWMU 1-006 (o)
•TA-1-34, -79 Storm Drain and Outfall	SWMU 1-006 (r)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (f)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (g)
•Suspected Subsurface Soil Contamination (one site)	SWMU 1-007 (j)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (o)

Note: Sub-SWMU numbers for SWMUs 1-003, 1-006 (o, r), and 1-007 (f, g, j, o) were derived from the February 1991 TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report. Sub-SWMU numbers 1-001 (a, e, n-p) and 1-004 (a) are as identified in the November 1990 SWMU Report.

*Also nominated for no further action (NFA).

6.4.1 Physical Description of the Site

The Bailey Bridge SWMU aggregate extends along the Los Alamos Canyon rim on both sides of Bailey's Canyon and northeastward in the direction of the former Theta and H Buildings (Figure 6.4-1). Surface water run-off from SWMUs in this aggregate would have drained into the Bailey Bridge Canyon. The area is currently occupied by residences, roadways, parking areas, and lawns. The Bailey Bridge aggregate has mesa-top and hillside components and consists of the area occupied by the following buildings used

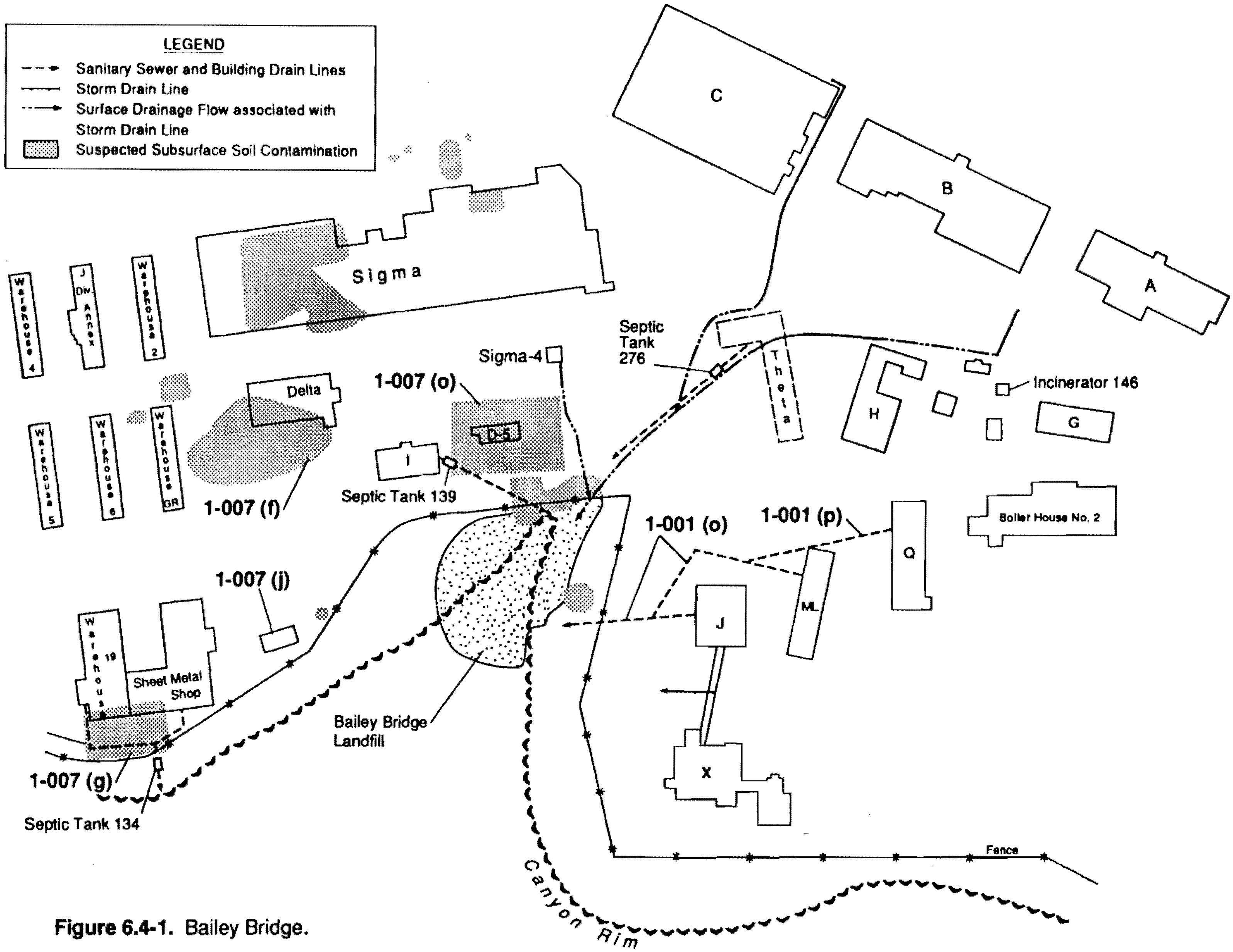


Figure 6.4-1. Bailey Bridge.

during the early days of the Manhattan Project: J, ML, Q, D-5 Sigma Vault, I, Delta, Warehouse 19, Sheet Metal Shop, Theta, H, X, and other small support structures.

6.4.2 Historical Use Of the Site

The buildings associated with the Bailey Bridge SWMU aggregate were vacated during the late 1950s and early 1960s. Each building and its associated land surface was surveyed for radioactive contamination as it was decommissioned. Radioactively contaminated demolition debris was disposed in Laboratory MDAs C and G; however, concrete with gross alpha activities less than 2500 counts/min may have been disposed in Bailey's Canyon.

J Building housed a laboratory of unknown function and was connected by a passageway to X Building which housed the cyclotron.

The storm drain between J and X Buildings [SWMU 1-006(r)] extended westward from the buildings to its outfall just south of J-7 Building. X Building used many solid radioactive sources and targets in association with the cyclotron. There is no record of any radioactive contamination in the area of this storm drain and outfall and a PHOSWICH survey in 1976 indicated there was no surface radioactivity in the area (Ahlquist et al. 1977, 0016).

ML Building was used as a medical laboratory. In January 1955, two members of Group J-11 broke an ampule containing an americium-curium mixture (91% curium) in the ML Building. Following decontamination operations, swipe monitoring showed the affected rooms had no higher than 1000 counts/min direct count radioactivity (Buckland 1955, 09-0020). On August 30, 1957, Group J-11 received some samples of plutonium-contaminated waste in plastic bags for investigation. Large quantities of radioactive contamination were dispersed over the floor, sink, and hood areas within three laboratories in the ML Building. Decontamination activities were not totally successful as the floor areas remained contaminated. Some of the floor was painted and covered with cardboard until the building's demolition in December 1958 (H-Division 1957, 0489).

In 1959, the industrial waste line (SWMU 1-002, discussed in the Industrial Waste Line SWMU aggregate) tie-ins between the former ML and Q Buildings were removed. The level of activity detected during excavation of those lines ranged from 2.5 to 3.7 mrem/hr (Buckland 1959, 09-0001). The sanitary waste line, which served former J and ML Buildings [SWMU 1-001(o)], was located just east of Bailey Bridge in TA-1 and discharged directly into Bailey's Canyon at this point (LASL 1958, 09-0048; Ahlquist et al.1977, 0016). Monitoring of the sanitary waste systems in 1959 indicated that the drain from J and ML Buildings was contaminated with between 500 to 4000 counts/min alpha. This sanitary waste line was reportedly removed in 1959; however, the TA-1 cleanup in 1974 to 1976 revealed part of the line still existed (Buckland 1959, 09-0001; Ahlquist et al. 1977, 0016). The remaining section of the contaminated line was subsequently excavated and removed to MDA G.

The sanitary waste line serving Q and ML Buildings [SWMU 1-001(p)] purportedly tied into the line serving the ML and J Buildings and extended to an outfall at the head of Bailey's Canyon. This waste line was mistakenly identified as a SWMU in the International Technology (IT) report of 1991 (International Technology Corporation February 1991, 09-0003). An examination of ENG-R27 (LASL 1947, 09-0010) documents determined that this line is a steam tunnel from Boiler House 2. SWMU 1-001 (p) is a nominee for NFA for this reason.

I Building was used between 1947 and 1958 for storing and machining beryllium (H-Division 1956, 0470).

The D-5 Sigma Vault was used for storage of ^{239}Pu and ^{235}U. Several small spills of these materials occurred in the building resulting in low-level contamination of the floor and shelves (Buckland 1964, 09-0021). During the 1974–1976 survey a three-feet-deep auger sample (soil) was collected in the area of the former D-5 Sigma Vault. A residual gross alpha concentration of 29 pCi/g was measured and no further excavation to remove soil occurred (DOE 1988, 09-0006).

A small area of surface uranium contamination [SWMU 1-007(j), in part] was located approximately 200 ft southwest of D-5 Sigma Vault. The contaminated soil was excavated and removed during the 1974–1976 survey and disposed at MDA G (Ahlquist et al. 1977, 0016).

The D-5 Sigma Vault and I Buildings were served by Septic Tank 139 [SWMU 1-001(e)]. The tank was reportedly abandoned in place in 1965; however, it was not found in the 1974–1976 survey (Ahlquist and Bayhurst 1977, 09-0022). Potential contaminants entering the septic tank included ^{239}Pu, ^{235}U, beryllium, and organic chemicals. The outfall discharged southeast of the buildings at the head of Bailey's Canyon (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016).

Warehouse 19 was used for storage of unknown materials (Buckland 1964, 09-0023). Soil contamination [SWMU 1-007(g)] by natural uranium oxide was discovered south of the building slab in the 1974–1976 radiological survey. Approximately 390 yds^3 of soil were excavated in the area and taken to MDA G at TA-54 (Ahlquist 1975, 09-0024; Ahlquist et al. 1977, 0016). The concrete floor for Warehouse 19 was found to be contaminated with ^{238}U ranging from 300 to 5000 counts/min during the building's final radioactive clearance in 1964 (Buckland 1964, 09-0023). The contaminated floor was demolished and disposed in Bailey's Canyon and subsequently covered with soil (Montoya 1965, 09-0025). It was suggested that contaminated plumbing, duct work, and wiring from the shop be taken to an MDA (Buckland 1964, 09-0023).

Warehouse 19 and the Sheet Metal Shop were served by Septic Tank 134 [SWMU 1-001(a)]. The tank was located south of the Sheet Metal Shop and was active from 1949 to 1964. Two separate sanitary waste lines connected the two buildings to Septic Tank 134. The outfall from Septic Tank 134 discharged south of the buildings over the canyon rim (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016). The tank was removed to MDA G in September 1975 (Ahlquist et al. 1977, 0016).

The storm drainage system serving Buildings A, B, C, H, and Sigma 4 [SWMU 1-006(o)] was found to be contaminated with up to 74 pCi/g of gross alpha activity in the H-Theta area (Ahlquist et al. 1977, 0016). No radioactivity was found in the area of the storm drain near H Building.

Septic Tank 276 served the Theta Building between 1944 and 1946. One sanitary waste line led from the building to Septic Tank 276. The line from the tank led to an outfall located northeast of the head of Bailey's Canyon (LASL 1958, 09-0048). Inconsistent records report the tank had either been abandoned in place or had been removed in 1946 (Ahlquist et al. 1977, 0016; LANL 1990, 0145; LANL undated, 0402); the tank was assumed to be free of contamination (Meyer 1964, 09-0026). The tank was found during the 1974–1976 radiological survey and was removed to MDA G (Ahlquist et al. 1977, 0016).

Incinerator TA-1-146 was installed just east of Building H in September 1947. Wastes incinerated were routine combustible solid waste materials (LANL 1990, 0145). The incinerator was inspected and found "free of any radioactive contamination that is dangerous to health" in December 1957 (Buckland 1957, 09-0004).

Bailey Bridge was constructed across Bailey's Canyon in 1948. The bridge was approved for removal through normal channels because the level of contamination was not considered to be a health hazard (Meyer 1964, 09-0026; Ahlquist et al. 1977, 0016).

The drainage and disposal area below Bailey Bridge (SWMU 1-003) began to be used for the disposal of demolition debris in 1964. In August 1964, a memo suggested that the floor and floor drains of the Sheet Metal Shop had been found to contain residual contamination to the extent that this condition would not allow disposal by an outside contractor (Buckland 1964, 09-0027). It specified that the floor and floor drains should be removed by the Zia Company to an MDA or a nearby canyon for fill. Consequently, a memo issued the following year confirmed "the radioactive contaminated concrete floor from the Sheet

Metal Shop was removed and pushed down the canyon south of the shop and covered with dirt" (Montoya 1965, 09-0025).

In September 1964, a Zia Company memo regarding the disposal of debris from TA-1 demolition activities specified that concrete walls and floor from the Sigma Building with activity less than 2500 counts/min be broken up and disposed in the canyon below Bailey Bridge (Hill 1964, 09-0028). The memo also stated that, at the conclusion of demolition efforts, the concrete disposed in the canyon at TA-1 be covered with 4 ft of earthen fill.

Demolition debris from several other buildings located in TA-1's western portion were disposed in Bailey's Canyon. A March 1978 laboratory memo stated that "massive quantities of concrete contaminated with low levels of normal and enriched uranium were encountered during the demolition of TA-1-11, 56, and 29 (D-5 Vault, Sigma, HT) and possibly 103 and 104 (Warehouse 19, Sheet Metal Shop). To expedite the disposal, much of this concrete was deposited in Bailey's Canyon" (Buckland 1978, 09-0029). The report by Ahlquist et al. in 1977 stated that material with less than 2500 counts/min of surface alpha contamination was disposed in the drainage area crossed by Bailey Bridge and covered with soil. An Environmental Restoration (ER) Program site reconnaissance survey in 1988 noted radiation readings greater than 25 microRoentgens/hour in the Bailey Bridge area (Bone 1988, 09-0047).

6.4.3 Summary of Existing Data

Table 6.4-1 lists the known and suspected site-related contaminants for each SWMU in the Bailey Bridge SWMU aggregate. Table 6.4-2 (DOE 1988, 09-0006) presents sampling results from the 1974–1976 radiological survey. Sample locations and maximum gross alpha measured for the radionuclides found are listed. Postremediation maximum gross alpha activities for the locations are also included in the table.

6.5 Hillside 140, SWMU Aggregate C

•Septic Tank 135	*SWMU 1-001 (b)
•Septic Tank 140	SWMU 1-001 (f)
•Surface Disposal West of Bailey's Canyon	*SWMU 1-003 (c)
•TA-1-29, -98 Storm Drain and Outfall	SWMU 1-006 (p)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (i)

TABLE 6.4-1

Bailey Bridge SWMU Aggregate
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(a)	^{238}U, Hazardous Chemicals	Ahlquist et al. 1977, 0016
1-001(e)	^{239}Pu, ^{235}U, Beryllium, ^{137}Cs, Metals	Ahlquist et al. 1977, 0016 LASL 1958, 09-0048
1-001(n)	^{239}Pu	Tribby 1946, 09-0030 Kingsley 1946, 09-0005
1-001(o)	^{239}Pu, ^{235}U, Metals	Ahlquist et al. 1977, 0016
1-001(p)	^{239}Pu, Metals	Ahlquist et al. 1977, 0016
1-003	^{239}Pu, ^{235}U, ^{238}U, Thorium, Metals	Ahlquist et al. 1977, 0016
1-004(a)	Metals	Ahlquist et al. 1977, 0016
1-006(o)	^{235}U, ^{238}U	Ahlquist et al. 1977, 0016
1-006(r)	Radioactive Targets, Metals	Ahlquist et al. 1977, 0016
1-007(d)	^{239}Pu, ^{235}U, ^{238}U, Fission Products	Ahlquist et al. 1977, 0016; Christensen and Maraman 1969, 0037
1-007(f)	^{235}U, ^{238}U, Thorium, Beryllium	Ahlquist et al. 1977, 0016
1-007(g)	Natural Uranium	Ahlquist et al. 1977, 0016
1-007(j)	^{137}Cs, ^{238}U	Ahlquist et al. 1977, 0016
1-007(o)	^{239}Pu, ^{235}U	Ahlquist et al. 1977, 0016

•Suspected Subsurface Soil Contamination SWMU 1-007 (p)

Note: Sub-SWMU numbers 1-003 (c), 1-006(p) and 1-007 (i, j, p) were derived from the February 1991 IT TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report. Sub-SWMU numbers 1-001 (b, f) are as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

TABLE 6.4-2

1974–1976 Radiological Survey Results
Bailey Bridge

Area of Contamination	Maximum Gross Alpha (pCi/g) Found	Maximum Gross Alpha (pCi/g) Remaining	Principal Contaminant
Vicinity of Delta Building:			
Trench 1	200	26	Uranium
South of Delta	86	86	Uranium
Warehouse 19	--	64	Uranium

6.5.1 Physical Description of the Site

The Hillside 140 SWMU aggregate is located at the western end of OU 1078. It consists of both mesa-top and hillside components and extends from former Warehouse 6 westward to the canyon rim. The area within the perimeter fence is currently occupied by private residences and the area outside the fence is owned by DOE. The former buildings composing this aggregate are Warehouses 5, 6, GR, Buildings FP, HT, HT Barrel House, HT Gas Storage, K-1, and M-1 (Figure 6.5-1).

The individual SWMUs that compose the Hillside 140 SWMU aggregate are Septic Tanks 135 and 140, TA-1-29, -98 Storm Drain and Outfall [SWMU 1-006(p)], the surface disposal area west of Bailey's Canyon [SWMU 1-003(c)], and three areas of suspected subsurface soil contamination, which include the area in the vicinity of Warehouses 5 and 6 [SWMU 1-007(i)], the area south of the HT Building [SWMU 1-007(p)], and the small area west of K-1 Building [SWMU 1-007(j), in part].

6.5.2 Historical Use of the Site

Buildings located in the Hillside 140 SWMU aggregate were vacated between 1954 and 1965 as new facilities south of Los Alamos Canyon became available. Below are brief histories of activities occurring during the buildings' tenure, decommissioning, disposal, and remediation activities following demolition.

HT Building was used by the shops department for heat treatment and machining of natural and enriched uranium (Ahlquist et al. 1977, 0016). In 1946, Tribby (1946, 09-0030) reported that low levels of plutonium and polonium were detected at the drain exit of the sanitary waste line (SWMU 1-001f) from HT Building. In 1965, substantial levels of contamination were found in HT Building during its decontamination and demolition. HT Building was disposed in an unspecified MDA.

FP Building, a foundry for nonradioactive and nonferrous metals, was constructed in November 1945. Records indicate it was free of radioactive contamination when it was demolished (Ahlquist et al. 1977, 0016; Buckland 1964, 09-0021).

Septic Tank 140, located west of K-1 Building, served Buildings HT and FP. The outfall west of the tank discharged over the canyon rim (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016). Septic Tank 140 managed liquid sanitary waste; however, it is evident that the heat treatment facility operations contributed radioactive waste to the tank (Tribby 1946, 09-0030).

During the 1974–1976 survey, Septic Tank 140 was found filled with sludge and roots that were highly contaminated with uranium (LASL 1976, 09-0031). Sludge in the tank read 60 000 counts/min of uranium activity (Ahlquist et al. 1977, 0016). Inlet and outlet lines were also both contaminated. The tank, its inlet and outlet lines, and approximately 351 yds^3 of surrounding soil were removed in 1975 (Ahlquist et al. 1977, 0016). Less than 25 pCi/g of gross alpha activity were found in all but 5 of the 56 final soil samples after the excavation. Possible soil contamination associated with Septic Tank 140 remains below the outfall area on Hillside 140. The upper level of soil in an area of 538 ft^2 had a maximum uranium concentration of approximately 3000 pCi/g (Ahlquist et al. 1977, 0016). No decontamination effort was performed on the hillside below the Septic Tank 140 outfall during the 1974–1976 survey because the area was inaccessible. The outfall area was fenced to prevent public access from the mesa top (Ahlquist et al. 1977, 0016).

Subsurface soil contamination was suspected south of HT Building [SWMU 1-007(p)] during the 1974–1976 radiological survey. Approximately 35 yds^3 of soil and a concrete slab contaminated with uranium were removed from this area and taken to MDA G (Ahlquist 1975, 09-0017; LASL 1976, 09-0031). The area was then considered decontaminated (Ahlquist et al. 1977, 0016).

Uranium contamination was detected on the asphalt road north of HT Building (Ahlquist 1975, 09-0024). The asphalt and hot spots below it were removed.

K-1 Building was the site of graphite machining. The final radiological survey on K-1 Building was conducted in 1964 when the building was declared free of contamination and approved for sale (Buckland 1964, 09-0023).

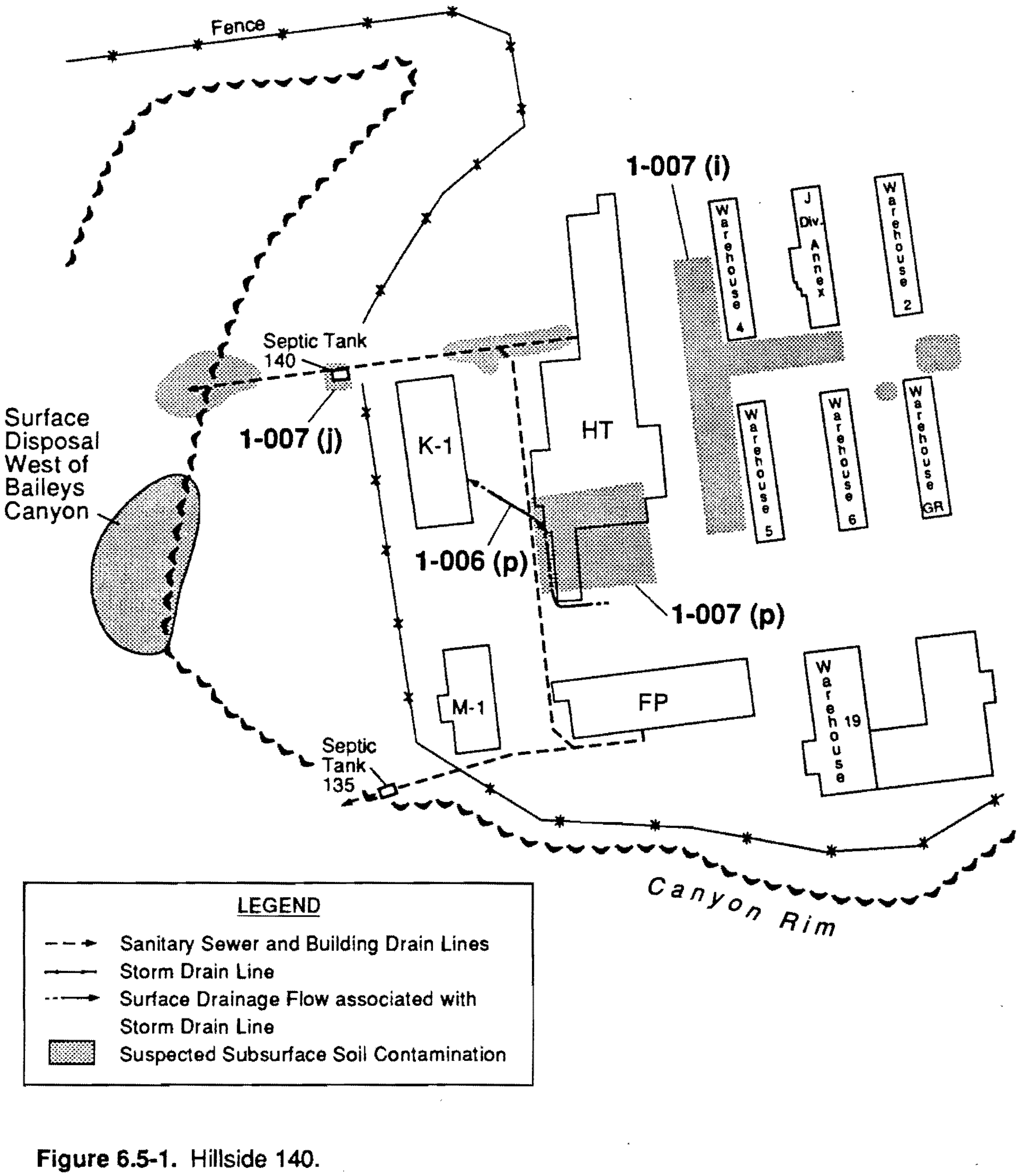


Figure 6.5-1. Hillside 140.

A storm drainage system served the southwest side of HT Building [SWMU 1-006(p)] and discharged east of K-1 Building at the rim of Los Alamos Canyon. A PHOSWICH survey conducted in 1976 indicated no activity in the area of the storm drain and outfall (Ahlquist et al. 1977, 0016). During the 1974–1976 survey, a small area of subsurface contamination [SWMU 1-007(j), in part] that had PHOSWICH activity of 5000 counts/min and gross alpha activity of 980 pCi/g was detected west of K-1 Building (Ahlquist et al. 1977, 0016). Residual uranium from Septic Tank 140 excavation and cleanup was thought to be the source. The locally contaminated area was removed by hand shoveling.

An area of subsurface uranium contamination was detected in the area of Warehouses 5, 6, and GR [SWMU 1-007(i)] during the 1974–1976 PHOSWICH survey (Ahlquist et al. 1977, 0016). Soil sampling was done to determine the extent of contamination. Gross alpha readings in the area ranged from 140 to 250 pCi/g. Further investigation uncovered a 187-ft-long drainage course or trench along the western edge of Warehouse 5 that contained visible yellow spots of uranium-oxide contamination. Considerable excavation was done along the northern and western edge of Warehouse 5 in order to remove this contamination. Approximately 503 yds^3 of soil were removed from this area. Positive PHOSWICH readings between Warehouses 4 and 5 prompted further excavation, which uncovered a 34-lb cylinder of natural uranium at a depth of 2 ft (Roeder 1976, 09-0032; Umbarger 1976, 09-0033; Ahlquist et al. 1977, 0016). In June 1976, the area was considered decontaminated because no PHOSWICH-detectable activity remained.

M-1 Building, completed in June 1950, was originally used for machining lithium and was later also thought to be used for machining ^{238}U (Ahlquist et al. 1977, 0016). The building superstructure was determined to be free of contamination in 1964; however, the floor drains were suspected of radioactive contamination. It was recommended that the drains be taken to an unspecified disposal area (Buckland 1964, 09-0023; LASL 1964, 09-0034). One sanitary waste line led from M-1 Building to Septic Tank 135. Septic Tank 135 was removed during the 1974–1976 radiological survey (Ahlquist et al. 1977, 0016). Apparently, the drain lines were not removed because the tank was not radioactively contaminated.

The HT Barrel House was built in 1946 for storage of uranium. Contamination was detected during a final radioactive contamination survey before building removal (Buckland 1964, 09-0023).

Records exist of unidentified solid wastes disposed [SWMU 1-003(c)] west of Bailey's Canyon on the hillside. The disposal area was identified during the 1986–1987 Comprehensive Environmental Assessment and Response Program (CEARP) field survey (DOE 1987, 0264). During the ER Program site reconnaissance survey in March 1989 (Bone 1988, 09-0047), an unsuccessful attempt was made to locate and characterize the site. It is possible that isolated debris, including a 55-gallon drum, found slightly north of the purported disposal area should be the area identified as this SWMU.

6.5.3 Summary of Existing Data

Several radionuclides and hazardous chemicals are suspected to exist at the Hillside 140 SWMU aggregate. A list of SWMUs and known or suspected contaminants appears in Table 6.5-1.

TABLE 6.5-1

Hillside 140 SWMU Aggregate
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(b)	None	Ahlquist et al. 1977, 0016 and Possibly Solvents
1-001(f)	^{235}U, ^{238}U, ^{239}Pu, Nonferrous Metals	Ahlquist et al. 1977, 0016; LASL 1976, 09-0031; Tribby 1946, 09-0030
1-006(p)	^{235}U, ^{238}U, ^{239}Pu, Nonferrous Metals	Ahlquist et al. 1977, 0016; Tribby 1946, 09-0030
1-003(c)	None	
1-007(i)	Uranium, Solvents	Ahlquist et al. 1977, 0016
1-007(p)	Uranium	Ahlquist et al. 1977, 0016
1-007(j),	Uranium, Plutonium, Nonferrous Metals	Ahlquist et al. 1977, 0016 (in part)

Table 6.5-2 (DOE 1988, 09-0006) presents sampling results from the 1974–1976 radiological survey. Sample locations and the maximum gross alpha measured for the radionuclides found are listed. Postremediation maximum gross alpha activities for the locations are also included in the table.

TABLE 6.5-2

1974–1976 Radiological Survey Results
Hillside 140

Area of Contamination	Maximum Gross Alpha (pCi/g) Found	Remaining	Principal Contaminant
Septic Tank 140 and vicinity:			
Trench 1	--	48	Uranium
Trench 2	--	26	Uranium
Septic Tank 140	--	27	Uranium
Outfall (DOE hillside property)	340	340	Uranium
General warehouse area:			
West of Whse 4 and 5 (PHOSWICH point no. 10)	250	36	Uranium
Between Whse 4 and 5	--	≤20	15.3 kg uranium cylinder (removed)
Warehouse 6 (PHOSWICH point no. 11)	140	≤20	Uranium
Warehouse GR (PHOSWICH point no. 12)	710	≤20	Uranium

6.6 J-2/TU Area, SWMU Aggregate D

•Septic Tank 143	SWMU 1-001 (i)
•Septic Tank 268	SWMU 1-001 (k)
•Bench-scale Incinerator	*SWMU 1-005
•TA-1-76 Storm Drain and Outfall	SWMU 1-006 (f)
•TA-1-75, -76 Storm Drain and Outfall	SWMU 1-006 (k)
•TA-1-74, -75 Storm Drain and Outfall	SWMU 1-006 (l)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (h)
•Suspected Subsurface Soil Contamination (two sites)	SWMU 1-007 (j)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (n)

Note: Sub-SWMU numbers 1-006 (f, k, l) and 1-007 (h, j, n) were derived from the February 1991 IT TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report. Sub-SWMU numbers 1-001 (i, k) and 1-005 are as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

6.6.1 Physical Description of the Site

The J-2/TU area SWMU aggregate is located in the northwest corner of OU 1078 site and has both mesa-top and hillside components. The area is now primarily occupied by townhouse and condominium complexes. The aggregate is comprised of the area that included former buildings J-2, TU, TU-1, J Division Annex, Warehouse 2, Warehouse 4, and the drainage to the south of J-2 Building (Figure 6.6-1).

The nine SWMUs contained in this aggregate include two septic tanks, a bench-scale incinerator(formerly housed in the TU-1 Building), three storm drains and associated outfalls, and three areas of suspected subsurface soil contamination.

6.6.2 Historical Use of the Site

J-2 Building housed fission product radiochemistry operations and a tracer lab in which experimentation with plutonium occurred. Investigation of fission products in the building resulted in considerable contamination of the building's sump pump and industrial waste disposal line (H-Division 1951, 0755).

In September 1957, the industrial drain line was found to be leaking on the edge of a playground area in back of a Finch Street apartment. The contaminated soil was removed and transported to an MDA and the line was repaired (H-Division 1957, 0489). The industrial drain line from J-2 Building was removed, along with some contaminated soils, during the demolition of the building in 1958 (Buckland 1959, 09-0001).

During the 1974–1976 radiological survey, ^{137}Cs was found in a location that corresponded with the previously described leak (H-Division 1957, 0489) in the industrial drain line. Additional trenching was conducted along the J-2 Building industrial waste line trench to determine the extent of the ^{137}Cs contamination. Much of the contaminated soil was removed from the trench; however, activity to a level of 168 pCi/g of ^{137}Cs was left in the floor of the trench in one location because of the depth of the trench (Ahlquist et al. 1977, 0016).

The suspected subsurface soil contamination in the area of J-2 Building [SWMU 1-007(n)] may be contaminated with fission products and plutonium.

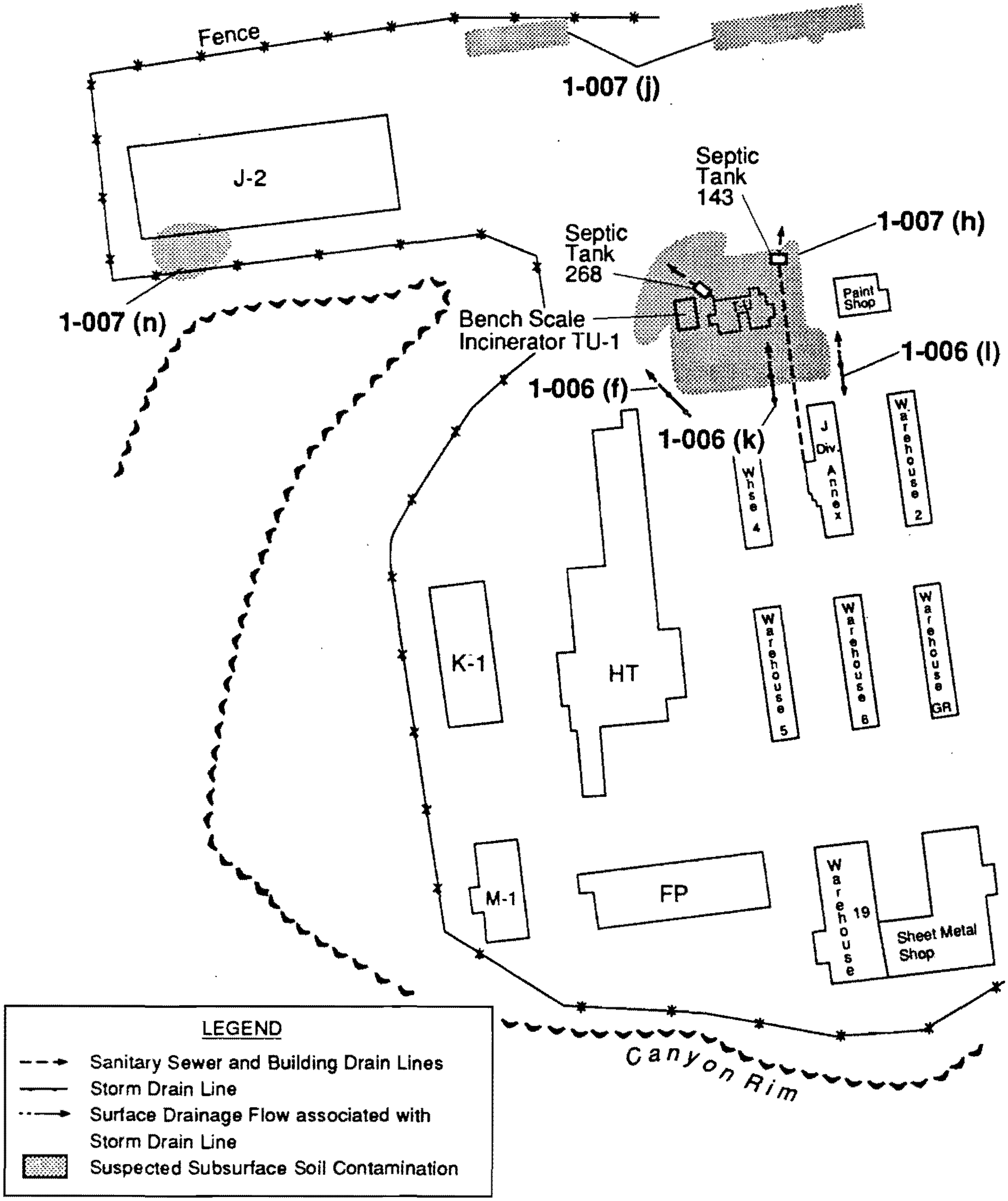


Figure 6.6-1. J-2/TU Area.

The J Division Annex, also identified as Warehouse 3, was used for storage and film calibration. A final radiation survey performed in 1964, however, found the building free of radioactive contamination (Buckland 1964, 09-0021).

TU Building was used for processing normal uranium and was found to be moderately contaminated at the time of its demolition in July, 1964. Drums of tuballoy (natural uranium) turnings were stored outside TU Building. In October 1947, a fire occurred in one of the drums. In the process of putting out the fire, the drum was flooded with water until it overflowed. Uranium-contaminated water flowed into the drainage to the north of the building (and south of J-2 Building) and eventually into Los Alamos Canyon (Kennedy 1948, 09-0035).

Septic Tank 143 was located north of TU Building and served J Division Annex and TU Building. While excavating uranium-contaminated soil near the TU Building site during the 1974–1976 radiological survey, an unidentified tank was found near the documented location of Septic Tank 143. The tank contained sludge, which was found to be free of radioactive contamination. It is suspected that this was Septic Tank 143, which was abandoned in place in 1965 rather than removed. The unidentified tank was removed by Ahlquist and taken to MDA G (Ahlquist et al. 1977, 0016).

Septic Tank 268 was located northwest of and served TU Building. A line from the tank led to the outfall, which was located in the drainage of a side canyon of Los Alamos Canyon northwest of the tank (LASL 1958, 09-0048). Records indicate that the tank was removed in 1964 along with TU Building (LANL 1990, 0145).

TU-1 Building was used for enriched uranium storage and recovery. SWMU 1-005, a bench-scale incinerator, was used to recover uranium from rags, paper, and other combustible items. The ash produced by combustion was treated by a uranium recovery process (LANL 1990, 0145).

Suspected subsurface soil contamination in the vicinity of the former TU and TU-1 Buildings has been designated as SWMU 1-007(h). The area is suspected of having uranium contamination from both buildings, such as contamination in the drainage areas because of run-off from fire control activities. The area soils were investigated during the 1974–1976 survey and found to have uranium contamination with gross alpha readings ranging from 27 to 15 000 pCi/g (Ahlquist et al. 1977, 0016). Decontamination was initiated and approximately 3700 yds^3 of soil were removed from the area. The area was then backfilled and contoured. However, two thin horizontal lenses of uranium contamination remained north of the TU-1 Building in the trench. The lenses were not completely removed during excavation because of the depth of the trench. It was determined that they were sufficiently thin and deep enough that any future excavations would dilute the contamination to acceptable levels (Ahlquist et al. 1977, 0016).

Warehouse 2 was used for storage (LANL undated, 0402). Records indicate that no radioactive materials were stored in the warehouse.

The TA-1-74, -75 Storm Drain and Outfall [SWMU 1-006(l)] served former Warehouse 2 and the J Division Annex. This storm drain served the area between the two buildings and had an outfall located just south of the former paint shop. The drain originated approximately 10 ft northeast of the J Division Annex and extended north-northwest for approximately 25 ft. A PHOSWICH survey conducted in 1976 indicated no contamination (Ahlquist et al. 1977, 0016).

TA-1-76 Storm Drain and Outfall [SWMU 1-006(f)] served former Warehouse 4, which was used for storage (Ahlquist et al. 1977, 0016). Although no radioactive or hazardous materials were stored in Warehouse 4, very low-level uranium contamination (gross alpha levels up to 44 pCi/g) was found in the outfall area during the 1974–1976 survey (Ahlquist et al. 1977, 0016). Excavation removed potentially contaminated soil to a depth of 2 ft (Ahlquist et al. 1977, 0016).

The TA-1-75, -76 Storm Drain and Outfall [SWMU 1-006(k)] drained the area between former Warehouse 4 and the J Division Annex. Ahlquist found uranium contamination believed to have originated from TU and TU-1 Buildings near the storm drain outfall (Ahlquist et al. 1977, 0016).

6.6.3 Summary of Existing Data

Several contaminants may be present within the J-2/TU Area SWMU aggregate. Table 6.6-1 lists the known and suspected contaminants associated with the J-2/TU Area SWMU aggregate. Table 6.6-2 (Ahlquist et al. 1977, 0016) presents sampling results from the 1974–1976 radiological survey.

6.7 Cooling Tower 80, SWMU Aggregate E

•Septic Tank 141	SWMU 1-001 (g)
•Surface Disposal East of Bailey's Canyon	*SWMU 1-003 (b)
•TA-1-80 Drain Line and Outfall	SWMU 1-006 (a)

TABLE 6.6-1

J-2/TU Area SWMU Aggregate
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(i)	Uranium, Metals, Solvents	Weston 1989, 09-0036 H-Division 1955, 0761
1-001(k)	Uranium, Metals, ^{137}Cs	Ahlquist et al. 1977, 0016
1-005	None	LANL 1990, 0145
1-006(f)	Uranium	Ahlquist et al. 1977, 0016
1-006(k)	Uranium	Weston 1989, 09-0036 Ahlquist et al. 1977, 0016
1-006(l)	Solvents	Ahlquist et al. 1977, 0016
1-007(h)	Normal and Enriched Uranium	Ahlquist et al. 1977, 0016
1-007(j)	^{137}Cs	Ahlquist et al. 1977, 0016 LASL 1975, 09-0050 H-Division 1953, 0764
1-007(n)	Plutonium, ^{137}Cs,	LASL 1975, 09-0050 Weston 1989, 09-0036 H-Division 1955, 0761 Ahlquist 1977, 09-0041

•TA-1-79, -42, -49, -6, -10, -13 Storm Drain and Outfall SWMU 1-006 (g)

Note: Sub-SWMU numbers for SWMUs 1-003 (a) and 1-006 (a, g) were derived from the February 1991 IT TA-1 work plan maps and are not identified as such in the November, 1990 SWMU Report. Sub-SWMU 1-001 (h) is as identified in the November, 1990 SWMU Report.

*Also nominated for NFA

TABLE 6.6-2

1974–1976 Radiological Survey Results
J-2/TU Area

Area of Contamination	Maximum Gross Alpha (pCi/g) Found	Maximum Gross Alpha (pCi/g) Remaining	Principal Contaminant
Acid-sewer trench (J-2 Building):			
Trench 3A	91	45	^{137}Cesium
Vicinity of TU/TU-1 Buildings:			
South of TU	15,000	<20	Uranium
North and west of TU/TU-1	230	40	Uranium
Two horizontal veins in pit	1,200	1,200	Uranium

6.7.1 Physical Description of the Site

The Cooling Tower 80 SWMU aggregate is located at the rim of Los Alamos Canyon just east of Bailey's Canyon. This mesa-top area is currently occupied by residences. The buildings that formerly occupied the aggregate were Building X and its cooling tower, which were among the original buildings constructed in TA-1 (Figure 6.7-1). The SWMU aggregate includes the hillside because three liquid discharges (septic tank, cooling tower drain, and storm drain) and a surface disposal site are located there.

6.7.2 Historical Use of the Site

X Building housed the Harvard cyclotron where many radioactive targets were undoubtedly tested. No archival information was available regarding radiological survey activities during decommissioning of the building, but standard practice was to provide extensive radiation surveys to protect workers and to determine the disposal fate of the buildings.

Septic Tank 141, located south of Building X near the edge of Los Alamos Canyon, received sanitary waste and served Building X. One sanitary waste line connected the building to Septic Tank 141, the outfall of which discharged south of Building X over the rim of the canyon (LASL 1958, 09-0048). Septic Tank 141 was located and removed during the 1974–1976 radiological survey (Ahlquist et al. 1977, 0016). At that time, the tank, its surrounding soil, and the sludge it contained tested free of radioactive

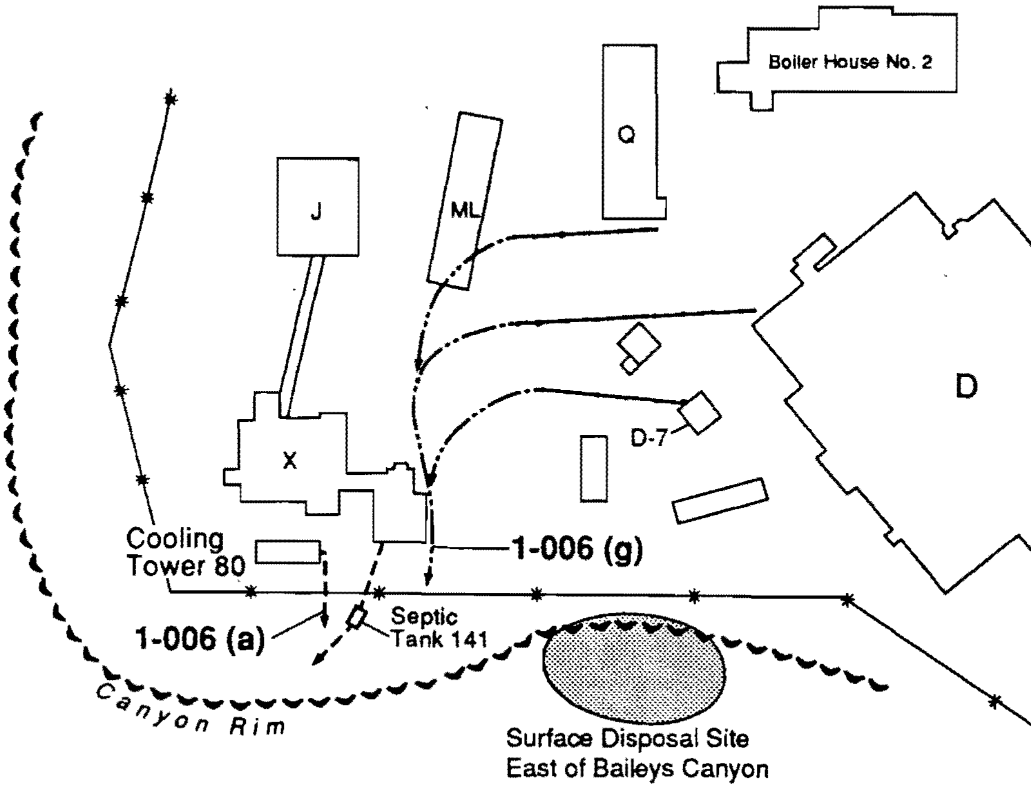


Figure 6.7-1. Cooling Tower 80.

LEGEND

- – – ➝ Sanitary Sewer and Building Drain Lines
- ——— Storm Drain Line
- ··—➝ Surface Drainage Flow associated with Storm Drain Line

contamination . The tank, sludge, outlet line, and approximately 151 ft of the inlet line were removed in September 1975 (Ahlquist et al. 1977, 0016).

The storm drainage system (SWMU 1-006g) serving Buildings X, ML, Q, D, D-4, and D-7 was constructed of varying diameter cast iron pipe that emptied into an open main drain. The open north-south main drain discharged approximately 20 ft south of the east side of Building X (Ahlquist et al. 1977, 0016; Weston 1989, 09-0036).

The 1974–1976 postdecontamination PHOSWICH meter survey indicated no radioactive contamination in the areas of the storm drain system surrounding Building X (Ahlquist et al. 1977, 0016).

Cooling Tower 80 was served by a drain line and outfall that were located south of Building X near the north rim of Los Alamos Canyon. The DOE verification survey of 1987 speculated that biocides containing chromium may have been added to the cooling tower, as was standard and acceptable practice at the time. One soil sample taken at this location indicated no metal, organic compound, or radionuclide above background (LANL 1987, 09-0045).

A surface disposal site for construction debris, identified as SWMU 1-003(b), is reputed to be located below the north rim of Los Alamos Canyon approximately 150 yards east of Bailey's Canyon. However, after several trips to the site by the OU 1078 work plan authors, this disposal area is not evident even though several pieces of metal piping were found. The pipe appears to be a component of the carriage supporting the steam lines that once traversed TA-1. This disposal site was not sampled during the 1974–1976 radiological survey and decontamination of TA-1 (Ahlquist et al. 1977, 0016).

6.7.3 Summary of Existing Data

A listing of SWMUs with known and suspected contaminants appears in Table 6.7-1.

6.8 Hillside 138, SWMU Aggregate F

•Septic Tank 138	SWMU 1-001 (d)
•TA-1-50, -81 Storm Drain and Outfall	SWMU 1-006 (h)

Note: The SWMU 1-006 (h) designation was derived from the February 1991 IT TA-1 work plan maps and is not identified as such in the November 1990 SWMU Report.

TABLE 6.7-1

Cooling Tower 80
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(g)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist, et al., 1977, 0016
1-003(a)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist, et al., 1977, 0016 Buckland, 1978
1-006(a)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist, et al., 1977, 0016
1-006(g)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist, et al., 1977, 0016 Christensen and Maraman, 1969, 0037

6.8.1 Physical Description of the Site

The Hillside 138 SWMU aggregate is located southeast of the Los Alamos Inn at the rim of Los Alamos Canyon. Its mesa-top component is currently occupied by office buildings. This SWMU aggregate includes the area adjacent to Septic Tank 138, which includes the location of former Buildings K, R, V, and Y, a septic tank, storm drain and outfall, and associated areas of Los Alamos Canyon below these two outfalls (Figure 6.8-1).

6.8.2 Historical Use of the Site

Septic Tank 138 was located southeast of Building Y (Ahlquist et al. 1977, 0016; LANL undated, 0402) and served K, V, and Y Buildings. These buildings were connected to Septic Tank 138 by one sanitary waste line. The outfall for the tank was located east of Building Y and discharged over the rim of Los Alamos Canyon. This outfall area is known as Hillside 138 (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016; LANL 1990, 0145).

During the1974–1976 radiological survey and decontamination operations, Septic Tank 138 was found below the floor of a storage shed located under an office building. When the tank was removed, it contained approximately 2 ft of sludge that was not radioactively contaminated. The outlet line was also free

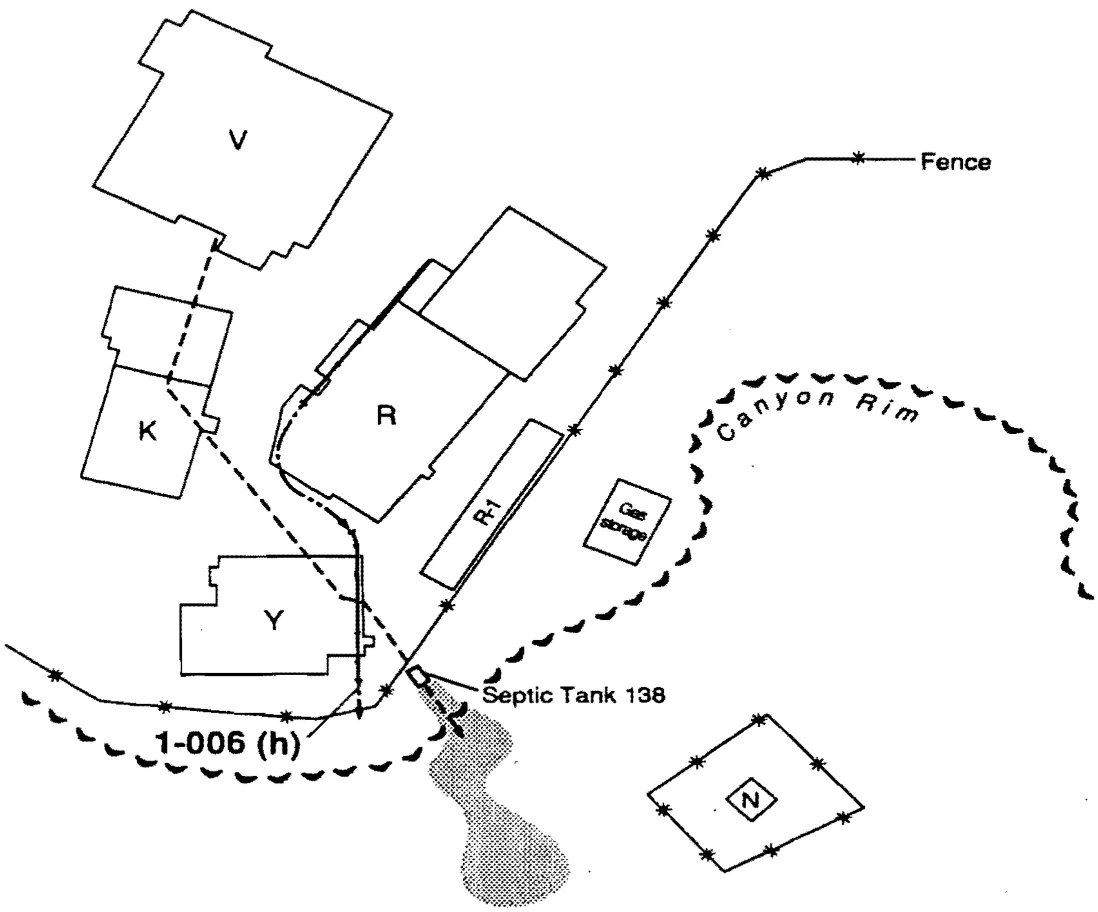
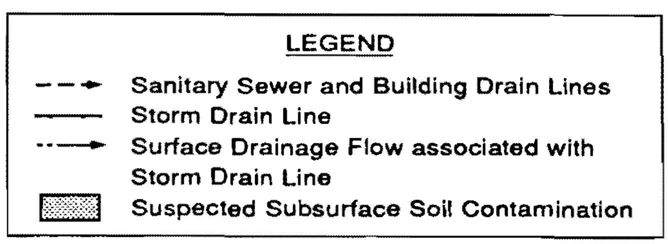


Figure 6.8.1 Hillside 138.



of radioactive contamination. For this reason, the inlet line beneath the office building was left in place (Ahlquist et al. 1977, 0016).

The 1974–1976 radiological survey, however, found that the hillside below Septic Tank 138 was contaminated. The maximum concentrations of ^{239}Pu found on Hillside 138, as detected in 1974–1976, are listed below.

	^{239}Pu Concentration
Upper Level	3600 pCi/g
Lower Level	8900 pCi/g

Hillside 138 was not decontaminated during the 1974–1976 radiological survey because of its inaccessibility. The area was fenced to prevent public access from the top of the mesa (Ahlquist et al. 1977, 0016).

Building K was used as a chemical stock room (Mitchell 1944, 09-0037; Kershaw 1945, 09-0043) and contained a mercury still. Spills from the still resulted in a decontamination effort, which included sealing holes in the floor in order to eliminate all sources of mercury vapor (H-Division 1952, 0464). The amounts of mercury spilled were not reported.

V Building housed TA-1's original uranium and beryllium machine shop. Dry grinding of boron was also conducted in this building (H-Division February 1952, 0756). In 1957, V Building was found to be free of radioactive contamination with the exception of some radioactively contaminated areas in the concrete floor (Buckland 1957, 09-0004).

Building Y housed a physics laboratory that handled tritium, ^{238}U, and ^{210}Po (Ahlquist et al. 1977, 0016). In 1946, high alpha and gamma radiation were confirmed at the waste outlet of Y Building (Drager 1946, 09-0038). Polonium was observed at the drain exit, but no plutonium was detected (Tribby 1946, 09-0030).

SWMU 1-006(h), Storm Drain and Outfall TA-1-50 and TA-1-81, served the northwest side of Building R and the east side of Building Y. The outfall was located 25 ft south of Building Y near the north edge of the perimeter patrol road adjacent to Hillside 138.

R Building housed model, glass, carpentry, and plumbing shops. Radioactive materials were not used in the building (Ahlquist et al. 1977, 0016).

During the 1974–1976 radiological survey, trenching was performed and the storm drain from Building Y was discovered. Puddles of elemental mercury were present in the line; however, the mass of the mercury found in the drain was not reported. The mercury and drain were removed (Ahlquist et al. 1977, 0016).

6.8.3 Summary of Existing Data

Table 6.8-1 lists the known and suspected site-related contaminants for each SWMU in the Hillside 138 SWMU aggregate.

The radioactive contamination found in this area was principally associated with the drain lines and Septic Tank 138. Plutonium-239 and Cesium-137 are the major constituents of the hillside radioactive contamination (Ahlquist et al. 1977, 0016) (Table 6.8-2).

TABLE 6.8-1

Hillside 138
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(d)	^{239}Pu, ^{235}U, ^{238}U, ^{137}Cs, Beryllium, Barium Chloride, Mercury, Tritium, Solvents	Mitchell, 1944, Ahlquist, et al., 1977, 0016; Buckland and Blackwell, 1946, 09-0042; Kershaw, 1945, 09-0043
1-006(h)	^{239}Pu, ^{235}U, ^{238}U, Mercury, Tritium	Ahlquist, et al., 1977, 0016 Buckland and Blackwell, 1946, 09-09-0042

TABLE 6.8-2

1974–1976 Radiological Survey Results
Hillside 138

Area of Contamination	Maximum Gross Alpha (pCi/g) Found	Maximum Gross Alpha (pCi/g) Remaining	Principal Contaminant
Septic Tank 138 (TA-1-138)	190	100	Pu, ^{137}Cs
Canyon rim at Septic Tank 138 (DOE property)	1,100	1,100	Pu, ^{137}Cs
Upper hillside below Septic Tank 138 (DOE property)	3,600	3,600	Pu, ^{137}Cs
Lower hillside below Septic Tank 138 (DOE property)	8,900	8,900	Pu, ^{137}Cs

6.9 Hillside 137 SWMU Aggregate G

•Septic Tank 137	SWMU 1-001 (c)
•TA-1-6 Drain line and Outfall	SWMU 1-006 (b)
•TA-1-8 Drain line and Outfall	SWMU 1-006 (c)
•TA-1-9 Drain line and Outfall	SWMU 1-006 (d)
•TA-1-6 Storm Drain and Outfall	SWMU 1-006 (n)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (a)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (b)
•Suspected Subsurface Soil Contamination	SWMU 1-007 (c)
•Suspected Subsurface Soil Contamination (two sites)	SWMU 1-007 (j)

Note: Sub-SWMU numbers 1-006 (b-d, n) and 1-007 (a-c) were derived from the February 1991 TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report. SWMU 1-001 (c) is as identified in the November 1990 SWMU Report.

6.9.1 Physical Description of the Site

The Hillside 137 SWMU aggregate is located at the rim of Los Alamos Canyon adjacent to the area presently occupied by the south end of the Los Alamos Inn parking lot. The hillside below is also contained in this SWMU aggregate. Backfilling and recontouring was completed on the mesa-top area where considerable excavation of contaminated soils and volcanic tuff occurred during the 1974–1976 decontamination effort. No remnants of any of the TA-1 buildings are currently evident at this aggregate, except for small pieces of concrete that are mixed with the backfilled materials.

Hillside 137 SWMU aggregate is composed of the area adjacent to former Buildings D, D-2, D-3, M, and Boiler House 2, which occupied this location during the 1940s and early 1950s. The SWMUs that compose this aggregate include a septic tank, drain lines and outfalls, a storm drain and outfall, and suspected subsurface soil contamination associated with these entities and the buildings themselves (Figure 6.9-1). This SWMU aggregate is composed of a significant mesa-top area as well as the hillside below the five outfalls.

6.9.2 Historical Use of the Site

The buildings associated with the Hillside 137 SWMU aggregate were vacated during the mid-1950s as new laboratory facilities south of Los Alamos Canyon and DP Site became available. Below are brief histories of the activities occurring during the buildings' tenure, disposal of the buildings, and remediation activities.

D Building was primarily used for processing plutonium. The early purification of plutonium performed in this building involved converting plutonium nitrate solution received from Hanford, Washington, into a purified metallic form that could be machined, tested, and ultimately fabricated into nuclear devices.

An area of suspected subsurface contamination in the vicinity of D Building has been identified as SWMU 1-007(a). During the 1974–1976 survey, over 9400 yds^3 of soil were removed from the D and D-2 Buildings area. The soil was monitored with gross alpha instruments until the excavated soil gross alpha activity was below the detection limit of 25 pCi/g, which was considered as low as reasonable at that time. Clean fill material (from TA-53 and TA-55) was used as backfill (LASL 1976, 09-0031).

The TA-1-6 drain line and outfall served D Building. This drain line exited the southwest side of the building and extended southwest and then south before discharging into Los Alamos Canyon. The types and quantities of fluids handled by this drain line are unknown. D Building was also served by the industrial waste drain line which presumably carried the acidic and radioactive waste fluids generated in the building (Ahlquist et al. 1977, 0016).

The TA-1-6 storm drain and outfall was located on the southeast side of D Building. This storm drain originated near the east corner of the building and extended along the southeast side of the building to an outfall into Los Alamos Canyon.

North and west of D Building, spotty, shallow, gross alpha soil contamination was found during the 1974–1976 PHOSWICH meter survey. This suspected subsurface soil contamination has been designated as SWMU 1-007(c). An unspecified amount of this soil was contaminated with plutonium at an unknown concentration. Approximately 1300 cubic meters of soil and the clay-tile waste line from D Building, which have associated gross alpha contamination, were removed from this area. The clay-tile waste line has been designated as SWMU 1-001(s) and will be addressed in the Western Sanitary Waste System SWMU aggregate (Ahlquist et al. 1977, 0016).

The D-2 Building was first used as a laundry facility for cleaning contaminated laboratory clothing, gloves, glassware, and other recyclable equipment that had been radioactively contaminated. Building D-2 served as the laundry facility for the entire technical area for a period of two years. Contaminated equipment and clothing were washed with detergent and water. Drain lines from the laundry facility discharged directly onto Hillside 137 southwest of Building D-2. Suspected subsurface soil contamination associated with the drain lines and outfalls from the laundry has been designated as SWMU 1-007(b).

In 1945, laundry operations were moved to TA-21 (DP Site, OU1106) when D-2 Building was converted into an electronics shop. After the laundry facilities had been removed, the contaminated water drain lines were placed below ground level and extended to discharge south of the perimeter patrol road. To contain contamination, several inches of soil were placed on the laundry facility's former outfall area. At that time, Septic Tank 137 was installed and one of the waste drain lines was connected to the septic tank (Ahlquist et al. 1977, 0016). In August 1975, Septic Tank 137 was relocated and investigated as the source of plutonium contamination found in the run-off area below the outfall pipe from the tank. The septic tank was then removed and disposed at MDA G (LASL 1976, 09-0031).

During excavation and removal of the tank, low levels of activity were detected in the soil along the sidewalls of the tank excavation. Soil was removed from the excavation until levels of gross alpha activity were below detection level (25 pCi/g). Clean soil was used as backfill. The outfall pipe from Septic Tank 137, along with two outfall pipes from the D-2 Building, were also removed at this time (Ahlquist et al. 1977, 0016).

The TA-1-8 drain line and outfall SWMU, consisting of three drain lines and outfalls that served D-2 Building, have been collectively designated as SWMU 1-006(c). The three drain lines exited the southwest side of the building and discharged directly onto Hillside 137.

In October 1975, surveillance trenching activities were conducted in the location of the former D-2 laundry facility to locate all drain lines and remove any contamination found. Significant contamination was found in one trench at the ends of two outfall pipes extending from the laundry. Both pipes were found contaminated with ^{239}Pu and ^{241}Am (Ahlquist 1975, 09-0017).

D-3 Building housed activities that included radioactive counting of filter papers from H-1 Building (Weston 1989, 09-0036). The TA-1-9 drain line and outfall served D-3 Building and discharged to Hillside 137 in the same area as the D-2 Building drain lines.

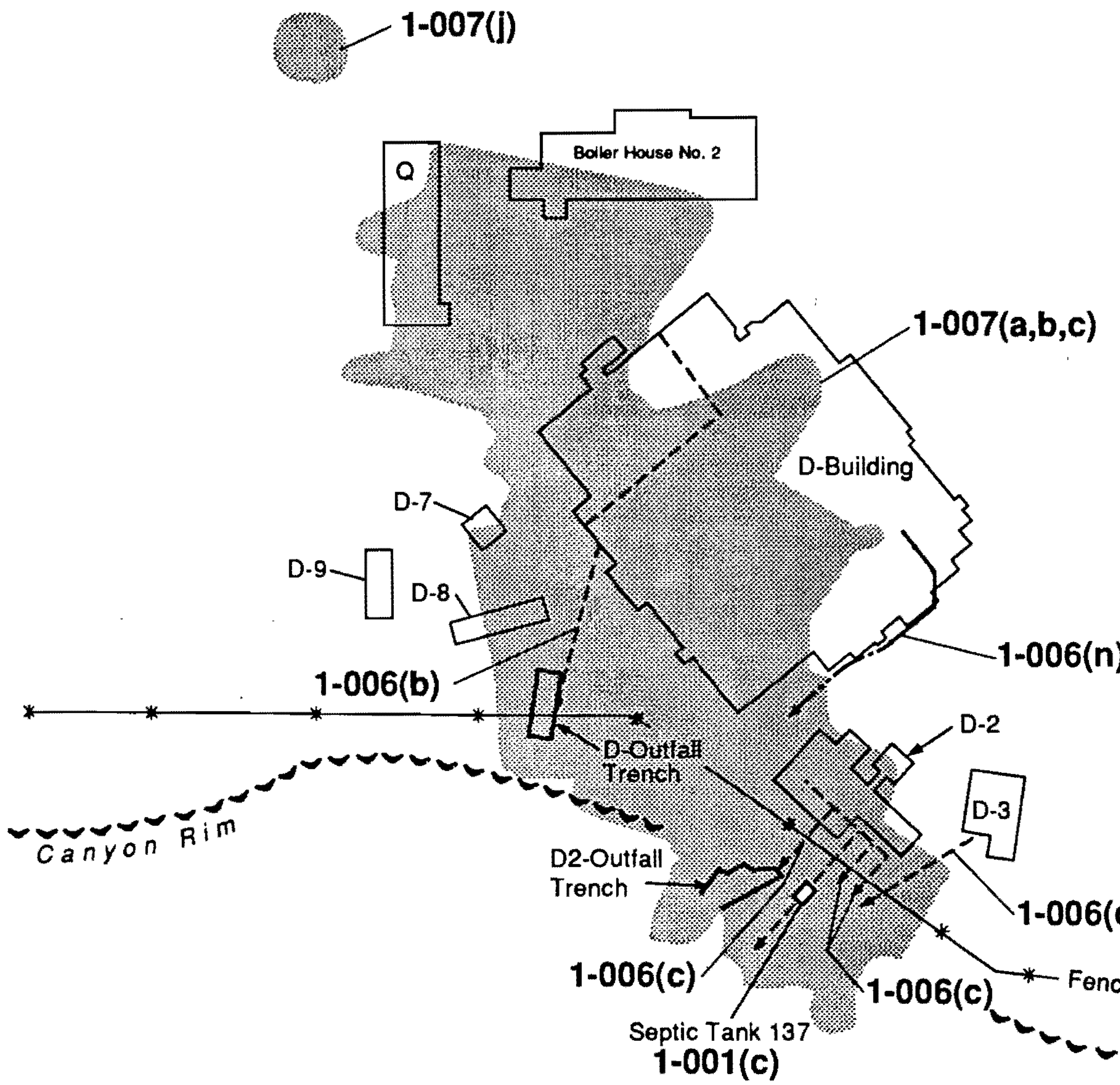
M Building, originally Boiler House 1, was converted to a chemistry laboratory in the summer of 1944

when Boiler House 2 became operational (Kennedy 1987, 09-0007). It was eventually used for processing and recovery of enriched uranium.

Boiler House 2, and the associated Cooling Tower TA-1-63, were constructed in late 1943. Boiler House 2 supplied steam for TA-1 (Kennedy 1987, 09-0007). Chemicals used in these buildings were typical of boiler house and cooling tower operations and might have included chromates. Two small areas of contamination were identified during the 1974–1976 PHOSWICH detector survey in the vicinity of Boiler House 2. The two areas of contamination have been collectively designated as SWMU 1-007(j) (in part). One of the areas is north of the boiler house and the other is between the boiler house and Q Building. These two minor sites were excavated by simple hand shoveling until no contamination was detectable with a PHOSWICH meter. Soil samples were subsequently collected, analyzed, and found to contain less than 90 pCi/g of gross alpha activity (Ahlquist et al. 1977, 0016).

6.9.3 Summary of Existing Data

The SWMUs in the Hillside 137 SWMU aggregate and associated known and suspected contaminants are listed in Table 6.9-1. Plutonium is the primary contaminant known to exist at the upper part of the Hillside 137 SWMU aggregate while ^{137}Cs may be found on the lower hillside. Due to the steepness of the Los Alamos Canyon walls, no remediation of soils or sediments located on the slopes below the rim of the canyon took place. These canyon walls will be investigated during the OU 1078 RFI.



Note: Suspected subsurface soil contamination, SWMUs 1-007 (a,b, and c) have been combined and are depicted by the large shaded area.

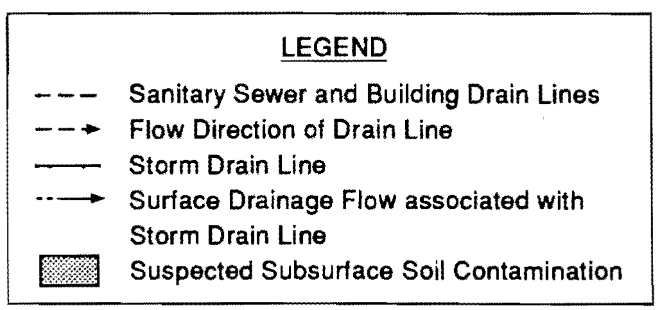


Figure 6.9-1. Hillside 137.

Table 6.9-2 (DOE 1988, 09-0006) presents sampling results from the 1974–1976 radiological survey. Sample locations and maximum gross alpha activity measured for radionuclides found are listed. The postremediation maximum gross alpha activities for the same locations are also included in the table.

The excavated areas around the D Buildings and Septic Tank 137 are depicted in Figure 4.5-1a.

6.10 Surface Disposal Site Southeast of Los Alamos Inn, SWMU Aggregate H

•Septic Tank 142	*SWMU 1-001(h)
•Septic Tank 149	*SWMU 1-001 (j)
•Septic Tank 269	*SWMU 1-001 (l)
•Surface Disposal Site SE of Los Alamos Inn	SWMU 1-003 (e)
•TA-1-147 Incinerator	*SWMU 1-004 (b)
•TA-1-54, -50 Storm Drain and Outfall	*SWMU 1-006 (i)
•TA-1-53 Storm Drain and Outfall	*SWMU 1-006 (j)
•TA-1-64 Storm Drain and Outfall	*SWMU 1-006(q)

Note: Sub-SWMU numbers 1-003 (e), and 1-006 (i, j, q) were derived from February 1991 TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report. Sub-SWMU numbers 1-001 (h, j, l) and 1-004 (b) are as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

6.10.1 Physical Description of the Site

This SWMU aggregate is located southeast of the Los Alamos Inn, partly on the mesa top and partly on the Los Alamos Canyon hillside. It is physically composed of the area adjacent to former Buildings R, S, S-1, and W, which occupied the location during the 1940s and 1950s (Figure 6.10-1). No remnants of any of these buildings exist today and the area is currently covered by a paved parking lot and a professional building.

SWMUs which make up this aggregate include three septic tanks, a surface solid waste disposal area, an incinerator, and three storm drains and associated outfalls. No known fugitive spills or leaks occurred at this SWMU aggregate. Run-off from the locations of these SWMUs would be toward the drainage in which the surface disposal site is found.

TABLE 6.9-1

Hillside 137
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(c)	^{241}Am, ^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist et al. 1977, 0016 Weston 1989, 09-0036
1-006(b)	^{239}Pu, ^{235}U, ^{238}U	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-006(c)	^{241}Am, ^{239}Pu, ^{235}U	Ahlquist et al. 1977, 0016; Weston 1989, 09-0036
1-006(d)	^{239}Pu, ^{238}U	Ahlquist et al. 1977, 0016
1-006(n)	^{239}Pu, ^{235}U, ^{238}U	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-007(a)	^{239}Pu, ^{235}U, ^{238}U	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-007(b)	^{241}Am, ^{239}Pu, ^{238}U, Metals	Ahlquist et al. 1977, 0016 Weston 1989, 09-0036
1-007(c)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-007(j) (two sites)	^{239}Pu, ^{235}U, ^{238}U, Metals	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037

TABLE 6.9-2

1974–1976 Radiological Survey Results
Hillside 137

Area of Contamination	Maximum Gross Alpha (pCi/g)		Principal Contaminant
	Found	Remaining	
Septic tank for Building D-2 (TA-1-137)	125,000	110	Plutonium
DOE property below Septic Tank 137	820	490	Plutonium
Building D-2 outfall trench (DOE property)	16,000	<100	Plutonium
DOE property below D-2 outfall trench	350	50	Plutonium
Vicinity of Building D-2	55,000	10	Plutonium
Building D outfall trench	15,000	80	Plutonium
Building D acid-sewer trench	89,600	110	Plutonium Uranium
Vicinity of Building D	5,400	120	Plutonium Uranium
DOE property below Building D	84	84	Plutonium
Area north and west of Building D	200	<20	Plutonium

6.10.2 Historical Use of the Site

Buildings associated with the Surface Disposal Site Southeast of Los Alamos Inn SWMU aggregate were vacated during the mid-1950s to the late 1950s as new laboratory facilities south of Los Alamos Canyon and at DP site became available. The following paragraphs recount the activities, removal, demolition, and decontamination of the buildings, structures, and contaminated soils in this aggregate.

R Building housed model (electrical), glass blowing, carpentry, and plumbing shops. Radioactive materials were not used in this building (Ahlquist et al. 1977, 0016).

S-1 Building served as Garage 1 and was later also used for storage of nonradioactive materials (Ahlquist et al. 1977, 0016; Blackwell 1956, 09-0039).

SWMU 1-006i drained the southwest side of S-1 Building and northeast side of R Building to an outfall approximately 20 ft south of Building S-1. Based on the 1974–1976 survey, no radioactive contamination is expected for this site.

Septic Tank 142 was located south-southeast of the former power plant and served Building 118. The outfall from Septic Tank 142 emptied over the canyon rim southwest of Building 118 (LASL 1958, 09-0048). Septic Tank 142 was located during the 1974–1976 survey, and the tank and sludge within were found not to be radioactively contaminated. The tank was removed to MDA G in 1976 (Ahlquist et al. 1977, 0016; LANL undated, 0402).

Septic Tank 149, as shown in Figure 6.10-1, is not a septic tank but rather some type of above-ground storage tank located between U and W Buildings. Septic Tank 149 is being nominated for NFA and will not be discussed further in this chapter.

Septic Tank 269 served S-1 Building. A sanitary waste line led from S-1 Building to Septic Tank 269, draining to the outfall at the canyon rim south of S-1 building (LASL 1958, 09-0048). The tank was reportedly removed under the same contract as S-1 Building in August 1954 (LANL undated, 0402).

S Building, completed in July 1943, was used as a technical warehouse and stock building (Kennedy 1987, 09-0007). In 1956, S Building, considered to be free from any significant radioactive contamination, was released for reassignment or removal (Blackwell 1956, 09-0039). During the 1974–1976 radiological survey no radioactive contamination was found at the S Building location (Ahlquist et al. 1977, 0016).

Storm Drain and Outfall TA-1-53 consisted of two storm drains, which served S Building and discharged into Los Alamos Canyon. The 1974–1976 radiological survey indicated no radioactivity associated with these storm drains (Ahlquist et al. 1977, 0016).

T Building, the first building constructed in TA-1 in March of 1943, housed the Theoretical Division. T Building contained offices, a technical library, a document room, drafting rooms, and a photographic laboratory (Kennedy 1987, 09-0007). A silver-soldering operation was also contained in this building. No radioactive materials were handled in T Building (Ahlquist et al. 1977, 0016; Blackwell 1956, 09-0039).

Storm Drain and Outfall TA-1-64 drained the east side of T Building with an outfall at Trinity Drive.

Run-off from this area would have been southeast toward Los Alamos Canyon. A PHOSWICH meter survey in 1976 detected no contamination near the outfall area (Ahlquist et al. 1977, 0016).

W Building was completed in April 1943 to house the Van de Graaff accelerator. Radioactive materials used in the building included uranium, polonium, and tritium (Ahlquist et al. 1977, 0016). The building was found to be free of radioactive contamination except for the concrete floor in the southwest corner of the building (Buckland 1957, 09-0004).

V Building contained offices, a drafting room, file room, and toolmaker's shop (Kennedy 1987, 09-0007). V Building was TA-1's original machine shop for machining of uranium and beryllium (Ahlquist et al. 1977, 0016). Dry grinding of boron was also conducted in this building (H-Division 1952, 0756). V Building was found to be free from radioactive contamination except for the concrete floor in one office in the southeast corner of the building. The remainder of the building was removed in February 1959.

Incinerator TA-1-147 was located in the area that is currently the driveway of the Los Alamos Inn (LASL 1958, 09-0048). It was used for the incineration of nonradioactive solid wastes from 1947 to 1957.

A surface disposal site located southeast of the Los Alamos Inn along the northern wall of Los Alamos Canyon has been designated as SWMU 1-003(e). Discarded materials observed in the disposal area include utility boxes, concrete construction debris, piping, and other miscellaneous objects (DOE 1987, 0264; Weston 1989, 09-0036). No information is available regarding the history of this hillside disposal area. However, there is no documentation that it was contaminated with radioactivity. It is probable that a portion of the debris came from the 1953–1959 demolition of the buildings in the eastern part of TA-1.

6.10.3 Summary of Existing Data

A variety of contaminants may have been disposed in this hillside SWMU aggregate. A listing of SWMUs with known and suspected contaminants appears in Table 6.10-1.

6.11 Can Dump Site, SWMU Aggregate I

•Septic Tank 275	*SWMU 1-001 (m)
•Can Dump Site	SWMU 1-003 (d)

Note: Sub-SWMU 1-003 (d) is derived from the February 1991 IT TA-1 SWMU description report maps and is not identified as such in the November 1990 SWMU Report. Sub-SWMU 1-001 (m) is as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

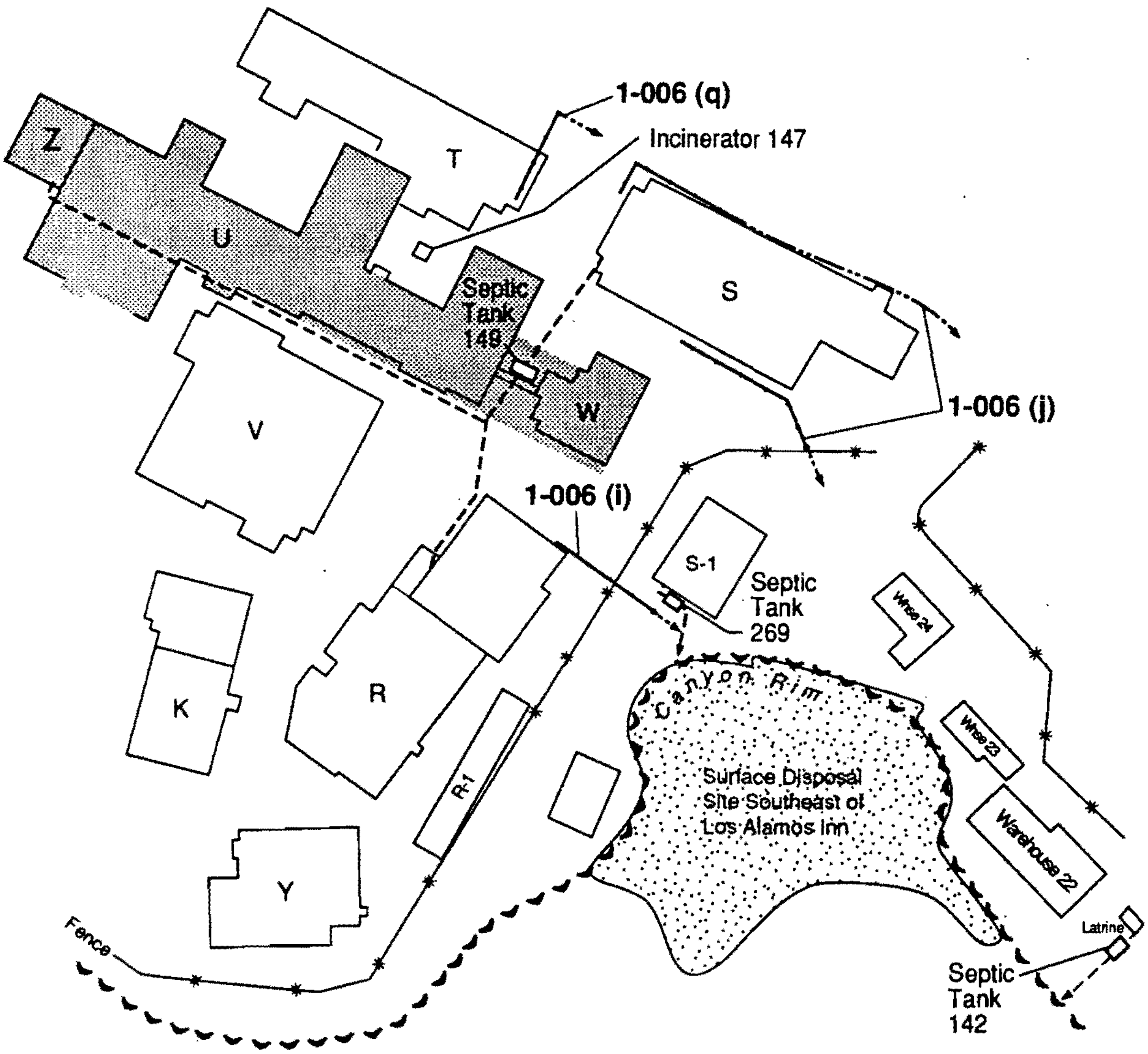


Figure 6.10-1. Surface Disposal Site Southeast of Los Alamos Inn.

LEGEND

- Sanitary Sewer and Building Drain Lines
- Storm Drain Line
- Surface Drainage Flow associated with Storm Drain Line
- Suspected Subsurface Soil Contamination

TABLE 6.10-1

Southeast of Los Alamos Inn
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(h)	None	Ahlquist et al. 1977, 0016
1-001(j)	None	Ahlquist et al. 1977, 0016
1-001(l)	None	Ahlquist et al. 1977, 0016
1-003(d)	Metals, Suspected Organic Chemicals	Ahlquist et al. 1977, 0016 H-Division 1955, 0760
1-004(b)	Metals	DOE 1987, 0264
1-006(i)	None	Ahlquist et al. 1977, 0016
1-006(j)	None	Ahlquist et al. 1977, 0016
1-006(q)	None	Ahlquist et al. 1977, 0016

6.11.1 Physical Description of the Site

The Can Dump Site SWMU aggregate is located at the eastern edge of OU 1078 on the northern rim of Los Alamos Canyon in the vicinity of the current Los Alamos County electric complex and US West Communications Building. It has both mesa-top and hillside components.

There are two SWMUs associated with this aggregate: Septic Tank 275, located to the east of the US West Communications Building, and the Can Dump Site, located on the north wall of Los Alamos Canyon south of the US West Communications Building and storage yard. The septic tank discharged over the side of Los Alamos Canyon (Figure 6.11-1).

6.11.2 Historical Use of the Site

Buildings in the vicinity of the Can Dump SWMU aggregate were vacated and demolished during the mid to late 1950s. Formerly the site of Zia Company operations, the aggregate was located east of the main TA-1 complex and adjacent to the former main power plant. The Zia buildings in this area were used as paint, carpentry, furniture repair, and sign shops (DOE 1988, 09-0006). Reportedly, the warehouses did not use radioactive materials and were outside the security fence of the main TA.

Warehouse 18 was used for storage of unspecified materials, although records indicate no radioactive materials were used in this building (Ahlquist et al. 1977, 0016).

Warehouse 13 was also used for storage of nonradioactive materials (Ahlquist et al. 1977, 0016; LANL undated, 0402).

Septic Tank 275 was located north of Warehouse 18 but served only Warehouse 13. The outfall from Septic Tank 275 was northeast of Warehouse 13 where it discharged over the canyon rim (LASL 1958, 09-0048). Attempts to locate the tank during the 1974–1976 radiological survey were futile because the hillside location of the tank had been bulldozed to an elevation lower than the tank's original elevation. It is a fair assumption that the tank had been removed during excavation into the hillside. Additionally, during the survey, a metal tank of the approximate reported volume of Septic Tank 275 was found on the hillside below and subsequently removed to MDA G (Ahlquist et al. 1977, 0016; Barthell 1968, 09-0040; LANL undated, 0402).

An area used for surface disposal of empty solvent and paint cans, known as the Can Dump Site [SWMU 1-003(d)], is located on DOE property on the hillside above Los Alamos Canyon just south of the current US West Communications Building. Information regarding the history of this site is not available. Several Zia warehouses located just northwest of this disposal site were used as paint, carpentry, furniture repair, and sign shops. It is very likely that the waste material came from these nearby shops.

The facilities at TA-1 handled a variety of radionuclides and hazardous organic chemicals, although the warehouses associated with this SWMU aggregate reportedly handled only hazardous chemical materials. Some confidence can be placed in the assumption that no radioactive materials were handled in these warehouses because they were outside the TA-1 security fence. Two small areas exhibiting very low radioactivity levels were documented on the mesa top by Ahlquist (Ahlquist et al. 1977, 0016). A listing of SWMUs and known and suspected contaminants for this aggregate appears in Table 6.11-1.

TABLE 6.11-1

Can Dump Site
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(m)	None	Ahlquist et al. 1977, 0016
1-003(d)	Metals	Weston 1989, 09-0036

6.11.3 Summary of Existing Data

The Can Dump Site SWMU aggregate was primarily a Zia operations complex. Given the nature of building uses (i.e., paint, carpentry, furniture , and sign shops), the possibility of nonradiological hazardous constituents exists. No appreciable levels of radioactive contamination were found in the area.

6.12 Drain Lines and Outfalls to Ashley Pond, SWMU Aggregate J

•TA-1-46 Drain lines and Outfalls to Ashley Pond SWMU 1-006 (e)

Note: Sub-SWMU Number 1-006 (e) was derived from the February 1991 TA-1 work plan maps and is not identified as such in the November 1990 SWMU Report.

6.12.1 Physical Description of the Site

The drain lines and outfalls to the Ashley Pond SWMU aggregate consisted of two outfalls, jointly identified as SWMU 1-006(e). One drain line originated at P Building; the other drain line served the cleaning plant (Figure 6.12-1). This aggregate has only a mesa-top component.

6.12.2 Historical Use of the Site

P Building was used for personnel offices and no radioactive materials were used in the building. An H-Division progress report, however, indicated that toluene was used in P Building. Two drain lines, SWMU 1-006(e), emptied into Ashley Pond. One 4-in.-diameter drain line served P Building (TA-1-46) and extended northeast for approximately 100 ft where it emptied into Ashley Pond. The second drain line (a blowoff line) served the cleaning plant about which little is known other than it was replaced early in the project by a parking lot. The types of materials used in this building are unknown, but because it was a cleaning plant, it is probable that solvents were used there. The drain line originated at the northwest corner of the cleaning plant and extended underground to Ashley Pond. This site currently is owned principally by Los Alamos County (Weston 1989, 09-0036).

6.12.3 Summary of Existing Data

Reports indicate that no radioactive or hazardous chemicals other than toluene were used at P Building. Therefore, it is unlikely that any radioactive contamination originated from this building (Weston 1989, 09-0036). The materials that were used in the cleaning plant are unknown but the potential exists for solvent use (Weston 1989, 09-0036). Insoluble contaminants (should they exist), such as heavy metals and radionuclides, that may have been discharged at the outfall are likely to have adsorbed onto pond sediments (which have been cleaned out several times) (Den-Barrs 1991, 09-0046). Table 6.12-1 lists those contaminants that potentially could exist in Ashley Pond.

TABLE 6.12-1

**Cleaning Plant Drain Lines and Outfalls to Ashley Pond
Suspected Hazardous Contaminants**

SWMU No.	Suspected Contaminants	Reference
1-006(e)	Toluene	Weston 1989, 09-0036

Los Alamos County personnel have stated that several total cleanouts of Ashley Pond have taken place. These occurred in the 1970s when the pond became septic, probably because of fertilizer running off the built-up surrounding grassy areas. The pond water is currently exchanged frequently in the summer because it is the source used in watering the surrounding lawns.

6.13 Industrial (Acid) Waste Disposal Line, SWMU Aggregate K

6.13.1 Physical Description of the Site

The Industrial Waste Disposal Line SWMU aggregate consists of a single SWMU (1-002), is located in the southern and western portion of OU 1078, and extends into TA-45 which is outside the boundaries of OU 1078. The site, currently occupied by private residences, apartments, townhouse complexes, and

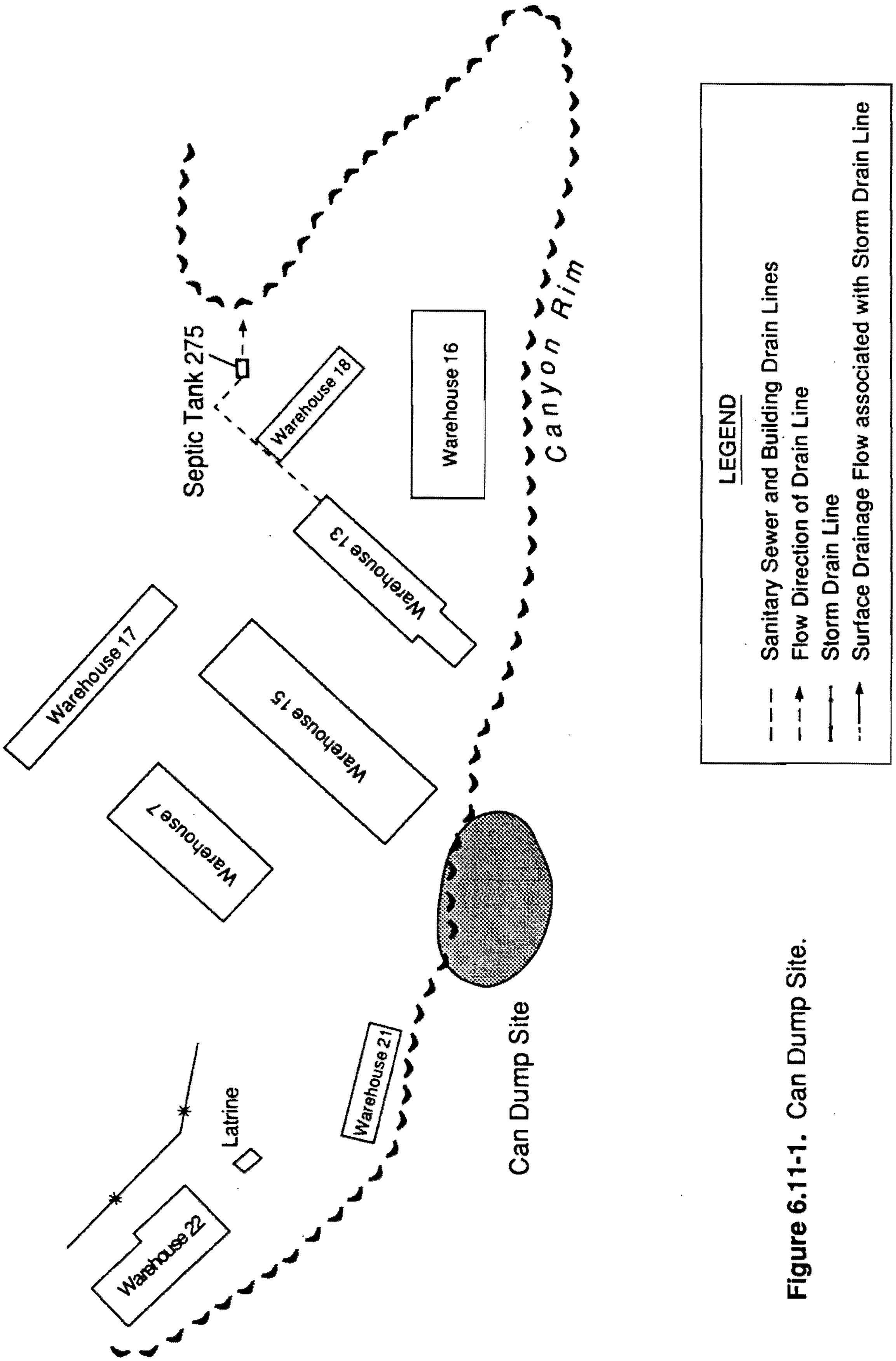


Figure 6.11-1. Can Dump Site.

commercial establishments, includes the area around the following former buildings: Boiler House 2, D, H, J-2, M, ML, Sigma, and Q and several properties north of Trinity Drive extending over to Canyon Road (near the former location of TA-45). These buildings were the sources of the major process discharges from TA-1 (Foldout Map B). This aggregate has only a mesa-top component.

6.13.2 Historical Use of the Site

The industrial waste line was used for the disposal of chemical and radioactive process wastes since the early operations of the Laboratory. From 1943 to 1951, wastes from the industrial waste disposal system were discharged untreated to a small branch (Acid Canyon) of Pueblo Canyon. In 1951, the TA-45 waste water treatment plant was constructed near the industrial waste line outfall and waste liquids subsequently were treated before disposal into the canyon (Ferenbaugh et al. 1982, 0668). TA-45 and the receiving canyon are outside the bounds of OU 1078.

The buildings being served by the industrial waste line have previously been described in other SWMU aggregate descriptions (Hillside 137, Sigma, J-2/TU), and this information will not be repeated here.

Possible radioactive and hazardous chemical contaminants disposed in the industrial waste lines include any contaminants that were used in the buildings that were connected to the line. Table 6.13-1 lists possible radioactive and hazardous materials used in the buildings connected to the industrial waste line.

The industrial waste line and all connections have been completely removed from OU 1078. Below is a brief summary of the 1974–1976 survey and the corrective actions that took place to remediate the industrial waste system (Ahlquist et al. 1977, 0016). These actions took place after the industrial waste line had been removed.

Because of discrepancies between records and physical observations, beginning in September 1975, attempts were made to verify that the main industrial waste line connecting TA-1 with the treatment plant at TA-45 had been completely removed as claimed. As part of the effort, exploratory trenches were dug behind the former Taco Bell and Exxon Station (now Hot Shots Restaurant and the Shell Service Station) to verify that the lines in that area had been removed. No waste line pipe appeared in any of the trenches, but portions of a filled-in trench were found in the tuff at several places where engineering drawings had indicated the industrial waste line; therefore, it was concluded that the industrial waste line had been removed (Ahlquist et al. 1977, 0016).

TABLE 6.13-1

Industrial (Acid) Waste Disposal Line
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-002	Plutonium, Natural and Enriched Uranium, Americium, Thorium, Tritium, ^{137}Cs, ^{90}Sr, Metals, Solvents	Ahlquist et al. 1977, 0016 Weston 1989, 09-0036 LASL 1975, 09-0050 H-Division December 1955, 0762 H-Division June 1955, 0761 Ahlquist 1977, 09-0041

During excavation, the 1974–1976 survey discovered substantial soil contamination in the industrial waste line trench at the location of the former D Building, resulting in further investigation. Subsurface contamination was also found in the vicinity of H and Theta Buildings where highly contaminated laterals connected with the main industrial waste line trench. Substantial alpha activity was also found in soil from the main trench in that area. These findings reopened the question of how best to decontaminate the industrial waste line trench. It was determined that it was necessary to attempt excavation of the entire trench from D Building to Trinity Drive. In most places an obvious trench was found in the tuff and was easy to follow with a back-hoe. The trench was cleaned out by back-hoe to the apparent original floor. Samples from the sidewalls and floor were taken for gross alpha activity. Some contamination was found throughout most of the trench. The highest levels were 1200 pCi/g of alpha activity. These particular samples were from the trench near where the contaminated laterals from H-Theta had been removed. To remove the additional contaminated soil, the trench was made considerably larger than the original (Ahlquist et al. 1977, 0016).

The industrial waste line trench was then traced continuously from H-Theta area to D Building, monitored, and decontaminated when necessary. A special attempt was made to determine whether any of the lateral connections to the main industrial waste line remained, but none were found (Ahlquist et al. 1977, 0016).

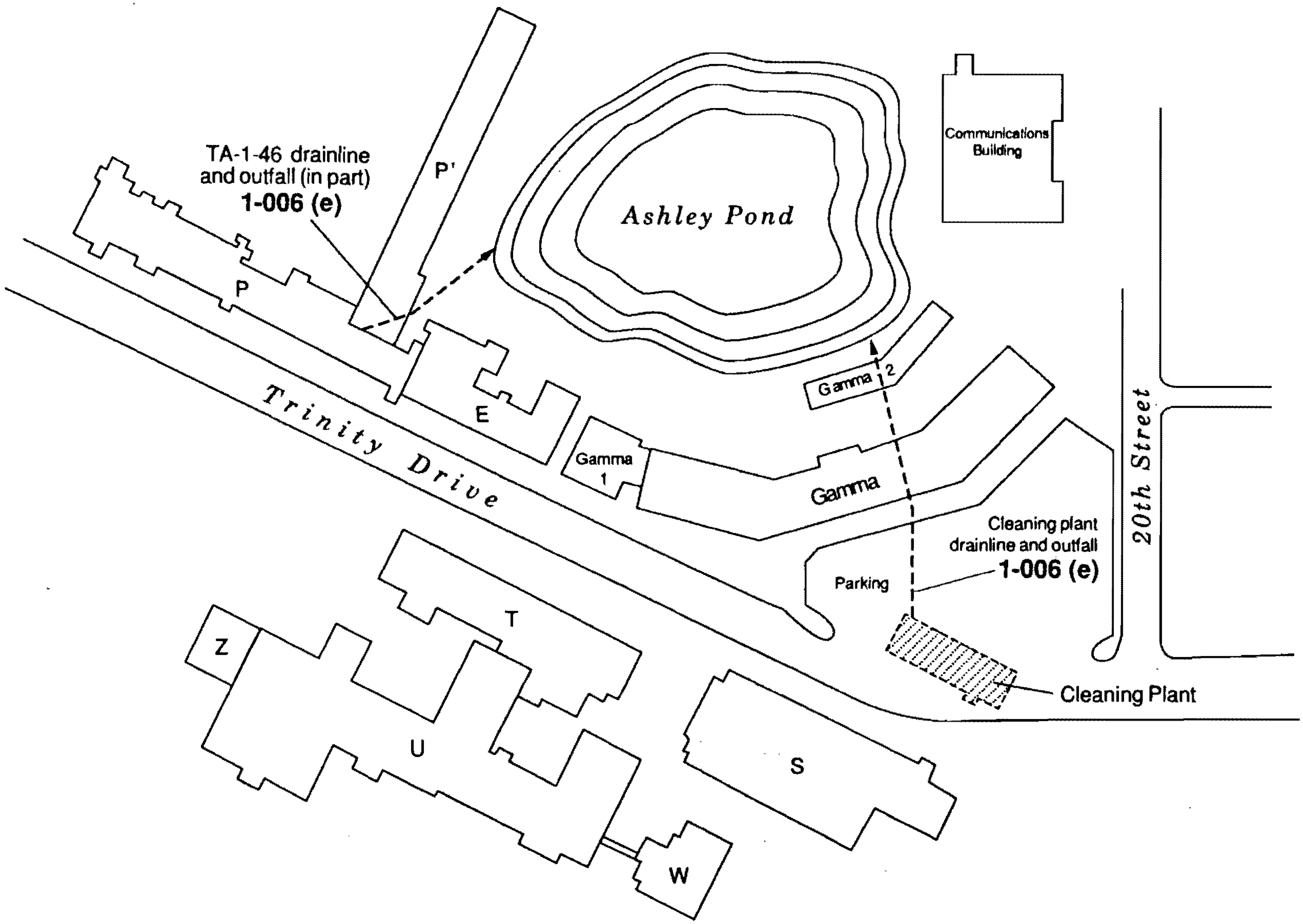


Figure 6.12-1. TA-1-46 and Cleaning Plant drainlines and outfalls to Ashley Pond.

At a meeting on July 28, 1976, the industrial waste line excavations were determined to be decontaminated because (1) no PHOSWICH-detectable activity remained in the trench (detection limit was approximately 1000 pCi/g); (2) most of the remaining gross alpha activity in soil was <25 pCi/g (maximum activity on an individual soil sample was 92 pCi/g); (3) all underground structures encountered in the trench had been monitored and those with detectable contamination had been removed; and (4) with the exception of a few laterals beneath developed portions of TA-1, the excavations included all of the known industrial waste line trench south of Trinity Drive (Ahlquist et al. 1977, 0016).

In the western portion of TA-1, a segment of industrial waste line ran from the Radiochemistry Building (J-2) to the main industrial waste line. J-2 Building had been used for radiochemical analyses on weapon debris from atmospheric bomb tests in the South Pacific and Nevada. The primary radioactive contaminants to the industrial waste line from J-2 Building were mixed fission products (^{137}Cs is the predominant isotope remaining from these mixed fission products).

In the vicinity of the J-2 Building, trenches were excavated to verify that the industrial waste line had been removed. A 37-meter-long section of 7.6-centimeter-diameter cast iron line was found below a former parking lot and removed (Ahlquist et al. 1977, 0016).

Discussions with former employees and information in an archival progress report indicated that on September 5, 1957, a leak had developed in the industrial waste line near the former apartments next to TA-1 and that this leak had emerged on the surface. The PHOSWICH survey in 1976 showed ^{137}Cs contamination in the area corresponding to the location of this leak. Therefore, it was decided to do a more thorough investigation of the J-2 industrial waste line trench in the vicinity of this PHOSWICH survey. The widened portion of the trench is the area from which the ^{137}Cs contaminated soil was removed on both sides to below detection limits on the PHOSWICH (1000 pCi/g). At the floor of the trench (approximately 4 meters deep), contamination was confined to a 10-centimeter-wide soil-filled fracture starting in the center of the trench and running southeast. The fracture was oriented N30W and did not extend up the trench walls. Further excavation would have been deeper than was practicable with a back-hoe. Activity to 168 pCi/g of ^{137}Cs is known to remain at the bottom of the trench 12 ft under the ground surface. No PHOSWICH-detectable activity was found in the trench in either direction from this spot (Ahlquist et al. 1977, 0016).

At a meeting on July 28, 1976, this portion of the industrial waste line excavation was considered decontaminated because (1) the primary contamination was ^{137}Cs; (2) the only PHOSWICH-detectable activity was approximately 12 ft deep and localized along a fracture; (3) only 3 of 54 post-excavation soil samples had gross alpha activity >25 pCi/g (maximum activity of a sample was 41 pCi/g); and (4) the excavation in either direction along the former industrial waste line was extensive enough to include the region of the known leak.

6.13.3 Summary of Existing Data

Radionuclide or hazardous constituents suspected in the industrial waste line SWMU are listed in Table 6.13-1.

6.14 Eastern Sanitary Waste SWMU Aggregate L

•Sanitary Waste Lines	*SWMU 1-001 (r)
•Sanitary Waste Lines	SWMU 1-001 (t)

Note: Sub-SWMU number designations are as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

6.14.1 Physical Description of the Site

The Eastern Sanitary Waste SWMU aggregate served buildings located in the east central portion of TA-1 (Foldout Map C). Currently the area is mainly occupied by the Los Alamos Inn. This aggregate was composed of two sanitary waste systems, which served the eastern part of TA-1. The first system, SWMU 1-001(r), served Building E. The second system, SWMU 1-001(t), served the Gamma, M, P-Prime, R, S, T, U, V, W, and Z Buildings. The effluent from the buildings connected to this sanitary waste system discharged to Septic Tank Number 1 [nomenclature derived from Corps of Engineers (COE) Record Drawing] (COE 1943, 09-0051] and proceeded to a drain field located southeast of the DP Road and Trinity Drive intersection. This tank and leach field are located out of the OU and 1078 will not be considered in this investigation.

6.14.2 Historical Use of the Site

The buildings served by the Eastern Sanitary Waste SWMU aggregate were vacated during the mid and late 1950s.

Building E, completed in July 1944, was used for administrative staff and theoretical physicist office space. No records indicate radioactive or hazardous chemical material use in the building (Kennedy 1987, 09-0007; Ahlquist et al. 1977, 0016). In 1956, E Building was released for reassignment or removal as it was considered free from any significant amount of radioactive contamination (Blackwell 1956, 09-0039). Building E was removed by a private firm in March 1958 (Ahlquist et al. 1977, 0016).

Building E was served by a sanitary waste line, SWMU 1-001(r), that was located southwest of Ashley Pond. During the early days of the Laboratory, the line was part of a larger sanitary waste system that served the northeast portion of TA-1. The segment that served Building E was abandoned early and replaced with another segment closer to Ashley Pond. Information regarding construction or removal of this segment is not available (Ahlquist et al. 1977, 0016; Weston 1989, 09-0036; LANL 1990, 0145). This sanitary waste line is unlikely to have received hazardous or radioactive materials. No documentation was found regarding the removal of this line. Therefore, it is possible that the line, or portions of it, still exist. No surveys for hazardous or radioactive constituents have been done in the area of this waste line, and consequently, it is unknown whether residual contamination exists.

The Gamma Building housed offices and a physics laboratory (Kennedy 1987, 09-0007) in which beryllium and toluene were used (H-Division February 1952, 0756; H-Division January 1953, 0763) as well as sealed sources including ^{137}Cs. An incident leading to contamination with ^{137}Cs occurred in the building (Ahlquist et al. 1977, 0016), but no information regarding the actual events, the amount spilled, or the associated cleanup is available.

M Building was used for processing and recovery of enriched uranium. M Building was served by two main sanitary waste lines. The first sanitary waste line, designated as SWMU 1-001(t), will be addressed later in this section. The second sanitary waste line, designated as SWMU 1-001(s), will be addressed as part of the Western Sanitary Waste aggregate. One of the two sanitary waste lines was surveyed and found to be free of contamination (Ahlquist et al. 1977, 0016); however, it is unclear which of the two was surveyed.

The P-Prime Building, completed in July 1945, was used for supply and property offices. No radioactive materials were used in the building (Ahlquist et al. 1977, 0016; LANL undated, 0402), and no documentation was available regarding the use of hazardous chemicals.

Buildings R, S, S-1, T, U, V, W, and Z were served by a sanitary waste line, SWMU 1-001(t). For a discussion of the R, S, T, U, and V and W Buildings see the surface disposal site southeast of Los Alamos Inn SWMU aggregate (Section 6.10).

Z Building, completed in April 1943, housed two Cockcroft-Walton high-voltage accelerators (Kennedy 1987, 09-0007). During removal of some equipment from Z Building in December 1955, high-level tritium contamination was detected in the vicinity of one accelerator. In 1956, Z Building was considered free from any significant amount of radioactive contamination (Blackwell 1956, 09-0039) and was released for reassignment or removal.

The SWMU 1-001(t) sanitary waste system was connected to a septic tank and a drain field located in TA-0 southeast of the intersection of Trinity Drive and DP Road; this portion of the sanitary waste system east of TA-1 will be addressed in the RFI Work Plan for Operable Unit 1071.

6.14.3 Summary of Existing Data

The sanitary system which served Building E (SWMU 1-001 (r)) is not expected to have been contaminated with hazardous or radioactive materials. The second system (SWMU 1-001t) served buildings in which both hazardous and radioactive materials were handled; thus the system and its outfall are suspected of having both radioactive and hazardous chemical contamination. A listing of SWMUs and known and suspected contaminants appears in Table 6.14-1.

The sanitary waste lines may still exist as no documentation verified that they had been removed.

TABLE 6.14-1

Eastern Sanitary Sewer
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(r)	None	
1-001(t)	^{137}Cs, ^{235}U, ^{238}U, ^{239}Pu, Beryllium, Tritium, Silver, Cadmium, Metals	Ahlquist et al. 1977, 0016

6.15 Northern Sanitary Waste SWMU Aggregate M

•Sanitary waste lines	*SWMU 1-001 (q)
•Sanitary waste lines	*SWMU 1-001 (v)
•Sanitary waste lines	*SWMU 1-001 (w)

Note: These sub-SWMU numbers are identified in the November 1990 SWMU Report.

*Also nominated for NFA.

6.15.1 Physical Description of the Site

The Northern Sanitary Waste SWMU aggregate is located north of Trinity Drive between Ashley Pond and 24th Street (Foldout Map C). All former TA-1 buildings have been removed and the area is currently occupied by Los Alamos County offices and a park surrounding Ashley Pond. This aggregate has only a mesa-top component.

The Northern Sanitary Waste SWMU aggregate is composed of sanitary waste drain lines that served an area formerly occupied by four TA-1 administration and service buildings constructed during the early days of the Manhattan Project. These buildings were P, P-Prime, AP, and the former PX. The SWMUs associated with this aggregate are the sanitary waste lines serving Building P and the PX [SWMU 1-001(q) and 1-001(v)] and the sanitary waste line serving Buildings P-Prime and AP [SWMU 1-001(w)].

6.15.2 Historical Use of the Site

The buildings associated with the Northern Sanitary Waste SWMU aggregate were vacated between 1953 and 1965.

P Building was used for personnel offices and no radioactive materials were used in the building. PX Building functioned as the post exchange in the early years of the Laboratory. The sanitary waste line [SWMU 1-001(v)], located north of Trinity Drive and west of Ashley Pond, served P Building. According to an engineering drawing (LASL 1947, 09-0010), this sanitary waste line also served the former PX Building through the 4-in. VCP lateral service lines, which are designated as SWMU 1-001(q). However, the lines no longer appear on 1958 engineering drawings and they may have been removed. A new addition to P Building is shown in this location (LASL 1958, 09-0048). The sanitary waste line transported waste northward toward Pueblo Canyon to Septic Tank Number 2; the tank designation and location appears on COE record drawings dated November 1943 (COE 1943, 09-0051). The effluent line from Septic Tank then proceeded northwest in 6-in. VCP to an outfall in the canyon. Both the septic tank and the outfall are outside of OU 1078 and will not be considered further in this work plan.

The sanitary waste line managed liquid sanitary waste. It is doubtful that the line received radioactive or hazardous chemical wastes from Building P; conflicting reports exist as to whether hazardous chemicals were used in P Building. The line, or portions of it, may still exist under the fill in the vicinity of Ashley Pond.

AP Building was used for offices until it was removed in 1965. No radioactive materials are believed to have been managed in the building.

The P-Prime Building, completed in July 1945, was used for supply and property offices; documents indicate that no radioactive materials were managed in the building (Ahlquist et al. 1977, 0016; LANL undated,0402).

A second sanitary waste line [SWMU 1-001(w)] also served the AP Building. The outfall for the larger sanitary waste system is discussed in the Eastern Sanitary SWMU aggregate description (Section 6.14). No information is available regarding the removal of either the northern or eastern waste systems. It should be noted that it is unclear whether AP and P-Prime Buildings' waste line [1-001(w)] discharged to Septic Tank in the northern sector or Septic Tank in the eastern sector (COE 1943, 0051; LASL 1947, 09-0010; LASL 1958, 09-0048). Both of these septic tanks are out of OU 1078.

Sanitary waste line 1-001(w) managed liquid sanitary wastes only and is unlikely to have received radioactive or hazardous materials. This sanitary waste line may still exist as no documentation indicates it has been removed. No sampling for radioactive or hazardous chemical constituents is believed to have been conducted in the area of this sanitary waste line.

6.15.3 Summary of Existing Data

A list of SWMUs and known or suspected contaminants appears in Table 6.15-1. The three sanitary waste systems, which compose the Northern Sanitary Waste SWMU aggregate, reportedly served only office buildings in which no radioactive chemicals were managed although it is unknown if any was discharged to sanitary waste lines . However, one report indicated that toluene was used in P Building (H-Division 1954, 0758). It is unknown whether activities in P Building involved any other hazardous materials.

6.16 Western Sanitary Waste SWMU Aggregate N

•Sanitary Waste Line	SWMU 1-001 (s)
•Sanitary Waste Line	*SWMU 1-001 (u)

NOTE: These sub-SWMU numbers are as identified in the November 1990 SWMU Report.

*Also nominated for NFA.

TABLE 6.15-1

Northern Sanitary Sewer
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(q)	None	Ahlquist et al. 1977, 0016
1-001(v)	None	Ahlquist et al. 1977, 0016
1-001(w)	None	Ahlquist et al. 1977, 0016

6.16.1 Physical Description of the Site

The Western Sanitary Waste SWMU aggregate was located south of Trinity Drive between areas currently occupied by the Los Alamos Inn to the east and Timber Ridge condominiums to the west (Foldout Map C). All former TA-1 buildings served by these two lines have been removed, and the area is currently occupied by various retail stores, office buildings, and residences. This SWMU aggregate contains only a mesa-top component.

The aggregate is composed of the area formerly occupied by ten buildings: A, B, Boiler House 2, C, D, G, J-2, M, V, and Sigma.

6.16.2 Historical Use of the Site

A Building (TA-1-1) included a basement and was used for administrative offices. Records indicate that no radioactive materials were used or stored in A Building.

B Building (TA-1-2) was used for administrative offices but contained electronic and metallurgical laboratories in the basement. Small amounts of ^{232}Th, ^{238}U and, ^{235}U foils were stored in a concrete vault in B Building (Ahlquist et al. 1977, 0016).

The original C Building (TA-1-5) was destroyed by fire before May 1945 and then rebuilt. A uranium machine shop occupied the southeast section of the building, and other machining operations (such as graphite machining) were conducted in the remainder of the structure. Before its removal in December 1964, C Building was found free of radioactive contamination except for its concrete building pad. The contaminated concrete pad was removed to an MDA.

Buildings D, M, and Boiler House 2 are discussed in the Hillside 137 SWMU aggregate description (Section 6.9).

G Building was constructed in August 1943. The Sigma Pile, a small graphite pile constructed of graphite and uranium, was located in G Building. The concrete floor of G Building became slightly contaminated with radioactivity (Ahlquist et al. 1977, 0016). The building structure was found to be uncontaminated and was removed in June 1959. The drain lines and concrete foundation were taken to an unspecified MDA.

J-2 Building, completed in December 1949, was used for radiochemistry work. This building is discussed in Section 6.6.2. J-2 and was connected to SWMU 1-001(s) through a sanitary waste service line designated SWMU 1-001(u).

V Building is discussed in the Surface Disposal Site SE of Los Alamos Inn SWMU aggregate (Section 6.10).

Sigma Building was completed in September 1944 and is discussed in Section 6.3.2.

The two SWMUs of this aggregate are sanitary waste lines 1-001(s) and 1-001(u). SWMU 1-001(u) is associated with only one structure, the J-2 Building. SWMU 1-001(s) served A, B, Boiler House 2, C, D, G, M, V, and Sigma Buildings, all located in central TA-1 south of Trinity Drive. The nine buildings served by SWMU1-001(s) housed most of the processing and production operations in the early days of the Laboratory; therefore, it is possible that this sanitary waste line was contaminated by radionuclides and hazardous chemicals.

Memos from Tribby and Drager in 1946 indicate that this entire sanitary waste line was radioactively contaminated (Tribby 1946, 09-0030; Drager 1946, 09-0038). However, 1-001u would not have been included in that assessment since J-2 Building was not built until 1949. The line may still exist as no documentation indicates it has been removed. SWMU 1-001u is thought to be uncontaminated because trenching done in that area indicated no residual radioactivity.

SWMU 1-001(s) exited from D Building, ran parallel to most of the main industrial waste line (SWMU 1-002), and passed near the southwest corner of C Building. It then proceeded west along Finch Street and turned north between Buildings T-221 and T-225. This sanitary waste line connected to Septic Tank 5 (COE 1943, 09-0051; identified as Septic Tank 6 in Kingsley 1947, 0680), located near Acid Canyon where the tank discharged. The septic tank and outfall are within TA-0 and will be addressed in the RFI Work Plan for Operable Unit 1071.

The sanitary waste line that served J-2 Building (TA-1-115) [SWMU 1-001(u)] led north of the building and combined with SWMU 1-001(s) before discharging through the septic tank and outfall to Acid Canyon, as stated above. The sanitary waste line from J-2 Building was not removed because the junction at Finch Street was not considered contaminated (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016).

6.16.3 Summary of Existing Data

The Western Sanitary Waste system managed liquid sanitary waste. However, it is possible that this line may have been contaminated with ^{238}U, ^{235}U, ^{239}Pu, radioisotopes and beryllium, as well as hazardous chemicals and solvents. A summary of suspected contaminants for these two sanitary waste lines are found in Table 6.16-1.

TABLE 6.16-1

Western Sanitary Sewer
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-001(s)	^{239}Pu, ^{232}Th, ^{137}Cs, ^{235}U, ^{238}U, Beryllium, Uranium, Tritium, Metals	Ahlquist et al. 1977, 0016 Christensen and Maraman 1969, 0037
1-001(u)	None	Ahlquist et al. 1977, 0016

6.17 Subsurface Contamination at U and W Buildings, SWMU Aggregate 0

•Suspected subsurface soil contamination at U and W Buildings—SWMU 1-007k.

6.17.1 Physical Description of the Site

This aggregate is composed of only one SWMU (1-007k) at the former site of U and W Buildings and is located entirely on the mesa top (Foldout Map C).

6.17.2 Historical Use of the Site

The Van de Graaff generator, located in W Building, was a primary research instrument used for studying atomic nuclei, including ^{239}Pu, ^{235}U, ^{238}U, ^{210}Po, and ^{3}H. U and W Buildings contained physics laboratories and Z Building housed the two Cockcroft-Walton accelerators and was also used for nuclear physics research on the same radionuclides mentioned above (Hawkins 1983, 0663). A small fire involving tritiated uranium hydride occurred between U and W Buildings.

6.17.3 Summary of Existing Data

The area where U and W Buildings were formerly located has largely been paved or built over (the Los Alamos Inn and associated parking lots). For this reason, no samples were taken in this area during the 1975–1976 Ahlquist study. Thus, no evidence exists of any contamination in this subsurface SWMU aggregate. The boundaries of this SWMU simply follow the outline of the W, U, and Z Buildings because of the lack of better data to define potential contamination. Radionuclides including ^{239}Pu, ^{235}U, ^{238}U, and ^{3}H are suspected in this area of possible subsurface soil contamination.

6.18 Soil Contamination Under Trinity Drive, SWMU Aggregate P

•TA-1-46 Storm Drain and Outfall	*SWMU 1-006(s)
•Suspected Subsurface Soil Contamination	SWMU 1-007(l)

Note: Sub-SWMU numbers for 1-006 (s) and 1-007 (l) were derived from the February 1991 IT TA-1 work plan maps and are not identified as such in the November 1990 SWMU Report.

*Also nominated for NFA.

6.18.1 Physical Description of the Site

The Trinity Drive SWMU aggregate is located beneath Trinity Drive and is bounded by 24th Street to the east and the road into the Timber Ridge development to the west. All former TA-1 buildings in this area have been removed and the area adjacent to Trinity Drive is now currently occupied by Los Alamos

County offices, commercial establishments, and two new office buildings at Oppenheimer and Trinity. The SWMU aggregate has only a mesa-top component (Foldout Map C).

This aggregate includes a former storm drain and outfall from P Building onto Trinity Drive, SWMU 1-006(s) and the Suspected Subsurface Soil Contamination under Trinity Drive, SWMU 1-007(l).

6.18.2 Historical Use of the Site

Records indicate that P Building was used for personnel offices and that no radioactive or hazardous materials other than toluene were used in the building (Ahlquist et al. 1977, 0016). In February 1959, the east portion of P Building was removed and the western portion was subsequently used for several years as the Los Alamos County Courthouse (Ahlquist et al. 1977, 0016).

An area on the northwest side of P Building (TA-1-46) was drained by a storm drain and outfall that paralleled Trinity Drive. The open storm drain originated near the southwest corner of the building and extended northwest along Trinity Drive for approximately 150 ft. There is no reason to believe that any radioactive or hazardous constituent would have made its way into this storm drain from within the P Building.

The fill material under Trinity Drive, designated as SWMU 1-007(l), is suspected to contain construction debris and other contaminated fill from the D Building area. Approximately 1308 to 2760 yds^3 of fill and other debris are reported to have been transported from the former location of the D Building to be used as fill during a 1966 Trinity Drive widening and repaving project (Ahlquist et al. 1977, 0016). The Trinity Drive site is currently owned by Los Alamos County (Weston 1989, 09-0036). Very little sampling was performed in this area during the 1974–1976 survey (DOE 1988, 09-0006).

The soil and construction debris reportedly used as fill under Trinity Drive may be contaminated with uranium, fission products, and plutonium. The fill contained soil, concrete debris, pipe insulation, and other potentially contaminated debris from areas around D Building (Ahlquist et. al. 1977, 0016). Fill also was brought in from off-laboratory sources. The Trinity Drive area is entirely paved precluding any potential radioactivity in the fill from being manifested at the surface.

6.18.3 Summary of Existing Data

The Trinity Drive suspected subsurface soil contamination may contain hazardous and radioactive constituents from the vicinity of the former D Building (Table 6.18-1). The Hillside 137 SWMU aggregate details D Building operations and also describes some of the hazardous contaminants that may be present.

On the basis of experience gained during the survey and the fact that fill was brought in from other areas, any remaining pockets of radioactively contaminated soil would have been greatly diluted by the spreading of the backfill for road construction (Ahlquist et al. 1977, 0016).

Based on the discussion above, it may be postulated that the SWMU of primary concern in this aggregate is the suspected subsurface soil contamination reported to exist beneath Trinity Drive and not the storm drain related to P Building.

TABLE 6.18-1

Soil Contamination Under Trinity Drive
Suspected Hazardous Contaminants

SWMU No.	Suspected Contaminants	Reference
1-006(s)	None	Ahlquist et al. 1977, 0016
1-007(l)	Uranium, Plutonium, Metals	Ahlquist et al. 1977, 0016

REFERENCES

Ahlquist, A. J., October 14, 1975. "TA-1 Operational Report September 30 to October 12, 1975," Los Alamos Scientific Laboratory memorandum H8-75-383 from A. J. Ahlquist to H.S. Jordan, Los Alamos, New Mexico. (Ahlquist 1975, 09-0024)

Ahlquist, A. J., October 28, 1975. "TA-1 Operational Report, October 13-26, 1975," Los Alamos Scientific Laboratory memorandum H8-75-421 from A. John Ahlquist to H.S. Jordan, Los Alamos, New Mexico. (Ahlquist 1975, 09-0017)

Ahlquist, A. J., June 21, 1977. "Pipes East of J-2 at TA-1," Los Alamos Scientific Laboratory memorandum H-8-77-414 from A. John Ahlquist to distribution, Los Alamos, New Mexico. (Ahlquist 1977, 09-0041)

Ahlquist, A. J. and T.L. Bayhurst, September 30, 1977. "Removed Structures, TA-1," Los Alamos Scientific Laboratory memorandum H8-77-740 from A. J. Ahlquist and T.L. Bayhurst to J.B. Montoya, Los Alamos, New Mexico. (Ahlquist 1977, 09-0022)

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory Report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

Barthell, S. G., February 15, 1968. "Abandonment of TA-1," Los Alamos Scientific Laboratory memorandum from S.G. Barthell through S.E. Russo to Lab Job 1927-1 and 1927-A1, Los Alamos, New Mexico. (Barthell 1968, 09-0040)

Blackwell, C. D., October 17, 1956. "Results of Radioactive Contamination Survey in TA-1," Los Alamos Scientific Laboratory memorandum from C. D. Blackwell to Dean D. Meyer, Los Alamos, New Mexico. (Blackwell 1956, 09-0039)

Blackwell, C. D., January 30, 1957. "Results of Radioactive Contamination in TA-1," Los Alamos Scientific Laboratory memorandum from C. D. Blackwell to S.E. Russo, Los Alamos, New Mexico. (Blackwell 1957, 09-0018)

Blackwell, C. D., October 19, 1971. "Management of Contaminated Real Property," Los Alamos Scientific Laboratory memorandum from H. J. Blackwell to H.C. Donnelly, Los Alamos, New Mexico. (Blackwell 1971, 09-0016)

Bone, M., July 1988. "Miscellaneous Small Projects & ER Program," Laboratory notebook Control #24, Los Alamos, New Mexico. (Bone 1988, 09-0047)

Buckland, C., and C. Blackwell, October 24, 1946. "Contaminated Room Y-1 of Building Group B-14 in Y-Building," Los Alamos Scientific Laboratory memorandum C. Buckland and C. Blackwell to L. Hempelmann, Los Alamos, New Mexico. (Buckland 1946, 09-0042)

Buckland, C. W., January 24, 1955. "Contaminated Accident in ML Building, TA-1-42 on January 13, 1955" Los Alamos Scientific Laboratory memorandum (LA55000223) from C. W. Buckland to L. G. Chelius, Los Alamos, New Mexico. (Buckland 1955, 09-0020)

Buckland, C., December 6, 1957. "Final Health Clearance of Various Buildings in TA-1 Located South of Trinity Drive," Los Alamos Scientific Laboratory memorandum from C. Buckland to S.E. Russo, Los Alamos, New Mexico. (Buckland 1957, 09-0004)

Buckland, C., September 15, 1959. "Final Radioactive Contamination Health Clearance of the Eastern Sector of TA-1 South of Trinity Drive and the J-2 Area," Los Alamos Scientific Laboratory memorandum from C. Buckland to Joe Hill, Los Alamos, New Mexico. (Buckland 1959, 09-0001)

Buckland, C., April 21, 1964. "Final Radioactive Contamination Survey of Certain Structures in TA-1," Los Alamos Scientific Laboratory memorandum from C. Buckland to S.E. Russo, Los Alamos, New Mexico. (Buckland 1964, 09-0021)

Buckland, C., May 11, 1964. "Final Radioactive Contamination Survey Clearance on Certain Structures in TA-1," Los Alamos Scientific Laboratory memorandum from C. Buckland to S.E. Russo through Dean D. Meyer, Los Alamos, New Mexico. (Buckland 1964, 09-0023)

Buckland, C., August 12, 1964. "Health Clearance of TA-1-104," Los Alamos Scientific Laboratory memorandum from C. Buckland through D. Meyer to S.E. Russo, Los Alamos, New Mexico. (Buckland 1964, 09-0027)

Buckland, C., March 21, 1978. "I. Recollection of 1945 Contaminated Dump Fire, II. Additional Waste Disposal Areas," Los Alamos Scientific Laboratory memorandum from C. Buckland to M. A. Rogers, Los Alamos, New Mexico. (Buckland 1978, 09-0029)

Christensen, E. L., and W. J. Maraman, April 1969. "Plutonium Processing at the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory report LA-3542, Los Alamos, New Mexico. (Christensen and Maraman 1969, 0037)

COE (Corps of Engineers), October 1943, "Los Alamos Project, Los Alamos, New Mexico, Record Drawing Area "L" US Engineer Office, Albuquerque, New Mexico." (COE 1943, 09-0051)

Den-Baars, P. S., October 31, 1991, "TA-1 Risk Assessment," International Technology Corporation letter from P. S. Den-Baars to A. Dorries, Project No. 301215.08.03.08, Los Alamos, New Mexico. (Den-Baars 1991, 09-0046)

DOE (US Department of Energy), October 1987. "Phase I: Installation Assessment, Los Alamos National Laboratory," Volumes 1 and 2, (draft), Comprehensive Environmental Assessment and Response Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1987, 0264)

DOE (US Department of Energy), September 1988. "Remedial Investigation Plan: Task 11, Technical Area 1," Environmental Restoration Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1988, 09-0006)

Drager, H. W., June 11, 1946. "Preliminary Survey of Sewer System," Los Alamos Scientific Laboratory memorandum from H. W. Drager to E.R. Jette, Los Alamos, New Mexico. (Drager 1946, 09-0038)

Ferenbaugh, R. W., T. E. Buhl, A. K. Stoker, and W. R. Hansen, August 1982. "Environmental Analysis of Acid/Middle Pueblo Canyon, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-9409, Los Alamos, New Mexico. (Ferenbaugh et al. 1982, 0668)

H-Division, November 1951. "H-Division Progress Report October 20–November 20, 1951," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1951, 0755)

H-Division, February 1952. "H-Division Progress Report January 20–February 20, 1952" Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1952, 0756)

H-Division, March 1952. "H-Division Progress Report March 20–April 20, 1952," Los Alamos Scientific Laboratory, New Mexico. (H-Division 1952, 0757)

H-Division, November 1952. "H-Division Progress Report October 20–November 20, 1952," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1952, 0464)

H-Division, January 1953. "H-Division Progress Report December 20–January 20, 1953," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1953, 0763)

H-Division, March 1953. "H-Division Progress Report February 20–March 20, 1953," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1953, 0764)

H-Division, November 1954. "H-Division Progress Report October 20–November 20, 1954," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1954, 0758)

H-Division, December 1954. "Health Division Progress Report November 20–December 20, 1954," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1954, 0759)

H-Division, January 1955. "H-Division Progress Report December 20–January 20, 1955," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1955, 0760)

H-Division, May 1955. "H-Division Progress Report April 20–Mary 20, 1955," Los Alamos Scientific Laboratory , Los Alamos, New Mexico. (H-Division 1955, 0482)

H-Division, June 1955. "H-Division Progress Report May 2–June 20, 1955," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1955, 0761)

H-Division, December 1955. "H-Division Progress Report November 20–December 20, 1955," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1955, 0762)

H-Division, April 1956. "H-Division Progress Report March 20-April 20, 1956," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1956, 0470)

H-Division, September 1957. "H-Division Progress Report August 20-September 20, 1957," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1957, 0489)

H-Division, September 1960. "H-Division Progress Report August 20-September 20, 1960," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1960, 0678)

Hawkins, D., 1983. Project Y: The Los Alamos Story, Part 1, Toward Trinity, Tomash Publishers, Los Angeles California. (Hawkins 1983, 0663)

Hill, J.F., September 15, 1964. "Disposal of Debris from TA-1 Demolition," Los Alamos Scientific Laboratory memorandum from J. F. Hill to All Concerned , Los Alamos, New Mexico. (Hill 1964, 09-0028)

Hinch, W. H., October 15, 1945. "Report on the Contamination of Creek Water," Los Alamos Scientific Laboratory memorandum from W. H. Hinch to L. Hempelmann, Los Alamos, New Mexico. (Hinch 1945, 09-0015)

International Technology Corporation, February 1991, "Solid Waste Managemenrt Unit Descriptions for the TA-1 Work Plan," Project No. 3012.15.08.01, Los Alamos, New Mexico. (Interntional Technology Corporation 1991, 09-0003)

Jette, E. R., December 15, 1946. "Tentative Health Standards for the Sigma Building," Los Alamos Scientific Laboratory memorandum from E. R. Jette to L. Hempelmann, Los Alamos, New Mexico. (Jette 1946, 09-0044)

Kennedy, W. R., January 16, 1948. "Soil Contamination," Los Alamos Scientific Laboratory memorandum from W. R. Kennedy to J. F. Tribby, Los Alamos, New Mexico. (Kennedy 1948, 09-0035)

Kennedy, W.R., January 26, 1987. "Summary of Environmental Data, 1943-1969," Los Alamos National Laboratory memorandum from W. R. Kennedy to R. W. Voke, Los Alamos, New Mexico. (Kennedy 1987, 09-0007)

Kershaw, S., August 3, 1945. "Unknown," Los Alamos Scientific Laboratory memorandum from S. Kershaw to Dr. J.R. Oppenheimer and Colonel G.R. Tyler, Los Alamos, New Mexico. (Kershaw 1945, 09-0043)

Kingsley, W.L., June 19, 1946. "Overflowed Sewer," Personal communication from W.L. Kingsley to J.F. Tribby, Los Alamos, New Mexico. (Kingsley 1946, 09-0005)

Kingsley, W. H., February 20, 1947. "Survey of Los Alamos and Pueblo Canyon for Radioactive Contamination and Radioassay Tests Run on Sewer-Water Samples and Water and Soil Samples Taken from Los Alamos and Pueblo Canyons," Los Alamos Scientific Laboratory Report LAMS-516, Los Alamos, New Mexico. (Kingsley 1947, 0680)

LANL (Los Alamos National Laboratory), April 1987. "Verification Sampling Plan For the Former Main Technical Area (TA-1). Los Alamos National Laboratory," Environmental Surveillance Group (HSE-8) and Health and Environmental Chemistry Group (HSE-9) report, Los Alamos, New Mexico. (LANL 1987, 09-0013)

LANL (Los Alamos National Laboratory), May 1987. "Analytical Results of Verification Sampling Former Main Technical Area (TA-1) Los Alamos National Laboratory," Environmental Surveillance Group (HSE-8) and Health and Environmental Chemistry Group (HSE-9) report, Los Alamos, New Mexico. (LANL 1987, 09-0045)

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), no date. "Database of Buildings and Structures, ENG-7." Los Alamos, New Mexico. (LANL undated,0402)

LASL (Los Alamos Scientific Laboratory), April 1947. "Sewer Lines Tech. Area 1," Drawing ENG-R27, Los Alamos, New Mexico, (LASL 1947, 09-0010)

LASL (Los Alamos Scientific Laboratory), November 21, 1958. "Main Technical Area Underground Utilities," Engineering Drawing ENG-R85, Los Alamos, New Mexico. (LASL 1958, 09-0048)

LASL (Los Alamos Scientific Laboratory), October 8, 1964. "Transfer of TA-1 Structures: TA-1-96, 98, 103, 104, and 131." Los Alamos Scientific Laboratory memorandum from Engineering Department to the Zia company, Los Alamos, New Mexico. (LASL 1964, 09-0034)

LASL (Los Alamos Scientific Laboratory), September 3,1975. "Summary of Records Search and Discussions With LASL Pioneers Concerning Building and Drain Lines in TA-1 Where Radioactive Materials Were Processed," Los Alamos, New Mexico. (LASL 1975, 09-0050)

LASL (Los Alamos Scientific Laboratory), January 1976. "Status and Plans Report for Former Technical Area One at Los Alamos Scientific Laboratory," Health Research Division, Los Alamos, New Mexico. (LASL 1976, 09-0031)

Meyer, D. D., June 4, 1964. "TA-1 Miscellaneous Structures," Los Alamos Scientific Laboratory memorandum from D. D. Meyer through T. L. Shipman to S.E. Russo, Los Alamos, New Mexico. (Meyer 1964, 09-0026)

Mitchell, D. P., October 25, 1944. "Special Instruction for Handling "X" Metal Scrap," Los Alamos Scientific Laboratory memorandum to all concerned, Los Alamos, New Mexico. (Mitchell 1944, 09-0037)

Montoya, T., October 11, 1965. "Removal of Radioactive Contaminated Concrete and Drain Pipe from TA-1-104," Los Alamos Scientific Laboratory memorandum from T. Montoya through D. Meyer to C. Buckland, Los Alamos, New Mexico. (Montoya 1965, 09-0025)

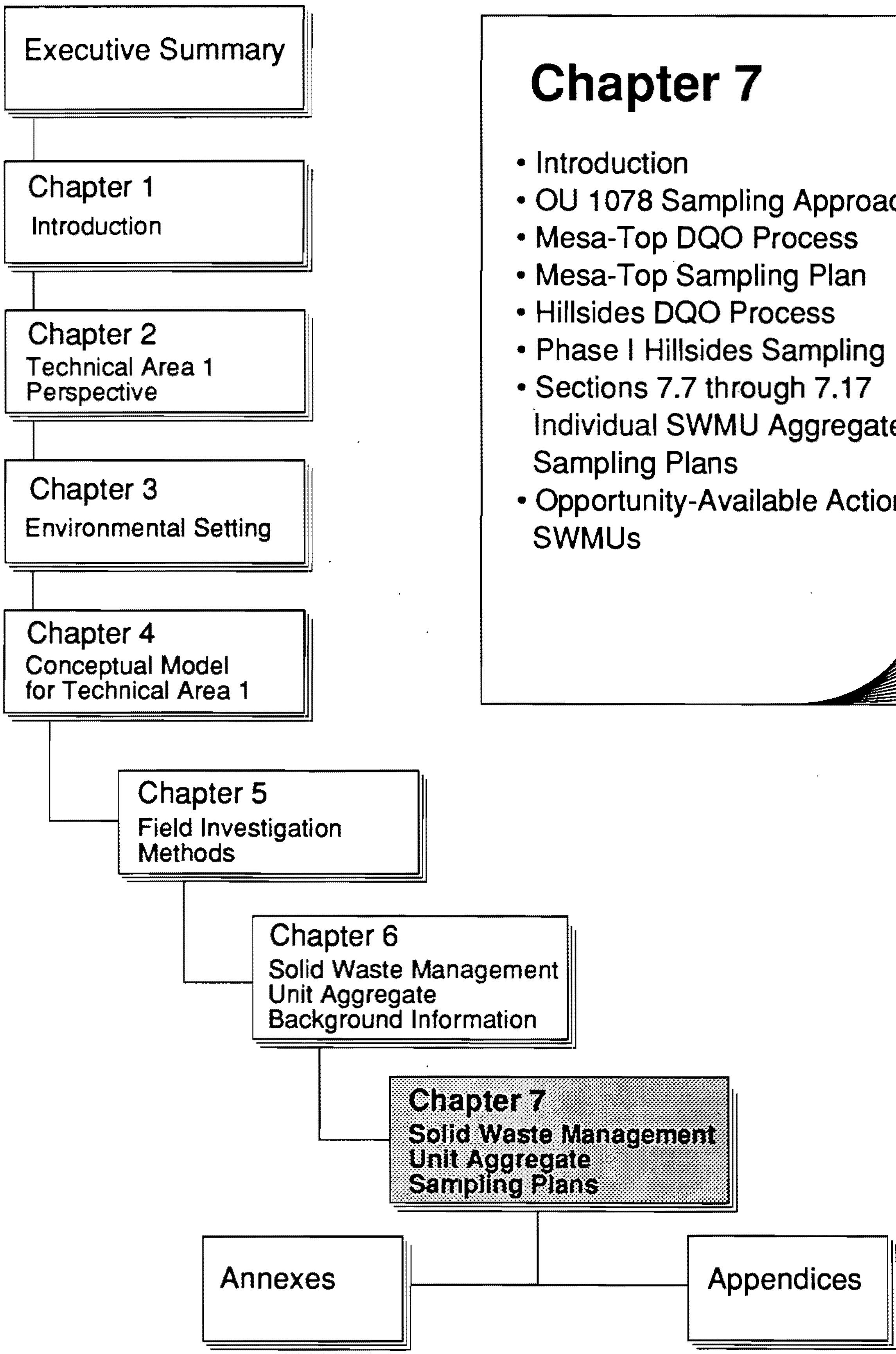
Pederson, R., September 16, 1957. "Demolition of H Building TA-1," Los Alamos Scientific Laboratory memorandum from R. Pederson to Ted Russo, Los Alamos, New Mexico. (Pederson 1957, 09-0019)

Roeder, J.R. April 30, 1976. "TA-1 Area, LASL," Los Alamos Scientific Laboratory memorandum from J. R. Roeder to file, Los Alamos, New Mexico. (Roeder 1976, 09-0032)

Tribby, J. F., July 25, 1946. "Result of Preliminary Survey of Contamination in the Drain Exits of All Sanitary and Acid Sewer Lines," Los Alamos Scientific Laboratory memorandum from J. F. Tribby to E.R. Jette, Los Alamos, New Mexico. (Tribby 1946, 09-0030)

Umbarger, J., April 22, 1976. "Results of Uranium Chunk Assay by H-1," Los Alamos Scientific Laboratory memorandum from J. Umbarger to R. Smale, Los Alamos, New Mexico. (Umbarger 1976, 09-0033)

Weston, R. F. Inc., September 26, 1989. "Site Database Task 11 TA-1." R. F. Weston Incorporated report W.R.N. 89-0049-LA-9, Albuquerque, New Mexico. (Weston 1989, 09-0036)



Chapter 7

- Introduction
- OU 1078 Sampling Approach
- Mesa-Top DQO Process
- Mesa-Top Sampling Plan
- Hillsides DQO Process
- Phase I Hillsides Sampling Plan
- Sections 7.7 through 7.17 Individual SWMU Aggregate Sampling Plans
- Opportunity-Available Action SWMUs

7.0 SOLID WASTE MANAGEMENT UNIT AGGREGATE SAMPLING PLANS

7.1 Introduction

Operable Unit (OU) 1078 has 68 individual solid waste management units (SWMUs) within two topographical areas, a mesa top and the canyon hillsides below. The mesa top is the region located on East Mesa; it includes the Ashley Pond area and extends south from Trinity Drive to the edge of Los Alamos Canyon. The hillsides refer to the Los Alamos canyon walls within the bounds of OU 1078. These two topographical regions have distinct past use, present use, and decontamination characteristics. Most of the operations in Technical Area (TA) 1 took place on the mesa top; past remediation efforts focused on this area, and heavy development has occurred there. The hillsides received outfall discharges during TA-1's operational years, surface water run-off during precipitation events, and debris deposition from mesa-top remediation efforts. No remediation efforts have occurred on the hillsides.

SWMUs located within the same topographical region are similar. Consequently, a general mesa-top sampling plan (Section 7.4) and a general hillside sampling plan (Section 7.6) have been developed and are described in this chapter.

OU 1078's 68 SWMUs have been grouped into 16 SWMU aggregates (Chapter 6). SWMU aggregation was based on common receptors and on common locations where contaminants would have been deposited initially or by run-off events. The soil sampling plans developed in this chapter categorize individual SWMUs according to their mesa-top or hillside locations (Table 7.1-1). Most SWMUs have been included in the mesa-top or hillside sampling plan. However, Trinity Drive, Ashley Pond, the industrial waste line, the three sanitary waste lines, and the suspected subsurface soil contamination at U and W Buildings aggregates have distinct sampling plans that are developed separately in Sections 7.16–7.18.

The Phase I OU 1078 sampling approach is detailed in Section 7.2. The general mesa-top and hillside sampling plans are developed in Sections 7.3 through 7.6. The remainder of the chapter presents SWMU-aggregate-specific sampling plans.

7.2 OU 1078 Sampling Approach

The data quality objectives (DQOs) process was applied to the OU 1078 work plan and provided the infrastructure on which individual SWMU aggregate Phase I sampling plans were built.

TABLE 7.1-1

GENERAL SAMPLING PLAN USED FOR EACH SWMU

SWMU Aggregate	General Sampling Plan	SWMU
Sigma Building	Mesa Top	1-006m, 1-006t, 1-007d, 1-007e, 1-007j, 1-007m
Bailey Bridge	Mesa Top	1-001e, 1-001n, 1-001o, 1-001p, 1-004a, 1-006o, 1-006r, 1-007f, 1-007g, 1-007j, 1-007o
	Hillside	1-001a, 1-003a
Hillside 140	Mesa Top	1-006p, 1-007i, 1-007j, 1-007p
	Hillside	1-001b, 1-001f, 1-003c
J-2/TU Area	Mesa Top	1-001i, 1-001k, 1-005, 1-006f, 1-006k, 1-006l, 1-007h, 1-007j, 1-007n
Cooling Tower 80	Mesa Top	1-006a 1-006g
	Hillside	1-001g, 1-003b
Hillside 138	Mesa Top	1-006h
	Hillside	1-001d
Hillside 137	Mesa Top	1-006b, 1-006c, 1-006d, 1-006n, 1-007a, 1-007b, 1-007c, 1-007j
	Hillside	1-001c
Surface Disposal Site SE of Los Alamos Inn	Mesa Top	1-001j, 1-004, 1-006i, 1-006j, 1-006q
	Hillside	1-001h, 1-001l, 1-003e
Can Dump Site	Hillside	1-001m, 1-003d
Ashley Pond	Mesa Top (Ashley Pond)	1-006e
Industrial Waste Line	Mesa Top (Industrial Waste Line)	1-002
Eastern Sanitary Waste Line	Mesa Top (Opportunity-Available Sampling)	1-001r, 1-001t
Northern Sanitary Waste Line	Mesa Top (Opportunity-Available Sampling)	1-001q, 1-001v, 1-001w
Western Sanitary Waste Line	Mesa Top (Opportunity-Available Sampling)	1-001s, 1-001u
Surface Contamination at U and W Buildings	Mesa Top (Opportunity-Available Sampling)	1-007k
Soil Contamination Under Trinity Drive	Mesa Top (Opportunity-Available Sampling)	1-006s,1-007l

7.2.1 Social, Political, and Economic Aspects and Decisions

This Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) is mandated under the Hazardous and Solid Waste Amendments Module of the Laboratory RCRA Part B permit (EPA 1990, 0306). Consequently, no cost/benefit analysis has been considered to ascertain whether OU 1078 should undergo an RFI. Social, political, and economic impacts on residents currently occupying OU 1078 and the townsite of Los Alamos are not addressed in this RFI work plan. Primary purposes of this study are to determine if residents and workers occupying the townsite are at risk from past Laboratory practices at TA-1 and to remove any unacceptable risks.

OU 1078 contains private and public land on a mesa top that is contiguous with Department of Energy (DOE) property on its hillsides. As discussed in Chapter 4, it is assumed that the mesa-top areas will be used for residences and that the hillside property will be released to the public for recreational use. Chapter 4 states that the 1975–1976 decontamination efforts have successfully reduced the present-day radiological dose to residents on the mesa top; the hillside areas have not yet been investigated for possible dose. The remediation responses that have been considered for OU 1078 SWMUs are (1) no further action (NFA); (2) release for public use; (3) further investigation and corrective measures (if necessary) to achieve acceptable health-based risk levels before release; and (4) surveillance of future construction activities that disturb or intersect those subsurface SWMUs that pose no risk to present-day residents.

This RFI may have a considerable effect on the present Los Alamos community. Initial reaction of townsite residents to the RFI largely has been concern about local economic impacts (e.g., property values). The most important consideration for this RFI is a timely and accurate assessment of any health risk caused by past TA-1 activity. A secondary consideration is to minimize the impact of the sampling plan on the Los Alamos community.

7.2.2 Assumptions

Methodology laid out in the DQO process has been followed in the development of OU 1078 sampling plans. During this process, the following assumptions based on logical inference, historical data, and expert opinion have been made.

1. There is no current human health risk from contaminants in soil and sediment located under buildings, pavement, or clean fill (except risk resulting from plant uptake and human ingestion) because no viable pathway for human ingestion or direct contact of contaminants exists under these conditions.

2. The mesa-top ground surface at OU 1078 has been homogenized because of

anthropogenic activities such as decontamination, construction, and landscaping and physical forces, such as wind and rain.

3. Fill brought in from TA-53 and TA-55 during the 1975-1976 decontamination effort was free of contaminants. Fill brought in during later commercial development was contaminant free.

4. Spills, discharges, and leaks of metals can be associated with radioactive contaminants. The same disposal systems were used for both hazardous and radioactive chemicals; therefore, discharges from these systems most likely contained both contaminant types.

5. Any metals codeposited with radioactive material during past leaks, spills, or discharges would have been removed in the soil excavated and disposed during the 1975–1976 decontamination effort.

6. Any nonradioactive metals codeposited with radioactive metal compounds behave in the same manner and have the same mobility as the radioactive metals (Appendix A).

7. The majority of organic compounds discharged 25–50 years ago during TA-1's operational period would have been almost totally reduced by physical and biological (bacterial action) forces (Appendix A).

8. Using improved techniques and instrumentation, gross alpha and beta values can be correlated with analytical values, even for low radioactive contamination levels. A dose can be estimated based on many gross alpha and beta values and fewer analytical values.

9. Contaminants deposited at or near the rim of the canyon would flow toward the canyon floor. In the 25 years since operations at TA-1 ceased, physical forces would have transported contaminants deposited on hillsides into the main drainages and toward the floor of Los Alamos Canyon. Also, contaminants may have moved to the floor of the canyon by traveling outside the main drainages by a mechanism known as gravity creep.

10. Former outfalls into the canyon can be located specifically. After entering a drainage channel, outfall discharges followed main channels down the hillside (Ahlquist et al.1977, 0016; and LASL 1958, 09-0048).

To improve techniques and instrumentation (Assumption 8), a new gas proportional counter for gross alpha and beta activity has been obtained. Pilot studies have been undertaken to improve gross alpha and beta readings. It is hoped that better correlations between low-level (less than 20 pCi/g) gross alpha and beta activity and analytical laboratory values can be realized so that more gross alpha and beta data can be used in lieu of analytical data.

Several of these assumptions have already been addressed in Chapter 4. The use of these assumptions will minimize the cost and time required to characterize OU 1078. It is probable that nonradioactive metals and semivolatile organic compounds were codeposited with radioactive metals and are still collocated today. However, the sampling investigation proposed in the OU 1078 work plan is not limited to examining radionuclides but will examine soil for all three types of constituents.

7.2.3 Phase I Sampling Plan Rationale

Because there are abundant historic information and data for TA-1, Phase I sampling should provide data usable in a radiological dose assessment. The primary purposes for sampling at OU 1078 are to determine

- the levels of any residual radiological or chemical contaminants and any localized areas of high concentration (should they exist),
- if a past release poses a threat to human health and the environment,
- if a SWMU or SWMU aggregate can be recommended for NFA, and
- if additional Phase I or Phase II investigation is appropriate.

Because no chemical disposal sites are located at OU 1078 and two extensive cleanup efforts were completed in the 1960s and 1970s, any residual contamination on the mesa top is expected to be at very low levels. Any residual contamination, should it exist, on the hillsides would come from point sources such as debris, former locations of septic tanks and drain line outfalls, or present-day surface water run-off. The identification of potential contamination areas requires a sampling plan based on a knowledge of operational history and an awareness of the physical, chemical, and anthropogenic effects on the area.

Historic data describe SWMU-specific operational processes, potential areas of disposal, and well-documented decontamination efforts. From the historic information, reasonable conclusions can be made as to where any contamination is most likely to be found. Sampling will concentrate in these areas. Expert judgment and radiological screening instruments will be used to determine sample locations. Samples collected at these locations will be called judgmental samples. Expert judgment in determining sampling locations increases the chance of finding contamination (if any exists) and reduces the number of samples required. The use of data from judgmental samples can produce statistically biased parameter estimates, but, in this case, bias should result in conservative estimates of contamination (i.e., estimated levels are higher than actual levels). A simple random sampling plan or a systematic sampling plan will be used in areas where minimal information on potential contamination exists or in areas where contamination has been postulated to be homogeneously distributed.

Available TA-1 historic data primarily focus on radionuclide contaminants. It is probable that contaminants codeposited with radionuclides moved with the radionuclides and are currently located with them (Assumptions 4, 5, 7, and 8). However, the sampling plans are not designed to specifically test these hypotheses. If data imply that the hypotheses are false, a Phase II sampling plan that looks for nonradioactive constituents independent of radioactive constituents will be developed.

Extensive buildings and roads on the mesa top and the steep hillside terrain cause unique logistical problems for sampling at OU 1078. Sampling plans developed in this chapter are designed to minimize disruption of privately owned mesa-top properties and to work within limitations imposed by hillside terrain. If more information is required or unforeseen logistical problems arise, sampling plans may need to be altered.

7.2.4 Data Analysis For Phase I Sampling

The analytical levels required for collected samples are discussed in Section 1.10. Several sites in OU 1078 will be investigated to determine whether a source of contamination is present. This statistical determination will be based on the results provided by analytical laboratory measurements and will require comparison of constituent concentration means with action levels or existing regional background (such as that for uranium). Regional background levels are being developed by the Los Alamos Environmental Restoration (ER) Program's framework studies. The analytical methods used must have detection levels below action levels, background concentrations, and risk guideline concentration levels. A broad compendium of quantitation limits for hazardous constituents is found in Annex II of the installation work plan (IWP) (LANL 1991, 0553).

7.2.5 Data Analysis For Human Health Risk

In this work plan, dose and concentration levels are often designated when risk values may be more appropriate. However, until more is known on how dose is converted to risk for radionuclides or how chemical concentration levels are converted to risk for nonradionuclides, dose and concentration terms will be used in data analyses. Risk will be estimated as an additive combination of individual risks attributed to radionuclides and to other constituents such as organics and metals. Radioactive gross counting and laboratory measurements will be used in radioactive risk analyses.

The final assessment of health risk is based on average risk calculated over an exposure unit. Chapter 4 discusses the following choices of exposure unit size and scenario. Exposure units for the mesa top are 5000 ft^2 (consistent with designation for residential use in Chapter 4). Exposure units on the hillside are

43 560 ft^2, or one acre, (consistent with designation for recreational use in Chapter 4). A rectangular exposure unit of length twice that of width is used because it fits both the shape of an average residential lot and an idealized pattern of activity within a recreational area.

Both gross radioactive counting and analytical data obtained from soil sample analyses will be used to assess degree and extent of radionuclide contamination and to determine the incremental dose in millirems per year. To analyze data for each sample point, an additive dose value will be derived from the radionuclide concentration data for that location. Using the residual radioactive materials (RESRAD) computer code, dose values will be computed based on input parameters and scenarios given in Chapter 4. From these data, spatial surface prediction techniques (e.g., kriging) can be used to estimate a dose surface over a particular site. The dose surface will be contoured to identify any areas with unacceptably high average dose over an exposure unit.

The health risk posed by nonradionuclide constituents will be calculated by comparison with action levels for soil. For each hazardous constituent, a concentration surface will be estimated and contoured using spatial statistical techniques (e.g., kriging).

Once dose or risk (radionuclide constituents) and concentration level (nonradionuclide constituents) surfaces have been contoured over the site, the placement of exposure units will be such that the highest additive risks are included within exposure units. This method identifies exposure units with maximum average risk levels. Exposure units will be allowed to fall anywhere and with any orientation on the area of investigation. For example, contamination on the hillsides is expected to follow drainages or cross outfall areas and contamination on the mesa top may be found along waste lines or in building footprints.

Residential and recreational areas with a common boundary exist where the mesa-top rim borders the hillsides. Size of exposure units is specific to land use, and, consequently, there are two exposure unit sizes at this boundary. Risk calculations account for this by allowing the residential exposure units to extend onto the hillsides at the mesa rim, thus providing a conservative estimate of risk at the boundary.

7.2.6 Uncertainty in Phase I Sampling and Data Analysis

Estimation of risk contains uncertainty. This uncertainty stems from three sources.

- Statistical methodology, sampling plans, and estimation procedure (number of samples and their spatial locations)
- Data quality (sample collection, preparation, and measurement)

- Conversion of radionuclide concentration levels to incremental dose using RESRAD (discussed in Chapter 4)

Uncertainty in risk estimates must be incorporated into remediation decisions. Decisions in the OU 1078 RFI are based on risk plus uncertainty, where uncertainty is twice the estimated standard error of the risk value (approximate 80% to 95% confidence level based on a one-sided Chebyshev's inequality) (Ross 1984, 0725).

The number of samples and their spatial locations factor into uncertainty in the statistical estimation procedure. Spatial variability of the measurements can be used to determine the number and spacing of samples to achieve an acceptable degree of uncertainty. However, little information about variability of constituent concentration levels is known for OU 1078. Historical data are predominantly gross radioactive measurements taken on the mesa top during remediation activities. Pilot sampling for a preliminary measure of spatial variability is not practical because it is likely that most samples will be at or below the detection limits of the instruments, yielding little new information. According to statistical expert judgment, all sampling plans presented in this OU 1078 RFI work plan have the minimum number of samples to give adequate geographic (spatial) coverage for statistical estimation procedures. Work is currently in progress to numerically quantify this.

Gross counting data and laboratory radioactivity measurements will be available for risk analysis (Assumption 7, Section 7.2.2). In some cases, counting data will be combined with laboratory measurements in an effort to reduce variability without directly increasing the number of laboratory analyses. In other cases, gross counting data alone may be used for dose and risk analysis. It is likely that uncertainty in dose or risk calculated from screening measurements will be greater than that calculated from laboratory measurements.

Two problems exist in using gross counting data for the assignment of dose in millirems per year or for risk calculations. First, a gross measurement can be attributed to a combination of constituents. To accurately estimate dose or risk, total counts need to be separated and assigned to individual constituents. Different radionuclide assignments yield different doses. Alternatively, counts could be assigned to the constituent expected to yield maximum dose value results. This is analogous to the technique used in the preliminary dose calculations in Section 4.5.

The second problem involves instrument detection limits. Current detection limits of field laboratory gross alpha or beta instruments are 20 pCi/g (the results of work in process may suggest that this limit be lowered). Dose at the instrument detection limit is not zero. If the 20 pCi/g value were assigned to

^{239}Pu or (^{235}U), the corresponding dose from RESRAD for a residential scenario would be 27.0 or (17.3) mrem/yr.

The third source of uncertainty cannot be controlled by statistical methodology or data quality. RESRAD varies with the input parameters for OU 1078 and with the interaction of various constituents with these parameters.

7.2.7 Phase I Quality Assurance

Quality assurance (QA) samples collected throughout the Phase I sampling process will be used to estimate the uncertainty of data across distinct phases of sample collection handling and analysis. Duplicate samples will be collected from the same sampling location but will be analyzed as any other sample in the laboratory. In order to ensure their anonymity, the identity of duplicate samples will be unknown to the individuals handling and analyzing them. Any variations in analytical results of duplicate samples will reflect the integrity of the entire sampling process from collection through analysis.

For Phase I of the OU 1078 sampling process, each sampling team should collect at least one duplicate or replicate (a split of the collected sample) for every 20 (or fewer) soil samples collected in each field sampling task assigned to that team. For example, if the sampling team tasked with the outfall area of the Bailey Bridge SWMU aggregate collects 16 soil samples for Level III analysis, 1 duplicate sample will be taken to accompany the standard samples. If 21 soil samples are collected, 2 duplicates will accompany the standard samples for Level III analysis. If 100 soil samples are collected for gross alpha and beta activity analysis, 5 duplicates are required for gross alpha and beta analysis. Duplicates may or may not be selected randomly.

Replicate samples may also be required to test uncertainty of sample handling after collection. When possible, the same contract analytical laboratory will be used to perform all analyses. Two replicates of three distinct samples will be submitted to each contract laboratory used. Standard deviation and coefficient of variation will be measured for each constituent analyzed.

7.2.8 Option to Delete From Full Suite Analyses List

The project leader, in consultation with the Environmental Protection Agency (EPA), reserves the right to delete individual analyses from the full suite if early soil samples in the sequential sampling process indicate the absence of a common constituent or family of constituents. For example, the project leader does not expect semivolatile organic compounds on soil to exceed Subpart S action levels (EPA 1990, 0432).

If semivolatile organic compounds are not found on soil at concentrations above Subpart S action levels, a decision may be made to delete semivolatile organic compounds from the full suite during the early stages of sequential sampling.

7.3 Mesa-Top DQO Process

The majority of TA-1 operations occurred on the mesa top. Discharged contaminants from operations were deposited both on the mesa top and on the hillside. This section focuses on the mesa-top SWMUs listed in Table 7.1-1.

7.3.1 Mesa-Top Problem Statement

For mesa-top SWMUs, the primary source of human exposure is assumed to be surface contamination. The soil in most individual mesa-top SWMUs has been excavated and disposed, and the SWMUs are now covered by fill or manmade structures. Therefore, no apparent pathway exists for-human exposure to any subsurface contamination.

It is assumed that minimal contamination is exposed at the surface (Ahlquist et al. 1977, 0016). If contamination exists on the mesa top, it is expected to occur in localized areas at low activity or concentration levels. Historically, Laboratory professionals were cognizant of the dangers of radioactivity and dissemination of contamination after spills, and inadvertent discharges were minimal. There are no mesa-top disposal areas or landfills in OU 1078. Radioactive contamination of a building and associated soil was extensively investigated before disposal or removal to off-site locations during decommissioning in the 1950s and 1960s. During the decontamination effort of the 1970s, as excavated septic tanks, waste lines, and building pads were monitored and removed to disposal areas, surface and subsurface soil and sediments were screened for residual radioactive contamination. Radioactively contaminated soil measuring above 25 pCi/g gross alpha was generally removed (Ahlquist et al.1977, 0016).

A closer look at past TA-1 data should help substantiate the assumption that contamination, should it exist, is at low levels and highly localized. Two sources of historical data (Ahlquist et al. 1977, 0016; LANL 1987, 09-0013) indicate little remaining contamination on the mesa top. Based on these data, Section 4.5 presents a preliminary radioactive dose estimation for various areas of OU 1078. The 1987 DOE data, termed verification sampling, (Figure 7.3-1) principally focused on the Sigma area. Seven surface soil samples were collected at the footprint of the Sigma Building, at the Sigma Building cooling tower, and near several of the 1976 industrial waste line excavations. Several surface samples were taken outside the Sigma area at other cooling tower locations. Additionally, two subsurface borings were done

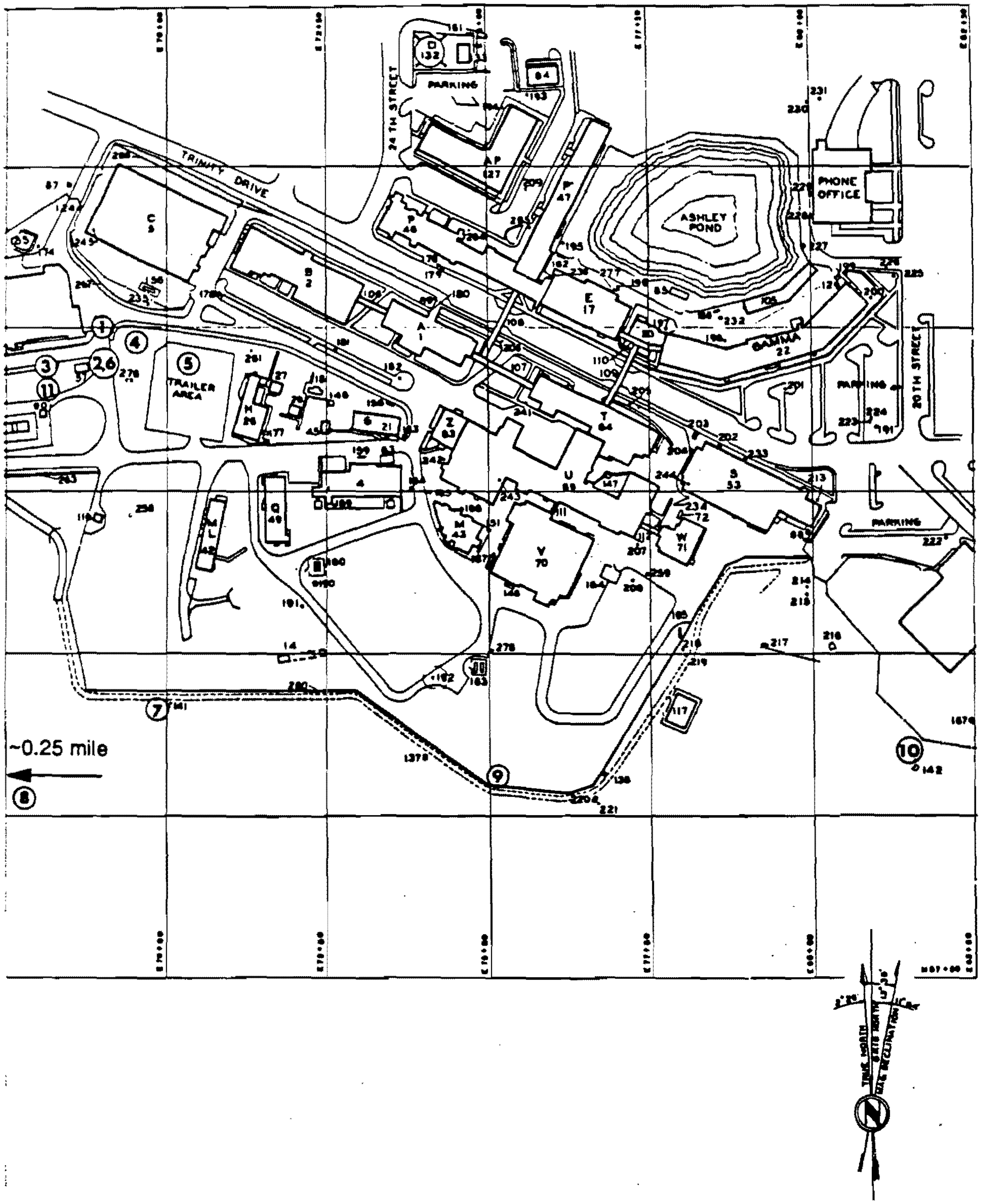


Fig. 7.3-1 Locations of the 1987 DOE Sigma area sampling points.

in the Sigma area. Boring samples were taken at the surface, the tuff-sediment interface, and 3 ft into the tuff. All samples were analyzed for gross alpha, beta, and gamma; total uranium; thorium; and volatile and semivolatile organic compounds. Assorted metals (beryllium, chromium, arsenic, barium, cadmium, lead, mercury, selenium, and silver) were also analyzed in soil samples. All concentration levels of data from the 1987 DOE investigation were below background.

7.3.2 Mesa-Top Decisions

If a risk to human health exists, it will be greatest for the undisturbed areas of the mesa top (Assumptions 1 to 3). This area is adjacent to a densely populated area, and, if any surface contamination exists, mesa-top residents could be exposed if they spend much time in the area. Two major areas on the mesa top have remained largely undisturbed since decommissioning and decontamination. One location is approximately a 2-acre tract called the Sigma area (Section 7.4). This tract was not developed and retains large areas of undisturbed surface. A second relatively undisturbed area exists near the heavily developed residential area. This area consists of a narrow band of soil (the length of Los Alamos Canyon) along the mesa-top rim directly outside DOE's limited access fence.

The Sigma area contains several sections of concrete pads from original TA-1 structures, including the Sigma Building dock and its cooling tower. Small fragments of the asphalt road that ran adjacent to the Sigma Building can still be seen. This 2-acre location was the site of a major 1976 decontamination effort that took place between H and Theta Buildings. This effort included the excavation of soil radioactively contaminated by leaks from the industrial waste line serving these buildings (Ahlquist et al. 1977, 0016).

Because of its undeveloped state, Phase I investigation of the Sigma area can best verify the effectiveness of past cleanups and the adequacy of available data for site characterization. This area is also representative of the condition of the mesa top after the 1976 decontamination. The Sigma area is the largest undisturbed exposed parcel of land at OU 1078, and, because it is located near residences, any existing residual contamination in this area could be a risk to residents.

In 1976, a fence was erected by DOE along the rim of the mesa to prevent intrusion of people from the mesa top into the canyon areas. The canyon rim soil along the fence line is potentially contaminated by discharges from outfalls or debris disposal. In addition, construction of present-day residences and decontamination efforts may have spread contaminants into these perimeter areas.

Townhouse backyards border the canyon rim. Because residents have limited access to canyon rim soil, the air pathway is the primary mechanism for any contaminant transport from the canyon rim soil to a human receptor. For this reason, surface soil samples will be taken in prescribed areas around the perimeter and outside the fence along the canyon rim.

It is likely that the highest dose values generated for the mesa top will result from data collected from the undeveloped areas. If data collected at these areas exhibit dose plus uncertainty at or below the preliminary dose estimates of Chapter 4, Ahlquist's 1977 data can be used to characterize a conservative dose for all mesa-top SWMUs. Limiting sampling to undisturbed areas will also minimize the impact of the implementation of this RFI on the Los Alamos community.

7.3.3 Mesa-Top Decision Logic

Sampling will be conducted in the Sigma area and along the canyon rim to validate the 1976 mesa-top clean-up. If no samples show calculated doses above those indicated by the 1976 cleanup data (Assumptions 4, 5, 6, and 7), it will be concluded that 1976 cleanup data reliably reflects incremental contaminant risks for the mesa top. If calculated doses are above those indicated by the 1976 cleanup data, a new sampling plan for nonradionuclide constituents may be needed. The formal decision logic is given below.

IF sampling in the Sigma area implies that 1976 data are reliable for use in risk assessment,

THEN characterize remaining mesa-top SWMUs based on Ahlquist's 1977 data (Ahlquist 1977, 0016)

IF health-based risk levels plus uncertainty derived from surface samples taken after the 1976 cleanup are acceptable,

THEN no remediation action will be taken;

ELSE assume no risk from unexposed mesa-top areas (because exposure transport pathways are all from the surface),

THEN recalculate risk using the 1976 and RFI collected data for the exposed areas.

IF these risks are acceptable,

THEN no remediation action will be taken; however, future subsurface construction activity in SWMUs will be monitored for subsurface hazardous and radioactive contaminants;

ELSE continue sampling to define areas of unacceptable risk and/or reduce uncertainty.

IF sampling in the Sigma area implies that 1976 data are not reliable for use in risk assessment,

THEN characterize the site according to the newly collected data.

IF risk levels plus uncertainty derived from these new data are acceptable,

THEN no remediation action will be taken and a mathematical adjustment will be made to the 1976 data for use in characterizing other mesa-top areas;

ELSE continue sampling to reduce uncertainty and more accurately define the risk or go into corrective measures study (CMS).

The decision logic presented focuses on radionuclide contaminants and is a function of Assumptions 4 through 7 presented in Section 7.2.2. The general strategy is to estimate risk and uncertainty values for all appropriate constituents in the Sigma and canyon rim areas and apply the results to the entire set of mesa-top SWMUs or to trigger further investigation of the mesa top according to decisions made on radionuclide data.

7.3.4 Phase I Mesa-Top Data Needs

The data needed to support the decision logic given above include soil samples to be analyzed for gross alpha, beta, and gamma activity, selected radionuclides, semivolatile organic compounds, and metal concentrations. These soil samples will be collected in the Sigma and canyon rim areas. If continued sampling outside of the Sigma and canyon wall areas is needed, soil samples will be taken over other exposed surface areas.

7.3.5 Decision Domain for the Mesa Top

The general mesa-top dose and risk assessment sampling is guided by the presence of manmade structures that cover areas where Laboratory activities occurred. Additionally, fill materials were brought in during decommissioning and decontamination, and significant quantities of soil were moved during the construction of residential and commercial buildings. This construction serves to physically limit contaminant mobility and prevents any existing subsurface contaminants from being exposed at the surface.

As areas were decontaminated during 1976 decontamination efforts (Ahlquist et al. 1977, 0016), gross alpha activity data on soil were collected. If these data can be used to assist in the characterization of residual radioactive contamination present at the site today, minimum disruption of the Los Alamos community will occur. It is unreasonable to try to prove that the 1976 data are similar to data that might be collected today. The passage of time and continuous construction activity that occurred on the mesa top would have diluted contaminant concentration levels. Instead, it will be shown that the 1976 data produce dose values higher than those of any data collected in this RFI Phase I sampling. If mesa-top risk exists today, it is expected to be most prevalent in the Sigma area and on the canyon rim adjacent to residences.

7.4 Mesa-Top Sampling Plan

In the Phase I sampling plan, data will be collected at three distinct levels. First, a PHOSWICH or FIDLER surface radiation survey of the entire Sigma area and mesa rim will be conducted. This survey will locate any soil with a potential radioactive count above background. Soil samples will be collected from those spots and measured for gross alpha and beta activity. Next, a collection of systematically located surface soil samples will be taken for the measurement of gross alpha and beta activity. A full suite of laboratory analyses will be completed for samples indicating gross alpha or beta activity above 20 pCi/g. Ten percent of the samples having gross activity below the 20 pCi/g detection limit will be randomly selected to receive a full suite laboratory analysis. Ten percent should provide an adequate characterization of the distribution of contaminants of concern in samples below gross counting detection limits. A combination of these two data types will allow identification of any large areas of low contaminant concentration. The third type of data are obtained from judgmental samples collected from areas where any contamination would be expected (e.g., excavated industrial waste line or septic tanks). These data provide a check on the random (or systematic) sampling and the radiological survey.

It is assumed that most, if not all, inadvertant discharges contained radioactivity. This Phase I plan should find any surface contamination that poses a risk to human health because of radioactivity. Radioactively contaminated soil with concentrations above background will be found with radiological survey instruments. Low-risk soil (soil in which activity levels are low) is only important if it covers a large area; it will be found by the random sampling activity. Specific logic flow for the Phase I mesa-top field investigation is detailed in Figures 7.4-1 and 7.4-2.

7.4.1 Sigma Area Sampling Plan

Locations, shapes, and sizes of contamination spots found and cleaned in central and western OU 1078 can be obtained from a map of the decontamination activities of 1975–1976. Figure 7.4-3 shows 18 of these small contamination areas. Several other very small spots (such as pipe shards removed by hand shovel) were also decontaminated but are not included in this figure. The dimensions of these remediated spots were used to estimate size and shape of potential contamination spots remaining from TA-1 activities (Table 7.4-1). Using ellipses of sizes that best capture the size and shape of each remediated spot (and remaining hot spot) in Sigma area, the probability of finding each remediated spot can be computed for various square grid sizes. Table 7.4-2 gives probabilities for square grids of 20, 30, and 40 ft.

Based on Table 7.4-2, a square grid with 30-ft spacing was selected for a sampling of the Sigma area.

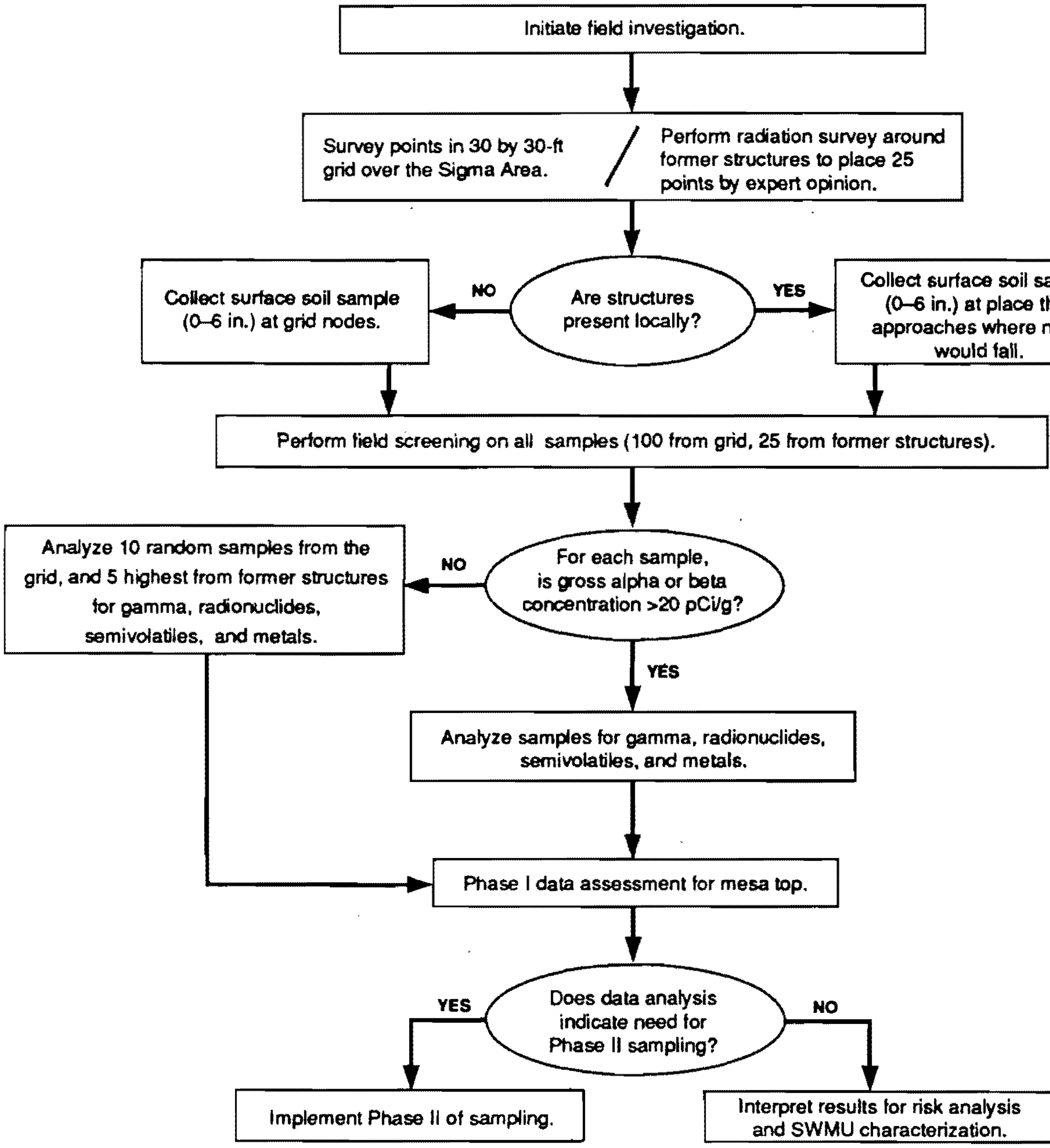


Figure 7.4-1. Logic flow for field investigation of surface soil characterization for the Sigma area of the mesa top.

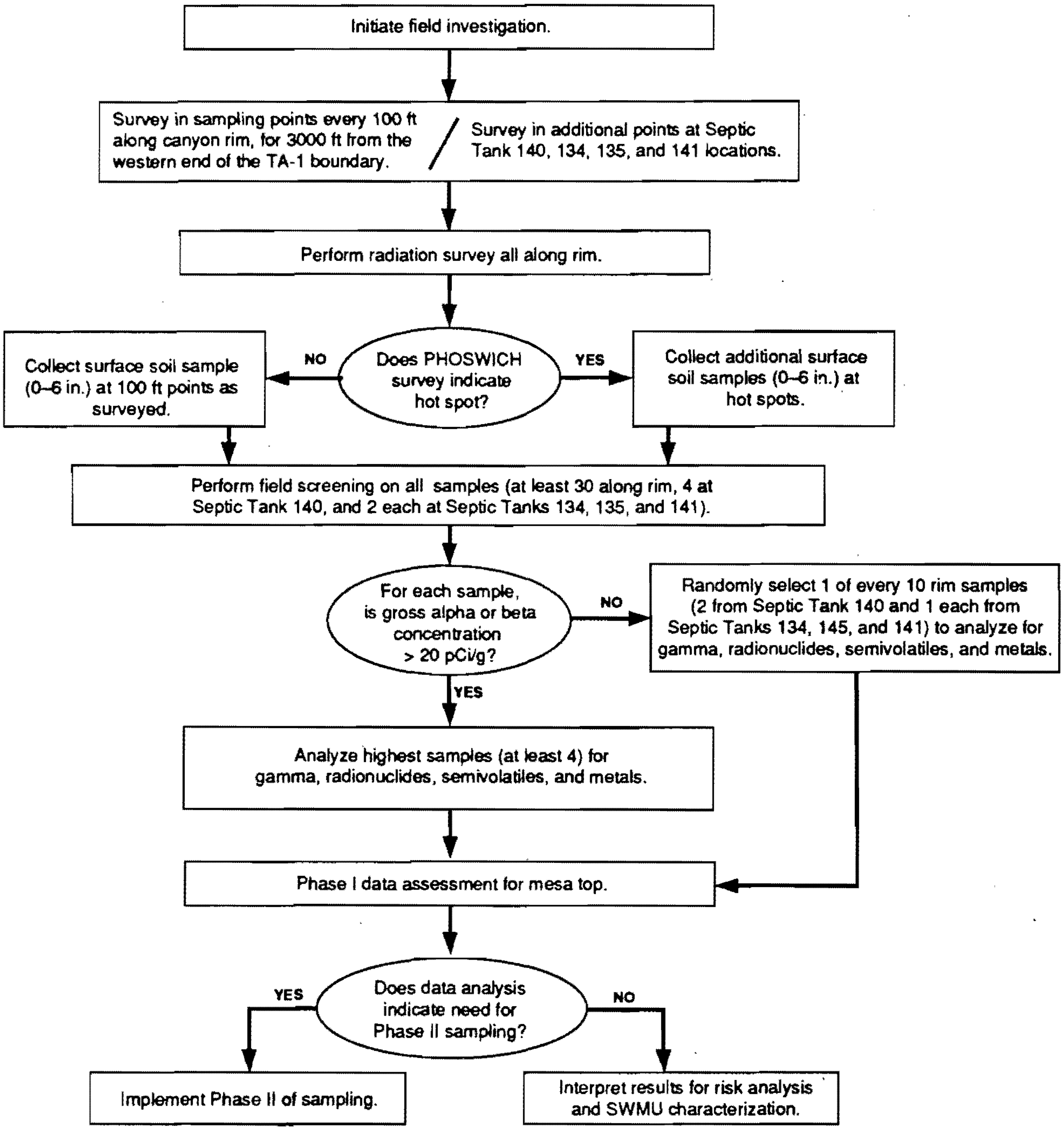


Figure 7.4-2. Logic flow for field investigation of surface soil characterization along the canyon rim of the mesa top.

TABLE 7.4-1

DECONTAMINATED HOT SPOTS* IN SIGMA AREA

Hot Spot Area No.	Area (ft^2)	Hot Spot Area No.	Area (ft^2)
1	682	10	658
2	2635	11	7856
3	7641	12	7282
4	2692	13	11919
5	1350	14	2169
6	3219	15	1408
7	618	16	5663
8	738	17	1548
9	8219	18	4237
			SUM 70565 ft^2
			AVG 3920 ft^2

*Areas cleaned during 1975–1976 decontamination efforts (Ahlquist et al. 1977, 0016).

TABLE 7.4-2

APPROXIMATE HOT-SPOT SAMPLING PROBABILITIES FOR SIGMA AREA

		Square Grid Sizes			
Hot-Spot Number	**Size and Shape**	**20 x 20 ft Grid**	**30 x 30 ft Grid**	**40 x 40 ft Grid**	**50 x 50 ft Grid**
		$1 - \beta_1$	$1 - \beta_1$	$1 - \beta_1$	$1 - \beta_1$
1	S = 1 L = 15.63 ft	1	.80	.50	.31
2	S = .5 L = 43.75 ft	1	1	1	.92
3	S = .5 L = 53.13 ft	1	1	1	1
4	S = .5 L = 59.38 ft	1	1	1	1
5	S = 1 L = 18.75 ft	1	.92	.78	.35
6	S = 1 L = 40.63 ft	1	1	1	1
7	S = .5 L = 15.63 ft	.83	.41	.25	.15
8	S = .5 L = 18.75 ft	.95	.57	.32	.18
9	S = 1 L = 65.63 ft	1	1	1	1
10	S = 1 L = 15.63 ft	1	.80	.50	.31
11	S = .5 L = 58.75 ft	1	1	1	1
12a	S = .5 L = 96.88 ft	1	1	1	1
12b	S = .5 L = 40.63 ft	1	1	1	.90
13	S = 1 L = 68.75 ft	1	1	1	1
14	S = .5 L = 68.75 ft	1	1	1	1
15	S = .5 L = 53.15 ft	1	1	1	.92
16	S = 1 L = 53.13 ft	1	1	1	1
17	S = .5 L = 46.88 ft	1	1	1	.97
18	S = 1 L = 43.75 ft	1	1	1	1

S=the ratio of the lengths of the axes of an ellipse (short axis divided by long axis).

L =the length of the semi-major axis of an ellipse.

$1 - \beta_1$=the probability that a hot spot of size and shape at least L is hit with the sampling grid, given that this particular size and shape hot spot exists.

The 30-ft by 30-ft grid was chosen because this grid size best provides adequate probabilities for detecting hot spots of the sizes and shapes given in Figure 7.4-3. There is an 80% probability that all hot spots, with the exception of Hot Spots 6 and 7, will be found. Detection probabilities drop off substantially for grid sizes of 40 x 40 ft and 50 x 50 ft. The 30-ft x 30-ft grid will be surveyed into the 270-ft x 270-ft (approximately 1.44 acres) undisturbed Sigma area, as shown in Figure 7.4-4. One hundred soil samples will be taken from within the grid (at every intersection) as shown in the figure. Each sample will be field laboratory analyzed for gross alpha, beta, and gamma activity. Ten randomly selected soil samples measuring below 20 pCi/g will be submitted for laboratory analysis of gamma spectrometry (^{137}Cs), total uranium, $^{239, 240}$Pu, semivolatile organic compounds, and total metals. All soil samples measuring above 20 pCi/g will also be submitted for this same suite of analyses.

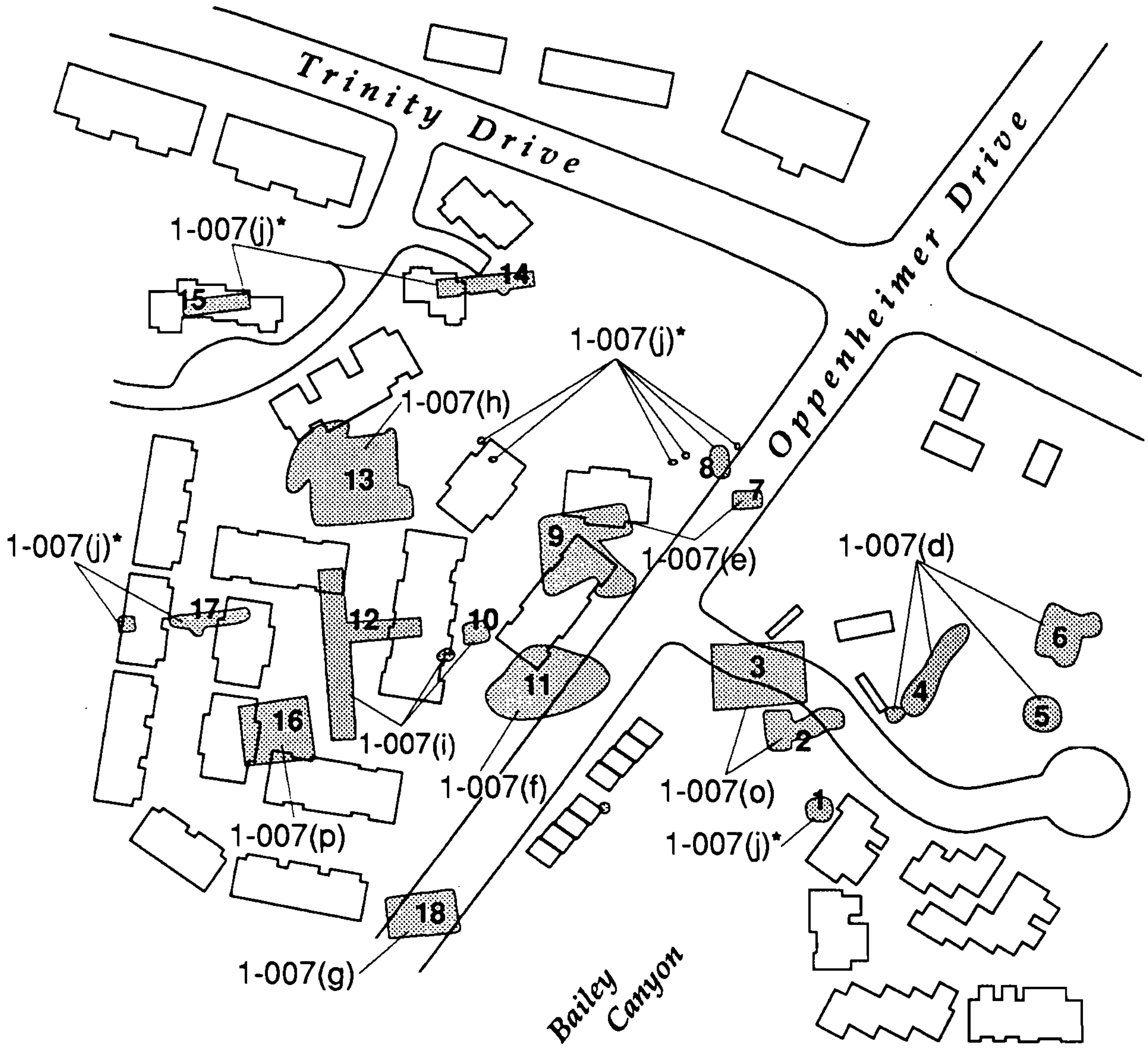
An additional 25 surface soil samples will be taken in the Sigma area from locations where concrete pads and discharge pipes are evident, from areas where the industrial waste line was excavated, and in other areas where previous decontamination efforts occurred. These areas have been added to the Sigma area sampling plan because they were judged to be places in which any residual contamination would most likely occur. A PHOSWICH or FIDLER meter surface survey of these suspected areas will be conducted to guide the sampling. If the surface survey indicates no areas of surface activity (above background), expert opinion will determine the placement of the 25 sampling points. All 25 samples will be measured for gross alpha, beta, and gamma activity. Any sample indicating gross alpha or beta levels above 20 pCi/g will be submitted for gamma spectrometry, radionuclide, semivolatile organic compound, and heavy-metal analysis. If none of the 25 samples exhibit gross alpha or beta above 20 pCi/g, the 5 having the highest gross alpha or beta activity will be submitted for gamma spectrometry, radionuclide, semivolatile organic compounds, and metal analysis.

For every 20 soil samples taken, 1 replicate sample will be collected. The replicate will be submitted for equivalent analyses (gross counting and/or laboratory analysis). Figure 7.4-1 depicts the logic flow of the Sigma area sampling plan.

7.4.2. Canyon Rim Sampling

In most places outside the fence, a small buffer zone of mesa-top topography exists that is still relatively undisturbed but possibly contains remnants of contamination from TA-1 operations. Surface soil samples will be taken in this area. A diagram depicting the logic flow of the canyon rim sampling plan is presented in Figure 7.4-2.

Canyon rim sampling points are depicted in Figure 7.4-4. Sample points will be systematically located at



* 1-007(j) is a SWMU that includes an assortment of suspected subsurface soil contamination locations.

Figure 7.4-3. Location of decontaminated hot spots in Sigma area.

100-ft intervals along the 3000-ft length of the canyon rim bordering present residences. A sampling location point will be marked by a metal tag attached to the fence above the location. In addition, the perimeter along the fence will be field screened with a PHOSWICH or FIDLER meter to determine if any hot spots outside the predetermined sampling points should be sampled. Additional soil samples will be taken if the PHOSWICH meter detects counts in soil above background. At least 30 perimeter soil samples will be taken and measured at the field laboratory for gross alpha, beta, and gamma activity. One in every ten soil samples will be randomly selected and submitted for gamma spectrometry, radionuclide, metal, and semivolatile organic analysis. If any other soil sample exhibits a gross alpha or beta activity greater than 20 pCi/g, that sample will also be submitted for gamma spectrometry, radionuclide, metal, and semivolatile organic analyses.

Additional samples will be taken in these same areas along the canyon rim where septic tanks were located. Septic Tanks 134, 135, 140, and 141 were located near TA-1's security fence. Today, the mesa-top population density is greatest along the canyon rim where the four septic tanks and their outfalls were located. Of the four septic tanks, only Septic Tank 140 and its outfall area exhibited any radioactive contamination before it was excavated and removed during the mid-1970s (Ahlquist et al. 1977, 0016). The former location of Septic Tank 140 is now covered by townhouses. The outfall area for this septic tank lies outside the DOE fence. A considerable amount of contaminated soil was excavated from around Septic Tank 140 when the tank was removed, but some residual contamination may still exist on the hillside below (Ahlquist et al. 1977, 0016).

Four judgmental soil samples will be taken at the Septic Tank 140 outfall location. A PHOSWICH or FIDLER meter surface survey will be done on the mesa top near the former tank and outfall location. If the survey indicates no hot spots, samples will be taken at the mesa-top portion of the outfall area in locations judged to be most representative of potential contamination. The sampling locations will be flagged, and the land will be surveyed.

At the the locations of Septic Tanks 134, 135, and 141, a PHOSWICH or FIDLER meter surface survey will be used to measure surface radioactive contamination, if any exists. If radioactive contamination is not indicated, two sampling points will be selected by expert judgment at each tank location (samples are limited to two because these tanks indicated no radioactive contamination when excavated).

The ten judgmental septic tank location samples will be analyzed in the field laboratory for gross alpha, beta, and gamma activity. Any soil sample exhibiting a gross alpha or beta activity greater than 20 pCi/g will be submitted for laboratory gamma spectrometry, radionuclide, semivolatile organic compound, and metal analyses. If none of the septic tank samples exhibits a gross alpha or beta activity greater than 20

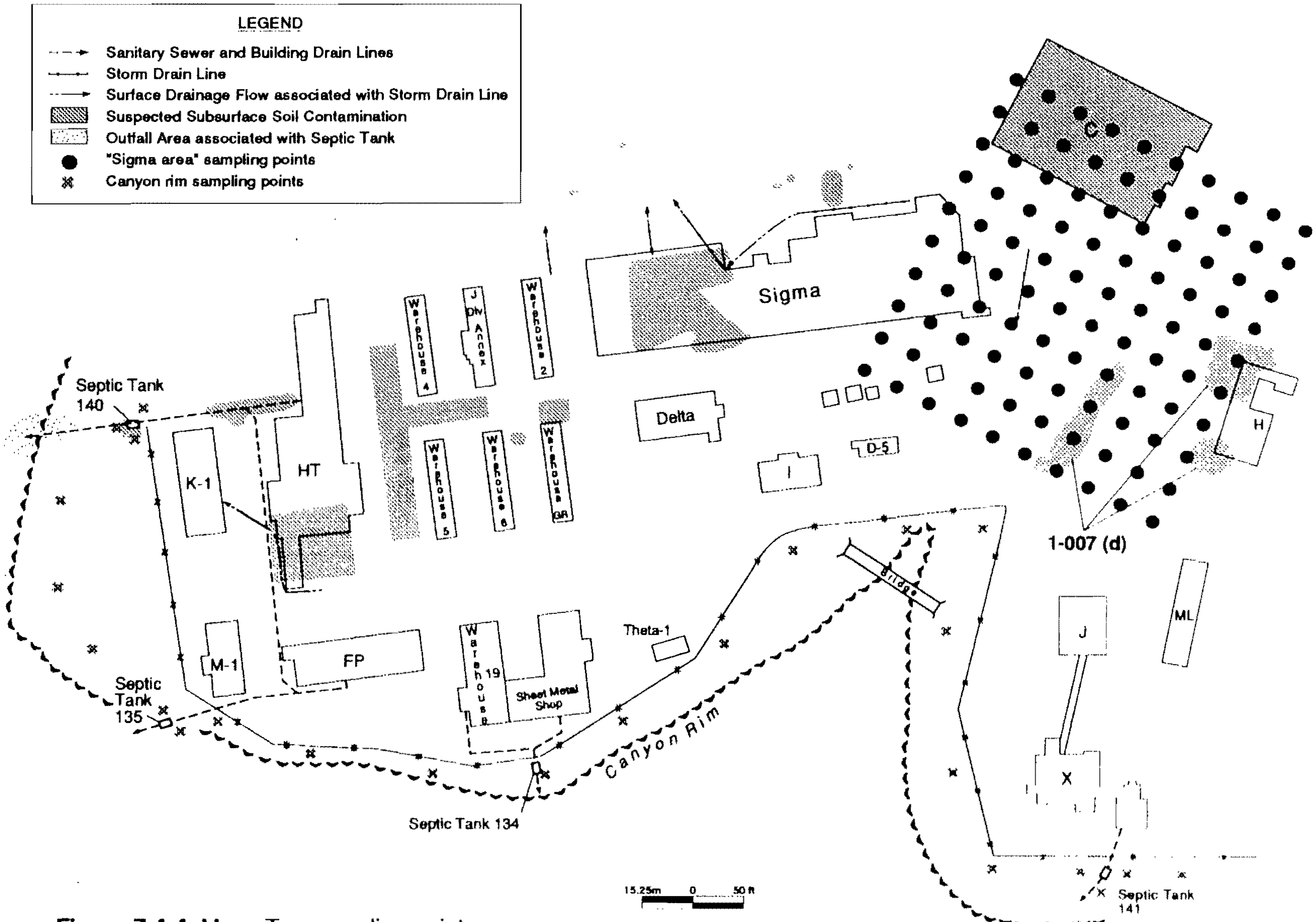


Figure 7.4-4 Mesa Top sampling points.

pCi/g, two samples from Septic Tank 140 and one each from the other three septic tanks will be selected for full suite analyses based on maximum gross alpha or beta counts.

One replicate sample for every 20 soil samples taken at the canyon rim will be submitted for equivalent analyses.

7.5 The Hillsides DQO Process

Contamination on the hillsides may have come from outfalls at the canyon rim, surface water run-off from SWMUs on the mesa top, and debris pushed over the canyon rim. During TA-1's operational years, liquid discharges occurred at eight hillside locations. Several debris sites are also visible on the hillsides. It is documented that construction debris was thrown into Los Alamos Canyon in the early 1960s (Ahlquist et al. 1977, 0016), especially in the Bailey Bridge area and in the area east of the Los Alamos Inn. Debris in the form of rusted cans is evident at the Can Dump Site SWMU.

The three types of hillside areas to be investigated are defined below.

Drainages consist of sectors of watersheds in which fluids drain into primary and secondary channels. A discharge of interest to this investigation originates at the top of the canyon near an outfall (or location of surface contamination) and pursues the most natural pathway down the hillside, following overland flow (during large storm events), specific incised path(s), or both. Overland flow is less important when compared with channel flow because overland flow eventually reports to a channel or results in water and sediments reporting to the canyon bottom. With time, the drainages receiving repeated flows become more sharply defined and channeled. Figure 7.5-1 is an artist's rendering of the type of drainage area of interest. The channel is subdivided into a primary channel with secondary channels. A primary channel carries most of the discharge or run-off flows. Secondary channels carry minor amounts of run-off flow and feed into the primary channel. A secondary channel may also be a watercourse that has accommodated overflow from the main channel or has served as a primary channel during the observable past.

Benches are relatively horizontal surfaces intersecting a drainage pattern. Because of the decrease of fluid velocity when water encounters a bench, sediment is deposited and may accumulate vertically and horizontally along the bench surface. Bench surfaces are of varying sizes and manifestations.

Out-of-drainage areas include the hillside surfaces between relevant drainages. The out-of-drainage areas contain ill-defined drainage patterns and are exposed to contaminants only if overland flow occurs or if contaminants are deposited directly onto these areas.

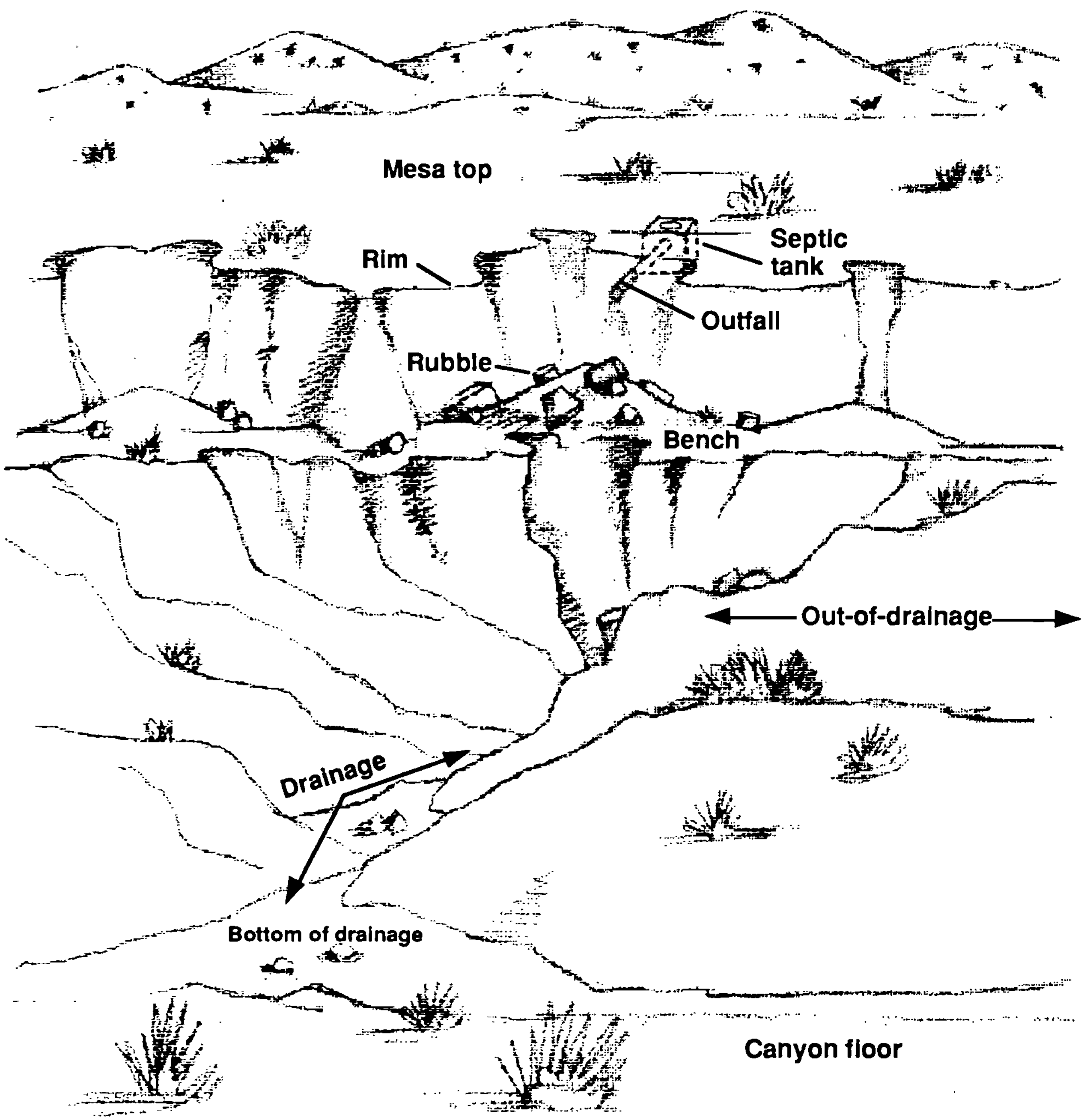


Figure 7.5-1. Hillside sampling terminology.

7.5.1 Hillsides Problem Statement

All hillside area SWMUs include at least one outfall area, primary drainage, bench (with the exception of Bailey Canyon), canyon bottom, and out-of-drainage area. Some SWMUs contain debris. Data from the 1970s cleanup indicate residual radioactive contamination on three hillside areas (137, 138, and 140). These hillside areas were not remediated at that or any subsequent time (Ahlquist et al. 1977, 0016). No contemporary data exist to provide information about variability of soil contaminant levels that can be used in designing the most efficient sampling plans.

Present-day exposure sources are surface soil, rock, and surface debris. Thus, the greatest risk is expected from the ground surface and exposed debris surface. A potential health risk resulting from subsurface contamination may be present in areas (e.g., a bench) having a buildup of sediment. Potential subsurface contamination may occur at benches because fluids have the tendency to infiltrate the more permeable sediments that compose the benches. Field geomorphic mapping will be undertaken to discern whether benches of substantial areal size and thickness exist at any of the drainages in the eight hillside SWMU aggregate.

It is not known whether contamination is still present on the hillsides. The primary purpose of each hillside sampling plan is the collection of data that can be used to estimate the average dose/risk over an exposure unit (recreational scenario) of one acre. The most detailed Phase I sampling will occur in outfalls, drainages, and benches because these areas are assumed to be the most likely places for any remaining contamination.

7.5.2 Hillsides Decisions

Decisions on the hillsides will be based on integrated risks over an exposure unit of 1 acre using the recreational scenario given in Chapter 4. A 1-acre exposure unit is a likely area in which a child might play on the hillsides. Exposure units will overlap drainages, benches, and out-of-drainage areas. Data collected in each of these areas will be combined to produce the dose and concentration surfaces described in Section 7.2.5.

Contamination, if it exists, is assumed to be concentrated at outfalls, drainages and benches. The probability of finding a contaminant on a hillside out-of-drainage area is expected to be small because overland flow washes away particulates carrying contaminants and because contaminants from outfalls are not believed to have been routinely deposited in these areas. Only the section of a bench that is located where run-off could have flowed from the drainage and where a significant sediment thickness exists will be sampled in Phase I. Geomorphic characterization will be used to identify the principal bench in each of the hillside drainages and the location on that bench most impacted by that drainage.

Based on Assumption 9 in Section 7.2.2, drainage data will first be collected at the top and bottom of each drainage. These data will be used to determine the extent of in-channel sampling.

The sampling plans and requisite decisions for the hillsides are principally motivated by beliefs about potential radionuclide contamination. Based on Assumptions 4 through 6 of Section 7.2.2, nonradionuclide hazardous constituents are collocated with radionuclides. If the hillsides data violate these assumptions, a sampling plan for nonradionuclide contamination may have to be developed separately.

In addition to surface soil contamination, potential health risks caused by building debris located in some of the outfalls and drainages will be evaluated. Debris sampling is treated separately in Section 7.6.4.

7.5.3 Phase I Hillsides Decision Logic

Data from all three types of hillside areas will be combined to find average dose and/or concentration levels over one-acre exposure units. The decision logic is given formally below.

> IF dose (risk) and/or concentration plus uncertainty levels computed over an exposure unit based on data from the top and bottom of drainages, primary drainages, and benches is acceptable (when compared to Subpart S action levels or radioactive levels defined in a future iteration of the IWP),
>
> THEN no remediation action will be taken;
>
> ELSE continue to sample in the vicinity of the highest concentration levels, refining the uncertainty in the dose (risk) and/or concentration values until dose (risk) and/or concentration plus uncertainty levels are acceptable or until it is determined whether a CMS will be needed.

The assumption that hazardous constituents collocate with radionuclides will be tested in parallel to the decisions made above. Finally, decisions about health risk caused by debris will be determined as described in Section 7.6.4.2.

7.5.4 Phase I Hillsides Data Needs

Three types of data are needed to make the decisions described above. Because drainages and former outfalls must be defined (Assumption 9), geomorphic characterization and a study of historic photographs and maps will be conducted to locate the present extent of drainages and benches. Once these areas have been mapped, soil samples will be collected; counted for gross alpha, beta, and gamma activity; and assayed (if appropriate) for gamma spectrometry, radionuclides, semivolatile organic compounds, and metals. Finally, building debris will be surveyed (if appropriate) for radioactive and hazardous constituent contamination that could transfer to persons, plants, or animals through direct contact or could affect species by way of radioactive emanation (Section 7.6.4).

7.5.5 Decisions Domain for the Hillsides

Decisions based on data collected from the hillsides will be made by calculating constituent concentration means and estimating the risk over 1-acre exposure units. Because exposure units will be allowed to lie anywhere on the hillsides, it is conceivable that a single exposure unit might overlap drainages, benches, out-of-drainage areas, and several SWMUs. Data from all these areas will be used to produce the dose and/or concentration surfaces described in Section 7.2.5.

7.6 Phase I Hillsides Sampling Plan

Each hillside SWMU aggregate may contain drainages, benches, debris, and out-of-drainage areas. Table 7.1-1 indicates which SWMUs impact that SWMU aggregate. The outfall, drainage, and bench sampling plans described below will apply once these areas have been mapped and specific sampling areas have been defined. One hillside area may be incorporated in more than one plan (e.g., Hillside 140 and J-2/TU aggregates). A diagram indicating the logic flow of the hillside sampling procedure is presented in Figure 7.6-1. Data from Phase I sampling results may be used for pilot studies to indicate whether a minimum number of samples can be used to adequately describe the study area. Out-of-drainage areas will be sampled only in Phase II and only if Phase I hillside sampling indicates that radiological action levels defined in proposed Subpart S or the IWP were exceeded.

7.6.1 Drainage Sampling

Drainages to be sampled encompass any present or former channels that could have carried contaminants. These drainages will be verified to the extent practical during pre-RFI geomorphic characterization and by observational comparisons of historical and present-day photographs and topographic maps.

An expert will do geomorphic field mapping of the hillsides, according to the ER Program standard operating procedure (SOP) for geomorphic characterization, to certify sampling points are properly located. Knowledge of the location and lateral extent of drainages and benches is necessary for an efficient and

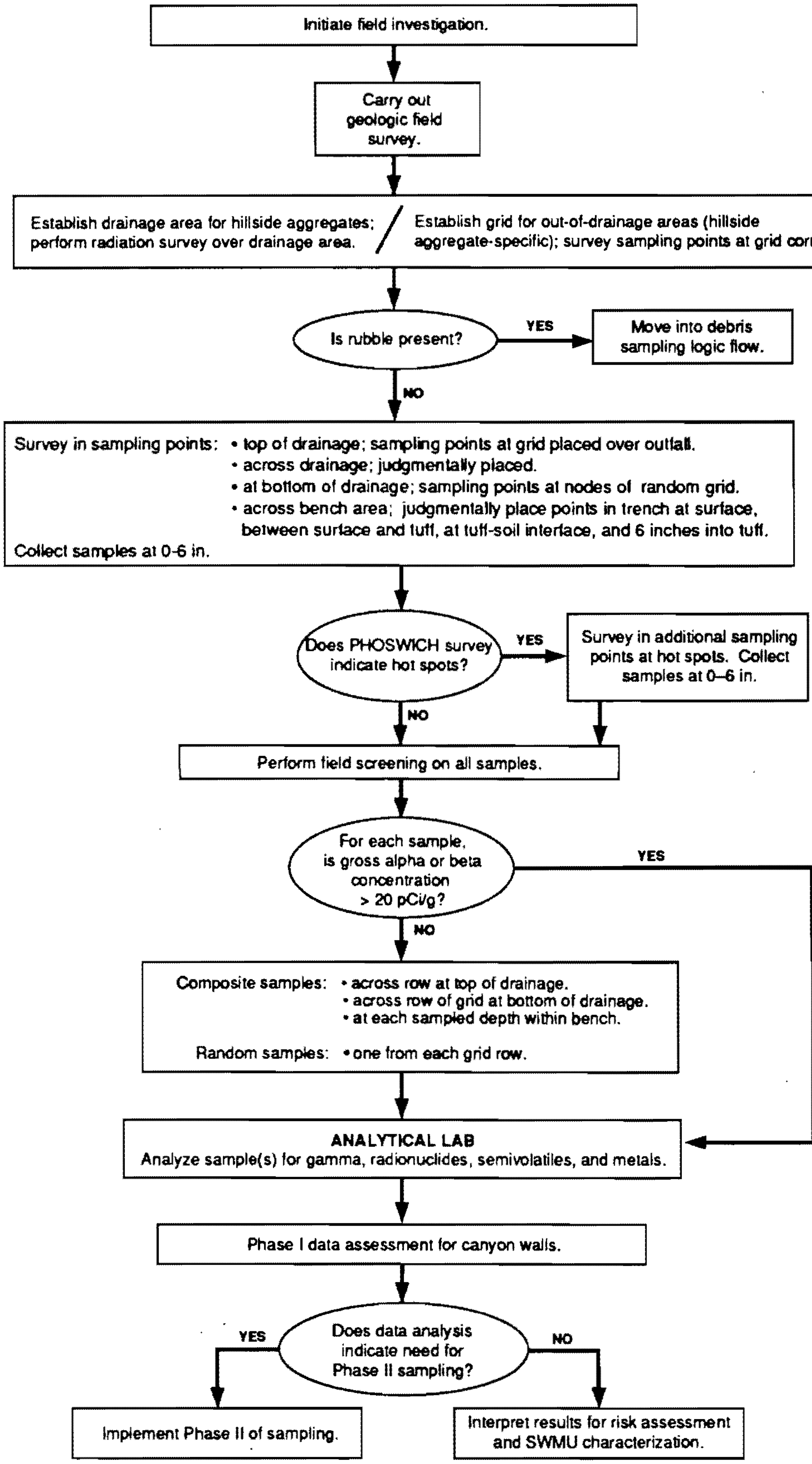


Figure 7.6-1. Logic flow for field investigation of surface soil characterization on the canyon walls.

accurate sampling plan to characterize risk. Field-mapping information will be incorporated into the individual hillside SWMU aggregate sampling plans and may alter the sampling point locations and number of samples specified in the formal plans developed later in this chapter. The basic concept of sampling hillside drainages presented here will apply to all hillsides, regardless of the drainage and bench sizes and geomorphic characterization.

The sampling plan for a drainage must account for the outfall(s), the drainages, the principal bench, outlets to the canyon bottom, and possible debris in drainages. The outfall area is localized in the canyon rim region, where liquid emanating from a pipe or drain would have splashed before flowing down the hillside or where surface water run-off transported contaminants into the drainage.

For each drainage, a radiological surface survey will be done with the PHOSWICH or FIDLER meter to give an initial surface radiological screening characterization of the outfall. This survey will identify surface areas with radioactivity above background indicating that potential radioactive contamination exists. An initial estimate of the surface radioactive contaminant variability in the drainage will be available from the surface survey and gross alpha and beta measurements of soil samples (should contamination exist).

A phased sampling plan will be used in the drainage areas. In Phase I soil sampling, samples will be taken at the top and the bottom of the drainage. Samples will also be taken in the main channel of the drainage and will be screened principally for gross alpha and gross beta activity. Geomorphic characterization will be used to determine the primary and secondary channels that make up the drainage and the major bench located in each drainage. Figure 7.6-2 depicts where Phase I samples might be taken for a typical hillside. The top, bottom, channel, and bench areas are marked.

In the outfall area at the top of a drainage, samples will be taken across grid rows that intersect the area of highest potential contamination (outfalls or areas in which debris is evident). The number of outfall grid rows sampled will depend on drainage shape and knowledge of outfall placement.

At the bottom of drainages, geomorphic characterization will define those areas that surface water would contact before moving into the relatively flat landscape at the bottom of the canyon. A 20 ft by 20 ft grid (or less) will be placed over this defined bottom land or outlet area. Depending on the uncertainty of the location, several grid rows may be necessary to characterize the outlet area. In several cases, it may prove necessary to establish several separate grid locations because of uncertainty of the outlet locations.

Samples collected at the top and bottom of the drainages will adhere to the following analysis protocol. In some cases (where a grid row is made up of seven of fewer samples), soil samples with gross alpha and beta activity less than 20 pCi/g will be composited across each row. A full suite analysis will be performed on each composited sample. One of the samples exhibiting gross alpha or beta activity below 20 pCi/g will be randomly selected from each row and submitted for full suite analysis. Compositing provides an inexpensive method of looking for anomalies (high concentrations). The randomly selected sample provides location-specific information needed for the statistical concentration variance procedure. All soil samples exhibiting above 20 pCi/g gross alpha or gross beta activity will also receive full suite analyses. The full suite analyses will include gamma spectrometry, radionuclides, semivolatile organic compounds, and metals.

Phase I sampling in a drainage will also take place along the entire primary channel. Soil samples will be located by expert opinion at approximately 100-ft intervals along the course of the drainage. These samples will each be measured for gross alpha, beta, and gamma activity. Soil samples with gross alpha or beta activity above 20 pCi/g will be submitted for full suite laboratory analyses. If none of the samples taken from the channel exhibits gross alpha or beta activity greater than 20 pCi/g, the investigation of the channel samples will await the results of the outfall and outlet analyses. If soil samples in the Phase I sampling of the outfall or outlet exceed proposed Subpart S action levels or IWP radiological soil guidelines, soil sampling will extend into Phase II in drainage and out-of-drainage areas where exposure units over the drainages indicate an unacceptably high risk or exceed proposed Subpart S action levels. Phase II sampling will continue across rows, working up from the bottom of the drainage or down from the top of the drainage, depending on which area exhibited the highest concentration levels. Sampling will continue until the uncertainty has been adequately reduced or the extent of contamination has been fully characterized. Phase II sampling at depth may also be required in Phase II if Phase I sampling indicates surface contamination and the physical properties of the surface (e.g., permeable soil of viable depth) are conducive to subsurface contamination.

7.6.2 Bench Sampling

The second type of sampling for the hillside (and the only subsurface sampling proposed in Phase I) occurs in the major bench within a drainage. Because contaminants may have been trapped in bench sediments at depths of several feet (having infiltrated as liquids into the more permeable sediments of the bench), benches may exhibit horizontal and vertical distributions of contaminants distinct from other regions of the drainage. Identification of the major bench and estimation of sediment depth for that bench will be components of the geomorphic characterization conducted before any sampling is undertaken.

Rather than auguring or drilling a series of shallow holes into the subsurface, trench sampling (if possible)

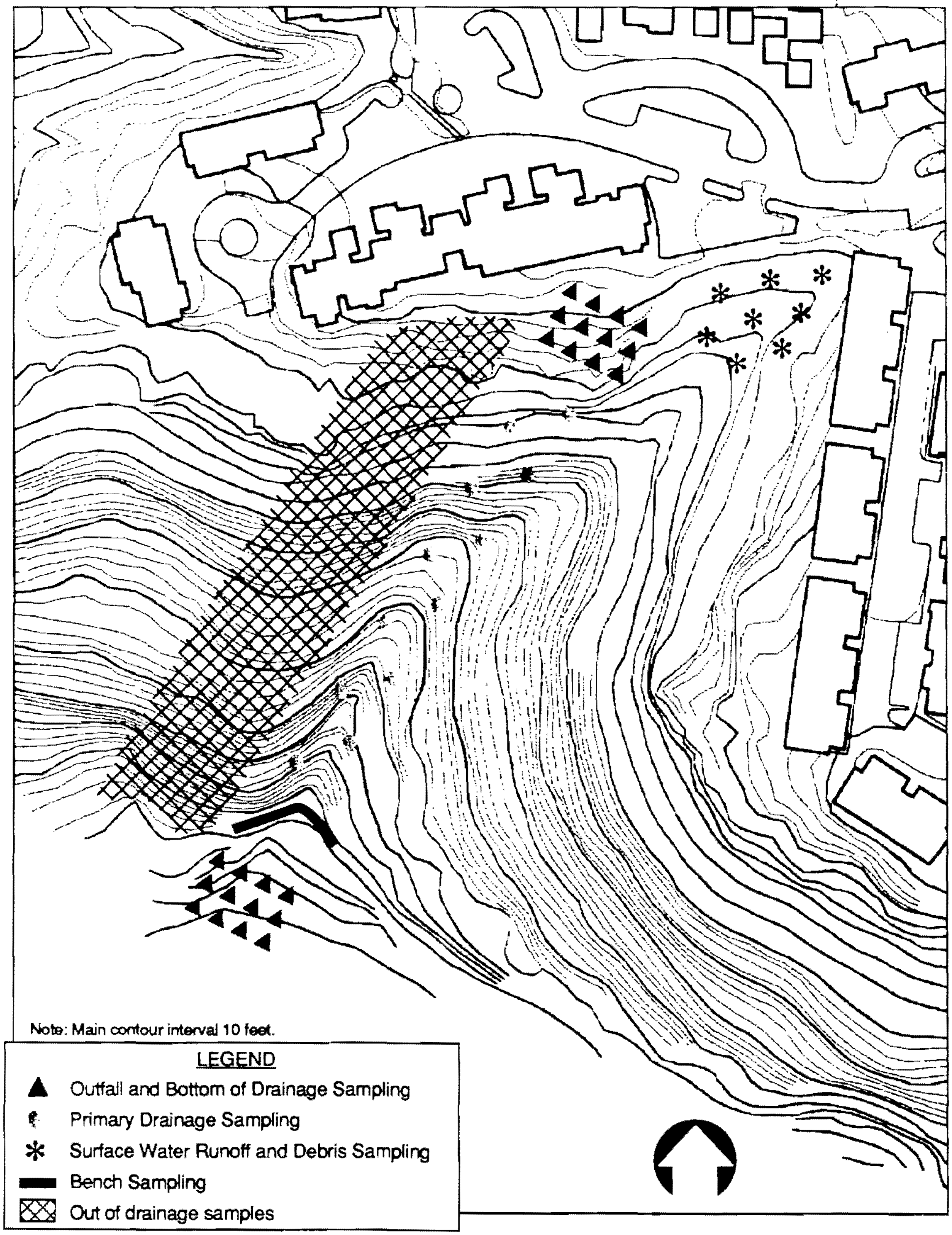


Figure 7.6-2 Generic hillside sampling plan.

will be conducted on benches. The use of trenching to sample benches offers two immediate advantages. First, a trench allows an investigator to observe a cross-sectional area of subsurface and to identify any soil discoloration or buried objects. Second, choices of judgmental samples are enhanced once an open trench is available. By observation of strata in the trench, decisions about taking the most representative samples can be made quickly and more knowledgeably. Also, a trench permits the collection of relatively undisturbed horizontal samples of sediments from prescribed locations and depths. Finally, by compositing samples across the profile of the trench, cost will be minimized. One composite sample may represent a series of samples across the width of the trench at whatever depth is chosen. Thus, an advantage is gained both in sampling at particular depths and across variable widths. At each bench, one sample will be collected from the surface, from the segment between the surface and the tuff, from the soil-tuff interface, and from a depth of 6 in. into the tuff (if necessary). The tuff sample will only be required if the overlying soil sample exhibits gross alpha or beta activity greater than 20 pCi/g.

The field strategy used for sampling a bench involves an initial survey of the soil surface of a bench area using a PHOSWICH or FIDLER meter. This survey may be helpful in defining the specific area of the bench where a trench should be dug. Grab samples of soil will be taken across the trench at specified depth locations. The grab samples will be screened for gross alpha, beta, and gamma activity. Samples with gross alpha or beta activity less than 20 pCi/g will be composited within a given depth. Individual samples with gross alpha or beta activity greater than 20 pCi/g will have full suite analyses. A random subset of samples from the set of individual samples composited within a trench will also receive full suite analyses. The number of samples in the subset is a function of trench length. The specific number of samples for each SWMU aggregate trench is described in the SWMU aggregate sampling plan (Sections 7.7–7.15). Compositing provides an inexpensive method for identifying anomalously high contaminant concentrations. Randomly selected samples provide location-specific information needed for the statistical variance procedure.

7.6.3 Out-of-Drainage Areas Sampling

Out-of-drainage areas will be sampled by using a 100-ft by 100-ft grid (only in Phase II if warranted by Phase I results). The grid for areas between drainages, depicted in Figure 7.6-2, will be used to locate sample locations at corners of grid squares. The number of grid squares will be determined by the area of out-of-drainage sectors. All soil samples will be analyzed for gross alpha, beta, and gamma activity. If any sample shows gross alpha or beta activity greater than 20 pCi/g, it will be analyzed for gamma spectrometry, radionuclides, semivolatile organic compounds, and metals. Ten percent of samples (at least one) randomly chosen from those measuring gross alpha and gross beta activity below 20 pCi/g will undergo gamma spectrometry, radionuclide, semivolatile, and metal analysis. Construction debris in out-of-drainage areas will be sampled according to the debris sampling plan in Section 7.6.4.

Phase II sampling will occur in out-of-drainage areas only if exposure units in adjacent drainage areas indicate an unacceptably high risk (as defined by a future iteration of the IWP) or if proposed Subpart S action levels are exceeded (EPA 1990, 0432). Sampling in out-of-drainage areas will continue until uncertainty has been adequately reduced or the extent of contamination has been fully characterized.

7.6.4 Construction Debris Sampling For Characterization and/or Removal

Several hillside SWMU aggregates require Phase I construction debris sampling. Concrete rubble resulting from the 1960s demolition of buildings and building pads is the principal type of debris found at OU 1078 hillside disposal sites. After demolition, debris from several buildings was pushed over the side of the canyon. Rebar, metal fragments, tires, and other miscellaneous material are also found in these disposal sites, but concrete will be the main target of debris sampling.

Sampling construction debris or any nonhomogeneous material is not a straightforward task. Sampling concrete debris will be doubly difficult because the debris requires characterization of both radioactive and hazardous constituents. This OU 1078 work plan proposes a two-stage sampling plan for debris. The first stage involves preliminary *in situ* radioactive and metal surveying and sampling of the concrete to characterize for surface gross alpha, beta, and gamma activity and metals. If necessary, a second stage of sampling will be performed that will involve collecting aliquots from individual pieces of debris and submitting them for laboratory analysis for radionuclides and/or metals. Figure 7.6-3 depicts the log flow for sampling surface debris.

7.6.4.1 Field Characterization of Debris

Two hillside areas contain concrete construction debris: Bailey Bridge and the Surface Disposal Area Southeast of Los Alamos Inn SWMU aggregates. Initially, a photographic or videotape record will be made of the type and extent of waste materials. As stated above, concrete building debris is the prevalent solid waste in both areas. Using a theodolite and a prism, each significant piece of debris will be land surveyed and located on a map generated by these field investigations. A significant piece of debris is defined as one that two men cannot lift or handle easily. Only surface debris will be mapped in this manner. If necessary, each piece of debris will undergo a two-stage sampling scheme as outlined below. Each significant piece of concrete debris on the hillsides will be surface surveyed for radioactivity with the appropriate meter. Debris measuring low-level radioactivity greater than background will be marked with red fluorescent paint and slated for early removal (if physically possible, if funding is available, and if risk

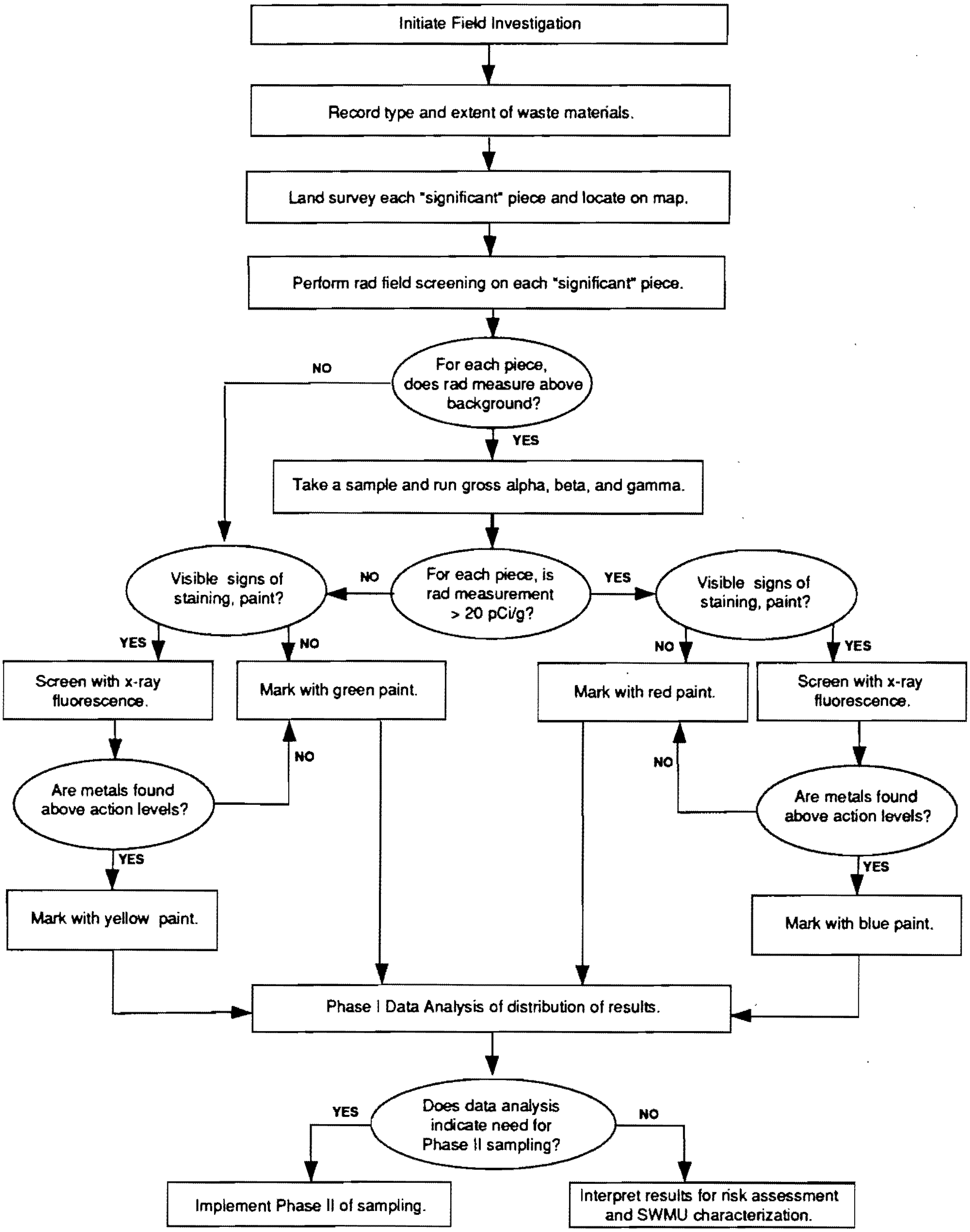


Fig. 7.6-3 Logic flow for field investigation of characterization of surface debris.

is indicated). Debris measuring activity at background will be marked with green paint. Only exposed surfaces of partially buried debris will be radioactively surveyed and marked. X-ray fluorescence measurements will be made on concrete debris surfaces that indicate greater than background for radioactivity and that have visible signs (such as rust) indicating metal contaminants. An x-ray fluorescence instrument with detection limits approaching proposed Subpart S action levels for metals in soil will be required for field metal analysis. Debris with metal concentrations above Subpart S guidelines will be marked with yellow paint; if the debris is also radioactive, it will be marked with blue paint.

Using a software package such as Wild Soft, radioactive and heavy-metal screening of cement debris will be used in conjunction with a land survey map to create a depiction of debris distribution. If necessary, a statistical package (Isaaks and Srivastava 1989, 0765) will be used to examine this collection of points for distribution of debris attributes. This method determines if a pattern of debris distribution exists that will provide stratification of the distribution before any Phase I sampling, or if a completely random collection of cement samples will be needed for laboratory analysis (if necessary) during Phase I.

It may prove necessary to use both judgmental and random selection for the second stage of debris sampling. Only cement debris will be chosen to undergo further testing. Aliquots will be chipped from the surface of cement debris, placed in polyethylene bags, and taken to the field laboratory. In the laboratory, cement samples will be pulverized and measured for gross alpha, beta, and gamma activity in the same manner as for soil samples. If laboratory tests indicate that a piece of concrete debris has gross alpha or beta greater than 20 pCi/g, removal and disposal at Area G, TA-54, will be considered. Only if x-ray fluorescence field surveying indicates that metal concentrations exceed proposed Subpart S levels will toxicity characteristic leaching procedure (TCLP) metal analysis be necessary for these samples. If a piece of debris above the TCLP level was slated for removal because of radioactivity, an ER RCRA compliance officer may need to decide if the debris is a mixed waste. Nonradioactive debris above TCLP levels, as measured by x-ray fluorescence or laboratory analyses, will be considered for removal under the CMS.

The decision for removal of concrete debris will largely be based on characterization by gross alpha and beta activity.

7.6.4.2 Decisions Involving Sampling and Removal of Debris

It may become important to weigh the cost of performing extensive sampling and expensive laboratory analyses to determine the necessity of debris removal against the cost of simply removing all exposed debris to a designated disposal area.

Regardless of debris disposal method, soil on the same hillsides will require sampling and will be discussed in the SWMU aggregate sampling plan for each area.

7.6.4.3 Physically Removing Debris

If debris removal is a viable option, hillside areas present various levels of removal difficulty. For instance, cans in the Can Dump Site (a nonconcrete debris site) are relatively easy to pick up and package. A voluntary corrective action (VCA) may be a viable alternative for the Can Dump Site SWMU. Debris located at the Disposal Area Southeast of Los Alamos Inn aggregate is easily accessible to heavy equipment because a paved parking lot occupies the rim immediately above this site. If removal proves to be the most viable response action, a crane, drag line, or conveyor system could be used in this area. Debris removal in Bailey's Canyon is very difficult. Access to this hillside disposal site from the canyon rim above is blocked by residential townhouses. The rugged terrain of the hillside makes access from the canyon bottom below difficult and presents a safety risk to workers performing debris removal.

7.6.5 Phase I Sampling for SWMU Aggregates

A discussion of Phase I sampling planned at individual OU 1078 SWMU aggregates follows. (Phase II sampling will also be discussed for the industrial waste line). The OU 1078 sampling plans have been developed based on best available information on TA-1 operations. The Phase I sampling proposed in this chapter is surface soil sampling. Subsurface sampling, if proven necessary, will occur only during Phase II investigation. All soil samples will undergo gross alpha, beta, and gamma activity measurements, but only selected soil samples (judgmental or random) will undergo full suite analyses. Other radionuclides may be laboratory analyzed if gamma spectrometry indicates their presence in above-background concentrations. Soil samples will be collected at the prescribed locations in each SWMU aggregate. The individual sampling plans described below provide more aggregate-specific information than the general mesa-top and hillside sampling plans discussed above. Sampling of Ashley Pond, the industrial waste line, and the opportunity-available SWMU aggregates receive separate treatment. All sampling exercises adhere to the ER SOPs listed in Table 1.10-4.

7.7 Sigma Area, SWMU Aggregate A (Includes Canyon Rim)

7.7.1 Problem Statement

The Sigma aggregate includes Sigma, H, Theta, and C Buildings and several small outbuildings. The aggregate description is presented in Section 6.3 and is depicted in Figure 6.3-1 . The canyon rim sampling plan is also included in this discussion. The Sigma Building aggregate contains four potential surface contamination sites and two storm drain outfalls. The storm drain outfalls were located on the mesa top, one north of Sigma Building and one south of C Building.

The potential contamination problems at this SWMU aggregate are all located on the mesa top, and problem statements follow the general mesa-top sampling plan presented in Section 7.3.1. The Sigma area sampling plan is detailed in Section 7.4. The canyon rim sampling details are found in Section 7.4.2 and are depicted in Figure 7.4-4.

7.7.2 Decisions

Decisions are the same as for the general mesa-top sampling plan (Section 7.3.2) and the canyon rim sampling plan(Section 7.4.2).

7.7.3 Data Needs

Data needs are those used in the general mesa-top sampling plan (Section 7.3.4).

7.7.4 Domain of Decision

The specific sampling domain, presented in Figures 7.4-1 and 7.4-2, follows the general domain in Section 7.3.5.

7.7.5 Decision Logic

The sampling decision logic is the same as used for the general mesa-top (Section 7.3.3) and canyon rim (Section 7.4.2) sampling plans.

7.7.6 Sampling Plan

The Phase I sampling plan is presented in Section 7.4. Figure 7.4-4 indicates the main region for surface soil sampling at the Sigma area SWMU aggregate. Table 7.7-1 is a compilation of the number and types of samples to be taken at Sigma area. Table 7.7-2 is a compilation of the number and types of samples to be taken during the sampling along the canyon rim.

TABLE 7.7-1

SIGMA AREA SAMPLING

Sub-sampling Area	Total Length or Width * (ft)	Number of Rows in Grid	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples**
Systematic Grid	270 X 270	10	30	30	100	15
Judgmental Samples***	—	—	—	—	25	5

*Total area on which systematic grid will be established is 1.67 acres.

**Minimum number of full suite samples.

***Judgmental samples at Sigma area will be determined by former structure footprints or at areas for which field radiological surveys (PHOSWICH, FIDLER) may indicate potential contamination.

TABLE 7.7-2

CANYON RIM SAMPLING

Sub-Sampling Area	Total Length of Canyon Rim Measured (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Canyon Rim Outside DOE Fence	3000	100	40**	5
Judgmental Samples***	—	—	10	5

* Minimum number of full suite samples.

** Samples will be collected every 100 ft. A radiological survey will be conducted on the canyon rim along the DOE fence, and any area indicating contamination will be sampled further. Allows for up to 10 non septic tank judgmental samples as determined by pre-sampling radiological survey.

*** Samples taken from areas surrounding former locations of septic tanks.

7.8 Bailey Bridge, SWMU Aggregate B

7.8.1 Problem Statement

The Bailey Bridge SWMU aggregate has both mesa-top and hillside components. The mesa-top area is relatively flat, with drainage flowing south toward the canyon, and is occupied primarily by residences, paved parking lots, and roadways. The canyon wall is steepest at the canyon rim, dropping irregularly to the canyon floor approximately 300 ft below. The Bailey Bridge aggregate, described in Section 6.4 and Figure 6.4-1, consists of 13 SWMUs, all of which generated waste water or contaminants that were carried into Bailey's Canyon by surface water run-off after precipitation events.

Data from the 1975–1976 cleanup indicates potential surface contamination at the sheet-metal shop; C, Delta, Sigma, Theta, H, I, and J Buildings; the land surrounding these buildings; and the Bailey Bridge area. Soil data evidence from the 1970s relies on gross alpha activity measurements. Soil with the highest measurement, 310 pCi/g gross alpha before soil remediation, was collected a few feet above the northwest corner of H Building (near the location of the former industrial waste line). After radioactive contamination was removed by soil excavation, most gross alpha readings for the remaining soil were below 25 pCi/g, but a few samples were above this value (Ahlquist et al. 1977, 0016). Following decommissioning and decontamination, surface water run-off from these areas would have reported to Bailey's Canyon, transporting any residual contaminants into the canyon. Most of the mesa-top area is now covered by buildings, asphalt, or lawns; thus any remaining contaminated soil is not exposed.

The canyon hillsides were not included in the 1975–1976 cleanup. Very few data exist on potential soil contamination on the hillsides. Potentially contaminated construction rubble, primarily concrete, is also located in Bailey's Canyon. As stated in Chapter 6, contaminated debris measuring 2500 counts/min or less was pushed into the canyon beneath Bailey Bridge. The floor of the sheet-metal shop, registering contamination between 300 and 5000 counts/min (Ahlquist et al. 1977, 0016), was also disposed in the canyon. Debris and soil was used to fill most of the upper canyon under Bailey Bridge. In some places (at the top of the canyon), several townhouses may be built on the fill.

7.8.2 Decisions

The Bailey Bridge SWMU aggregate has both mesa-top and hillside components. Decisions for the general hillside (Section 7.5.2) and the general mesa-top (Section 7.3.2) sampling plans are applied.

7.8.3 Data Needs

Data needs are the same as those for the general hillside sampling plan (Section 7.5.4) and the mesa-top sampling plan (Section 7.3.4).

7.8.4 Domain of Decision

The specific sampling domain of this SWMU aggregate will depend on geomorphic characterization. A preliminary estimate of the area to be sampled is presented in Figure 7.8-1. The hillside sampling plan will be applied only to the area at or below the canyon rim and uses the same general hillsides decision domain described in Section 7.5.5. The mesa-top sampling plan will be applied to the area above the canyon rim and uses the general mesa-top decision domain described in Section 7.3.5.

7.8.5 Decision Logic

The sampling decision logic is the same as that used for the general hillside (Section 7.5.3) and the general mesa-top (Section 7.3.3) sampling plans .

7.8.6 Sampling Plan

The Phase I sampling plan follows the guidelines presented for the general mesa-top (Section 7.4) and the general hillside (Section 7.6) sampling plans.

Specific number and locations of Phase I hillside samples will depend on the geomorphic mapping conducted before sampling. Figure 7.8-1 depicts sample locations for Phase I sequential sampling. This figure is based on outfall location and on preliminary judgmental placement of drainages. Table 7.8-1 describes the number and relative placement of the Phase I sampling locations. The total number of samples may change; however, the relative placement (i.e., the number of grid rows and distance between each sample) will remain the same.

Because accessibilty is limited, there will be no Phase I mesa-top sampling for this SWMU aggregate. Decisions to sample the mesa top in Phase II will rely on the findings from the Sigma area aggregate and the canyon rim sampling.

TABLE 7.8-1

BAILEY BRIDGE SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Outfall (east)**	225	1	—	10	30	3
Surface Water*** Run-off	375	1	—	10	50	5
Outfall (west)**	50	1	—	10	5	2
Benches: none						
Primary Drainage	1300	1	—	100	13	2
Bottom of Drainage	50	1	—	10	5	1

* Minimum number of full suite samples.

** The top of drainage sampling indicated in this aggregate reflects not only outfalls but also areas in which concrete debris has been disposed near the top of the canyon. The total number of samples may be fewer than stated because of inaccessible terrain in some of these areas

*** The middle outfall received most of precipitation runoff from the mesa top SWMUs located in the Bailey Bridge Aggregate. The coverage approximates the areas into which surface water runoff would be expected to flow into Bailey's Canyon.

7.9 Hillside 140, SWMU Aggregate C

7.9.1 Problem Statement

Hillside 140 includes suspected subsurface soil contamination, a storm drain outfall on the mesa top, septic tank outfalls, and debris on the hillside. Surface water run-off from precipitation would have carried surface contaminants into the drainage below Septic Tank 140. The aggregate is detailed in Section 6.5 and Figure 6.5-1. The storm drain outfall and the subsurface soil contamination follow the mesa-top sampling plan. In 1976, Septic Tank 140 and the hillside below were found contaminated with low levels of

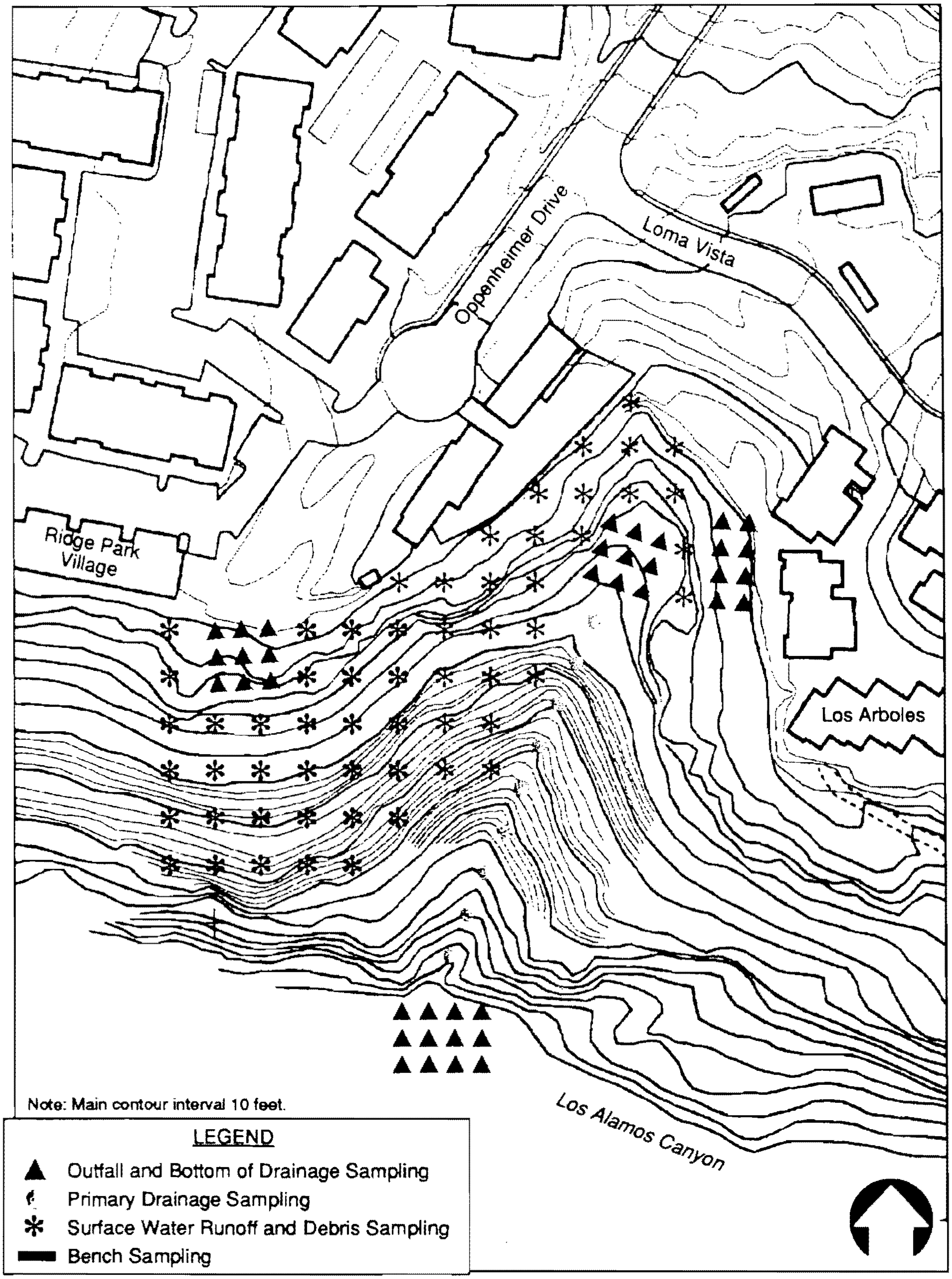


Figure 7.8-1 Sampling locations for "Bailey Bridge" SWMU aggregate.

radioactivity. The outfall area and its drainage to the canyon bottom will be investigated.

The sludge from Septic Tank 135 and the surrounding soil were not radioactively contaminated (Ahlquist et al. 1977, 0016). This outfall area will be sampled to determine the existence of any contamination above proposed Subpart S action levels or future IWP radioactivity guidelines. If contamination is found at the Septic Tank 135 outfall, the upper drainage will be defined and soil sampling will be required.

7.9.2 Decisions

The same sampling decision structure as that of the general mesa-top sampling plan in Section 7.3.2 is used for the suspected subsurface soil contamination and storm drain. General hillside sampling plan decisions (Section 7.5.2) are applied to Septic Tanks 140 and 135 and the storm drains. Because Septic Tank 135 has no history of contamination, only the outfall of Septic Tank 135 (not the drainage below) will be initially sampled for the presence of contaminants.

7.9.3 Data Needs

General mesa-top sampling data needs (Section 7.3.4) apply to the subsurface soil contamination and storm drains. Septic tanks and surface debris follow the general hillside sampling plan (Section 7.5.4).

7.9.4 Domain of Decision

The specific sampling domain for the septic tanks and surface debris site depends on geomorphic mapping; the general domain in Section 7.5.5 will also be followed. Figure 7.9-1 presents a preliminary depiction of the proposed sampling location for Hillside 140 and J-2 and TU aggregate. The general mesa-top domain discussed in Section 7.3.5 applies to this mesa-top area.

7.9.5 Decision Logic

The sampling decision logic for the Hillside 140, J-2/TU mesa-top area is the same as that for the general mesa-top sampling plan (Section 7.3.3). The decision logic for the hillside area is the same as that for the general hillside sampling plan (Section 7.5.3).

7.9.6 Sampling Plan

The Phase I sampling plan for the Hillside 140, J-2/TU mesa-top area will depend on results of the Sigma area sampling, as detailed in the mesa-top model in Section 7.4. Limited Phase I mesa-top sampling is planned for this SWMU aggregate because of the inaccessibility of these areas. The general plan for the hillsides follows the guidelines set forth in Section 7.6. Specific number and locations of Phase I samples will depend on geomorphic mapping occurring before any sampling is done. Figure 7.9-1 depicts the hillside area of this SWMU aggregate and the general locations for Phase I sequential sampling. This figure is based on the location of outfalls and a preliminary placement of drainages. Table 7.9-1 describes the number and relative placement of samples. The total number of samples may change, but the number of grid rows and distance between each sample will remain the same.

7.10 J-2/TU Area, SWMU Aggregate D

7.10.1 Problem Statement

The J-2/TU SWMU aggregate is adjacent to the Hillside 140 SWMU aggregate, described in Section 6.6 and shown on Figure 6.6-1. This aggregate consists of mesa-top and hillside SWMUs and areas that receive run-off from mesa-top SWMUs. The mesa-top area was investigated and remediated by Ahlquist. The hillside area has been neither radioactively surveyed or remediated. The mesa top has four areas of suspected subsurface soil contamination, three storm drains with outfalls, and two septic tank locations. Run-off from these areas moves toward the canyon rim and down the hillside. The lower part of this drainage is the same drainage described for the Hillside 140 SWMU aggregate, and the sampling plans for this area will be the same for both aggregates.

In the past, levels of radioactive contamination in the J-2/TU SWMU aggregate were found south of the TU and TU-1 Buildings (Section 6.6.3). Ahlquist performed extensive excavation over this entire area to remove radioactively contaminated soil with activity above 25 pCi/g gross alpha. However, two deep (approximately 15 ft) narrow veins of low ^{238}U contamination were not removed (Ahlquist et al. 1977, 0016) but were covered with 15 ft of clean fill.

Contamination outside the J-2 Building was primarily associated with the industrial waste line and was cleaned; the gross alpha detection limit was below 25 pCi/g.

The problem statement for the J-2/TU mesa-top area is the same as that of the general mesa-top problem statement in Section 7.3.1. Because no debris is present on the hillside, the hillside problem statement follows the general hillside problem statement in Section 7.5.1.

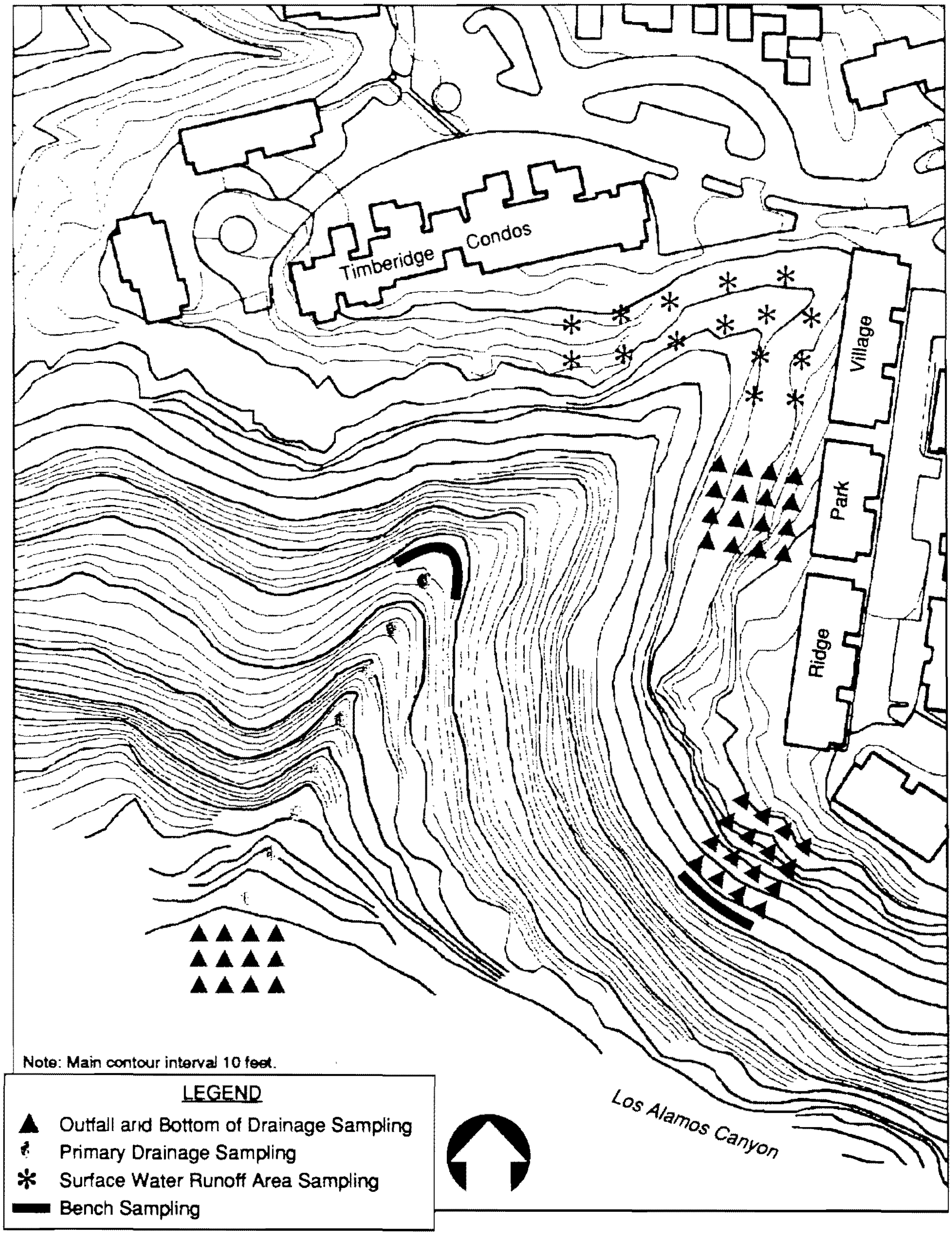


Figure 7.9-1 Sampling locations for "Hillside 140" and "J-2/TU Area" SWMU aggregates.

TABLE 7.9-1

HILLSIDE 140, J-2/TU SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Septic Tank 140 Outfall	100	1	20	20	5	3*
	100	2	20	20	5	3*
	100	3	20	20	5	3*
J-2 Area Outfall	300	1	20	20	15	2
	300	2	20	20	15	2
	300	3	20	20	15	2
Bench	75	Surface	—	10	8	2
		1 ft below surface	—	10	8	2
		Soil-tuff interface	—	10	8	2
		6 in. into tuff (if necessary)	—	10	8	(2)
Drainage	1700	—	—	100	17	(2)
Bottom of Drainage	120	1	20	20	6	2
	120	2	20	20	6	2
Septic Tank 135 Outfall	20	1	10	10	2	
	50	2	10	10	5	1

TABLE 7.9-1, (continued)

Sub - sampling Area	Total Length or Width (ft)	Grid Row Number	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Septic Tank 135 Bench**	100	Surface	—	25	(4)	(1)
		1 ft Below Surface	—	25	(4)	(1)
		Soil-tuff Interface	—	25	(4)	(1)
		6 in. into Tuff (If Necessary)***	—	25	(4)	(1)

* Minimum number of full suite samples, including one composite for each grid row.
** Septic Tank 135 is being nominated for NFA. Limited sampling will be done at its outfall.
*** If the Septic Tank 135 bench is sampled, tuff will be investigated only if hazardous or radioactive constituents are indicated.
() Sample numbers contained in parentheses indicate optional Phase I sampling.

7.10.2 Decisions

All SWMUs in the J-2/TU area are located on the mesa top. Because past remediation occurred in these mesa-top areas, the decision structure in Section 7.3.2 will be followed to determine whether sampling is necessary. Mesa-top inaccessibility allows no Phase I sampling. The hillsides must be investigated because surface water run-off may have carried contaminants from mesa-top SWMUs onto the hillsides. Phase I sampling follows the general hillsides decision structure in Section 7.5.2.

7.10.3 Data Needs

Data needs for areas described in 7.10.2 are detailed in the general mesa-top (Section 7.3.4) and the general hillside (Section 7.5.4) sampling plans.

7.10.4 Domain of Decision

The sampling decision domains used in the general mesa-top (Section 7.3.5) and the general hillside (Section 7.5.5) sampling plans apply to the areas described in Section 7.10.2. Specifically, the hillside domain consists of the hillside and drainage areas (specified in Figure 7.9-1) south of J-2 Building. This study area will be confirmed by geomorphic mapping conducted at the beginning of the study.

7.10.5 Decision Logic

The sampling decision logic for the mesa-top areas described in Section 7.10.2 follows the general mesa-top sampling plan (Section 7.3.3); that of the hillsides follows the general hillside sampling plan (Section 7.5.3).

7.10.6 Sampling Plan

The sampling plan for the mesa-top area is described in Section 7.4. No Phase I sampling will be done because the area is inaccessible. Any future mesa-top sampling will depend on the Sigma area sampling results.

The Phase I sampling plan for the hillside area follows the guidelines in Section 7.6. The specific number and locations of samples will depend on future geomorphic mapping that will locate viable drainage areas. Figure 7.9-1 depicts the J-2/TU SWMU aggregate hillside area, the Hillside 140 SWMU aggregate, and general locations for Phase I sequential sampling. This figure is based on outfall locations and preliminary placement of drainages. Table 7.9-1 describes the number and relative placement of samples. The J-2/TU drainage area intersects the drainage area from the Hillside 140 SWMU aggregate. Samples taken below this area of intersection will serve both the J-2/TU sampling plan and the Hillside 140 sampling plan. The total number of samples to be taken in Phase I may change, but the relative placement will remain the same.

7.11 Cooling Tower 80, SWMU Aggregate E

7.11.1 Problem Statement

The Cooling Tower 80 SWMU aggregate has both mesa-top and hillside components. Section 6.7 describes this aggregate, and Figure 6.7-1 depicts its SWMU configuration. The area of the mesa top toward which contaminants transported by run-off would flow to the rim of the canyon and down the hillside contains a drain line, a storm drain, and associated outfalls. The hillside area, which contains Septic Tank 141, its outfall, and a small amount of surface construction debris, is nominated for NFA.

The limited data available indicate no contamination in the mesa-top area. No radioactive contamination was found in Septic Tank 141's sludge when the tank was removed in the 1974–76 remediation (Ahlquist et al. 1977, 0016). Contamination was found northeast of Septic Tank 141 at the D Building area, where the storm drains that discharged onto Hillside 140 originated. No data on potential hillside contamination are available.

The drain line, storm drains, and their outfalls follow the general mesa-top problem structure in Section 7.3.1. The septic tank and surface disposal site follow the general hillside problem structure Section 7.5.1.

7.11.2 Decisions

The drain line, storm drains, and their associated outfalls follow the general mesa-top decision structure in Section 7.3.2. The septic tank and surface disposal area follow the general hillside decision structure in Section 7.5.2.

7.11.3 Data Needs

The drain line, storm drains, and their associated outfalls follow the general mesa-top data needs structure in Section 7.3.4. The septic tank and surface disposal site follow the general hillside data needs structure in Section 7.5.4.

7.11.4 Domain of Decision

The drain line, storm drains, and their associated outfalls follow the general mesa-top sampling decision domain structure in Section 7.3.5. The septic tank and surface disposal site follow the general hillside decision domain structure in Section 7.5.5 but will specifically apply to the drainage area below Cooling Tower 80. This hillside domain will be confirmed through geomorphic mapping at the beginning of the study.

7.11.5 Decision Logic

The drain line, storm drains, and their associated outfalls follow the general mesa-top sampling decision logic structure in Section 7.3.3. The septic tank and surface disposal site follow the general hillside decision logic structure in Section 7.5.3.

7.11.6 Sampling Plan

The sampling plan for the mesa-top area is described in Section 7.4. No Phase I sampling will take place because townhouses cover the mesa top. Mesa-top constituent concentrations will be projected based on Sigma area sampling results.

The Phase I sampling plan for the hillside area will follow guidelines presented in Section 7.6. The specific number and locations of samples will depend on geomorphic mapping that will specifically locate areas for sampling. Figure 7.11-1 depicts the hillside area and general locations for Phase I sequential sampling. This figure is based on the location of the outfalls and a preliminary placement of drainages. Table 7.11-1 describes the number and relative placement of Phase I samples. The drainage area intersects the drainage area from Hillside 137. At the intersection point and on the hillside below, the sampling locations for the Cooling Tower 80 and Hillside 137 SWMU aggregates coincide.

7.12 Hillside 138, SWMU Aggregate F

7.12.1 Problem Statement

Hillside 138 includes the former location of Septic Tank 138 and its outfall to Los Alamos Canyon, a storm drain with its associated outfall, and the hillside below. Section 6.8 and Figure 6.8-1 describe this aggregate.

The 1975–1976 cleanup discovered soil contamination at Septic Tank 138, but the sludge in the tank and the tank inlet/outlet pipes was free of contamination. Contaminated soil was removed from around the tank. Contamination was also found at the outfall of Septic Tank 138, but no removal of contamination was conducted below the outfall because of the steepness of the canyon walls. In 1946, gamma and alpha were found at the waste line outlet of Y Building (Septic Tank 138). It seems probable that, at some point, contamination was moving out of Y Building and through Septic Tank 138. If sludge had been periodically pumped from Septic Tank 138, potential contaminants would have been pumped or flushed out of the tank early in its history. Uncontaminated fluids would have moved through the tank toward the end of

TABLE 7.11-1

C0OLING TOWER 80 SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Cooling Tower 80 Outfall	100	1	15	20	5	2*
	100	2	15	20	5	2*
	100	3	15	20	5	2*
Bench**	150	Surface	—	30	5	2
		1 ft Below Surface	—	30	5	2
	Soil-tuff	— Interface	30	5	2	
	6 in. into	— Tuff (If Necessary)	30	(5)	(2)	
Security Road**	500	1	—	50	10	1
Drainage A***	700	—	—	100	7	1
Drainage B***	700	—	—	100	(7)	(1)
Bottom of	150 Drainage A	1	20	20	8	1
	150	2	20	20	8	1
Bottom of Drainage B	150	1	20	20	8	1
	150	2	20	20	8	1

* Minimum number of full suite samples including one composite for each grid row.

** Discharges to the hillside below the Cooling Tower 80 outfall most likely flowed east down the security road. The road leveled into a bench area. The bench is common to both Cooling Tower 80 and Hillside 137 SWMU aggregates.

***Run-off from the bench into Los Alamos Canyon appears to have two possible drainages. However, geomorphic mapping and observations during storm events may prove that there is only one possible drainage into the canyon from this bench. If this is the case, only one drainage will be investigated. Otherwise, the drainages will be designated A and B and both will require sampling.

() Sample numbers contained in parentheses indicate optional Phase I sampling.

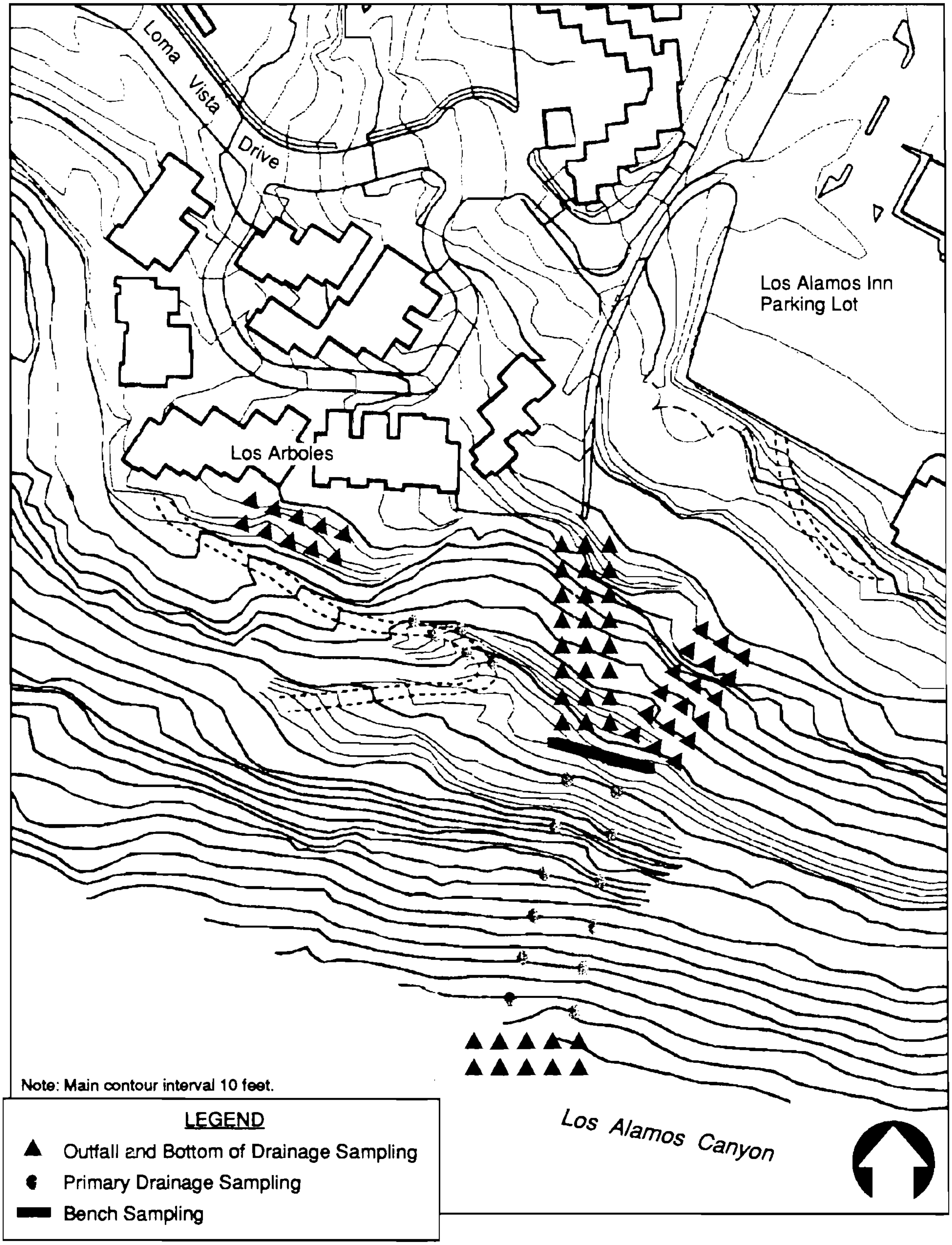


Figure 7.11-1 Sampling locations for "Cooling tower 80" and "Hillside 137" SWMU aggregates.

its lifetime.

After remediation, sample gross alpha activities in the excavated area around Septic Tank 138 ranged from 100 pCi/g to less than 25 pCi/g (detection limit was 25 pCi/g). Backfilling occurred after samples were collected; therefore, present surface radioactivity would be lower than the radioactivity of surface samples cited for the 1976 data. No remediation was performed on Los Alamos Canyon walls. Gross alpha activity for soil at one sampling point below the outfall of Septic Tank 138 was as high as 8900 pCi/g.

7.12.2 Decisions

The same sampling decision structure used in the general mesa-top sampling plan, Section 7.3.2, applies to Septic Tank 138 subsurface soil contamination and storm drain. General hillside sampling plan decisions (Section 7.5.2) are used for Septic Tank 138 and its outfall.

7.12.3 Data Needs

The subsurface soil contamination and storm drains have the same data needs as those presented for the general mesa-top sampling (Section 7.3.4), and the data needs for the septic tank are the same as those of the general hillside sampling plan (Section 7.5.4).

7.12.4 Domain of Decision

The specific sampling domain for the septic tank impacts will be determined by geomorphic mapping; the general domain in Section 7.5.5 will also be followed. A preliminary estimate of the hillside Phase I sampling effort is presented in Figure 7.12-1. The general mesa-top domain is discussed in Section 7.3.5 and applies for this area.

7.12.5 Decision Logic

The sampling decision logic for the mesa-top area of Hillside 138 is the same as that for the general mesa-top sampling plan (Section 7.3.3). The decision logic for Hillside 138's hillside area is the same as that for the general hillside sampling plan (Section 7.5.3).

7.12.6 Sampling Plan

The Phase I sampling plan for the mesa-top area is as described in Section 7.4. Most of the mesa-top area is inaccessible for sampling. The Phase I Sigma area sampling results will guide the necessity for sampling this area in Phase II.

The general plan for the hillside area follows the guidelines set out in Section 7.6. The specific location and numbers of Phase I samples will depend on geomorphic mapping that will take place before any sampling is done. Figure 7.12-1 depicts sample locations for Phase I sampling. This figure is based on the location of the outfalls and a preliminary placement of drainages. Table 7.12-1 describes the number and relative placement of the samples. The number of samples may change, but the relative placement will remain the same.

7.13 Hillside 137, SWMU Aggregate G

7.13.1 Problem Statement

The Hillside 137 SWMU aggregate is described in Section 6.9 and Figure 6.9-1.

Radioactive contamination was found associated with the drain lines, septic tanks, building footprints, industrial waste line hookups to D Building, and assorted outfalls. The 1974–1976 cleanup effort concentrated on these locations. Remediation involved removal of contaminated pipelines, a septic tank and sediments, and excavation of a considerable volume of contaminated soil and sediments. After remediation, maximum sample gross alpha levels for various locations ranged from 490 pCi/g (a hillside location) to less than 25 pCi/g for surface soil scoop samples (detection limit was 25 pCi/g). Backfilling occurred after surface samples were collected, making the present surface radioactivity much lower than surface readings from sample data of the 1970s. No remediation was performed on the Los Alamos Canyon walls. Any chemicals on the canyon walls or in the canyon would come from direct drain line discharges, outfalls from septic systems, or surface water run-off. Organic chemicals would generally be exposed to ambient conditions (physical and biological) and may have been almost entirely biodegraded or washed down the canyon. Little information exists on the potential presence of hazardous chemicals, but remediation activities and natural dissemination have undoubtedly reduced their occurrence in this area.

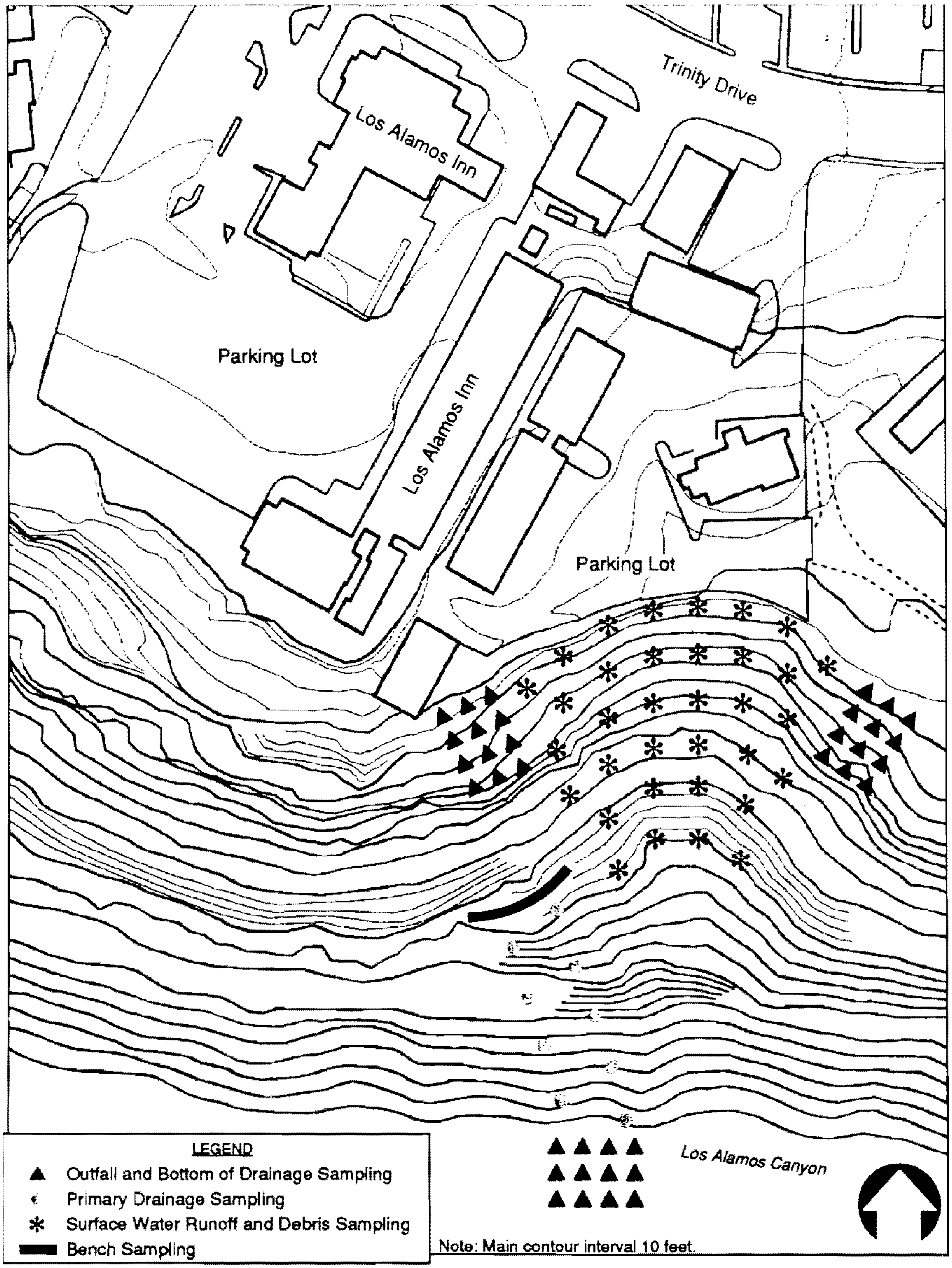


Figure 7.12-1 Sampling locations for "Hillside 138" and "Surface disposal site Southeast of Los Alamos Inn" SWMU aggregates.

TABLE 7.12-1

HILLSIDE 138 SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number	Row Spacing (ft)	Distance Between Samples (ft)	Total Number of Samples	Number of Full Suite Samples*
Septic Tank 138 Outfall	100	1	20	20	5	2*
	100	2	20	20	5	2*
	100	3	20	20	5	2*
	100	4	20	20	5	2*
	100	5	20	20	5	2*
	100	6	20	20	5	2*
	100	7	20	20	5	2*
Bench	150	Surface	—	30	5	2
		1 ft below surface	—	30	5	2
		Soil-tuff Interface	—	30	5	2
		6 in. into tuff (if necessary)	—	30	(5)	(2)
Drainage A**	700	1	—	100	7	1
Drainage B	700	1	—	100	7	(1)
Bottom of Drainage A	100	1	10	10	10	2
	100	2	10	10	10	2
	100	3	10	10	10	2
Bottom of Drainage B	100	1	10	10	(10)	(2)
	100	2	10	10	(10)	(2)
	100	3	10	10	(10)	(2)

*Minimum number of full suite samples, including one composite for each grid row.

**Run-off from the Hillside 138 bench may flow down one of two possible drainages, designated A and B. Geomorphic mapping and observations during storm events may indicate that only one of the drainages is viable. If this is the case, sampling will take place in that drainage only.

() Sample numbers contained in parentheses indicate optional Phase I sampling.

7.13.2 Decisions

The sampling decision structure for Hillside 137's suspected subsurface soil contamination and storm drain is the same decision structure as that for the general mesa-top sampling plan in Section 7.3.2. Septic Tank 137 and the other outfalls have the same decision structure as in the general hillside sampling plan (Section 7.5.2).

7.13.3 Data Needs

The suspected subsurface soil contamination and storm drains follow the general mesa-top sampling data needs (Section 7.3.4). Septic Tank 137 and the outfalls follow the general hillside sampling data needs (Section 7.5.4).

7.13.4 Domain of Decision

The specific sampling domain for the septic tank area will depend on geomorphic mapping but will still follow the general domain described in Section 7.5.5. A preliminary depiction of the hillside area is presented in Figure 7.11-1. The general mesa-top domain is discussed in Section 7.3.5 and applies to the Hillside 137 mesa-top area.

7.13.5 Decision Logic

The sampling decision logic for the Hillside 137 mesa-top area is the same as that for the general mesa-top sampling plan (Section 7.3.3). The decision logic for the hillside area is the same as that for the general hillside sampling plan (Section 7.5.3).

7.13.6 Sampling Plan

The sampling plan for Hillside 137's mesa-top area relies on the results of the RFI sampling described in Section 7.4. Any Phase II subsurface sampling done in this area will await the results of Phase I mesa-top and hillside sampling below Septic Tank 137.

The general plan for the hillside follows guidelines set out in Section 7.6. The specific number and locations of samples will depend on geomorphic mapping that will occur before any sampling is done. Figure 7.11-1 depicts Phase I sample locations. The Hillside 137 and Cooling Tower 80 aggregates have common sampling areas that are depicted on the same figure. This figure is based on the location of outfalls and a preliminary placement of drainages. Table 7.13-1 describes the number and relative placement of samples. The number of samples may change, but the number of grid rows and distance between each sample will remain the same.

7.14 Surface Disposal Site Southeast of Los Alamos Inn, SWMU Aggregate H

7.14.1 Problem Statement

The Surface Disposal Site Southeast of Los Alamos Inn aggregate is detailed in Section 6.10 and Figure 6.10-1. The aggregate includes three storm drains (associated with R, S, and T Buildings), a septic tank from S-1 Building, two outfalls from other septic tanks, and an incinerator (believed to have burned non-hazardous, nonradioactive combustible waste) that was located west of S-1 Building. Debris was also deposited in the canyon south of S-1 Building. It is likely that precipitation washed discharges from the storm drains into the canyon. Septic Tank 269 and the storm drain near R Building had outfalls that discharged at or near the canyon rim.

The 1976–1977 cleanup effort collected no samples in this area or at the outfall for Septic Tanks 142, 149, and 269. No information on potential contamination from hazardous chemicals is available; however, natural dissemination and/or biological degradation most likely have reduced any hazardous chemical occurrence from TA-1's operational years.

7.14.2 Decisions

The same sampling decision structure used for the general mesa-top sampling plan in Section 7.3.2 is used for this aggregate's storm drain and area of suspected subsurface soil contamination. The general hillside sampling plan decisions (Section 7.5.2) apply to all outfalls.

7.14.3 Data Needs

The suspected subsurface soil contamination and storm drains data needs follow the general mesa-top sampling data needs (Section 7.3.4), and those for the septic tanks and outfalls follow the general hillside sampling data needs (Section 7.5.4).

TABLE 7.13-1

HILLSIDE 137 SAMPLING

Sub-Sampling Area	Total Length or Width (ft)	Grid Row Number (ft)	Row Spacing Samples (ft)	Distance Between Samples	Total Number of Samples*	Number of Full Suite Samples
Septic Tank 137 and D-2 Drain	75	1	20	20	4	2*
Line Outfalls	75	2	20	20	4	2*
	75	3	20	20	4	2*
	75	4	20	20	4	2*
	75	5	20	20	4	2*
	75	6	20	20	4	2*
	75	7	20	20	4	2*
D Building Drains and Natural Run-Off	75	1	20	20	4	2*
Outfalls	75	2	20	20	4	2*
	75	3	20	20	4	2*
	75	4	20	20	4	2*
	75	5	20	20	4	2*
	75	6	20	20	4	2*
	75	7	20	20	4	2*
Bench Area**						
Drainage Area**						
Bottom of Drainage**						

* Minimum number of full suite samples including one composite from each grid row.

** See Table 7.11-1, Cooling Tower 80 Sampling. The Cooling Tower 80 and Hillside 137 aggregates have a common bench, lower drainage, and outfall to the canyon. Consequently, these entities share the same sampling scenario.

7.14.4 Domain of Decision

The specific domain for the septic tank outfall area will depend on geomorphic mapping; the general domain described in Section 7.5.5 will also be followed. A preliminary depiction of the hillside domain area is presented in Figure 7.12-1. The Hillside 138 and Surface Disposal Site SE of Los Alamos Inn aggregates share common areas of investigation, and their sampling locations are depicted together in Figure 7.12-1. The general mesa-top domain is discussed in Section 7.3.5 and applies for this mesa-top area.

7.14.5 Decision Logic

The decision logic used for this aggregate's mesa-top area is the same as that for the general mesa-top sampling plan (Section 7.3.3). The same decision logic used for the general hillside sampling plan (Section 7.5.3) applies to this surface hillside disposal site area.

7.14.6 Sampling Plan

The sampling plan for the surface disposal site mesa-top area is as described in Section 7.4. Subsurface sampling (Phase II) and mesa-top sampling will occur only if results of the Sigma area sampling and Phase I hillside sampling for this aggregate warrant Phase II sampling.

The general plan for this disposal site's hillside area follows guidelines set out in Section 7.6. The specific number and locations of samples will depend on geomorphic mapping that will occur before any sampling is done. Figure 7.12-1 depicts sample locations for Phase I sampling. This figure is based on known locations of outfalls and a preliminary placement of drainages. Table 7.14-1 describes the number and relative placement of the samples. The number of samples may change, but the number of grid rows and distance between each sample will remain the same.

7.15 The Can Dump Site, SWMU Aggregate I

7.15.1 Problem Statement

The Can Dump Site SWMU aggregate, described in Section 6.11 and Figure 6.11-1, includes Septic Tank 275 and a surface solid waste disposal site on the hillside below the canyon rim. The canyon wall drops gradually from the rim for approximately 150 ft; then it drops sharply until it levels out near the canyon bottom.

TABLE 7.14-1

SURFACE DISPOSAL SITE SOUTHEAST OF LOS ALAMOS INN SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number (ft)	Row Spacing Samples (ft)	Distance Between Samples	Total Number of Samples*	Number of Full Suite Samples
Septic Tanks 142 and 269	400	1	40	40	10	2
Storm Water Run-off Outfalls and Debris Area	400	2	40	40	10	2
Bench Area**						
Drainage Area**						
Bottom of Drainage**						

* Minimum number of full suite samples.

** See Table 7.12-1, Hillside 138 Sampling. The Hillside 138 and Surface Disposal Site Southeast of Los Alamos Inn aggregates appear to have a common bench, lower drainage, and outlet at the bottom of the canyon. Expert geomorphic mapping most likely will confirm the commonality of these areas.

There is no evidence that radioactive chemical were used or stored the buildings associated with this aggregate. Hazardous chemicals, such as paints and solvents, could have been associated with the shop and maintenance buildings. The septic tank line originated at Warehouse 13 and discharged onto the hillside. Debris (largely empty cans) was deposited in the canyon south of Warehouses 7 and 15.

Data from the 1975–1976 decontamination effort includes three mesa-top soil samples measuring slightly above the gross alpha detection limit of 25 pCi/g. Two of these samples were from the canyon rim south of Warehouses 7 and 15 (above the Can Dump Site), and one was north of this area between Warehouses 7 and 21. A septic tank (believed to be Septic Tank 275) was found on the side of the canyon. Apparently it had been pushed over the rim during post-1950s construction activities. No radioactive soil contamination was found in or around the area when the septic tank was found (Ahlquist et al. 1977, 0016). Septic Tank 275 is being nominated for NFA, and no Phase I sampling for this SWMU is included in this sampling plan.

No hazardous chemicals sampling or analyses were done during the 1975–1976 decontamination effort. No sampling or cleanup action was initiated at the Can Dump Site. There is no reason to believe that significant amounts of contamination from organic compounds or hazardous metal disposal are present at the Can Dump Site. An effort will be made to undertake a VCA at the Can Dump Site early in the RFI. The VCA will involve removal of the cans and disposal at an appropriate disposal area.

The general hillside problem statement specified in Section 7.5.1 applies to the Can Dump Site.

7.15.2 Decisions

The Can Dump Site uses the same sampling decision structure as that of the general hillside sampling plan (Section 7.5.2).

7.15.3 Data Needs

Data needs for the Can Dump Site are the same as those for the general hillside sampling plan (Section 7.5.4). Because of the nature of the material disposed (paint and solvent cans) at this site, emphasis is placed on looking for organic compounds and metals. Considering the condition of the cans, it is unlikely that organic compounds have persisted in the 30 years since the cans were deposited.

7.15.4 Domain of Decision

The specific sampling domain for the Can Dump Site will depend on geomorphic mapping. A preliminary estimate of the extent of the domain is presented in Figure 7.15-1. The cans are scattered over a wide area that has no clearly defined drainage. Therefore, the entire disposal site will be sampled as if it were at the top of a drainage. However, the extent of sampling will be limited if a VCA is conducted early in the RFI.

7.15.5 Decision Logic

The same sampling decision logic used in the general mesa-top sampling plan of Section 7.3.4 applies to the mesa-top area of the Can Dump Site. The decision logic of the general hillside sampling plan (Section 7.3.5) applies to the Can Dump Site hillside area.

TABLE 7.15-1

CAN DUMP SITE SAMPLING

Sub-sampling Area	Total Length or Width (ft)	Grid Row Number (ft)	Row Spacing Samples (ft)	Distance Between Samples	Total Number of Samples*	Number of Full Suite Samples
Septic Tank 275**						
Can Dump Site	250	1	—	20	13	2
	100	2	15	20	5	2*
Bench†	100	Surface	—	20	(10)	(2)
		1 ft Below Surface	—	20	(10)	(2)
		Soil-tuff Interface	—	20	(10)	(2)
		6-in. into Tuff (If Necessary)	—	20	(10)	(2)
Drainage†	500	1	—	100	5	(1)
Bottom of Drainage†	500	1	—	100	5	(1)

* Minimum number of full suite samples including one composite for each grid row.

** No sampling is planned for Septic Tank 275. This tank served a warehouse and was in use between 1944 and 1946. Septic Tank 275 was believed to be found by Ahlquist. The tank and its surrounding soil tested negative for radioactivity. This septic tank is being nominated for no further action.

† The Can Dump Site is located outside the main technical area, and its potential for contamination by radioactivity, hazardous metals, or organic compounds is believed to be minimal. A voluntary corrective action (VCA) by removal-and-disposal is planned early in the RFI. Sampling is planned around the location of the cans and four full suite samples will be submitted from this area. If none of these samples indicate that Subpart S action levels or radioactive soil guidelines to be established by the ER Program Office were exceeded, samples will not be taken from the bench, drainage, and bottom outlet to the canyon.

() Sample numbers contained in parentheses indicate optional sampling.

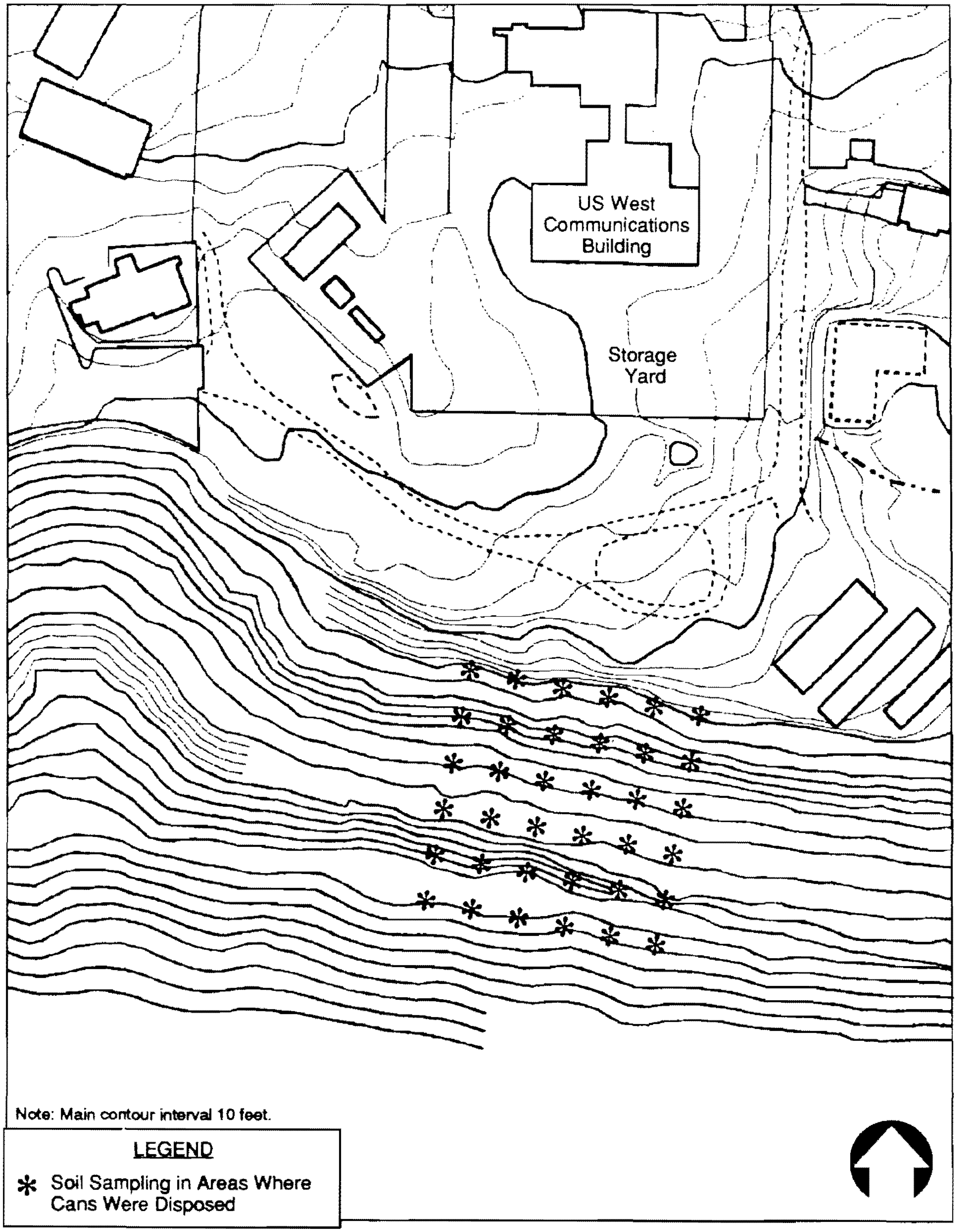


Figure 7.15-1 Sampling locations for "Can Dump Site" SWMU aggregate.

7.15.6 Sampling Plan

No Phase I sampling will occur on the mesa top above the Can Dump Site because no cans were deposited there. Septic Tank 275 was located on the mesa top, but no sampling is scheduled for this SWMU because it is nominated for NFA. The hillside sampling plan for the Can Dump Site follows the general guidelines put forth in Section 7.6. The specific number and locations of samples will depend on geomorphic mapping that will occur before any samples are collected. Figure 7.15-1 depicts sample locations for Phase I sampling. Table 7.15-1 describes the number and relative placement of sampling locations. The number of samples may change slightly, but the relative placement will remain the same.

The sampling plan for the Can Dump Site will not extend to the canyon bottom if contaminants are not found in the vicinity of the cans. If no contamination above Subpart S levels is detected in soil near the cans, there is little probability that contamination is present farther down the hillside.

7.16 Ashley Pond, SWMU Aggregate J

7.16.1 Problem Statement

Ashley Pond, described in Section 6.12 and shown in Figure 6.12-1, is located slightly north of the center of OU 1078. The addition of large amounts of fill have changed the topography around the pond from the time when TA-1 was operationally active, limiting any health risk from potential contaminants to the area adjacent to the pond. Two outfalls that formerly discharged into the pond may have contaminated the water, pond sides, and pond bottom. There is no evidence that radioactive or hazardous constituents were discharged from the outfalls. The pond is frequently recharged with fresh water. It has been completely drained, and the sludge has been removed several times since TA-1 was decommissioned. Therefore, any residual contamination in the pond would be limited to sludge not removed in cleanings or to contamination bound to the adobe mud at the bottom of the pond. Because the mud at the bottom is semi-impermeable, any contaminants likely to occur at the pond bottom would be found on the surface of the mud. Any residual contaminant in water and sludge would have been homogeneously distributed by water action and pond draining and cleaning.

7.16.2 Decisions

If health-based risks (plus uncertainty) calculated from samples of pond water, sludge, and bottom mud are above the maximum contaminant levels in proposed Subpart S or IWP guidelines for radionuclides in water, further sampling will be needed to characterize the extent of contamination and/or reduce uncertainty. If additional sampling indicates risk plus uncertainty above action levels, a CMS will be needed.

7.16.3 Data Needs

Data from water and sludge are needed to characterize any radionuclides, semivolatile organic compounds, and metals that may be present.

7.16.4 Domain of Decision

Water and sludge samples will indicate presence of contaminants if the water, sludge, or pond bottom is a source. If pond samples indicate unacceptable risk (or mean concentrations above action levels), further pond characterization will be necessary.

7.16.5 Decision Logic

Health risk will be calculated based on average constituent concentrations. Uncertainty is defined as twice the standard error. Because the entire pond is defined as one exposure unit, risk will be calculated for pond water and sludge from the averaged risk for the pond.

7.16.6 Sampling Plan

The highest probability of finding any residual contaminants exists at the two areas where outfalls discharged into the pond. If contaminants are found, samples from other portions of the pond will be used for a measure of variability.

Five sample locations (the center and four corners of the pond) will be established approximately 20–50 yards offshore. Two of the samples will be collected near the locations of the former outfalls. At each location, a water sample from 1–2 ft below the surface and a sludge sample will be collected.

Each water sample will be analyzed for gross alpha and beta activity. Any sample having a reading above 15 pCi/l will undergo further analysis for total uranium and isotopic plutonium (if gross alpha is exceeded) or ^{137}Cs (if gross beta is exceeded). Two of the five water samples will be randomly chosen for semivolatile organics and metals analyses. If any sample constituent exceeds proposed Subpart S action levels or maximum concentration limits, new samples will be taken in the area where the high contami-

TABLE 7.16-1

ASHLEY POND SAMPLING

Type and Area of Sample	Location of Sample	Total Number of Samples for Gross Alpha and Beta	Number of Full Suite Samples*
Water**	20–30 yards in from each corner (NW, NE, SW, SE) of pond and approximate middle of pond (near aerator)	5	1
Sludge***	Collected from same location as water samples from first solid or semisolid material encountered at bottom of pond	5	1

*Minimum number of full suite samples.

**Water samples will be screened for gross alpha and beta. Those that exceed 15 pCi/l will be submitted for full suite analysis.

***Sludge requires drying before measurement of gross alpha and beta.

nant level was found. Each new sample will be analyzed for all contaminants that exceed the proposed Subpart S action limits.

A portion of each of the five sludge samples will be dried and measured for gross alpha and beta activity. Any sludge sample above 20 pCi/g will be submitted for gamma spectrometry, radionuclide, semivolatile organic compound, and metal analyses. If no sludge sample is above the gross alpha or beta activity of 20 pCi/g, one randomly chosen sample will be submitted to EM-9 for radionuclide, metal, and semivolatile organic compound analyses. Resampling and analysis of individual sludge samples will be based on comparison with proposed Subpart S action levels and radionuclide concentrations guidelines in the IWP. If data show a health-based risk for the pond, Phase II sampling will be necessary. Laboratory analyses for any Phase II samples will be guided by those contaminants having elevated concentrations in Phase I sampling. Table 7.16-1 summarizes the Ashley Pond sampling.

7.17 The Industrial Waste Line, SWMU Aggregate K

7.17.1 Problem Statement

The industrial waste line, described in Section 6.13 and depicted in Foldout Map B, served many of the original TA-1 process buildings and was used for disposal of chemical and radioactive liquid waste. The line has been entirely removed, and the excavation trenches have been decontaminated and backfilled (Buckland 1973, 09-0008; Meyer 1971, 09-0014; Ahlquist et al. 1977, 0016). Decontamination efforts in a trench continued until most soil samples showed radioactivity below the gross alpha detection limit of 25 pCi/g or until excavation depths became too deep for safe mechanical digging (Ahlquist et al. 1977, 0016).

It is assumed that organic compounds, metals in solution, and radionuclides flowed through these pipelines. Of these three types of contaminants, organic compounds are the least likely to pose a health risk. It has been 32 years since the pipeline was used and 26 years since the pipeline was removed (Buckland 1973, 09-0008). It is likely that past soil removals also removed all organic compounds. Physical processes such as evaporation and vapor-phase transport, would additionally diminish organic compounds. Ubiquitous aerobic bacteria would have degraded any remaining organic compounds (Appendix A). All OU 1078 sampling assumes that it is extremely unlikely that volatile organic compounds resulting from TA-1 operations are still present (even in subsurface soil). Thus, no analyses for volatile organic compounds are being considered.

The question to be answered is whether past decontamination efforts adequately removed radionuclides, metals, and semivolatile organics so that acceptable risk results from any residual contaminants in the industrial waste line subsurface area do not result in unacceptable risk.

7.17.2 Decisions

Only portions of the excavated trench that are accessible (not covered by streets, buildings, parking lots) will be investigated in the Phase II sampling. If contaminant concentrations above action levels still exist in the trench, the area will be remediated immediately. If broad areas above acceptable risk are found, a decision analysis process will identify what additional sampling and further investigation should be done on portions of the industrial waste line (accessible and inaccessible) not examined in Phase II. If no area examined in the Phase II sampling has unacceptable risk, a decision analysis approach will determine if the remaining inaccessible trench areas pose unacceptable risk.

7.17.3 Data Needs

Precise data which are needed to locate the trenches include photographic information, land surveying, and site visits. Samples from industrial waste line trenches will be taken to determine presence of radionuclides, semivolatile organics, and metals.

7.17.4 Domain of Decision

Initially, two portions of the industrial waste line trench (now filled and accessible) will be investigated. The first portion is in the undisturbed area behind the Shell Service Station (at Oppenheimer and Trinity), where Ahlquist conducted substantial decontamination of the industrial waste line trench in 1976. At this location, excavation will focus on two subareas. The first subarea is the keyway trench (Ahlquist et al. 1977, 0016), which was dug to investigate lateral connections between H building and the industrial waste line. The keyway trench subarea is indicated by Hot Spot 6 in Figure 7.4-3. The second subarea is a trench that runs from H and Theta Buildings to Oppenheimer Drive. The second portion of the industrial waste line trench to be sampled is near the area where the industrial waste line crossed Rose Street and Canyon Road before its entry into TA-45. (Figure 7.17-1).

7.17.5 Decision Logic

Individual samples with contaminant concentrations above action levels (IWP guidelines) or above 20 pCi/g gross alpha or beta will trigger further excavation and soil removal followed by more sampling. Excavation and sampling will continue until no individual samples with gross alpha or beta activity greater than 20 pCi/g are found. At the end of the excavation process, full suite analyses will be conducted on approximately 10% of all trench samples taken from the trench side and floor.

Baseline risk will be calculated using all surface samples collected after excavation. Associated dose will be calculated (for health and safety purposes) during excavation using RESRAD. Using spatial prediction techniques, dose also will be averaged over the total surface area of the trench. If dose plus twice the standard error results in unacceptable dose for either of the two sampling areas discussed above, unacceptable dose may be assumed elsewhere in the unexcavated trenches. If the risk level is acceptable, it will be assumed that no unacceptable risk exists along the other portions of the industrial waste line trench. These decisions will await a formal decision-making process.

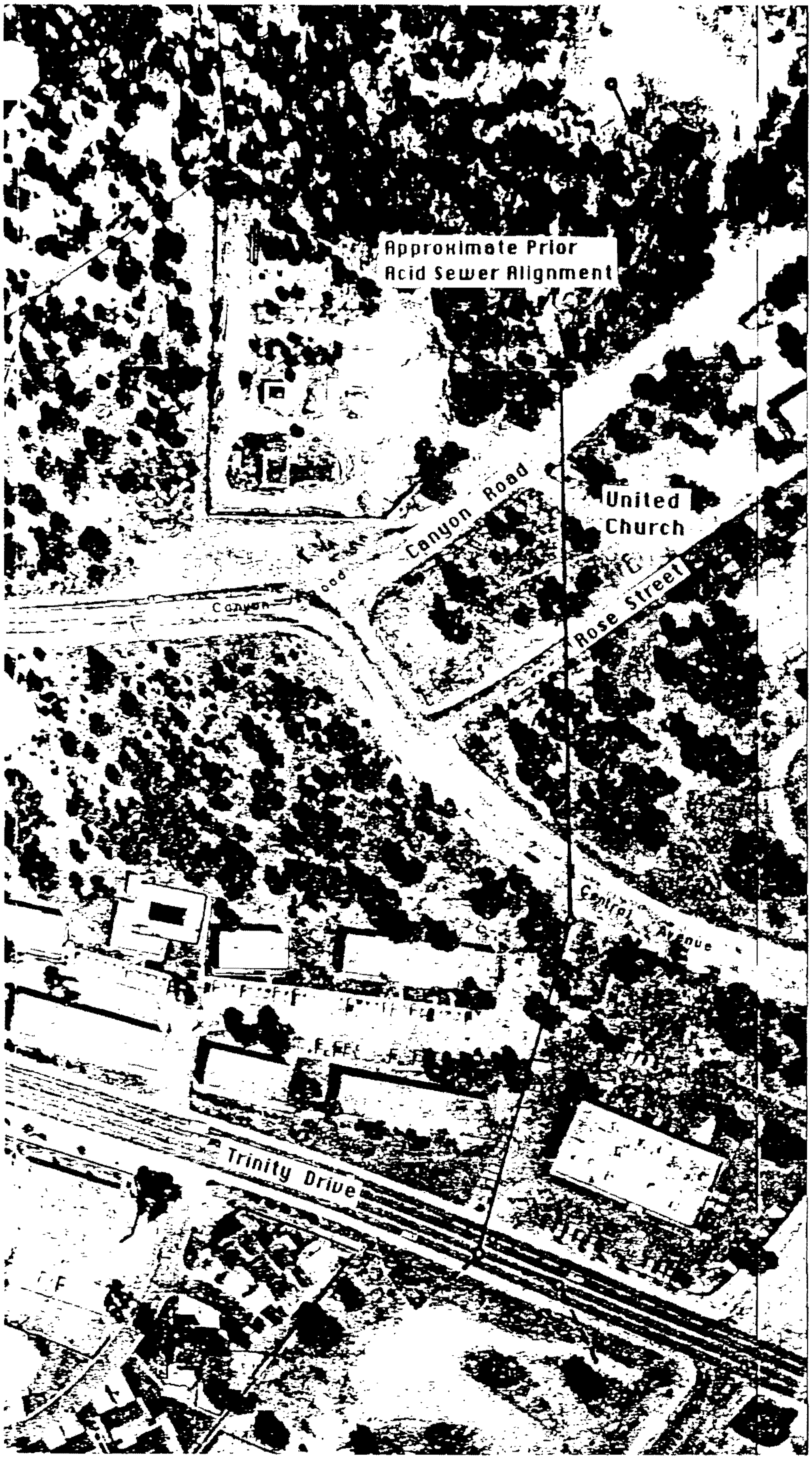
The industrial waste line trench is nearly 3200 ft in length. Approximately 100 ft will be excavated and sampled at Canyon Road and Rose Street, and approximately 200–300 ft will be excavated and sampled behind the Shell Service Station. About 10% of the total length of the industrial waste line trench will be investigated.

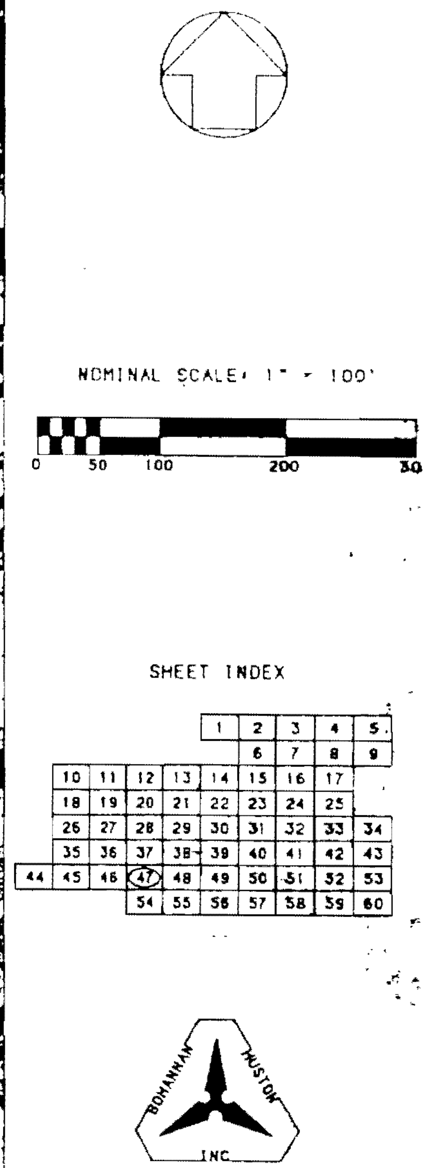
7.17.6 Sampling Plan

When exposing the industrial waste line trench, care must be taken to minimize exposure to site workers. Continual monitoring of excavated soil will be conducted with hand-held instruments (Annex III) and with field laboratory gross alpha and gamma measurements of soil samples. Soil with unacceptable contamination, based on proposed Subpart S action levels and radioactivity guidelines in the IWP, will be drummed (or otherwise packaged) and stored until the proper disposal method can be determined. Once gross alpha and beta screening methods have determined that the trench fill and excavated surfaces have no soil contamination above 20 pCi/g gross alpha and beta activity, trench contaminant levels will be determined by laboratory analyses of soil samples from the trench surface.

All trench investigations will be conducted in the following manner. Photographs, radioactivity survey measurements, land surveys, and preliminary digging will be used to locate the former industrial waste line trench. Once located, the trench will be excavated along specified lengths (100 ft between Canyon Road and Rose Street and 200–300 ft behind the Shell Station at Oppenheimer and Trinity). Samples collected every 10 ft along the length of the trench will be measured for gross alpha and beta activity and metals (x-ray fluorescence). Because sample soil will be removed from the trench by backhoe, these screening samples will be composite samples taken across the width of the trench. If a sample exhibits gross alpha or beta activity above 20 pCi/g or metals above proposed Subpart S action levels, laboratory analyses for radionuclides, metals, and semivolatile organics will be conducted on two random samples collected from the Shell Service Station trench fill and on random samples collected from the Canyon Road/Rose Street Trench fill. The sections of trench behind the Shell Service Station and between Canyon Road and Rose Street will be totally excavated. Any sample having gross alpha or beta activity above 20 pCi/g or metals above proposed Subpart S action levels (LANL 1991, 0553), will trigger lateral excavation to determine the extent of the contamination. Excavation in these specified areas will continue until screening measurements on soil samples taken from each trench wall or floor are below 20 pCi/g and/or metal action levels. Five random samples scraped from the walls and floor of the trench will be sent for a full suite analysis.

Dose estimates will depend on both gross alpha and beta screening results and laboratory analyses. Priority A, or quick-turnaround, laboratory analyses will be requested. If risk calculations indicate acceptable risk (IWP guidelines), the trench will be determined to pose no risk and will be backfilled. If acceptable risk is found in both trench areas, all remaining portions of the industrial waste line trench will be





THIS RECTIFIED PHOTOBASE MAP WAS PRODUCED FROM VERTICAL AERIAL PHOTOGRAPHY EXPOSED APRIL 10 AND APRIL 30, 1986, AT A NOMINAL SCALE OF 1:5600 WITH A WILD RC8 CAMERA, WILD UNIVERSAL AVIOGON LENS TYPE, CALIBRATED FOCAL LENGTH OF 152.226 MM.

Figure 7.17.-1. Locations of industrial waste line near Canyon Road and Rose Street.

judged to pose no public health risk. If unacceptable risk is found in either area, a decision analysis will be conducted to determine which (if any) inaccessible areas of the remaining sections of the trench should be investigated.

7.18 Opportunity-Available Action SWMUs

Five SWMU aggregates in the OU 1078 mesa-top area will be treated as opportunity-available action SWMU aggregates.

- Eastern Sanitary Waste System
- Northern Sanitary Waste System
- Western Sanitary Waste System
- Subsurface contamination associated with U and W Buildings
- Soil contamination under Trinity Drive

7.18.1 Problem Statement

Only SWMUs with no apparent risk to the public (SWMUs located in the subsurface) will be investigated as opportunity-available action SWMUs. SWMUs considered under this scenario are those that

- reside in the subsurface;
- are covered, in part, by impermeable material such as paved roads, sidewalks, or buildings; and
- have undergone no past investigation.

Under the opportunity-available action approach, these SWMU aggregates will be investigated when a county or private soil disturbance construction project yields an opportunity to investigate these SWMU aggregates.

The sanitary waste lines and subsurface soil contamination areas proposed for opportunity-available actions pose no present-day risk to residents because all of these SWMUs are located in the subsurface, are covered by several feet of soil, and/or are covered by manmade structures. These types of cover block any pathway (save for plant uptake) for potential contaminants to migrate to the surface, where they might be ingested or come into direct contact with human skin. Figure 4.5-2 depicts the protection an earthen cover affords against radioactivity. If organic chemicals had been discharged into soil from leaks or spills, bacterial action and physical processes would have greatly diminished organic chemical concentrations in the 30 years since spills may have occurred. No transport mechanism (except plant uptake) exists for metal contaminant migration to the surface, where it could be a risk to human health. Contaminants having short half-lives, such as ^{210}Po (heavily used at TA-1 during World War II), would have decayed by today. Any tritium (half-life of 12 years) that may have been discharged would have decayed by more than 88% since the mid-1950s when the SWMUs 1-001s and 1-001t sanitary drain lines ceased operation. Any radionuclides with long half-lives (such as ^{239}Pu and ^{235}U) that may have been discharged into these sanitary drain lines would not have decayed in this time. However, these isotopes were so precious and scarce during the early years of the Laboratory that great care would have been taken to limit any discharge.

The Laboratory and the DOE have a draft agreement with Los Alamos County (Los Alamos County 1991, 09-0049) stating that every construction project in Los Alamos County must undergo review (by way of an excavation permit) to ascertain whether prospective private or county construction activities will intersect a SWMU. A committee of Laboratory, ER, DOE, and county personnel regularly meets to review upcoming construction projects. A draft procedure has been adopted stating that the OU project leader should be contacted to verify whether a proposed construction intersects a SWMU in the OU. If a SWMU is to be intersected during construction, the opportunity-available action (similar to the ER interim-action reconnaissance sampling SOP) is initiated. This action mandates that, before any construction activities can proceed, ER personnel (located in EM-8) must develop a sampling plan for the immediate vicinity of the proposed construction.

The purpose of the sampling is twofold. It provides enough real-time data to ensure the safety of on-site construction workers and determines the presence or absence of contaminants in the area where the SWMU and construction activity intersect.

In a situation involving potential human exposure, problems may arise. The impetus to those parties responsible for the construction is to finish the project in a timely, cost-efficient way. The goal of the OU project leader is to ensure that the SWMU affords no health risk to construction workers, nearby residents, or the public at large. Decisions allowing a cost-effective and timely resolution of potential impasses between commercial (or county) interests and the Laboratory ER Program must be reached. This may require the interaction of DOE, the Laboratory ER Program Office, EM-8, and Laboratory management personnel with parties conducting the construction project. Decision analysis protocols are being developed by the ER Program Office and will be incorporated into the IWP.

7.18.2 Decisions

Proposed construction areas will be considered safe if no soil contaminant concentration above proposed Subpart S action levels or IWP radioactivity guidelines can be exposed by a construction activity. If contaminated soil is found in a small area, it will be removed and the area will be investigated further. Construction will continue after the investigation. If significant contamination is found and cannot be readily removed because of large volume, decision analysis comes into play and a CMS will need to be conducted (with parties specified in Section 7.18.1).

7.18.3 Data Needs

Data needs include concentrations of any potential contaminants, including radionuclides, metals, or semivolatile organic compounds from samples collected from the excavated surfaces.

7.18.4 Domain of Decision

Decisions will be specific to the subsurface disturbance being investigated. The investigation trench or area of construction activity is the domain for which the decision is applied.

7.18.5 Decision Logic

Contaminant concentrations will be compared with action levels to determine if contamination that poses a health risk exists. If large areas will be exposed through construction, exposure units will be used in risk assessment, as discussed in Section 7.2.4.

7.18.6 Sampling Plans

Opportunity-available action sampling must be approved by the ER Program Office and the EPA. Once sampling has been approved, samples will be taken during construction activity and will be evaluated as described earlier in this chapter. Before submitting samples for various laboratory analyses, gross alpha and beta activity on soil will be measured. Gross alpha and gross beta activity measurements will be used to determine whether additional laboratory radionuclide, semivolatile organic compound, and metal analyses on the soil are necessary. Gross alpha and beta activity readings greater than 20 pCi/g will be used to determine if additional samples should be taken at the construction project. For example, if soil from the base of a trench exhibits gross alpha activity greater than 20 pCi/g, additional soil may need to be removed and staged at the site while additional soil samples are taken and measured for gross alpha and beta activity. This iterative process will continue until the project leader is confident that the extent of the contamination has been defined, all contaminated soil has been removed, and an exposure assessment has been calculated based on soil samples taken from the walls and base of the excavation.

At this point, a full suite laboratory analysis will be conducted on any excavation sample with gross alpha or beta activity greater than 20 pCi/g. If no samples have activity greater than 20 pCi/g, random samples from all strata in the subsurface disturbance will undergo a full suite laboratory analysis (specifics depend on the type of disturbance). At least one sample from each stratum will be taken, in an interval to be determined, and will be submitted for the full suite analyses. All laboratory samples must receive Priority A effort so that the construction can continue in a timely manner.

Specifics for sampling the sanitary waste systems, the subsurface contamination associated with Buildings U and W, and the Trinity Drive SWMU aggregates are presented in Sections 7.18.6.1, 7.18.6.2, and 7.18.6.3, respectively.

7.18.6.1 Eastern Sanitary Waste Line, SWMU Aggregate L, Northern Sanitary Waste Line, SWMU Aggregate M, and Western Sanitary Waste Line, SWMU Aggregate N

The three sanitary waste line SWMU aggregates will be investigated according to the opportunity-available action procedure. Evidence that the individual sanitary lines composing these aggregates received any radioactive or hazardous waste is weak. All lines are located in the subsurface, where they present no risk to present-day residents. These SWMU aggregates are detailed in Sections 6.14 through 6.16 and are depicted on Foldout Map C.

Five of the seven individual SWMUs composing the sanitary waste line SWMU aggregates are being nominated for NFA (Section 2.5). These include all three components of the Northern Sanitary Waste Line (SWMUs 1-001q, v, and w), SWMU 1-001r of the Eastern Sanitary Waste Line, and SWMU 1-001u of the Western Sanitary Waste Line. The areas surrounding these sanitary waste drain lines are not expected to be contaminated. Section 7.18.1 discusses several reasons why contamination is not expected around the sanitary waste drain lines. Uncontaminated sanitary waste line discharges would have diluted and flushed out any past contamination that may have been disposed through the drain lines. However, none of the sanitary waste lines discharged within OU 1078. Leaking pipelines would have been the only mechanism by which these SWMUs could have deposited constituents.

The two SWMUs for which further action is recommended, SWMUs 1-001s and 1-001t, served process buildings in eastern TA-1. Because radioactive and hazardous materials were handled in these buildings, these two sanitary drain lines might have received small quantities of hazardous and/or radioactive contaminants. They will be investigated in the future.

Any remaining sanitary waste line encountered in the sampling activity will be surveyed for radiation before removal is attempted. After the survey, the section of pipe will be removed and any sludge or solid material contained in the pipe will be sampled and measured for gross alpha and beta activity. Soil samples collected will be a combination of judgmental (e.g., soil samples will be taken under pipe joints) and random samples collected from the walls and floor of the excavation. A value exceeding 20 pCi/g gross alpha or gross beta will be the measure used to decide whether samples from the final excavation should be submitted to a laboratory for radionuclide, semivolatile organic, and metals analyses. Soil samples reading greater than 20 pCi/g gross alpha or beta activity will determine the soil that will be excavated and disposed. Random sampling requirements for final risk assessment will depend on the configuration of the excavation. In general, soil samples will be taken from the trench every 20 linear feet from the walls (at 3-ft differential depths) and from the floor. The number of samples taken depends on the configuration of the excavation.

7.18.6.2 Subsurface Contamination at U and W Buildings, SWMU Aggregate O

Soil in the vicinity of U and W Buildings (where the Los Alamos Inn is now located) is suspected of being contaminated with tritium, ^{239}Pu and ^{238}U (Ahlquist et al. 1977, 0016). No sampling was done near these buildings in the 1975–1976 Ahlquist survey because construction of the Los Alamos Inn over the former locations of U and W Buildings had made these locations inaccessible. No records are available that indicate the definite presence of contamination in this area. Risk to present-day residents or workers is restricted by the fact that the area is covered. This aggregate is detailed in Section 6.17 and depicted on Foldout Map C.

Any discussion of a sampling plan is limited by lack of knowledge of extent and concentration of potential contamination. Contamination would have occurred near the surface when deposited; however, because construction activities (including the addition of large amounts of fill) altered the area, the depth of potential contamination is unknown. Sampling will be restricted to the depth of the construction disturbance (unless contaminants at concentrations above action levels are found).

The sampling plan follows the guidelines presented in Section 7.18.6. Soil samples will be taken in any excavation that intersects the U and W Building SWMU. Soil samples will be taken at various depths along the horizontal axis of any excavation into the SWMU boundaries and will be measured for gross alpha and beta activity. The number of samples depends on the extent of the excavation into the SWMU and data variability. The same radioactive screening mechanism that is used for all other soil samples will be used. If possible, x-ray fluorescence will also be used to screen the soil samples for metals. At the completion of the excavation, those soil samples with gross alpha or beta greater than 20 pCi/g will undergo laboratory analyses for radionuclides, semivolatile organic compounds, and metals. A randomly selected number of other samples will be collected from the final surface of the excavation for full suite analysis.

7.18.6.3 Trinity Drive, SWMU Aggregate P

The Trinity Drive SWMU aggregate, detailed in Section 6.18, lies between the Los Alamos Inn and Timber Ridge Road beneath concrete and asphalt paving material. In 1954, D Building was demolished (et al. 1977, 0016), and the building, its foundation, and underlying soil (to a 1-ft depth beneath the ing) were removed to a designated material disposal area. During the 1966 Trinity Drive widening and repaving project, from 1300 to 2800 yd^3 of soil and construction debris were transported from the vicinity of D Building and were used for fill beneath Trinity Drive. Other Laboratory or off-site areas may have also contributed to this fill. Thus, the presence of radioactive and hazardous contaminants in the fill is unknown.

Planning a detailed sampling strategy without knowing the nature of the future construction project that may breach Trinity Drive is difficult. The general sampling ideas described in Section 7.18.6 are followed, with the exception that soil and fill at the surface will not have semivolatile organics included in their analyses because the asphalt itself contains large amounts of semivolatile organic compounds. So samples will be taken from the walls of a trench dug across Trinity Drive

- at levels directly beneath the pavement and every 3 ft vertically down the trench walls until the bottom of the fill is reached,
- in the horizontal direction at points randomly selected, and
- at points randomly selected along the floor of the trench.

Sampled soil or sediment will be screened for gross alpha and beta activity in the field laboratory. If all samples have gross alpha and beta activity less than 20 pCi/g, one randomly selected sample from the stratum directly beneath the pavement, one from the trench walls, and one from the trench floor will be submitted for full suite analyses.

It is possible that access to sampling points along the south side of Trinity Drive is limited. If soil is accessible, Trinity Drive may be sampled in Phase I.

7.19 Summary of Phase I Sampling

Table 7.19-1 summarizes the number of samples that will be collected during Phase I sampling at OU 1078. The total number of full suite samples is a minimum and may be increased as much as 20%, depending on gross alpha and beta screening results. The per-sample cost of a full suite analysis is approximately $3500. The per-sample cost of a gross alpha and beta analysis is $88.

TABLE 7.19-1

SUMMARY OF PHASE I SAMPLING

Sampling Area		Total Number of Samples, Gross Alpha and Beta	Total Number of Full Suite Samples
Sigma Area		125	15
Canyon Rim		50	10
Bailey Bridge		103	13
Hillside 140/J-2-TU		144	34
Cooling Tower 80		91	21
Hillside 138		129	37
Hillside 137		56	28
Surface Disposal Site SE of Los Alamos Inn		20	6
Can Dump Site		68	14
Ashley Pond		10	2
	Subtotal	796	178
QA Samples (5%)		40	9
	Total	836	187

REFERENCES

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory Report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

Buckland, C., February 16, 1973. "Summary of Records Search for Radioactivity Remaining in TA-1, Acid Waste Lines, TA-10, TA-45, and Acid Canyon Below TA-45," Los Alamos Scientific Laboratory memorandum from C. Buckland to D. D. Meyer, Los Alamos, New Mexico. (Buckland 1973, 09-0008)

LANL (Los Alamos National Laboratory), April 1987. "Verification Sampling Plan For the Former Main Technical Area (TA-1). Los Alamos National Laboratory," Environmental Surveillance Group (HSE-8) and Health and Environmental Chemistry Group (HSE-9) report, Los Alamos, New Mexico. (LANL 1987, 09-0013)

LASL (Los Alamos Scientific Laboratory), November 21, 1958. "Main Technical Area Underground Utilities," Engineering Drawing ENG-R85. (LASL 1958, 09-0048)

EPA (US Environmental Protection Agency), April 10, 1990. RCRA Permit No. NM0890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, 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)

Isaaks, E., and R. M. Srivastava, 1989. An Introduction to Applied Geostatistics, Oxford University Press, New York, New York. (Isaaks and Srivastava 1989, 0765)

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)

Los Alamos County, June 24, 1991. "County Procedures For Soil Disturbance," Attachment B to minutes from the SWMU Working Group, Los Alamos, New Mexico. (Los Alamos County 1991, 09-0049)

Meyer, D., September 23, 1971. "Decontamination of Excess Property Returned to AEC," Los Alamos National Laboratory memorandum from D. Meyer to S. E. Russo, Los Alamos, New Mexico. (Meyer 1971, 09-0014)

Ross, S., 1984. A First Course in Probability, Second Edition, Macmillan Publishing Company, New York, New York. (Ross 1984, 0725)

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1 Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model for Technical Area 1

Chapter 5
Field Investigation Methods

Chapter 6
Solid Waste Management Unit Aggregate Background Information

Chapter 7
Solid Waste Management Unit Aggregate Sampling Plans

Annexes

Appendices

Annexes

I Project Management Plan
II Quality Assurance Project Plan
III Health and Safety Plan
IV Records Management Plan
V Community Relations Plan

This annex presents the technical approach, proposed budget and schedule, reporting milestones, and management structure for implementing the Resource Conservation and Recovery Act (RCRA) field investigation (RFI) for TA-1 as set forth in the work plan for Operable Unit (OU) 1078. This project management plan for OU 1078 is an extension of Los Alamos National Laboratory's (the Laboratory's) Project Management Plan for the Environmental Restoration (ER) Program described in Annex I of the Installation Work Plan (IWP) (LANL 1991, 0553). This annex for OU 1078 discusses the project management plan requirements specified by the Hazardous and Solid Waste Amendments (HSWA) Module (Task II, E., p. 39) of the Laboratory's permit to operate under RCRA (EPA 1990, 0306) as they apply to OU 1078.

1.0 TECHNICAL APPROACH

The technical approach, as described in Chapter 1 of the work plan for OU 1078, is based on the ER Program's overall technical approach to the RFI/corrective measures study (CMS) process described in Chapter 3 of the IWP (LANL 1991, 0553). The ER Program's technical approach includes

- decision analysis to support selection of corrective measures and investigation alternatives;
- data quality objectives (DQO) approach to site characterization;
- application of sequential sampling and the observational approach to the RFI/CMS process; and
- health-based action levels as a basis for choosing a corrective action.

This approach provides an efficient, scientifically defensible means of collecting samples and generating data that will be used to support a risk assessment, a recommendation for no further action, opportunity-available action, or other corrective actions.

The technical objectives for the OU 1078 work plan include

- determining whether contaminants are present at each solid waste management unit (SWMU) aggregate in OU 1078,
- if contaminants are found above action levels, defining the lateral and vertical extent of contamination,
- acquiring sufficient data to perform a risk assessment, when appropriate, and
- providing sufficient data to recommend no further action or plan and perform a CMS.

1.1 Technical Implementation Rationale

The investigation priorities for OU 1078 field work are based on the available data and the radiological doses that could result from contaminants in OU 1078 SWMUs, based on those data. The basis for this dose prioritization is established in Chapter 4 of this work plan. The areas adjacent to the most populated areas in OU 1078 are slated for early investigation.

1.2 Field Methods

Field methods for the OU 1078 phased RFI include three general categories. These methods, summarized below, are discussed in detail in Chapters 5 and 8 of this work plan:

- field survey methods for radiological constituents
    - conducting radiation surveys (low-energy gamma) of general areas
    - conducting surveys for gross contamination
- field screening methods for nonradiological constituents
    - monitoring organic vapor (active)
    - monitoring combustible gas
    - using x-ray fluorescence
- sample collection methods
    - sampling surface soils and sediments
    - sampling subsurface soils
    - collecting air samples
    - sampling surface water (Ashley Pond).

2.0 SCHEDULE

The schedule for the entire RFI/CMS process at the Laboratory, including at OU 1078, is prescribed in Table I-3 of the IWP and the Projected Schedule and Cost for the Corrective Action Process at Los Alamos National Laboratory (Appendix S of the IWP).

A preliminary schedule for Phase I of the OU 1078 RFI is presented in the figure provided in Attachment I-1. The figure is derived from the sampling plans described in Chapter 7 of the work plan. The RFI is assumed to start July 1, 1992. The schedule for each sampling plan is based on the estimated time necessary to complete the field work, analyze the samples (90-day turnaround time), assess statistical data and perform a risk analysis, and report the data gathered in phase reports. Normally, field work is conducted only between March 1 and December 1 because of winter conditions during the remainder of the year, but the entire calender year may be used for field work as necessary. The activities described in this schedule are contingent on the following considerations:

- Regulatory agencies review and approve the RFI work plan for OU 1078 and supporting project plans by July 1992 (Attachment I-1).
- The OU project leader (OUPL) may initiate certain tasks (e.g., interim corrective measures and surface soil sampling) before the regulatory agencies grant final approval of the work plan.
- An adequate number of support personnel (technicians from the Environmental Management (EM) and Health and Safety (H&S) divisions, trained drilling contractors, etc.) are available for conducting necessary tasks.
- Environmental Protection Agency (EPA) approval of phase reports (including EPA comments, Laboratory revisions, and final EPA approval) takes ten weeks, of which four weeks are allowed for EPA review and comment and six weeks for Laboratory revisions.
- Planned Department of Energy (DOE) budgets for OU 1078 for fiscal years (FYs) 1992 and 1993 constrain the work scheduled in the first two years of investigation.

3.0 COST ESTIMATION

The schedule presented above is based on fixed budgets for the first two years of the RFI. The fixed budgets in FYs 1992 and 1993 are based on constrained DOE funding levels. DOE funding requests are set two years in advance; thus, past budget estimates will no longer constrain the OU 1078 RFI in FY 1994. Funding requests for FY 1994 and beyond will reflect the cost and schedule that most efficiently complete the RFI. Attachment I-2 presents a summary cost estimate for Phase I of the RFI for OU 1078. Costs are broken down by activity for each SWMU-aggregate-specific sampling and analysis plan, voluntary corrective action, and pilot study.

4.0 REPORTING

The progress of the OU 1078 RFI field work will be presented in four principal types of documents: monthly and quarterly technical progress reports, phase reports (which include work plan modifications, when appropriate), and an annual report. At the end of the process, the RFI report is produced. The schedule for submitting these reports to EPA is provided in Table I-1.

TABLE I-1

REPORTING REQUIREMENTS FOR OU 1078

Document	EPA	DOE	Due Date
Monthly	X	X	25th of the following month
Quarterly	X		February 15, May 15, August 15
Annual	X	X	November 15
Phase Reports	X	X	As in baseline; DOE milestones

4.1 Monthly and Quarterly Technical Progress Reports

The progress of the OU 1078 field work and data assessment will be summarized in monthly and quarterly technical progress reports, which will be submitted to the EPA's Region VI office and the New Mexico Environment Department (NMED). This task is required in the HSWA Module (Task V, C, p. 46). The phase reports will be used to provide timely technical information, which will allow regulatory agencies sufficient information to gauge the progress of the RFI. It is expected that the EPA and the NMED will provide timely comments on these reports to assist the Laboratory in progressing through the RFI process.

4.2 Annual and Phase Reports

Annual reports will be completed each year to provide a regular technical update of RFI progress on individual SWMU aggregates and to modify plans for upcoming field work, when necessary. If the need to modify work plans arises more frequently than annually, phase reports will be prepared. The phase reports will provide a more detailed summary of data and analysis generated during the RFI than is provided in the quarterly technical progress reports. The phase report will also contain plans for additional characterization of SWMUs in OU 1078, when necessary.

4.3 RFI Report

As required by the HSWA Module (Task V, D, p. 46), the Laboratory will submit the RFI report for OU 1078 within 60 days of completion of the RFI. As stated in Section 3.5.3 of the IWP (LANL 1991, 0553), the RFI report will describe the procedures, methods, and results of field investigations and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support corrective actions, including no further action.

5.0 CORRECTIVE MEASURES

The schedule for OU 1078 given in Attachment I-1 estimates the completion dates of all Phase I RFI activities for OU 1078. If extensive additional characterizations (Phase II studies) are required for the sampling plans (such as sampling under and around existing structures), the CMS may slip to a later date.

Discussion of the CMS timetable at this time is hindered because of the lack of data currently available for most of the SWMUs in OU 1078. Following the Phase I investigation and data assessment, a more precise estimate of the schedule for Phase II investigations and the CMS will be proposed.

Corrective measures will be proposed for SWMUs if the RFI characterizations described in this work plan and subsequent risk assessment indicate that a significant threat of exposure to humans exists and that remediation is required.

5.1 Estimated Number of SWMUs in Corrective Measures Study

It is difficult to predict the number of SWMUs that will be considered in the CMS before the RFI data have been collected. Based on current information, the CMS may eventually include one or more of the following SWMU aggregates: Bailey Bridge Landfill, Septic Tank 140, Septic Tank 138, and Septic Tank 137.

6.0 ORGANIZATION AND RESPONSIBILITIES OF THE PROJECT TEAM FOR OU 1078

The organizational and management structure for the Laboratory's ER Program is described in Section 2 of the Quality Program Plan (Annex II of the IWP). Figure I-1 shows the project-specific organization for the field investigation for OU 1078, and this section describes the management organization for the OU 1078 RFI. A discussion of the organization and management for OU 1078 can also be found in Annex II of this work plan. The positions and their major responsibilities are listed below.

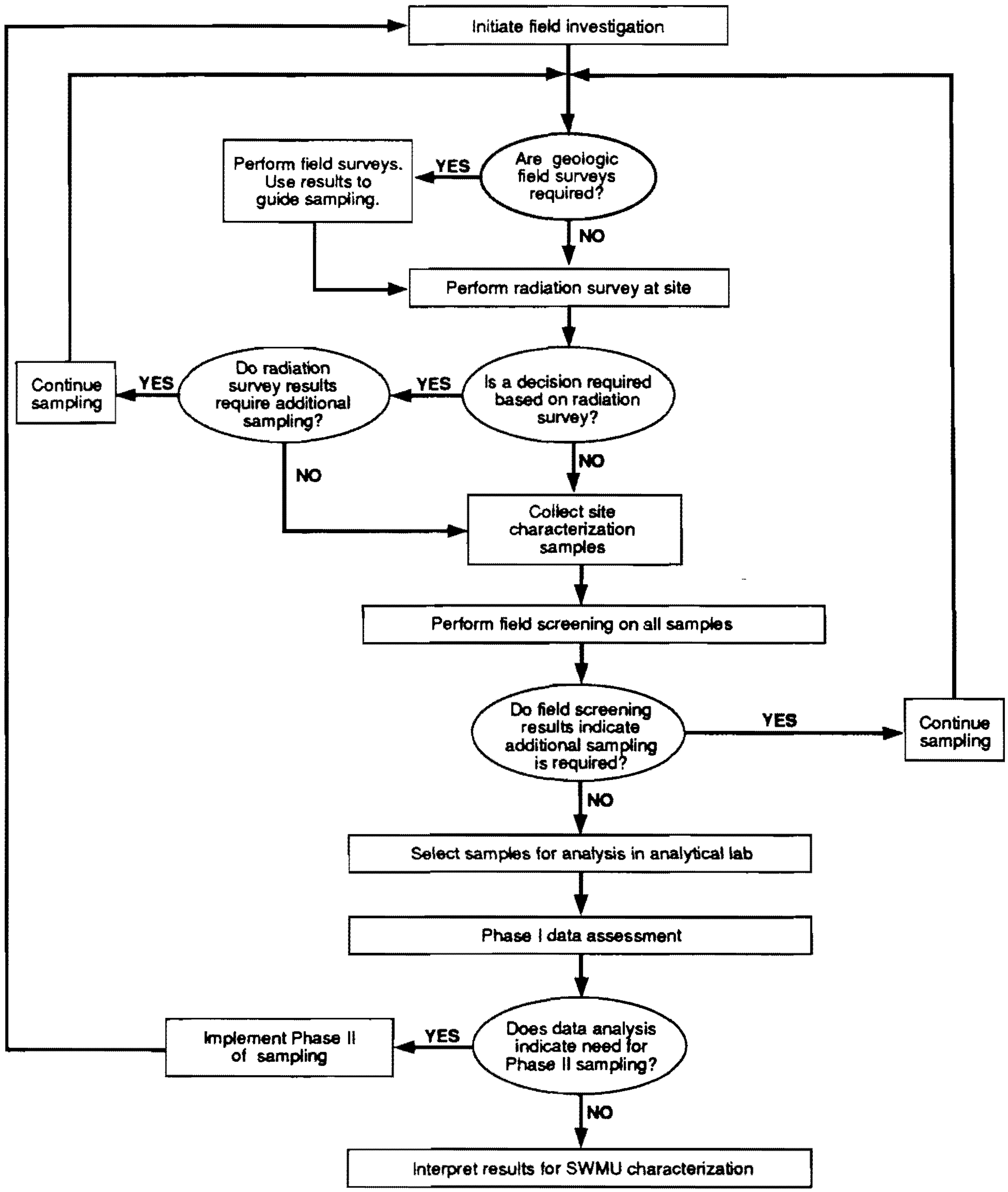


Figure I-1. Logic flow diagram for field investigations.

6.1 EM Division Leader

The EM division leader is responsible for directing the organizations conducting the ER Program.

6.2 ER Program Manager

The program manager is responsible for the overall management of the ER Program, including

- ensuring that Laboratory ER activities are consistent with the goals and objectives of the EM division leader, DOE, EPA, and the NMED;
- ensuring compliance with the HSWA Module;
- ensuring compliance with change control procedures;
- costing, scheduling, and measuring performance;
- submitting monthly and quarterly reports to DOE;
- tracking deliverables and milestones established by DOE, EPA, and NMED; and
- ensuring the establishment, implementation, and support of the quality assurance project plan, H&S project plan, records management project plan, and community relations project plan.

6.3 Quality Program Project Leader

The quality program project leader (QPPL) is responsible for directing and managing the ER quality program plan as described in Annex II of the IWP. The QPPL will function and be funded independently from the technical projects undergoing QA review. The QPPL will not be assigned duties that preclude full attention to quality assurance (QA) responsibilities or that conflict with the reporting and resolution of QA issues and problems. The QPPL reports directly to the ER program manager.

6.4 Project Leader for OU 1078

The OUPL for OU 1078 is responsible for

- overseeing day-to-day operations, including planning, scheduling, and reporting technical and related administrative activities;
- preparing all reports for the program manager and EPA;
- coordinating with technical team leaders;

- interfacing with the ER QPPL to resolve quality concerns and to coordinate audits with the QA staff;
- complying with the program management plan, H&S program plan, records management program plan, and community relations program plan in the IWP (LANL 1991, 0553);
- overseeing RFI field work and directing the field teams manager (whose functions are described below); and
- complying with the technical and QA requirements of the Laboratory's ER Program.

6.5 Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. Team members have participated in the development of this work plan and the individual field sampling plans and will participate in field work, data analysis, report preparation, work plan modifications, and planning subsequent investigations, as necessary.

The primary disciplines currently represented on the OU 1078 technical team are engineering, sampling, hydrogeology, statistics, geochemistry, safety, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the OU 1078 RFI changes.

6.6 Health and Safety Project Leader

The H&S project leader (H&SPL) is responsible for

- preparing and implementing the H&S program plan;
- reviewing H&S project plans prepared by subcontractors or Laboratory personnel;
- interfacing and coordinating with Laboratory personnel to use resources appropriate for the H&S program as described in the IWP (LANL 1991, 0553);
- ensuring compliance of the ER Program with applicable environmental regulations, DOE orders, Laboratory policy, and applicable New Mexico laws and regulations;
- overseeing the maintenance of the H&S data base for the ER Program, as described in the IWP (LANL 1991, 0553), in such areas as worker training and medical surveillance; and
- preparing monthly reports for the ER program manager.

6.7 OU 1078 Field Teams Manager

The OU 1078 field teams manager is responsible for

- overseeing day-to-day field operations,
- planning and scheduling the implementation of the RFI field activities described in Chapters 5 and 7 of this work plan,
- overseeing engineering and construction activities, and
- implementing waste management operations.

6.8 Field Team Leaders

Each field team leader will direct the execution of field sampling activities in accordance with ER Program standard operating procedures (SOPs), using crews of field team members appropriate for the activity. Field team leaders may be contract personnel.

6.9 Site Safety Officer

The field team leader will also serve as the site safety officer as discussed in Annex III. The site safety officer will ensure that the ER Program work plan is safely implemented during the field operations.

6.10 Field Team Members

Field team members may include, as appropriate, sampling personnel, the site safety officer, geologists, hydrologists, monitors from HS-1 and HS-5, and representatives of other applicable disciplines. All teams will have, at a minimum, a site safety officer, a qualified field sampler, and a sampler's helper. Teams are responsible for conducting the work described in field sampling plans in accordance with ER Program SOPs and are under the direction of the field team leader. Field team members may be contractor personnel.

REFERENCES

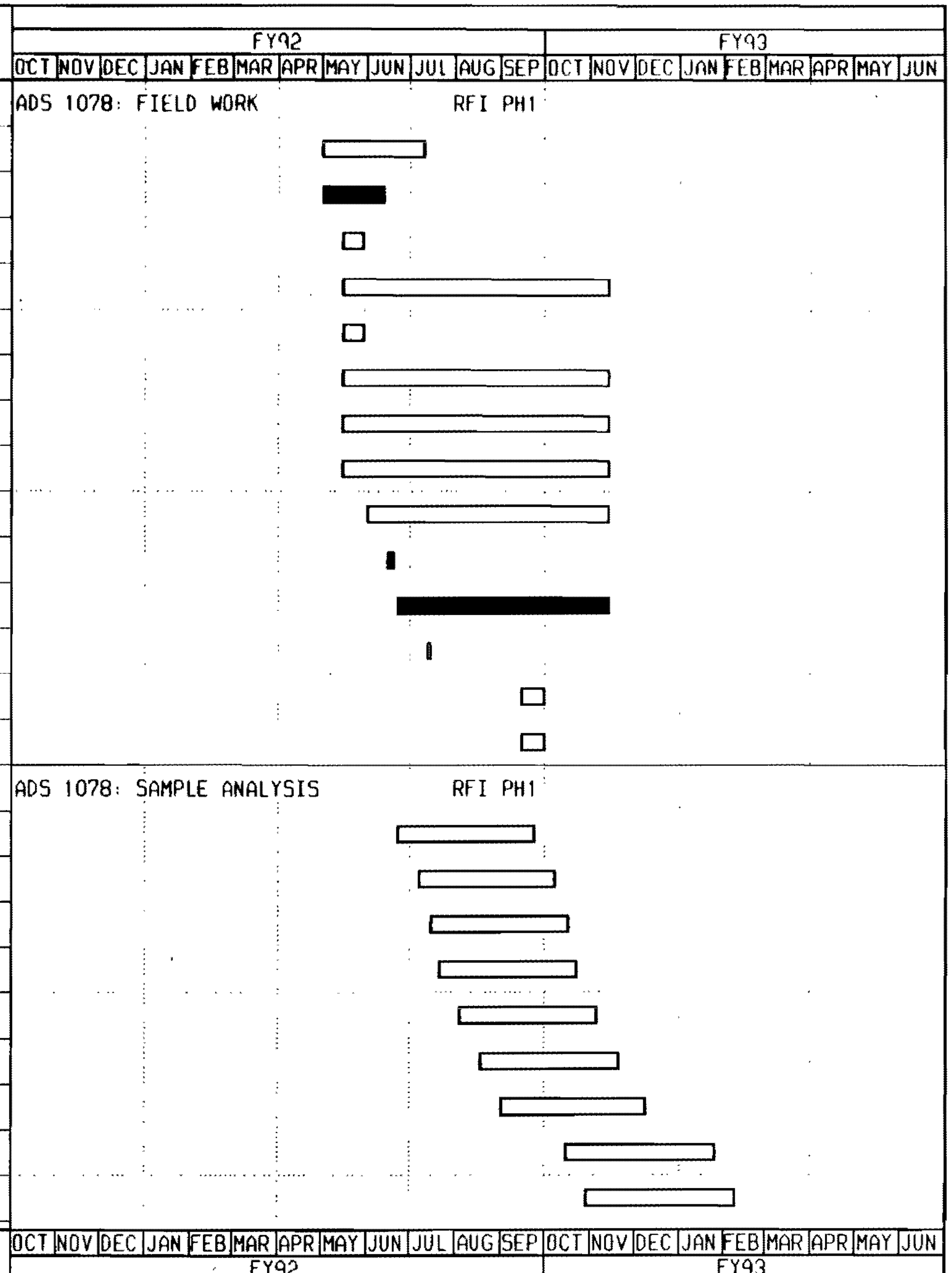
U.S. Environmental Protection Agency (EPA), 1990. RCRA Permit No. NM0890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, Dallas, Texas. (EPA 1990, 0306).

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

ATTACHMENT I-1

DETAILED DESCRIPTION OF PHASE I OF THE RFI INVESTIGATIONS AT OU 1078

Activity	Description	RD	ES	EF	BC
	ADS 1078: FIELD WORK RFI PH1				
071012	ADS 1078: A1 STATISTICAL ANALYSIS RFI PH1	49	1MAY92	10JUL92	71314
071016	ADS 1078: CAPITAL EQUIP DELIVERY RFI PH1	30	1MAY92	12JUN92	66000
071000	ADS 1078: GEOLOGICAL MAPPING RFI PH1	10	15MAY92	29MAY92	7360
071001	ADS 1078: LAND SURVEYING RFI PH1(LOE)	126	15MAY92	13NOV92	53005
071011	ADS 1078: GEOLOGICAL MAPPING SUBCON RFI PH1	10	15MAY92	29MAY92	35700
071013	ADS 1078: ENG3 LAND SURVEY RFI PH1(LOE)	126	15MAY92	13NOV92	8591
071014	ADS 1078: HS1 MONITORING RFI PH1(LOE)	126	15MAY92	13NOV92	11780
071015	ADS 1078: HS5 MONITORING RFI PH1(LOE)	126	15MAY92	13NOV92	16947
071009	ADS 1078: PHOSWICH SURVEY RFI PH1(LOE)	116	1JUN92	13NOV92	53064
071007	ADS 1078: HARRIS BUILDERS SAMPLE RFI PH1	5	15JUN92	19JUN92	28480
071002	ADS 1078: COLLECT SAMPLES RFI PH1	101	22JUN92	13NOV92	201641
071006	ADS 1078: ASHLEY POND SAMPLE RFI PH1	2	13JUL92	14JUL92	3488
071003	ADS 1078: DEBRIS MAPPING RFI PH1	12	15SEP92	30SEP92	26160
071004	ADS 1078: DEBRIS RADIATION SURVEY RFI PH1	12	15SEP92	30SEP92	10172
	ADS 1078: SAMPLE ANALYSIS RFI PH1				
072000	ADS 1078: SIGMA AREA LAB ANALYS RFI PH1	66	22JUN92	23SEP92	101590
072001	ADS 1078: PERIMETER RIM LAB ANALYS RFI PH1	66	7JUL92	7OCT92	55550
072002	ADS 1078: ASHLEY POND LAB ANALYS RFI PH1	66	15JUL92	16OCT92	47230
072003	ADS 1078: BAILEY BRIDGE LAB ANALYS RFI PH1	66	21JUL92	22OCT92	100663
072004	ADS 1078: HILLSIDE 140/J22-TO LAB A RFI PH1	66	4AUG92	5NOV92	198419
072005	ADS 1078: COOLING TOWER 80 LAB ANA RFI PH1	66	18AUG92	20NOV92	135373
072006	ADS 1078: HILLSIDE 138 LAB ANALYS RFI PH1	66	1SEP92	8DEC92	180463
072007	ADS 1078: HILLSIDE 137 LAB ANALYS RFI PH1	66	15OCT92	25JAN93	131768
072008	ADS 1078: SE LOS ALAMOS INN LAB ANA RFI PH1	66	29OCT92	8FEB93	91336



Plot Date 14APR92
Data Date 1OCT91
Project Start 1OCT91
Project Finish 3JUN93

Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

1078

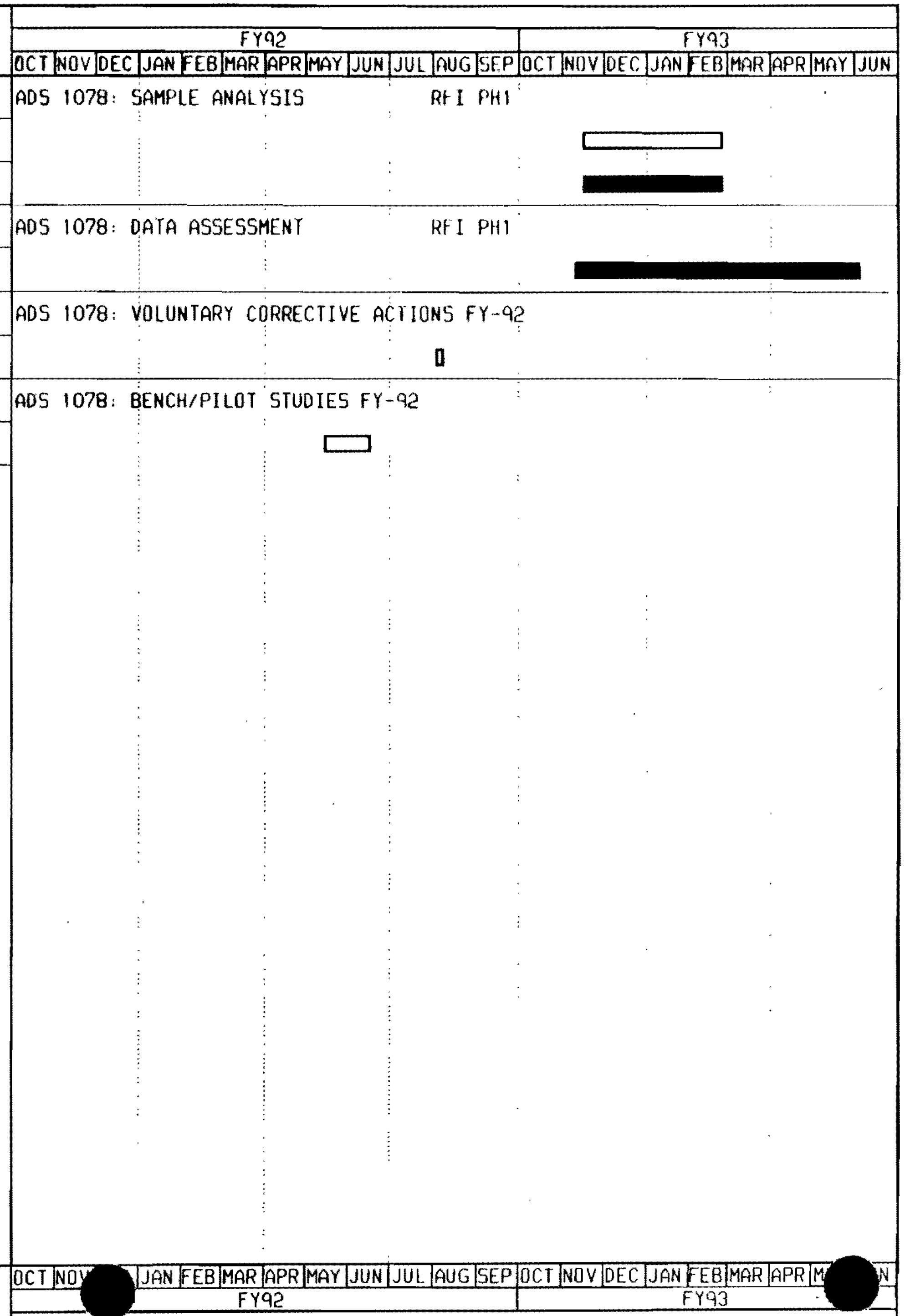
Sheet 1 of 2

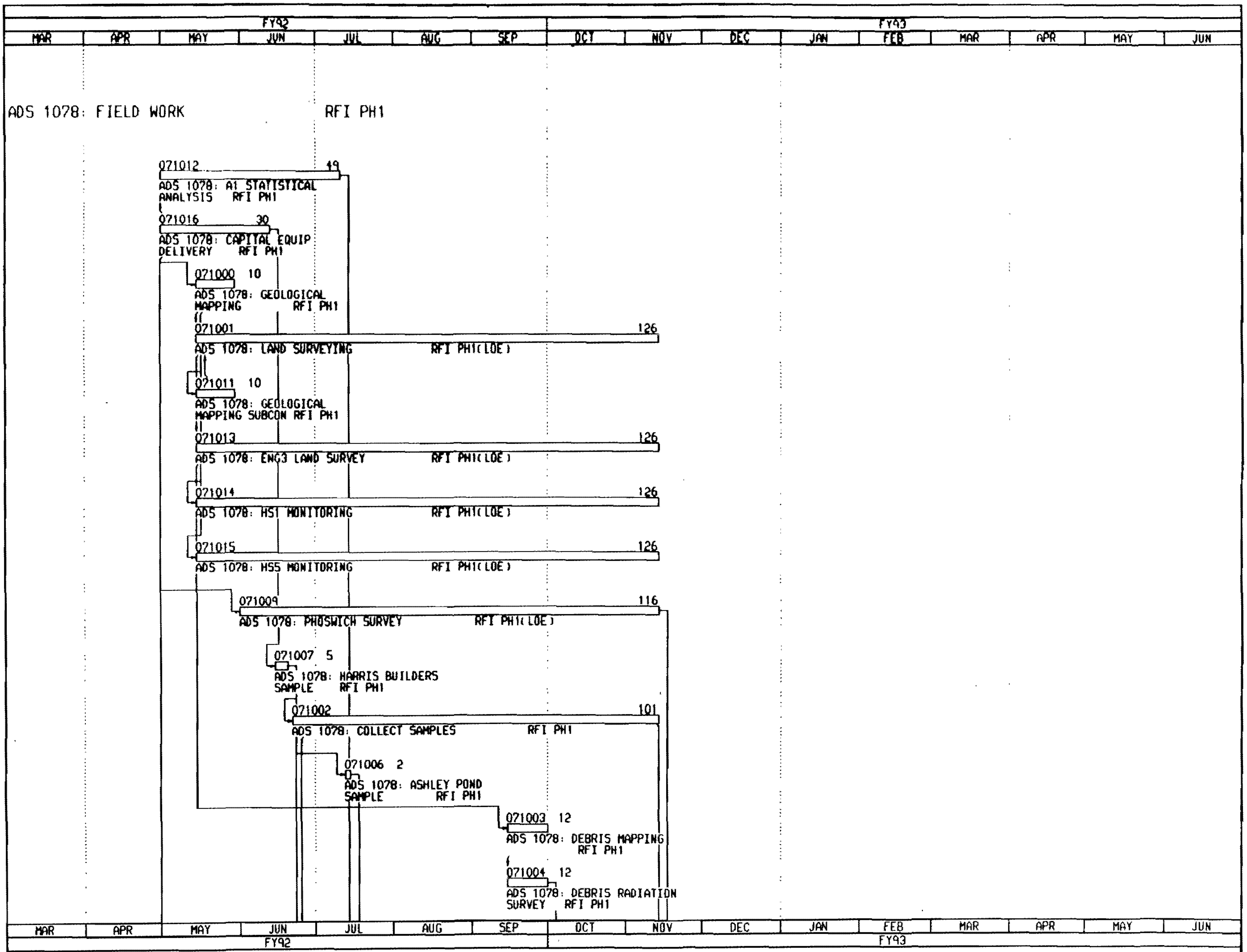
LANL EM-8 R. CONRAD 667-0950
ADS 1078: TA-1 DETAIL FIELD WORK
DETAILED FIELD WORK RFI PH1

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved

ADS 1078: SAMPLE ANALYSIS RFI PH1								
	072009	ADS 1078: CAN DUMP SITE LAB ANALYS						RFI PH1
RD	66	ES 16NOV92	EF 24FEB93	BC	59544			
	072010	ADS 1078: SEPTIC TK 275 LAB ANALYS						RFI PH1
RD	66	ES 16NOV92	EF 24FEB93	BC	72247			
ADS 1078: DATA ASSESSMENT RFI PH1								
	073000	ADS 1078: DATA ASSESSMENT						RFI PH1
RD	140	ES 10NOV92	EF 3JUN93	BC	181825			
ADS 1078: VOLUNTARY CORRECTIVE ACTIONS FY-92								
	071005	ADS 1078: VCA CAN DUMP SITE						RFI PH1
RD	5	ES 3AUG92	EF 7AUG92	BC	19760			
ADS 1078: BENCH/PILOT STUDIES FY-92								
	071008	ADS 1078: PILOT STUDIES						RFI PH1(LOE)
RD	22	ES 15MAY92	EF 16JUN92	BC	24800			





Plot Date 14APR92
Data Date 1OCT91
Project Start 1OCT91
Project Finish 3JUN93

(c) Primavera Systems, Inc

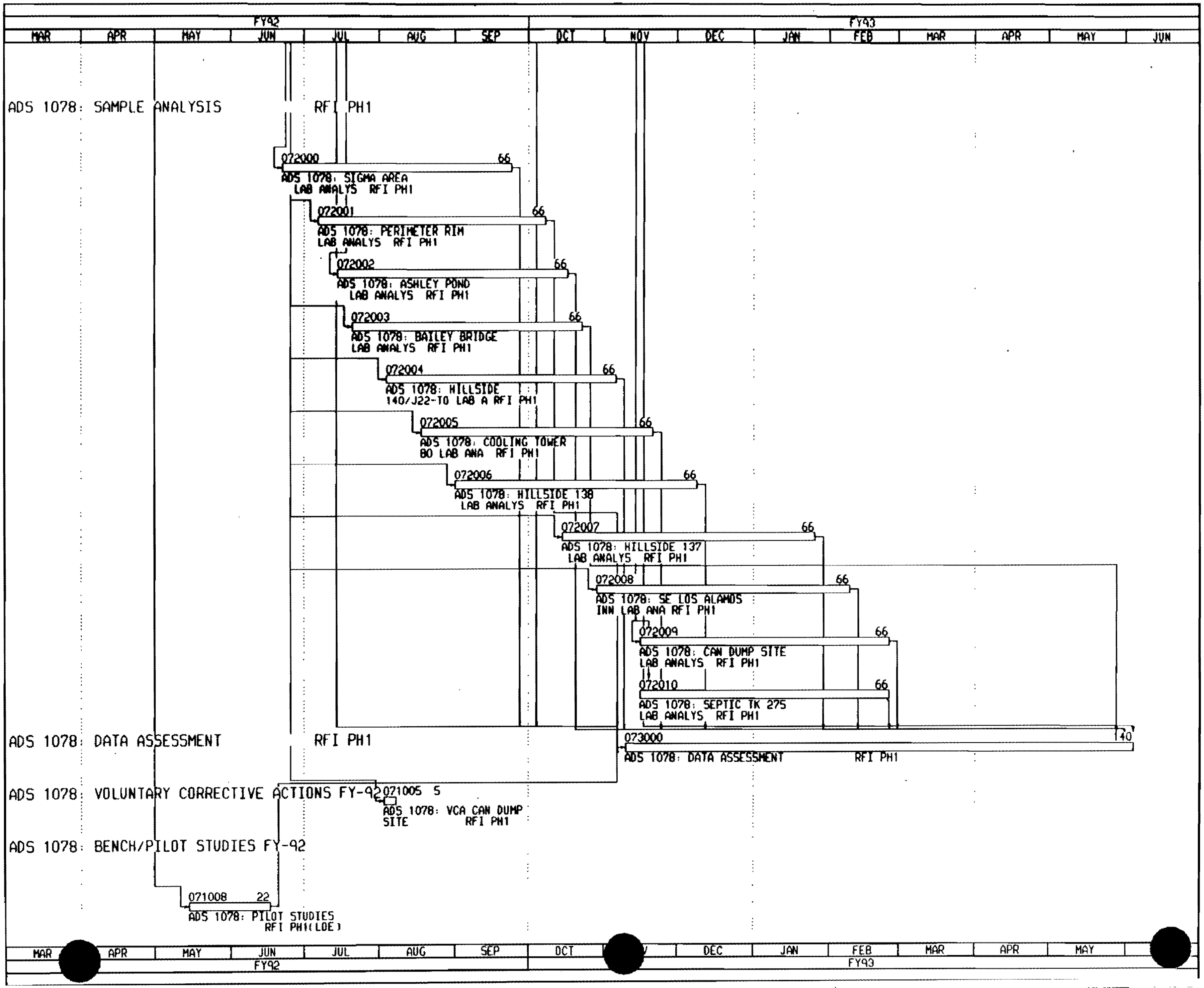
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

LANL EM-8 R. CONRAD 667-0950
ADS 1078: TA-1 DETAIL FIELD WORK
DETAILED FIELD WORK RFI PH1

Sheet 1 of 2

ENVIRONMENTAL RESTORATION

Date	Revision	Checked	Approved



FY92
FY93
MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN
ADS 1078: SAMPLE ANALYSIS RFI PH1
072000 66
ADS 1078: SIGMA AREA LAB ANALYS RFI PH1
072001 66
ADS 1078: PERIMETER RIM LAB ANALYS RFI PH1
072002 66
ADS 1078: ASHLEY POND LAB ANALYS RFI PH1
072003 66
ADS 1078: BAILEY BRIDGE LAB ANALYS RFI PH1
072004 66
ADS 1078: HILLSIDE 140/J22-TO LAB A RFI PH1
072005 66
ADS 1078: COOLING TOWER 80 LAB ANA RFI PH1
072006 66
ADS 1078: HILLSIDE 138 LAB ANALYS RFI PH1
072007 66
ADS 1078: HILLSIDE 137 LAB ANALYS RFI PH1
072008 66
ADS 1078: SE LOS ALAMOS INN LAB ANA RFI PH1
072009 66
ADS 1078: CAN DUMP SITE LAB ANALYS RFI PH1
072010 66
ADS 1078: SEPTIC TK 275 LAB ANALYS RFI PH1
ADS 1078: DATA ASSESSMENT RFI PH1
073000 40
ADS 1078: DATA ASSESSMENT RFI PH1
ADS 1078: VOLUNTARY CORRECTIVE ACTIONS FY-92
071005 5
ADS 1078: VCA CAN DUMP SITE RFI PH1
ADS 1078: BENCH/PILOT STUDIES FY-92
071008 22
ADS 1078: PILOT STUDIES RFI PH1(LOE)
MAR APR MAY JUN JUL AUG SEP OCT DEC JAN FEB MAR APR MAY
FY92
FY93

ATTACHMENT I-2

SUMMARY COST ESTIMATE FOR PHASE I OF THE RFI FOR OU 1078

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071000	10	10	0	ADS 1078: GEOLOGICAL MAPPING RFI PH1	7360.00	.00	15MAY92*	29MAY92

OTH4608 NON-STAFF MEMBER EM-8
8.00 MH /DAY 80

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071001	126	126	0	ADS 1078: LAND SURVEYING RFI PH1(LOE)	53005.14	.00	15MAY92*	13NOV92

OTH4608 NON-STAFF MEMBER EM-8
1.90 MH /DAY 240
SM 4608 STAFF MEMBER EM-8
1.90 MH /DAY 240

LAND SURVEYING WILL BE LEVEL OF EFFORT. IT WILL BE PERFORMED PRIOR TO SAMPLING IN EACH AREA IDENTIFIED IN THE SCHEDULE. PL FELT IT UNNECESSARY TO BREAK THIS ACTIVITY INTO FURTHER DETAIL.MLS.4/15/92.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071002	101	101	0	ADS 1078: COLLECT SAMPLES RFI PH1	201641.19	.00	22JUN92	13NOV92

OTH4608 NON-STAFF MEMBER EM-8
12.67 MH /DAY 1280
SM 4608 STAFF MEMBER EM-8
6.34 MH /DAY 640

THE SCOPE OF THIS ACTIVITY INCLUDES ALL SAMPLING NOT RELATED TO HARRIS BUILDERS (SIGMA AREA) OR ASHLEY POND. THE AREAS INVOLVED IN THIS ACTIVITY ARE HILLSIDE 140, BAILEY BRIDGE, HILLSIDE 137 HILLSIDE 138, THE CAN DUMP SITE, PERIMETER RIM, COOLING TOWER 80, SE LOS ALAMOS INN AND SEPTIC TANK 275.MLS.4/15/92.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071003	12	12	0	ADS 1078: DEBRIS MAPPING RFI PH1	26160.00	.00	15SEP92*	30SEP92

OTH4608 NON-STAFF MEMBER EM-8
10.00 MH /DAY 120
SM 4608 STAFF MEMBER EM-8
10.00 MH /DAY 120

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071004	12	12	0	ADS 1078: DEBRIS RADIATION SURVEY RFI PH1	10172.00	.00	15SEP92	30SEP92

OTH4608 NON-STAFF MEMBER EM-8
.08 MH /DAY 1
SM 4608 STAFF MEMBER EM-8
6.67 MH /DAY 80

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071005	5	5	0	ADS 1078: VCA CAN DUMP SITE RFI PH1	19760.00	.00	3AUG92*	7AUG92

OTH4608 NON-STAFF MEMBER EM-8
32.00 MH /DAY 160

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	FINISH

SM 4608 STAFF MEMBER EM-8
8.00 MH /DAY 40

RUSTED CANS IN THE AREA APPEAR TO BE FROM SOLVENTS AND PAINTS.SWMU 1-003.

071006 2 2 0 ADS 1078: ASHLEY POND SAMPLE RFI PH1 13JUL92* 14JUL92
3488.00 .00
OTH4608 NON-STAFF MEMBER EM-8
8.00 MH /DAY 16
SM 4608 STAFF MEMBER EM-8
8.00 MH /DAY 16

4/10/92: OUTFALL FROM A DRAIN LINE INTO ASHLEY POND THAT SERVICED A CLEANING PLANT UNTIL 1947. OUTFALL FROM STORM DRAIN LINES SERVICING BLDG P. SAMPLES IN THE SCOPE ARE WATER AND SEDIMENT FROM ASHLEY POND.

071007 5 5 0 ADS 1078: HARRIS BUILDERS SAMPLE RFI PH1 15JUN92* 19JUN92
28480.00 .00
OTH4608 NON-STAFF MEMBER EM-8
40.00 MH /DAY 200
SM 4608 STAFF MEMBER EM-8
16.00 MH /DAY 80

4/10/92: LOCATED ON THE NE CORNER OF OPPENHEIMER & LOMA VISTA DR. SITE OF THE MAIN SIGMA BLDG , SIGMA 1, 2, 3 & 4; AND THE THETA BLDG.

071008 22 22 0 ADS 1078: PILOT STUDIES RFI PH1(LOE) 15MAY92* 16JUN92
24800.00 .00
OTH4608 NON-STAFF MEMBER EM-8
7.27 MH /DAY 160
SM 4608 STAFF MEMBER EM-8
3.64 MH /DAY 80

071009 116 116 0 ADS 1078: PHOSWICH SURVEY RFI PH1(LOE) 1JUN92* 13NOV92
53064.21 .00
OTH4608 NON-STAFF MEMBER EM-8
2.07 MH /DAY 240
SM 4608 STAFF MEMBER EM-8
2.07 MH /DAY 240

071011 10 10 0 ADS 1078: GEOLOGICAL MAPPING SUBCON RFI PH1 15MAY92 29MAY92
35700.00 .00
SCIEN SUBCONTRACTOR
34.00 MH /DAY 340

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
071012	49	49	0	ADS 1078: A1 STATISTICAL ANALYSIS RFI PH1	71314.00	.00	1MAY92	10JUL92
				SM 9801 STAFF MEMBER A-1 8.04 MH /DAY 394				
071013	126	126	0	ADS 1078: ENG3 LAND SURVEY RFI PH1(LOE)	8591.05	.00	15MAY92	13NOV92
				OTH8403 NON-STAFF MEMBER ENG-3 .63 MH /DAY 80 SEE ACTIVITY # 071001.				
071014	126	126	0	ADS 1078: HS1 MONITORING RFI PH1(LOE)	11780.03	.00	15MAY92	13NOV92
				OTH5701 NON-STAFF MEMBER HS-1 1.62 MH /DAY 204 THIS ACTIVITY IS LOE, AND WILL BE IN EFFECT AS LONG AS SAMPLING OR OTHER RELATED FIELD WORK IS IN PROGRESS.				
071015	126	126	0	ADS 1078: HS5 MONITORING RFI PH1(LOE)	16947.06	.00	15MAY92	13NOV92
				OTH5705 NON-STAFF MEMBER HS-5 1.62 MH /DAY 204 SEE ACTIVITY # 071014.				
071016	30	30	0	ADS 1078: CAPITAL EQUIP DELIVERY RFI PH1	66000.00	.00	1MAY92*	12JUN92
				ODC SUBCONTRACTOR .00 $$$$/DAY 0 THIS ACTIVITY INCLUDES ALL MONEY REQUIRED TO PURCHASE SPECIFIC TOOLS EQUIPMENT AND SAMPLE STORAGE CONTAINERS REQUIRED TO SUPPORT RFI PH1 FIELD WORK. DELIVERY IS SET TO COINCIDE WITH START OF SURVEYING AND PROCEEDING THRU TO THE FIRST SAMPLES STARTING ON JUNE 15,1992 WITH THE SIGMA AREA (HARRIS BUILDERS) ACT # 071007.				
072000	66	66	0	ADS 1078: SIGMA AREA LAB ANALYS RFI PH1	101590.00	.00	22JUN92	23SEP92
				ODC SUBCONTRACTOR .00 $$$$/DAY 0 4/10/92: SEPTIC TANK 139 AND ASSOCIATED DRAIN LINES WITH BLDGS DELTA AND D-5.SWMU 1-001E. SEPTIC TANK 276 AND ASSOC DRAIN LINES WITH THE THETA BLDG.OUTFALL WENT TO THE HEAD OF BAILEY'S CANYON.THETA BLDG REMOVED 1947.SWMU 1-001N.				

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072001	66	66	0	ADS 1078: PERIMETER RIM LAB ANALYS RFI PH1		7JUL92	7OCT92
				55550.00	.00		

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

THIS ANALYSIS WILL INCLUDE SAMPLES TAKEN FROM THE 3 MAJOR DEBRIS SITES ON THE CANYON PERIMETER RIM. THIS EXCLUDES BAILEY BRIDGE, THE CAN DUMP SITE AND HILLSIDES 137, 138 AND 140.THESE ARE COVERED IN SEPARATE ANALYSIS ACTIVITIES.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072002	66	66	0	ADS 1078: ASHLEY POND LAB ANALYS RFI PH1		15JUL92	16OCT92
				47230.00	.00		

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

THIS ACTIVITY WILL ANALYZE WATER AND SEDIMENT SAMPLES TAKEN FROM ASHLEY POND.SWMU 1-001R.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072003	66	66	0	ADS 1078: BAILEY BRIDGE LAB ANALYS RFI PH1		21JUL92	22OCT92
				100663.00	.00		

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/10/92: ANALYSIS OF DEBRIS LOCATED AT BAILEY BRIDGE.THIS IS THE LOCATION OF SEVERAL OUTFALLS PARTICULARLY FROM SEPTIC TANKS 139 (SIGMA AREA) AND 276 (THETA BLDG).THESE WERE COVERED WHEN THE BAILEY BRIDGE AREA WAS FILLED IN DURING THE DEMOLITION OF AREA BLDGS.SWMU 1-003A.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072004	66	66	0	ADS 1078: HILLSIDE 140/J22-TO LAB A RFI PH1		4AUG92	5NOV92
				198419.00	.00		

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/10/92: OUTFALL FROM SANITARY LINES AND SEPTIC TANK 140 ASSOC WITH BLDGS FP AND HT.SWMU 1-001F.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072005	66	66	0	ADS 1078: COOLING TOWER 80 LAB ANA RFI PH1		18AUG92	20NOV92
				135373.00	.00		

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/15/92: OUTFALL FROM A BLDG DRAIN LINE THAT SERVICED COOLING TOWER 80. NO RECORD OF RADIO-ACTIVE MATERIALS. TOWER REMOVED IN AUGUST 1954. DOE SPECULATES BIOCIDES CONTAINING CHROMIUM MAY HAVE BEEN ADDED TO COOLING WATER. 74-76 SURVEY. ONE SAMPLING POINT HAD NEGATIVE RESULTS.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH
072006	66	66	0	ADS 1078: HILLSIDE 138 LAB ANALYS RFI PH1		1SEP92	8DEC92
				180463.00	.00		

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	SCHEDULED START	SCHEDULED FINISH

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/10/92: SEPTIC TK 138 AND ASSOC SANITARY DRAIN LINES SERVICING BLDGS Y K AND V. ALSO STORM DRN LINE FROM BLDG R. SWMU 1-001D.
BLDG Y WAS A PHYSICS LAB THAT USED TRITIUM AND U-238 AND CONTAINED ALPHA CONTAMINATION.REMOVED IN JUNE 1956.
BLDG V WAS THE ORIGINAL MACHINE SHOP. SOME URANIUM AND BERYLLIUM WERE MACHINED THERE. BLDG WAS REMOVED IN 1959.
BLDG K WAS A STORAGE AREA WITH NO INDICATION OF RADIOACTIVE MATERIALS.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	START	FINISH
072007	66	66	0	ADS 1078: HILLSIDE 137 LAB ANALYS RFI PH1	131768.00	.00	15OCT92	25JAN93

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/10/92: OUTFALL FROM SEPTIC TK 137 & SANITARY WASTE LINES THAT SERVICED BUILDING D-2.THIS BLDG HAD FOUR USES FROM JUL44 TO OCT53: 1)LAUNDRY FOR RADIOACTIVE CONTAMINATED CLOTHING AND GLASSWARE, 2)ELECTRONICS SHOP, 3)DECON OF BLDG D, 4)STORAGE ALSO, OUTFALL FROM A DRAIN LINE THAT SERVICED BLDG D-3.THIS BLDG WAS USED AS A COUNT ROOM FOR BLDG H-1 FILTER PAPERS FROM ROOM AIR TESTS. SWMU 1-001C.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	START	FINISH
072008	66	66	0	ADS 1078: SE LOS ALAMOS INN LAB ANA RFI PH1	91336.00	.00	29OCT92	8FEB93

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

4/10/92: SEPTIC TANK 269 AND ASSOC SANITARY DRN LINES WITH BLDG S-1.SWMU 1-001L.OUTFALL IS NOW COVERED BY A DEBRIS DISPOSAL AREA SOUTH OF THE SUNNY DAYS PLAZA OFF TRINITY DR.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	START	FINISH
072009	66	66	0	ADS 1078: CAN DUMP SITE LAB ANALYS RFI PH1	59544.00	.00	16NOV92	24FEB93

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

LOCATED JUST SOUTH OF THE TELEPHONE BUILDING. THE RUSTED CANS APPEAR TO BE FROM SOLVENTS AND PAINTS.SWMU 1-003.

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION	BUDGET	EARNED	START	FINISH
072010	66	66	0	ADS 1078: SEPTIC TK 275 LAB ANALYS RFI PH1	72247.00	.00	16NOV92	24FEB93

ODC SUBCONTRACTOR
.00 $$$$/DAY 0

SCOPE INCLUDES SEPTIC TANK AND OUTFALL TO THE NE

ACTIVITY ID	ORIG DUR	REM DUR	%	ACTIVITY DESCRIPTION / BUDGET	EARNED	SCHEDULED START	FINISH
				AREA OF LOS ALAMOS CANYON.THE WAREHOUSE WAS IN USE UNTIL 1954 AND SHOWS NO RECORD OF CONTAINING RADIOACTIVE MATERIALS.SWMU 1-001M.			
073000	140	140	0	ADS 1078: DATA ASSESSMENT RFI PH1		10NOV92	3JUN93
				181824.91	.00		

EDIT O SUBCONTRACTOR
.74 MH /DAY 103
ENGR SUBCONTRACTOR
.74 MH /DAY 103
GEO-IIS SUBCONTRACTOR
1.19 MH /DAY 166
OTH4608 NON-STAFF MEMBER EM-8
.22 MH /DAY 31
OTH5811 NON-STAFF MEMBER IS-11
.14 MH /DAY 19
PRS-ID SUBCONTRACTOR
.74 MH /DAY 103
SCIEN SUBCONTRACTOR
1.11 MH /DAY 155
SCIIIIO SUBCONTRACTOR
3.35 MH /DAY 469
SM 4608 STAFF MEMBER EM-8
1.94 MH /DAY 271
SM 5601 STAFF MEMBER EES-1
.20 MH /DAY 28
SM 5615 STAFF MEMBER EES-15
.14 MH /DAY 19
SM 8401 STAFF MEMBER ENG-1
.14 MH /DAY 19
SM 9804 STAFF MEMBER A-4
.59 MH /DAY 83
WDPROC SUBCONTRACTOR
1.24 MH /DAY 173

	BUDGET	EARNED
REPORT TOTAL	1994270.59	.00

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1
Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model
for Technical Area 1

Chapter 5
Field Investigation
Methods

Chapter 6
Solid Waste Management
Unit Aggregate
Background Information

Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans

Annexes

Appendices

Annexes

I Project Management Plan

II Quality Assurance Project Plan

III Health and Safety Plan

IV Records Management Plan

V Community Relations Plan

I.0 APPROVAL FOR IMPLEMENTATION

NAME: Robert Vocke

TITLE: ER Program Manager, Los Alamos National Laboratory

SIGNATURE______________________________________DATE:________

NAME: Larry Maassen

TITLE: Quality Assurance Project Leader, ER Program, Los Alamos National Laboratory

SIGNATURE:______________________________________DATE:________

NAME: Craig Leasure

TITLE: Group Leader, Health and Environmental Chemistry Group (EM-9)

SIGNATURE:______________________________________DATE:________

NAME: Margaret Gautier

TITLE: Quality Assurance Officer, Health and Environmental Chemistry Group (EM-9)

SIGNATURE:______________________________________DATE:________

NAME: Ron Conrad

TITLE: Project Leader, Environmental Protection Group (EM-8), Los Alamos National Laboratory

SIGNATURE:______________________________________DATE:________

NAME: Charles Ritchey

TITLE: Acting Chief of Office of Quality Assurance, Region VI Environmental Protection Agency

SIGNATURE:______________________________________DATE:________

2.0 CONTENTS AND LIST OF ACRONYMS

LIST OF ACRONYMS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
DOE	US Department of Energy
DOT	US Department of Transportation
DQO	Data quality objective
EPA	US Environmental Protection Agency
ER	Environmental restoration
FIMAD	Facility for Information Management, Analysis, and Display
H&S	Health and safety
IWP	Installation work plan
LANL	Los Alamos National Laboratory
NQA	Nuclear quality assurance
OU	Operable unit
OUPL	Operable unit project leader
PCB	Polychlorinated biphenyl
QA	Quality assurance
QAPjP	Quality assurance project plan
QC	Quality control
QP	Quality procedure
QPPL	Quality program project leader
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SMF	Sample management facility
SOP	Standard operating procedure
SWMU	Solid waste management unit
TTL	Technical team leader

3.0 PROJECT DESCRIPTION

3.1 Introduction

This Quality Assurance Project Plan (QAPjP) for Operable Unit (OU) 1078 supplements the Los Alamos National Laboratory (Laboratory) Environmental Restoration (ER) Program's Quality Assurance Program Plan [Annex II of the Installation Work Plan for Environmental Restoration (IWP)] (LANL 1991, 0553) as specified in the ER Program's generic QAPjP (Appendix T of the IWP). Sections of this QAPjP for OU 1078 are incorporated by reference to the generic QAPjP and to the Resource Conservation and Recovery Act (RCRA) field investigation (RFI) work plan for OU 1078. In these cases, the appropriate document and section are given. The text in this QAPjP provides information specific to OU 1078, as directed by the generic QAPjP. To facilitate cross-referencing, the section titles and numbers in this QAPjP correspond directly to those contained in the generic QAPjP.

This OU 1078 RFI QAPjP integrates the Environmental Protection Agency's (EPA's) 16-point quality assurance management staff (QAMS)-005/80 guidance (EPA 1980, 0552), as well as the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1-1989 edition of "Quality Assurance (QA) Program Requirements for Nuclear Facilities" (ANSI/ASME 1989, 0018), as specified in Department of Energy (DOE) Order 5700.6C.

3.2 Facility Description

A facility description of the Laboratory is presented in Section 2 of the IWP. Additional historical information on OU 1078 is presented in Chapters 1 and 6 of the work plan.

3.3 Environmental Restoration Program

A description of the ER Program is presented in Section 3 of the IWP.

3.4 Project Description

3.4.1 Project Objectives

Information regarding the project objectives for OU 1078 is presented in Chapters 1 and 7 of the work plan.

3.4.2 Project Schedule

Project activity dates are presented in Annex I of the work plan for OU 1078.

3.4.3 Project Scope

This information is presented in Chapters 1 and 7 of the work plan.

3.4.4 Background Information

This information is presented in various sections of Chapter 3 of the work plan.

3.4.5 Data Usage

Information regarding data usage and data users is presented in Chapter 7 of the work plan. Data collected during the RFI at OU 1078 will be used to determine whether a source of contamination is present and, if present, to define the extent of contamination at solid waste management units (SWMUs) or SWMU aggregates, as described in the field sampling plans in Chapter 7 of the work plan. The investigation should provide sufficient data for a baseline risk assessment and corrective measures study, if needed. Chapter 7 of the work plan provides an overview of important aspects of data analysis for OU 1078. Data collected during the RFI will be entered in the Facility for Information Management, Analysis, and Display (FIMAD) in accordance with the records management procedure (LANL-ER-AP-02.1) and will be analyzed, as appropriate, using statistical techniques, kriging, 2- and 3-dimensional modeling, and other appropriate methods. Annex IV of the IWP describes the functions of the FIMAD.

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The overall organizational structure of the ER Program is presented in Annex II, Section 2 of the IWP, in which ER Program personnel are identified down to the level of technical team leader (TTL) and OU project leader (OUPL) and personnel responsibilities and line authority are described. In addition, the quality assurance (QA) organizational structure is presented, and personnel qualifications are described.

Detailed information pertinent to the management organization for conducting the field work at OU 1078 is provided in Annex I. Annex IV contains information on the management of records maintained for OU 1078.

The QA responsibilities for OU 1078 project team members are described below.

4.1 Operable Unit Project Leader

The OUPL

- oversees day-to-day operations, including planning, scheduling, and reporting on various aspects of implementing the ER Program;
- ensures preparation of planning documents and procedures for conducting scientific investigations;
- prepares monthly and quarterly reports for the program manager;
- oversees subcontractors, as appropriate;
- coordinates with TTLs;
- conducts technical reviews of milestones and final reports;
- interfaces with the ER quality program project leader (QPPL) to resolve quality concerns and to coordinate audits with the QA staff;
- complies with the ER Program's health and safety, field sampling, and records management procedures;
- oversees RFI field work and manages the field teams leader; and
- complies with the technical and QA requirements for the Laboratory's ER Program.

4.2 Field Team Manager for OU 1078

The field team manager for OU 1078

- oversees day-to-day field operations including planning, scheduling and implementation of the RFI field activities described in Chapter 7 of the RFI work plan for OU 1078,
- manages field team members,
- coordinates team activities with OUPL,
- issues programmatic guidance to team members,
- ensures independent review of team deliverables,
- ensures development of standard operating procedures (SOPs), as appropriate,
- ensures the quality and completeness of deliverables, and
- designates QA representatives, as appropriate.

4.3 Field Team Leader for OU 1078

The field team leader for OU 1078

- oversees daily field operations, including planning, scheduling, and implementing RFI field activities at OU 1078; and
- manages field team members, who, depending on the sampling activity being conducted, include sampling personnel, a site safety officer, and staff members with technical knowledge of geology, hydrology, statistics, and other applicable disciplines.

Field team members will include, depending upon the sampling activity being conducted, sampling personnel, a site safety officer, and staff members with technical knowledge of sampling, geology, hydrology, statistics, and other applicable disciplines.

The project management plan for OU 1078 is presented in Annex I.

5.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS, AND COMPARABILITY

Table 1.10-1 in the work plan summarizes the analytical levels appropriate to data uses at OU 1078.

5.1 Level of Quality Control

5.1.1 Field Sampling

A discussion of quality control samples for the ER Program is presented in Section 5 of the ER Program's generic QAPjP, which is included as Appendix T of the IWP. The frequency and type of field quality control samples identified in the generic QAPjP will be followed for chemical analyses of samples during the RFI at OU 1078, except for reagent blanks. A reagent blank will be provided for each analytical batch or every 20 water samples, whichever is greater. Reagent blanks will not be used for soil samples because no reagent preservatives are used.

5.1.2 Field Measurements

The quality control procedures used for obtaining data from nonradiological field samples during the RFI will follow the recommendations presented in Table V.1 in Section 5 of the generic QAPjP. Table X.1 in Section 10.3.3 of the generic QAPjP describes the field radiological quality control samples.

5.1.3 Analytical Laboratory

The level of quality control for laboratory analyses for the RFI at OU 1078 will follow the recommendations specified in EPA methods or the frequency presented in Table V.2 of Section 5 of the generic QAPjP.

5.2 Precision, Accuracy, and Sensitivity of Analyses

The quality control acceptance criteria for precision, accuracy, and sensitivity of laboratory analyses performed for the OU 1078 RFI will use the methods and detection limits specified by EPA and DOE methods presented in Section 5 of the generic QAPjP. Specifically, the following will be used at OU 1078:

- Table V.4, for semivolatiles;

- Table V.7, for inorganics;
- Table V.8, for radionuclides; and
- Table V.9, for miscellaneous analytes.

Any specific analyte identified in the tables listed above may be included in the RFI investigations at OU 1078. Broad categories excluded from this work are volatile organic compounds, poloychlorinated biphenyls (PCBs), pesticides, and high explosives (included in Tables V.3, V.5, V.6, and V.10). The analytical laboratory quality control acceptance criteria for precision, accuracy, and sensitivity of analyses that are to be used are not specific to this OU. The table numbers cited in the sections below correspond to the table numbers in the generic QAPjP and include the analytes specific to OU 1078.

5.3 Quality Assurance Objectives for Precision

The QA objectives for precision of laboratory analyses for samples taken at OU 1078 will follow the EPA guidance specified in Section 5.3 and Table V.11 of the generic QAPjP.

5.4 Quality Assurance Objectives for Accuracy

The QA objectives for accuracy of laboratory analyses for samples taken at OU 1078 will follow the EPA guidance specified in Section 5.4 and Tables V.11 and V.12 of the generic QAPjP.

5.5 Representativeness, Completeness, and Comparability

The field sampling plans in Chapter 7 of the work plan for OU 1078 were developed to meet the criteria for sample representativeness described in Section 14.3 of the generic QAPjP.

Completeness of analytical data from OU 1078 will be calculated according to the formula presented in Section 14.4 of the generic QAPjP. The QA objective for analytical data completeness for the ER Program is 90%, which is also the objective for OU 1078.

Data comparability for the RFI at OU 1078 will be achieved through the use of standard sampling and analytical techniques. Sampling will be performed according to ER Program SOPs (LANL 1992, 0688).

Sample analyses will be performed according to analytical methods referenced in the generic QAPjP or in this QAPjP. Data results will be reported in appropriate units consistent with existing site data and applicable regulatory requirements.

5.6 Field Measurements

Field laboratory measurements for OU 1078 will be performed according to quality assurance/quality control (QA/QC) procedures described in a future version of the ER Program's SOPs. Adherence to these SOPs will ensure the accuracy, precision, and completeness of the field measurement data.

5.7 Data Quality Objectives

All data quality objective (DQO) elements are covered in Chapters 1 and 7 of this work plan and in the generic QAPjP. DQOs and the development process for the RFI at OU 1078 are described in Chapters 1 and 7 of this work plan. Chapter 1 also contains a list of data needs, location figures, and tables of sampling and analytical requirements that are specific to each SWMU and SWMU aggregate in OU 1078.

Data analysis, interpretation, statistical representativeness, and applicability to the conceptual model are discussed in Chapter 7 of this work plan.

Budget and schedule information relative to anticipated field and laboratory activities is presented in Annex I of this work plan.

6.0 SAMPLING PROCEDURES

Procedures for collecting soil and aqueous samples will be selected, as appropriate, from ER Program SOPs. A general description of field investigations is also presented in Chapter 5 of the work plan for OU 1078.

Information on required sample containers, volume, preservation, and holding times is presented in ER Program SOP, "Containers, Sampling and Preservation." Information regarding sample decontamination is contained in ER Program SOP, "General Equipment Decontamination."

Instructions for handling, packaging, and shipping samples are described in detail in ER Program SOP, "Guide to Handling, Packaging and Shipping of Samples." Documentation procedures are described in ER Program SOP, "Sample Control and Documentation."

6.1 Sample Preservation During Shipment

Information on sample preservation during shipment is presented in ER Program SOP, "Containers, Sampling and Preservation," and in Section 6.2 of the generic QAPjP.

6.2 Equipment Decontamination

Equipment decontamination is described in Section 6.3 of the generic QAPjP, and in ER Program SOP, "General Equipment Decontamination." ER Program SOP, "RFI Generated Waste Management," provides information for proper handling and disposal of wash water and other materials generated during equipment decontamination.

6.3 Sample Designation

Samples will receive a unique alphanumeric identifier to provide chain-of-custody control during the transfer of samples from the time of collection through analysis and reporting. This information is provided in ER Program SOP, "Sample Control and Documentation."

LANL-ER-QAPjP, R0
May 23, 1992
Section Number: 7.0
Page 1 of 2

7.0 SAMPLE CUSTODY

7.1 Overview

Field and laboratory sample chain-of-custody procedures are described in Section 7 of the generic QAPjP. An example of a chain-of-custody form is contained in Section 7 of the generic QAPjP. These procedures will be followed for sampling activities conducted during the RFI for OU 1078. The ER Program SOP, "Sample Control and Documentation," also provides the guidance for chain-of-custody procedures, including example chain-of-custody records and tags.

7.2 Field Documentation

A sample-numbering system developed for the ER Program uniquely identifies each boring location, monitor well, and sample collected. The numbering system, including standard sample identifiers, identifiers for quality control samples, and the code system to be used, is described in ER Program SOP, "Sample Control and Documentation." Section 7.2 of the generic QAPjP provides sample documentation guidance for field personnel. The numbering system will be followed for all sampling activities conducted during the RFI. All field data collection forms will be reviewed by the field teams manager or a designated technical reviewer before the forms are submitted to the ER Program's Records-Processing Facility. Incorrect entries will be crossed out with a single line and will be signed and dated by the person originating the entry and by the field teams manager or a designated technical reviewer.

7.3 Sample Management Facility

Section 7.3 of the generic QAPjP provides a discussion of the ER Program activities coordinated by the Sample Management Facility (SMF). The project team for OU 1072 will carry out these activities.

7.4 Laboratory Documentation

Custody procedures for analytical laboratories associated with sample receipt, storage, preparation, analysis, and general security are described in Section 7.4 of the generic QAPjP. These procedures will be followed by all laboratories participating in chemical analysis of samples obtained at OU 1078.

Laboratories providing radiological and geotechnical analyses of these samples also will follow chain-of-custody and record-keeping procedures as described in Section 7.4 of the generic QAPjP. These samples will be stored in accordance with the requirements of ER Program SOPs or in the analytical laboratory's QA plan. Tracking these samples will follow the requirements described in that QA plan. The SMF is responsible for acquiring appropriate QA manuals from all laboratories performing analysis of OU 1078 samples, including EM-9.

7.5 Handling, Packaging, and Shipping Samples

Procedures for handling, packaging, and shipping are described in ER Program SOP, "Guide to Handling, Packaging and Shipping of Samples," and in Appendix N of the IWP. Also, the Department of Transportation (DOT) (1985, 0278) and the International Air Transportation Association (International Air Transport Association 1988, 0519) have established specific regulations governing the packaging of hazardous samples for shipment.

7.6 Final Evidence File Documentation

Final evidence file documentation is described in the Records Management Program Plan, Annex IV of the IWP (LANL 1991, 0553). Activities conducted at OU 1078 will follow these programwide procedures. SOPs will be developed, reviewed, and approved, as needed.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

8.1 Field Equipment

Field equipment that will be used during the RFI includes those instruments described in Chapter 5 of this work plan. Specific information regarding calibration procedures and frequency of calibration for field equipment is presented in the applicable ER Program SOPs and in manufacturers' equipment manuals.

8.2 Laboratory Equipment

Section 8.3 of the generic QAPjP contains general information on the calibration procedures and frequency of calibration for laboratory equipment. Specific instrument calibration procedures for various analytical instruments are described in detail in the QA manuals of the participating laboratories. The SMF is responsible for acquiring the appropriate QA manuals from all laboratories participating in the RFI for OU 1078, including EM-9. The ER Program SOPs have been provided to EPA Region VI under separate cover and are not attached to this QAPjP.

9.0 ANALYTICAL PROCEDURES

9.1 Overview

Field and laboratory analytical measurements for samples obtained at OU 1078 will be performed in accordance with ER Program SOPs.

9.2 Field Testing and Screening

Field testing of aqueous samples for specific conductance, temperature, pH, and alkalinity during the RFI will follow ER Program SOP "Field Analytical Measurements of Groundwater Samples." Field screening for volatile organic compounds will follow ER Program SOP, "Portable G.C. for Field Screening of VOC's" or "Portable G.C./M.S. for Field Screening" or will be accomplished using photoionization detectors and/or flame ionization detectors. Procedures for using these instruments will follow the manufacturers' equipment manuals.

9.3 Laboratory Methods

The analytical methods to be used for aqueous and soil/sediment samples obtained during the RFI at OU 1078 are those presented in Section 9.3 of the generic QAPjP. All of the analytical methods presented there are applicable to samples obtained at OU 1078, with the exceptions noted in Section 5.2 of this QAPjP; volatile organic compounds, PCBs, high explosives, and pesticides will not be analytes in this investigation, and analyses of high explosives are not required for this investigation. Although those analytes appear in Tables IX.1 and IX.2 of Section 9 of the generic QAPjP, they do not apply to the RFI for OU 1078.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Reduction

Reduction of field and laboratory data for the RFI at OU 1078 will follow the protocols described in Section 10.1 of the generic QAPjP.

10.2 Data Validation

Validation of field and laboratory data for the RFI will follow the protocols described in Section 10.2 of the generic QAPjP, except in the case of the samples to be collected at Ashley Pond (Chapter 7 of this work plan).

10.3 Data Reporting

Reporting field and laboratory data for the RFI at OU 1078 will be as described in Section 10.3 of the generic QAPjP.

11.0 INTERNAL QUALITY CONTROL CHECKS

11.1 Field Sampling Quality Control Checks

A discussion of field quality control samples for the ER Program is presented in Section 6.1 of the generic QAPjP. The frequency and type of field quality control samples identified in the generic QAPjP will be followed, in general, for chemical analyses performed during the RFI at OU 1078.

11.2 Laboratory Analytical Activities

The types and frequency of internal quality control samples that are necessary for analyses performed by analytical laboratories will follow those presented in Section 11.2 of the generic QAPjP.

12.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits for field and laboratory operations will be conducted during the RFI at OU 1078. The process for conducting performance audits is described in the ER Program's Quality Procedure (QP), "Audits." The term used by the ER Program for a performance audit is "survey." The process for conducting surveys is described in ER Program QP, "Surveys."

13.0 PREVENTIVE MAINTENANCE

13.1 Field Equipment

Preventive maintenance requirements for the field equipment used during the RFI will follow the specifications described in Section 13.1 of the generic QAPjP. Additional information provided in the ER Program SOPs defines the required checks for each type of field equipment. ER Program SOPs have been provided to EPA Region VI under separate cover and are not attached to this QAPjP.

13.2 Laboratory Equipment

Preventive maintenance requirements for laboratory equipment used during the RFI at OU 1078 will follow the specifications of Section 13.2 of the generic QAPjP. The elements of EM-9's preventive maintenance program are discussed in Chapters 12 and 14 of the Health and Environmental Chemistry Laboratory Quality Assurance Program Plan (Gladney and Gautier 1991, 0410).

14.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, REPRESENTATIVENESS, AND COMPLETENESS

14.1 Precision

Analytical precision for RFI data will be calculated according to the formula presented in Section 14.1 of the generic QAPjP.

14.2 Accuracy

The analytical accuracy of RFI data for OU 1078 will be calculated according to the formula presented in Section 14.2 of the generic QAPjP.

14.3 Sample Representativeness

The field sampling plans in Chapter 7 of this work plan were developed to meet the sample representativeness criteria described in Section 14.3 of the generic QAPjP.

14.4 Completeness

The completeness of analytical data from the RFI for OU 1078 will be calculated according to the formula presented in Section 14.4 of the generic QAPjP.

The QA objective for analytical data completeness for the ER Program is 90%, which will also be the objective for the RFI at OU 1078.

15.0 CORRECTIVE ACTION

15.1 Overview

The procedures, reporting requirements, and authority for initiating corrective action during the RFI at OU 1078 will follow those given in Section 15 of the generic QAPjP and in ER Quality Procedure, "Deficiency Reporting."

15.2 Field Corrective Action

Field corrective actions required during the RFI for OU 1078 will follow the process defined in Section 15.2 of the generic QAPjP.

15.3 Laboratory Corrective Action

Laboratory corrective actions required during the RFI will follow the process given in Section 15.3 of the generic QAPjP.

16.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

16.1 Field Quality Assurance Reports to Management

The field teams manager or a designee will provide a monthly field progress status report to the ER program manager. This report will consist of the information identified in Section 16.1 of the generic QAPjP.

16.2 Laboratory Quality Assurance Reports to Management

The laboratory QA reports identified in Section 16.2 of the generic QAPjP will be prepared during the RFI for OU 1078.

16.3 Internal Management Quality Assurance Reports

The internal management QA reports identified in Section 16.3 of the generic QAPjP will be prepared during the RFI for OU 1078.

REFERENCES

ANSI/ASME (American National Standards Institute/American Society of Mechanical Engineers) 1989. "Quality Assurance Requirements for Nuclear Facilities," NQA-1-1989, 345 East 47th Street, New York, New York. (ANSI/ASME 1989, 0018)

DOT (Department of Transportation) 1978. Code of Federal Regulations, Title 49, Parts 100–199. (DOT 1978, 0278)

EPA (US Environmental Protection Agency), December 29, 1980. "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," QAMS-005/80, Office of Monitoring Systems and Quality Assurance, Office of Research and Development, Washington, DC. (EPA 1980, 0552)

Gladney, E. S., and M. A. Gautier, January 1991. "Health and Environmental Chemistry Quality Assurance Program Plan," Los Alamos National Laboratory, Los Alamos, New Mexico. (Gladney and Gautier 1991, 0410)

International Air Transport Association, January 1988. "Dangerous Goods Regulations," Montreal, Quebec, Canada. (International Air Transport Association 1988, 0519)

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), March 16, 1992. "Environmental Restoration Standard Operating Procedures," Vols. I and II, Los Alamos, New Mexico. (LANL 1992, 0688)

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1
Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model
for Technical Area 1

Chapter 5
Field Investigation
Methods

Chapter 6
Solid Waste Management
Unit Aggregate
Background Information

Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans

Annexes

Appendices

Annexes

I Project Management Plan
II Quality Assurance Project Plan
III Health and Safety Plan
IV Records Management Plan
V Community Relations Plan

1.0 INTRODUCTION

1.1 Purpose

This Health and Safety (H&S) Project Plan (hereafter referred to as the H&S project plan) has been developed for the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) to be conducted at Operable Unit (OU) 1078. Implementation of this plan will lead to a safe environment for workers because it establishes health and safety procedures and guidelines for activities specified under the sampling plans for OU 1078 presented in Chapter 7 of this RFI work plan. This H&S project plan includes an assessment of hazards, provisions for personnel protection requirements, and emergency response procedures.

This document supplements the H&S program plan provided in Annex III of the Installation Work Plan (IWP) (LANL 1991, 0553) (hereafter referred to as the H&S program plan) as health and safety planning applies to OU 1078 and the standard operating procedures (SOPs) prepared for Los Alamos National Laboratory (the Laboratory); therefore, these documents must be in the possession of the field team during all operations of the sampling phase.

This H&S project plan provides the framework within which personnel protection will be provided during the implementation of the RFI at OU 1078. Task-specific H&S plans will be prepared before any field task is initiated. These site-specific plans will spell out the specific measures to be taken for personnel protection during implementation of the task. They will also define individual responsibilities that are described in this H&S project plan.

As field investigations progress, more effective measures for personnel protection may be identified than those presented here. Deviations from this H&S project plan will be documented in the task-specific plans, and the reasons for deviations will be given. As changes are required, this plan will be updated.

1.2 Organization of the Health and Safety Plan for OU 1078

This plan addresses all aspects of sampling conducted for the RFI. General responsibilities, as well as individual roles in the implementation of this H&S project plan, are given in Section 2. The prerequisites for personnel involved in the OU 1078 investigation are outlined in Section 3. Brief descriptions of the scope of the RFI at OU 1078 and the required sampling tasks are reviewed in Section 4. The assessment of hazards associated with the sampling tasks and the solid waste management units (SWMUs) are summarized in Section 5. To determine hazards that require personnel protection, air monitoring will be performed during the sampling phase of the investigation, as prescribed in Section 6. Personnel protection will be accomplished by implementing a combination of engineering controls, work practices, and use of personal protective equipment (PPE) on a task-specific basis. Personnel protection and safety requirements are discussed in Section 7. The delineation of work zones and provisions for site control are recommended in Section 8. Decontamination procedures for both personnel and equipment are presented in Section 9. The emergency response plan and requirements for notification and documentation are included in Section 10.

1.3 Basis for the Plan

In addition to the general guidance provided by the IWP and the SOPs, this plan is based on the following regulations and guidance: Laboratory policies, the Laboratory's H&S Manual, Department of Energy (DOE) Orders, Occupational Safety and Health Administration (OSHA) regulations, National Institute for Occupational Safety and Health (NIOSH) recommendations, American Conference of Governmental Industrial Hygienists (ACGIH) recommendations, Nuclear Regulatory Commission (NRC) regulations and Environmental Protection Agency (EPA) guidance. New Mexico state and local regulations, as well as the Laboratory's Facility Contingency Plan, were also considered during the development of this H&S project plan. These regulations and guidelines have been established for the protection of workers at hazardous waste and radiologically hazardous sites and therefore apply to personnel engaged in the investigations of OU 1078. A listing of requirements governing this H&S project plan is presented in Section 2 of the H&S program plan.

2.0 ORGANIZATION OF THE OPERABLE UNIT FIELD WORK

This section describes the general responsibilities for health and safety prescribed by the Laboratory's Environmental Restoration (ER) Program, as well as the specific responsibilities of the individuals who implement this H&S project plan for the investigation of OU 1078. This section includes a list of the roles in the field organization, an organizational chart, provisions for health and safety audits, and a mechanism for requesting variances from the H&S project plan.

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health Manual delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities are summarized in Section 5.0 of the IWP, Annex III, H&S Plan (LANL 1991, 0553). Specific safety responsibilities for personnel involved in this OU investigation are listed in this section.

2.2 Individual Responsibilities

Both Laboratory employees and contract personnel have health and safety responsibilities for ER Program activities. The field work organization chart, which depicts the line organization, is given in Figure III-1.

2.2.1 Deputy Division Leaders of the Environmental Management and Health and Safety Divisions

The deputy division leaders of the Environmental Management (EM) and H&S divisions are responsible for addressing programmatic health and safety concerns. They are also responsible for promoting a comprehensive health and safety program that includes special areas, such as radiation protection, occupational medicine, industrial safety, industrial hygiene, criticality safety, waste management, and environmental protection and preservation.

2.2.2 Environmental Restoration Group (EM-13) Leader

The group leader of the Environmental Restoration Group (EM-13) is responsible for implementing the overall health and safety program plan. The ER group leader provides for the establishment, implementation, and support of H&S measures.

2.2.3 Health and Safety Project Leader

The H&S project leader (H&SPL) is responsible for updating and implementing the H&S program plan and for reviewing H&S project plans. The H&SPL is also responsible for coordinating with Laboratory personnel in identifying resources to be used for the H&S program and in ensuring Laboratory-wide compliance with all applicable H&S policies and regulations. In conjunction with the field team leaders, the H&SPL oversees daily H&S activities in the field, including scheduling of the HS-1 and HS-5 monitors.

2.2.4 Operable Unit Project Leader

The operable unit project leader (OUPL) is responsible for all RFI activities for his/her assigned OU. Specific safety responsibilities include

- preparing, reviewing, implementing, and revising OU health and safety documents and
- interfacing with the H&SPL to resolve health and safety concerns.

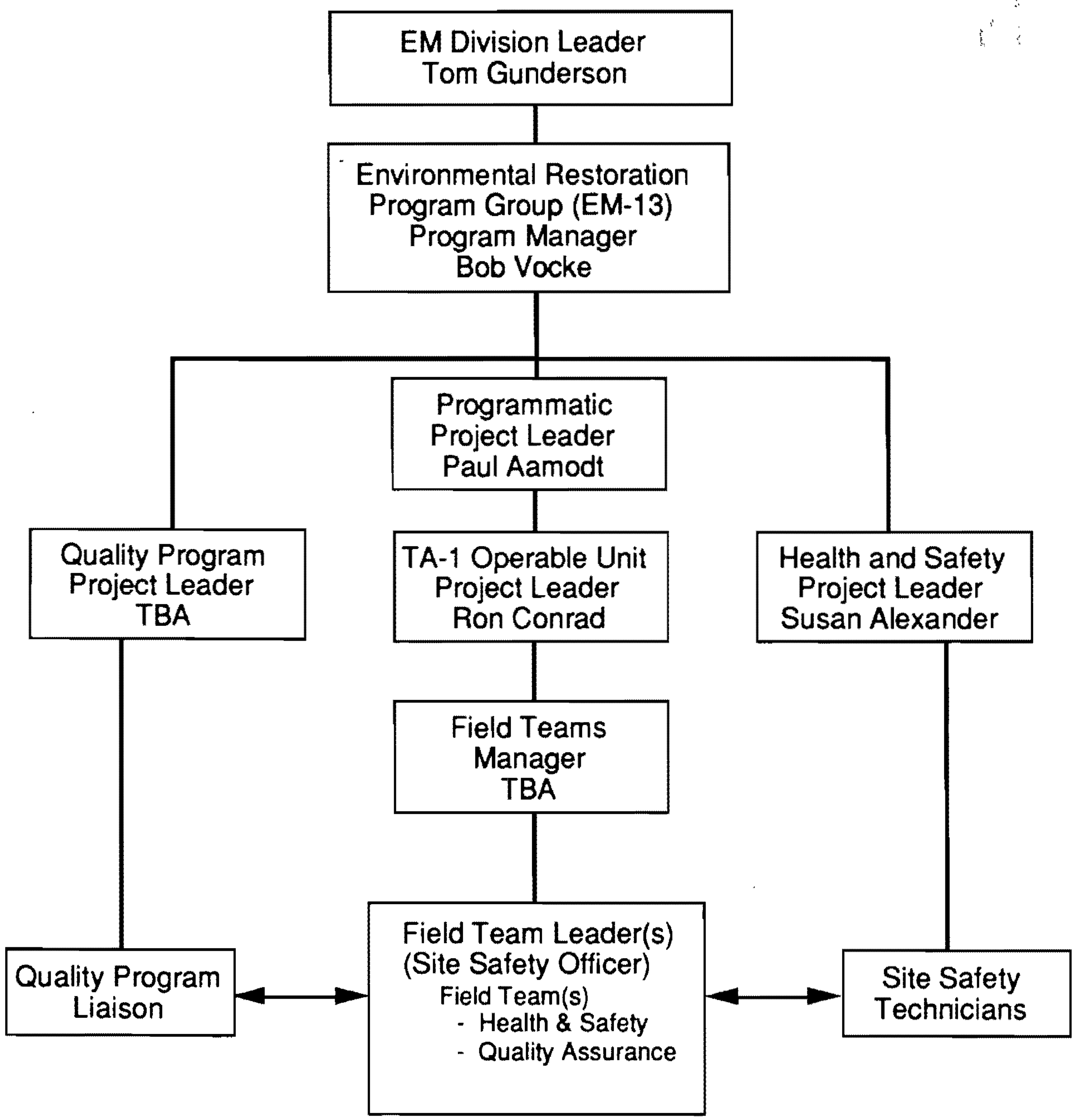


Figure III-1. OU 1078 Field Work Organization Chart.

2.2.5 Operable Unit Field Team Manager

The OU field team manager is responsible for

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

2.2.6 Field Team Leader

The field team leader is responsible for implementing the sampling and analysis plan, this H&S project plan, and the project-specific quality assurance project plan (QAPjP) (Annex II). He/she also serves as the site safety officer. Safety responsibilities include

- ensuring the health and safety of the field team members and
- being familiar with emergency response procedures and notification requirements and their implementation.

2.2.7 Site Safety Officer

For OU 1078, the field team leader will also be the site safety officer. The site safety officer has the following additional responsibilities:

- performing and documenting initial inspections for all site equipment;
- evaluating the potential hazards at a site, based on the recommendations of the HS-1 and HS-5 on-site monitors;
- being informed about the results of sample analyses pertaining to health and safety as the ER site investigation and remediation work progress;
- determining protective clothing requirements for workers, based on recommendations from HS-1 and HS-5 monitors;
- determining personal dosimetry requirements for workers;
- maintaining a current list of telephone numbers for emergency situations;

- having an operating radio transmitter/receiver in case telephone service is not available;
- maintaining an up-to-date copy of the H&S project plan for work at the site;
- maintaining an up-to-date copy of the emergency plan and procedures for the site;
- establishing the safety requirements to be followed by visitors;
- providing visitors with a safety briefing;
- maintaining a logbook of workers in the exclusion area at a site;
- determining whether workers can perform their jobs safely under prevailing weather conditions;
- taking control of an emergency situation in collaboration with HS-1 and HS-5 site monitors;
- ensuring that all personnel have been trained in the appropriate safety procedures, that all personnel have read and understood the OU 1078 site-specific H&S plans, and that all requirements are followed during OU activities;
- conducting daily H&S briefings for field team members;
- conducting daily H&S audits of work activities; and
- having authority to require and requiring that field work be terminated if unsafe conditions develop or an imminent hazard is perceived.

The site safety officer will be trained in first-aid procedures and in cardiopulmonary resuscitation. The site safety officer will ensure that first-aid supplies are available at the site and will know the location of facilities for emergency medical care, including those for injuries that might involve contamination by radioactive materials or hazardous chemicals.

2.2.8 Field Team Members

Field team members are responsible for conducting the assigned work in a manner that ensures the safety of themselves and other team members.

2.3 Health and Safety Audits

H&S audits will be performed during activities associated with this plan to ensure compliance with LANL-ER-SOP-02.05, Safety Meetings and Inspections (LANL 1992, 0688). The frequency of these audits will depend on the characteristics of the site and the equipment used.

2.4 Variances from Health and Safety Requirements

When special conditions exist, the site safety officer may submit to the H&SPL a written request for a variance from a specific health and safety requirement. If the H&SPL agrees with the request, it will be reviewed by the OUPL or a designee. Higher levels of management may be consulted as appropriate. The condition of the request will be evaluated, and, if appropriate, the H&SPL will grant a written variance specifying the conditions under which the requirements may be modified. The variance will become part of this H&S project plan.

3.0 PERSONNEL PREREQUISITES

This section describes the prerequisites for all personnel involved in site work for OU 1078. Further guidance is provided in Sections 10, 11, 12, and 13 of the H&S program plan.

3.1 Training Requirements

The training requirements for ER Program workers at hazardous sites are established in Section 11 of the H&S program plan and in the ER Program's SOP "Training and Medical Surveillance." The requirements include training in health and safety at hazardous waste sites, emergency response, respiratory protection, radiation safety, and specialized areas such as cardiopulmonary resuscitation and first aid.

All site workers must be trained according to 29 CFR 1910.120 (OSHA 1991, 0610) before their initial assignment to any project. All site workers, including subcontractors, will receive between 24 and 40 hr of hazardous worker and emergency response training off the site and a minimum of 3 days of actual field experience directly managed by a trained, experienced supervisor. A copy of the ER SOPs will be available on the site, and field team members will be briefed on their use.

On-site field team leaders and the field teams manager must receive a minimum of 8 hr of additional training on program supervision. Each site worker must receive 8 hr annually of refresher hazardous worker training. Certification that training has been completed will be maintained in the project files. Subcontractors must provide certificates of training for the project files for all field team members assigned to the project. Records of training will also be kept at the job site. The training requirements for the site-specific tasks will be defined in each site-specific H&S plan.

The ER Program's SOP, "Training and Medical Surveillance," prescribes specific training requirements for ER field team members.

3.2 Medical Surveillance Program

Field team members who may be exposed to hazardous materials during ER Program investigations will participate in a medical surveillance program provided by the Laboratory in accordance with the requirements of 29 CFR Part 1910.120 (OSHA 1991, 0610) and DOE Order 5480.8 (DOE 1987, 0731). According to 29 CFR Part 1910.120, a medical examination is required for (1) all employees who are exposed or who may be exposed to substances at or greater than the established permissible exposure limits (Table III-1) for more than 30 days/yr, (2) for all employees who wear a respirator for 30 days or more per year, and (3) for members of hazardous materials teams. Such examinations must occur

- before the employee begins the assignment to establish baseline conditions,
- at least every 12 months,
- at termination of employment or reassignment if the employee has not had an examination within 6 months of the reassignment date,
- upon notification that the employee has developed symptoms of exposure, and
- upon the exposure of an unprotected employee and in cases in which the physician recommends a specific schedule for examination. (Suitability of field team members for conducting field sampling activities, including using a respirator, will be evaluated and documented by a physician).

TABLE III-1

POTENTIAL CONTAMINANTS, OU 1078 EXPOSURE LIMITS

CONTAMINANTS	OSHA CEILING		OSHA PEL[a]		OSHA STEL[b]		OSHA TWA[c]		OSHA STEL	
	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
Barium	—	—	—	.500	—	—	-	.500	—	—
Beryllium	—	.005	—	.002	—	—	-	.002	—	—
Concrete (Silica)	—	—	—	—	—	—	-	.050	—	—
Diesel Fuel	—	—	5.0	—	—	—	-	5.00	—	10.0
Fuel Oil	—	—	—	5.0	—	—	-	50.0	—	10.0
Lead	—	—	—	. 05	—	—	-	.150	—	—
Toluene	—	—	100	375	150	560	100	377	150	565
Uranium	—	—	—	. 200	—	.6	—	.200	—	.560
Xylenes	—	—	100	435	150	655	100	434	150	651

a. PEL= permissible exposure level
b. STEL= short-term exposure limit
c. TWA= time-weighted average

A fitness-for-duty certificate must be issued by HS-2 for each site worker in OU 1078. Further details of the medical surveillance program are provided in Section 12 of the H&S program plan and in the ER Program's SOP "Training and Medical Surveillance." In addition, the program must comply with the Laboratory's Administrative Requirement (AR) 2-1, Occupational Medicine Program; AR 3-6, Biological

Monitoring for Radioactive Materials; AR 6-4, Biological Monitoring for Hazardous Materials; and Laboratory Technical Bulletin (TB) 606, Biological Sample Monitoring.

3.3 Documentation

The training and medical records of all ER Program workers will be retained in accordance with the requirements in Section 13.1 of the H&S program plan. In addition, DOE Order 5484.1, Summary of Exposure Resulting in Internal Body Depositions of Radioactive Materials for CY 19___, (DOE 1990, 0733) and DOE Order 5484.6, Annual Summary of Whole Body Exposure to Ionizing Radiation, will be followed, as required. Preparation of these reports will be coordinated with the Health Physics Operations Group (HS-1). Reporting requirements for injuries, exposures, accidents, releases, and unplanned occurrences will be addressed in Section 10 of this H&S project plan.

4.0 SCOPE OF WORK

This section describes the SWMUs in OU 1078 and the tasks to be performed during the sampling phase of the RFI.

4.1 Purpose

The sampling effort supports the RFI by determining the nature and extent of contamination at the SWMUs in OU 1078. This determination includes the identification of sources and environmental receptors associated with each SWMU. The tasks and activities in the sampling phase are described in the sampling and analysis plans in Section 7 of this work pan. The H&S project plan will establish procedures for performing activities in a safe manner.

4.2 Description of OU 1078

In 1974, 1975, and 1976, the Los Alamos Scientific Laboratory (LASL), prompted and supported by the Atomic Energy Commission (AEC) and later the support of the Energy Research and Development Administration (ERDA), carried out surveys and decontamination operations on land in the townsite of Los

Alamos, New Mexico. The land had been the site of the main technical area of the Laboratory [later, TA-1 (OU 1078)] during the development of the atomic bomb and for some years thereafter. Later, the Laboratory facilities were relocated, leaving the land that is located near the center of town open for public and private ownership. Transfer of the land began in 1966.

The TA-1 site was selected in November 1942 for developing, assembling, and testing the atomic bomb. In January 1943, the University of California was selected to operate the new laboratory. Initially, technical facilities were constructed mainly on approximately 40 acres near the Los Alamos Ranch School—around Ashley Pond and along the south side of Trinity Drive. The complex was known as the Main Technical Area.

The original technical buildings were military in style, with exteriors of drop siding or asbestos or cement shingles, pitched roofs covered with asphalt shingles, and interiors of gypsum board sheathing. Sanitary wastes went to septic tanks placed around the perimeter of the technical area. Sanitary waste was also collected in sanitary waste lines, which terminated outside the technical area. Industrial waste lines, known as acid sewers, allowed laboratory waste to flow into a main acid sewer that extended north to a discharge point in Pueblo Canyon.

Between March 1943 and the end of July 1945, much of the theoretical, experimental, and production work involving radioactive materials essential to the development of the first atomic bombs took place in the Technical Area buildings. For several years that followed, much of the work involved improving and evaluating explosives, including constructing field test devices.

In early 1947, the Laboratory became known as the Los Alamos Scientific Laboratory, operated by the University of California for the newly created AEC. After 1949, as the Laboratory expanded, technical activities were gradually relocated to the south, across Los Alamos Canyon, where major new facilities were consolidated and research areas became separate from the residential and community areas. During this expansion, the Main Technical Area became known as Technical Area 1 (TA-1).

At the time of the new laboratory construction in 1950 and 1951, the thermonuclear, or fusion, weapon was being developed. Throughout the 1950s, the Laboratory devoted most of its efforts to developing a family of fission weapons ranging from artillery shells to large strategic weapons. Portions of all these activities were carried out in TA-1 facilities, and some continued there until 1965, when the last buildings were demolished. These tasks resulted in varying degrees of radioactive contamination to the equipment, buildings, waste collection systems, and land at TA-1.

As new, more permanent, facilities became available, research work was moved out of TA-1. Once vacated, the old structures were surveyed by health physics personnel, decontaminated as necessary, and removed or demolished. Uncontaminated materials were salvaged. Highly contaminated materials were removed to solid radioactive waste disposal sites on AEC-controlled land outside TA-1.

Currently, the site is crisscrossed by paved roads to accommodate residents and businesses. Water is available at all the mesatop sites, as well as electricity and telephone service. None of these services is available on the TA-1 hillsides.

4.2.1 SWMU Sampling Locations

The sampling locations for the SWMUs in OU 1078 are specified in the sampling and analysis plan in Chapter 7 of this RFI work plan. Foldout Maps A, B, C, and D in the OU 1078 work plan show the relative locations of all SWMUs in OU 1078.

4.2.2 Topographical Considerations

The environmental setting for TA-1 is described in Chapter 3 of this RFI work plan. Because some of the SWMUs are located near the edges of mesas, in the canyons, or on the canyon shelves, accessibility and logistics will be difficult. Investigating these areas requires special precautions as outlined in Section 7 of this H&S project plan.

4.2.3 Meteorological Considerations

The climate of Los Alamos County is reviewed in Chapter 3 of this RFI work plan. Most of the field work will be conducted between March 1 and December 1. Because of the semiarid, temperate mountain climate in Los Alamos, the field teams must be prepared for a wide variety of weather conditions during sampling excursions. Problems such as heat stress, cold stress, and exposure to lightning and slippery surfaces, as well as the equipment necessary to minimize these hazards, are addressed in Section 7 of this H&S project plan.

4.3 Description of Tasks

Three categories of tasks will be performed to determine the nature and extent of contamination:

- field surveys, which include geomorphic mapping, and radiological surveys;

- surface sampling, which includes collecting soil or sediment from outfall points, channels, drainage areas, and sediment traps; and
- subsurface sampling, which consists of borehole sampling beneath drainlines, storm sewers, septic tanks, and sumps; and coring and trenching.

The hazards associated with each task and the protective measures that address them are described in Sections 5, 6, and 7 of this H&S project plan.

5.0 HAZARD ASSESSMENT

This section presents potential hazards that may be encountered by site workers. The tasks and activities scheduled for OU 1078 will be analyzed with respect to these hazards.

5.1 Types of Hazards

The types of hazards that may be encountered during work at OU 1078 are discussed in the following paragraphs.

5.1.1 Oxygen Deficiency

The oxygen content of normal atmospheres is approximately 21% by volume. Oxygen-deficient atmospheres are defined in 29 CFR Part 1910.120 as atmospheres in which the percentage of oxygen per volume is less than 19.5. As the percentage of oxygen approaches a deficient level, workers exhibit symptoms of oxygen deprivation that include impaired attention, coordination, and judgment and increased breathing and heart rates.

Because the sampling activities for OU 1078 will be conducted outdoors, oxygen-deficient atmospheres are not expected. The field team must, however, be aware of the potential for oxygen deficiency in confined spaces or low-lying areas such as natural depressions, excavations, or trenches.

5.1.2 Explosivity and Flammability

There are several potential sources of explosive or flammable hazards in OU 1078:

- ignition of explosive or flammable chemicals;

- ignition of materials as the result of oxygen enrichment;
- sudden release of materials under pressure; and
- chemical reactivity that may result in explosions, fires, or heat.

These conditions may result in such hazards as intense heat, open flame, smoke inhalation, flying debris, and the release of toxic chemicals. Field team members must be aware of materials, which may vary from SWMU to SWMU, that may contribute to these conditions; however, at OU 1078, explosivity and flammability could only occur during subsurface sampling on the mesatop.

5.1.3 Radiological Hazards

Radiological constituents emit one or more of three types of ionizing radiation: alpha, beta, and gamma. Although beta and gamma radiation may deposit energy (dose) in the body tissues from external exposure, all radiation types may contribute to the internal dose after being inhaled, ingested, or absorbed through the skin. Depending on where the radiation energy is deposited in the body, exposure to ionizing radiation may cause health effects in the exposed individuals or their descendants. When relatively small amounts of radiation exposure occur, the most probable health impact to the exposed individual is an increased risk of cancer. The risk of cancer depends on the type of radiation, the total dose incurred, the time of exposure, and the particular tissue exposed. Radiation dose to the germ cells may result in genetic or hereditary effects, which are manifest in the descendants of the exposed individual. Current radiation exposure standards, as specified in DOE Order 5480.11 (DOE 1990, 0732), are designed to limit the probability of contracting cancer or causing hereditary health impacts to a very small value.

Women of child-bearing age should be particularly cautious when working with radioactive materials or near sources of ionizing radiation. Exposure of the unborn fetus to ionizing radiation may cause birth defects, including abnormal growth and small head size, and childhood cancer, particularly leukemia. The period of greatest radiation sensitivity for the fetus occurs in the first trimester of pregnancy, when the major organ systems are first developing. In order to minimize the possibility of health effects, the DOE has established a dose limit of 0.5 rem for the unborn child during the entire gestation period.

The presence of very low levels of radiological constituents has been suggested by historical evidence from several SWMUs at TA-1. Specific radionuclides that might be present at low concentrations at TA-1 sites include ^{3}H, ^{90}Sr, ^{137}Cs, ^{226}Ra, ^{229}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am.

The primary pathways by which field team members may be exposed to radiological hazards during sampling are

- inhalation of contaminated particulates,
- ingestion of contaminated materials,
- dermal absorption of contaminated particulates,
- injection of contaminated particulates into the body through puncture wounds, and
- direct exposure to gamma radiation, especially from ^{137}Cs.

The specific properties of the above radionuclides, including type of emission and half-life, are provided in Table III-2. As concentrations of these radionuclides are determined, and if new radionuclides are discovered, Table III-2 will be updated. The site safety officer will be responsible for adding radionuclides to this table and for notifying field personnel as needed. Table III-3 describes the suspected radionuclides for each individual SWMU or groups of similar SWMUs and OU-wide contaminants.

5.1.4 Toxicological Hazards

Exposure to toxic chemicals can result in a wide range of adverse effects that depend on the specific toxicological action of the chemical, the concentration, the route(s) of exposure, the duration and frequency of exposure, and personal factors.

Historical evidence from OU 1078 indicates the presence of chemical wastes in several of the SWMUs. Potential toxicological wastes include radioactive, sanitary, laboratory, building debris, solvent, asphalt, and unknown waste products. In the 25 to 35 years since TA-1 operations ceased, many of these chemical categories (especially sanitary and volatile organic chemicals) have undoubtedly decreased to very low levels. The primary pathways for chemical exposure include

- inhalation of contaminated particulate matter,
- inadvertent ingestion of contaminated particulate matter,
- dermal absorption through contact with contaminated particulate matter, and
- injection of contaminated particulate matter through puncture wounds.

TABLE III-2

PROPERTIES OF RADIONUCLIDES OF CONCERN

Radionuclide	Major Radiations	DAC (≤μCi/mL) [a,b]	Critical Organ [c]	Radioactive Half-Life	Monitoring Instrument
Americium-241	Alpha	$2 X 10^{-12}$	Bone	432 yrs	Alpha scintillometer
Cesium-137	Beta, gamma	$5 X 10^{-5}$	Total body	30 yrs	GM[d], NaI[e]
Plutonium-238	Alpha, gamma	$3 X 10^{-12}$	Bone	87.7 yrs	Alpha scintillometer, FIDLER
Plutonium-239	Alpha, gamma	$2 X 10^{-12}$	Bone	$2.4 X 10^{4}$yrs	Alpha scintillometer, FIDLER
Plutonium-240	Alpha, gamma	$2 X 10^{-12}$	Bone	6537 yrs	Alpha scintillometer, FIDLER
Radium-226	Alpha	$3 X 10^{-10}$	Bone	1622 yrs	Alpha scintillometer
Strontium-90	Beta	$2 X 10^{-9}$	Total body	29 yrs	GM
Tritium	Beta	$2 X 10^{-5}$	Total body	12.26 yrs	Liquid scintillation
Thorium-229	Alpha, gamma	$4 X 10^{-13}$	Bone	7340 yrs	Alpha scintillometer
Thorium-230	Alpha, gamma	$3 X 10^{-12}$	Bone	$8 X 10^{4}$ yrs	Alpha scintillometer
Thorium-232	Alpha, gamma	$5 X 10^{-13}$	Bone	$1.41 X 10^{510}$yrs	Alpha scintillometer, NaI
Uranium-234	Alpha, gamma	$2 X 10^{-11}$	Total Body	$2.47 X 10^{5}$ yrs	Alpha scintillometer, FIDLER
Uranium-235	Alpha, gamma	$2 X 10^{-11}$	Total Body	$2.47 X 10^{5}$ yrs	Alpha scintillometer, FIDLER
Uranium-238	Alpha, gamma	$2 X 10^{-11}$	Total Body	$2.47 X 10^{5}$ yrs	Alpha scintillometer, FIDLER

a. DAC - derived air concentration (DOE Order 5480.11)

b. Most restrictive solubility class assumed.

c. Total body indicated DAC based on limiting stochastic health effects. Organ listed indicates DAC based on limiting nonstochastic health effects in that organ.
Critical organ - that part of the body that is most susceptible to radiation damage under the specific conditions being considered.

d. GM - Geiger-Müller detector

e. NaI - sodium iodide scintillometer

Table III-3
Summary of Potential Waste Materials and Required Initial Levels of Protection for Operable Unit 1078

Potential Waste Materials in SWMU Aggregates	Required Levels of Protection		
	Surface Sampling	Subsurface Sampling	Other
A Sigma Building Vicinity			
^{239}Pu, ^{235}U, ^{238}U, Thorium Beryllium, other metals Semivolatile organic compounds Cyanide Acids	D	D/C	
B Bailey Bridge			
^{239}Pu, ^{235}U, ^{238}U, Thorium, ^{137}Cs Beryllium, other metals Concrete rubble and other debris	D	D	
C Hillside 140			
^{239}Pu, ^{235}U, ^{238}U Metals Semivolatile organic compounds	D	D/C	
D J-2/TU Area			
^{239}Pu, ^{235}U, ^{238}U, Thorium, ^{137}Cs Metals Semivolatile organic compounds	D	D	
E Cooling Tower 80			
^{239}Pu, ^{235}U, ^{238}U Metals Semivolatile organic compounds	D	D	
F Hillside 138			
^{239}Pu, ^{235}U, ^{238}U, ^{3}H Metals, Mercury Semivolatile organic compounds Acids	D/C	D/C	
G Hillside 137			
^{239}Pu, ^{235}U, ^{238}U, ^{241}Am Metals Semivolatile organic compounds Acids Nitrates	D	D/C	
H Surface Disposal Site Southeast of LA Inn			
Silver, Mercury, other metals Semi-volatile organic compounds Concrete rubble and other debris	D	D	
I Can Dump Site			
Rusted cans Possibly metals	D	D	

Table III-3 (continued)

Potential Waste Materials in SWMU Aggregates	Required Levels of Protection		
	Surface Sampling	Subsurface Sampling	Other
J Ashley Pond			
^{239}Pu, ^{235}U, ^{238}U, ^{137}Cs Semivolatile organic compounds Toluene	Level D and lifejackets (water and sludge sampling)		
K Industrial Waste Disposal Line			
^{239}Pu, ^{235}U, ^{238}U, ^{137}Cs, ^{90}Sr, Thorium, Americium Metals Semivolatile organic compounds Acids	D/C	D/C	
L Eastern Sanitary Sewer			
^{239}Pu, ^{235}U, ^{238}U, ^{137}Cs, ^{3}H Metals, Beryllium, Silver Semivolatile organic compounds	D	D/C	
M Northern Sanitary Sewer			
None	D	D/C	
N Western Sanitary Sewer			
^{239}Pu, ^{235}U, ^{238}U, ^{232}Th Metals, Beryllium Semivolatile organic compounds	D	D/C	
O Subsurface Contamination Under U and W Buildings			
^{239}Pu, ^{235}U, ^{238}U, ^{3}H Metals Semivolatile organic compounds	D	D/C	
P Soil Contamination Under Trinity Drive			
^{239}Pu, ^{235}U, ^{238}U Metals Semivolatile organic compounds	D	D/C	

- inadequate housekeeping,
- using mechanical and flame cutting equipment,
- handling materials,
- temperature extremes,
- excavations,
- traffic,
- breaking concrete,
- topography, and
- lightning.

5.1.6.1 General Physical Hazards

A variety of materials will be handled during sampling. Physical hazards to personnel include encounters with waste materials and work conditions that may cause slips, trips, falls, or cuts.

5.1.6.2 Noise

The operation of the vehicles, machinery, and equipment necessary to conduct the sampling activities can create areas where noise levels will exceed 85 dB. This noise level may lead to temporary or permanent hearing loss.

5.1.6.3 Working Around Heavy Equipment and Machinery

The size of the equipment, the driver's limited range of vision, and underfoot and overhead hazards can lead to crushing, tripping, falling, cuts, and punctures. The high noise levels created by the equipment can also cause injury.

5.1.6.4 Inadequate Housekeeping

Inadequate housekeeping can lead to congestion, disorder, dirt, waste, trash, and obstacles and can cause slipping, tripping, and falling, which can result in strains, sprains, broken bones, bumped heads, fractured ribs, and fatalities.

5.1.6.5 Using Mechanical and Flame-Cutting Equipment

Welding and cutting operations can present ignition and airborne contaminant sources. Cutting equipment and compressed gas cylinders present potential physical, electrical, tripping, and flammable hazards, such as welding flash and welding burns.

5.1.6.6 Materials Handling

Handling materials manually can lead to cuts, bruises, splinters, mashed fingers and toes, fractures, and a variety of strains and sprains from lifting, handling, and/or dropping loads. Wire rope used in rigging and lifting may have broken strands and frayed ends, which can cause punctures and cuts. Banding wraps used to secure loads can snap, leading to crushing, lacerations, and puncture wounds.

5.1.6.7 Temperature Extremes

Site activities may take place during either excessively hot or cold weather, creating the following heat- and cold-related problems:

- **heat rash**, which causes irritation and decreases a person's ability to tolerate heat and is aggravated by chafing clothing.
- **heat cramps**, which are caused by a chemical electrolyte imbalance brought on by profuse perspiration combined with inadequate water intake, resulting in muscle spasm and pain in the extremities and abdomen.
- **heat exhaustion**, which occurs when stress on various organs to meet increasing demands to cool the body results in shallow breathing; pale, cool, moist skin; profuse sweating; and dizziness and lassitude.
- **heat stroke**, which is the most severe form of heat stress. It must be treated immediately by cooling the body, or death may result. Symptoms include red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.
- **frostbite**, which is characterized by pain, reddening of tissue, loss of dexterity, and tingling or lack of sensation in the affected extremities.
- **hypothermia**, whose symptoms include pain and loss of dexterity in the extremities; severe or uncontrollable shivering; inability to maintain normal rate of activity; and excessive fatigue, drowsiness, or euphoria. Severe hypothermia leads to clouded consciousness, low blood pressure, cessation of shivering, dilated pupils, unconsciousness, and possibly death.

5.1.6.8 Excavation

Excavation will take place at some of the SWMUs. The hazards go beyond excavation to include the potential for direct or airborne contact with site contaminants. Also, sampling may require personnel to enter an excavation to adequately collect the sample. Excavations that are not carefully controlled pose a significant threat to employees. The excavation may collapse in on itself if it is improperly dug or shored. The hole is also a fall hazard.

5.1.6.9 Underground Hazards

Underground hazards are those that occur when subsurface structures, such as gas utilities, power lines, product lines, concrete vaults, and tanks, are encountered during drilling or excavation. Unexpected encounters with these structures creates the potential for electrocution, explosion, contact with hazardous spills and releases, or other injuries to the crew.

5.1.6.10 Traffic

The possibility of vehicle-related injury or accident is inherent in all aspects of field work. Vehicle-related accidents may occur during travel to or from the site, as well as during on-site activities. Accidents involving vehicles are highly likely, given the fairly continuous Laboratory activities and the use of heavy equipment during several of the planned sampling tasks. Additionally, work may take place in or near roadways on which there is heavy vehicle traffic.

5.1.6.11 Breaking Concrete

Gaining access to sampling areas will sometimes require breaking through a concrete pad, which may present the following hazards:

- increase in airborne concentration of site contaminants, particularly if the ground is heavily saturated,
- exposure to dust created by using concrete saws,
- flying debris,
- noise,
- vibration of the hands and body of an employee operating a jackhammer, and
- increased likelihood of electrical shock to an employee operating a jackhammer.

5.1.7.12 Topography

Injuries from slips, trips, and falls at OU 1078 may occur around uneven terrain, slippery surfaces, embankments, cliffs, excavations, heavy equipment, and areas that are littered with debris.

5.1.7.13 Lightning

Fire is the most common danger associated with lightning, but explosions, falling trees, power outages, and momentary blindness caused by flash are other examples. Field personnel hit by lightning will almost certainly be severely injured or killed. Lightning is a significant hazard at Los Alamos during the summer.

5.2 Assessment of Task-Specific Hazards

The three major sampling tasks to be conducted during this sampling effort are field surveys, surface sampling, and subsurface sampling. Under each of these tasks are various activities that will be performed, depending on which SWMU is being investigated. The details for the tasks are described in Chapter 7 of this work plan. The potential hazards associated with the tasks are evaluated in the following text. The protective measures to be used during the tasks are outlined in Section 7 of this H&S project plan.

5.2.1 Field Surveys

Geomorphic mapping and radiologic survey are activities included in the RFI work plan for OU 1078. Geomorphic mapping is a relatively low-risk activity, which requires walking through the site. SWMUs can be avoided during geomorphic mapping to minimize chemical and radioactive exposure to the geomorphic mapping team. Oxygen-deficient and flammable hazards are not expected during these surveys. HS-1 and EM-8 will be responsible for the radiation surveys. It is unlikely that chemical concentrations in the surficial soils are high enough to cause any hazards.

It is possible that field team members will encounter minimal radiation hazards by contacting contaminated surface soil and dust or by inhaling dust. Biological hazards may be encountered through poisonous or infectious agents and unhygienic practices. Physical hazards include the potential for slips, trips, and falls while surveying uneven terrain or at the edges of a mesa; the potential for heat and cold stress when working outdoors for a prolonged time; and lightning strikes.

5.2.2 Surface Sampling

The surface sampling program will consist of soil or sediment sample collection from the following locations:

- surface SWMUs,
- eolian sediment,
- outfall points, and
- channels and drainage areas.

Surface sampling of soil and sediment is typically a low-risk activity. Oxygen deficiency and explosive or flammable vapors or gases will generally not be a problem. Radiological contaminants may be present in the top 6 in. of soil. Contact with contaminated soil, sediment, or dust or inhalation of dust is possible. Field team members will exercise caution toward biological hazards such as animals and rodents. Physical hazards such as slips, trips, and falls are site-specific. Weather-related problems can occur during extended work periods and/or when protective gear is worn.

5.2.3 Subsurface Sampling

The subsurface sampling program will consist of collecting soil and sediment samples, which includes

- sampling beneath former locations of drain lines, storm sewers, and septic tanks and
- sampling in excavated trenches.

The aforementioned activities involving the drain line, storm sewers, and trenches may be associated with oxygen-deficient atmospheres. All of the aforementioned operations may result in explosive or flammable conditions because of potential contamination by solvents, gasoline, and fuels. Drilling and excavation activities may enhance volatilization of these materials. The potential for the accumulation of explosive/ flammable gases and vapors will be greatest in excavated areas and trenches.

Because the SWMUs in OU 1078 have a history of radionuclide and chemical use, the potential for low levels of radiation and toxic hazards exists. The primary exposure pathways are potential contact with contaminated soil, sediment, or dust or with the waste itself through inhalation of contaminated dust and volatiles from soil disturbed during drilling, backhoeing, and excavation.

Natural biological hazards also pose a potential hazard for all of the activities under this task, which include contact with animals or insects.

Using drill rigs and backhoes presents possible physical hazards such as noise, pinch points, and the failure of safety systems. It is imperative that the locations of overhead and underground utilities be identified in advance of such operations. Other electrical hazards may involve short circuits in equipment and shock caused by using electrical gear in wet conditions.

Field team members must be aware of slipping, tripping, or falling around cliffs, slippery surfaces, uneven terrain, excavations, and trenches. Excavated areas and trenches may collapse if they are not properly prepared.

In rare cases, field team members will wear respiratory protection and protective clothing. This gear will increase the potential for heat stress. Survey personnel should also be aware of the possibility of lightning strikes.

5.2.4 Special Sampling—Ashley Pond

A special sampling event will consist of surface water and sediment sampling at SWMU 1-006e, Ashley Pond. The following activities may be performed:

- sampling pond sediment using a boat and
- sampling surface water along the edge of the pond or off the shore using a boat.

The use of a boat presents the possibility of physical hazards and drowning. It is imperative that procedures comply with applicable state and Laboratory boating regulations and that standard small craft safety be used, including procedures for boat handling, use of personal floatation devices, and rescue methods. Survey personnel should also be aware of weather conditions and the possibility of lightning strikes.

5.3 Assessment of SWMU-Specific Hazards

Table III-3 lists the potential chemical and radiological contaminants in each of the SWMUs in OU 1078. Very low levels of these contaminants are expected to be found. The initial level of personal protection required is also listed.

6.0 AIR-MONITORING PROGRAM

In accordance with 29 CFR 1910.120, an air-monitoring program will be implemented during the sampling activities required by this RFI work plan during which HS-1 or HS-5 personnel or their designees will use hand-held instruments. The objectives of the air-monitoring program will be to identify and quantify levels of hazardous substances in the air, to determine the appropriate level of personnel protection, to delineate the boundaries of work zones, to ensure that decontamination procedures are effective, and to protect public health and safety. In addition to initial monitoring at the site, periodic monitoring is required when

- work begins in a different portion of the site,
- contaminants other than those previously identified are being encountered, and
- a different type of operation is initiated (e.g.,subsurface sampling).

Instruments should be read at ground, waist, and head levels to obtain representative readings of the ambient air. Measurements will also be made in enclosed spaces and in boreholes.

This section provides a brief description of the monitoring equipment used to detect hazards posed by various airborne contaminants and to determine the action levels that will be observed during work in OU 1078. The subsections are presented according to the importance of the hazards they describe. Additional guidance is available in Sections 8 and 9 of the H&S program plan. Operating procedures for the instruments are in the ER Program's SOPs for Combustible Gas Levels, photoionization detectors, flame ionization detectors, radiation survey meters, and Draeger tubes.

6.1 Oxygen Deficiency

An oxygen indicator will be used to measure oxygen levels to detect oxygen-deficient conditions in confined spaces, such as a trench. The action level for oxygen is 19.5%. Areas in which levels are below 19.5% must be evacuated and ventilated. In addition, oxygen-rich atmospheres create an increased potential for fires; therefore, the affected areas will be evacuated if levels exceed 25%. If evacuation is necessary, the area will be ventilated, and the site safety officer will continue monitoring the oxygen levels.

6.2 Explosivity and Flammability

A combustible gas indicator will be used to monitor for explosive or flammable atmospheres. Field team members should be cautious in trenches in which flammable and combustible gases could collect. The action level for explosive and flammable gases is 20% of the lower explosive limit. If this action level is exceeded, all activities in the area will cease, the work area will be evacuated, and appropriate safety measures (such as removing ignition sources and ventilating the area) will be implemented. The site safety office will obtain continuous combustible gas indicator readings.

6.3 Radiological Air Monitoring

Personal sampling pumps will be used to sample airborne particulates. Representative individuals will be monitored, based on the highest probability for exposure in each sampling team. At least one individual from each sampling team will be monitored at the beginning of field activities for each sampling site. Sample collection times should be maximized in order to achieve the lowest possible minimum detectable activity. For example, air samples must be collected for 5 hr at a flow rate of 3 L/min to achieve an minimum detectable activity equal to the derived air concentration (DAC) for ^{239}Pu.

The filter samples collected for airborne particulates will be analyzed for gross alpha radioactivity. Initially, all samples will be screened for radiation levels using a zinc sulfide scintillation detector. Following the screening, the samples will be held for 8 hr and will then be formally analyzed for gross alpha activity. This holding period will allow decay of the short-lived radon daughters. Gross alpha activity results will be compared with the derived air concentration (DAC) for ^{239}Pu, 2×10^{-12} µCi/ml. Of the radionuclides most likely to be encountered, ^{239}Pu produces the highest internal dose when inhaled. If elevated levels of gamma activity (above 1 mrem/hr) are observed in an area, the air samples from that area will also be analyzed for gross beta activity. If the air sample results are less than 10% of the DAC for ^{239}Pu, air monitoring may be discontinued, provided that work activities and radionuclide contents in the work area remain constant.

AR 3-1 specifies that the magnitude of prospective dose equivalent must be limited to 5 rem through administrative and engineering controls. The limit of 5 rem is equivalent to an inhalation exposure of 2,000 DAC-hr. During field activities at OU 1078, exposure will be controlled administratively and, if necessary, with respirators. Because of the short duration of the project, the exposure limit has been set at 500 DAC-hr. The airborne exposure limit of 500 DAC-hr assumes that the field portion of the project lasts 3 months, approximately one-third (160 hr) of which is spent in the field collecting samples and making measurements. The remaining two-thirds of the time is assumed to be spent in work assignments that do not involve radioactive materials. If exposure times vary, the site safety officer will have to adjust the exposure limits accordingly.

The need for respiratory protection will be evaluated by the HS-1 monitors in a multistage process. First, the average gross alpha concentration will be calculated from all samples collected to date. This calculation involves adding all sample results in units of microcuries per milliliter and dividing the sum by the number of samples collected thus far. Minimum detectable activity values will be substituted for all sample results lower than the minimum detectable activity. The resultant average concentration will be converted to predicted DAC-hours for the project by dividing the average by the DAC for ^{239}Pu, 2×10^{-12} µCi/ml, and then multiplying the quotient by the expected duration of field work (160 hr). If the number of DAC-hours predicted for the project exceeds 500, respiratory protection or administrative controls will be required until the concentration drops and lowers the predicted exposure in DAC-hours.

When analyses are performed for gross beta activity, a calculation parallel to that described above should be performed using the DAC for ^{60}Co. If significant external exposures occur [as measured by the thermoluminescent dosimeters (TLDs), Section 7.13)], they also must be considered in limiting the prospective dose. The external dose in millirem can be converted to inhalation exposure in DAC-hours by multiplying it by 0.40 DAC-hr/mrem of external dose. The total exposure will then equal the sum of the exposures from the gross alpha, gross beta, and any external dose. This predicted total exposure should be used to make decisions pertaining to the use of respiratory protection and administrative controls. The site safety officer or HS-1 monitor, in consideration of policies to make personnel exposures as low as reasonably achievable (ALARA), may also require the use of respiratory protection in cases where predicted total exposures do not exceed 500 DAC-hr.

Continuous air monitoring may be conducted to measure the concentration of radionuclides suspended in the ambient air as particulates. This type of data is already collected at a station located behind the Shell Station at the corner of Trinity and Oppenheimer drives. The results of the air-monitoring program will be used to evaluate the need for respiratory and skin protection to prevent intake of radionuclides.

Airborne particulates will be sampled, if appropriate, with two types of pumps, depending on the type of operation being performed. Large stationary activities such as drilling operations may be monitored by collecting air samples with high-volume air pumps that operate with flow rates of 4-5 ft^3/min. Less intensive and more mobile activities, such as manual sampling, will be monitored by collecting air samples from the workers' breathing zone with personal sampling pumps. Sample collection times should be maximized for both types of pumps to minimize the lower limits of detection.

The filter samples collected for airborne particulates will be analyzed for gross alpha and gross beta radioactivity. All samples will be held for 8 hr before analysis to allow decay of short-lived radon daughters. The data on gross alpha activity will be compared with the DAC for ^{239}Pu because this radionuclide is potentially the most prevalent one at TA-1.

Additional air samples will be collected by passing an air stream through a silica gel column to collect water vapor. The silica columns will be sent to a remote laboratory and analyzed for tritium activity with a liquid scintillation counter. These results will be compared with the DAC for tritium, 2×10^{-5} µCi/ml.

The results of all three types of air samples will be used to evaluate the need for respiratory protection. Exposure in DAC-hours will be estimated from each day's sample results by multiplying the air sample results by the exposure time expected for the work week and then summing across all three sample types. If the predicted exposure exceeds 40 DAC-hr for the week, respiratory protection will be required. When no activity is detected, minimum detectable activity results will be assumed to represent environmental concentrations for the most restrictive radionuclides, ^{239}Pu and ^{3}H. These assumptions must be made to ensure adequate worker protection. In addition, if projected tritium exposures exceed 40 DAC-hr, protective clothing must be worn to minimize the uptake of tritium through the skin.

6.4 Toxicological Hazards

No one instrument can detect all toxic gaseous materials; therefore, a variety of instruments will be used by the HS-5 monitors to determine the presence of potentially toxic airborne constituents. Although some of these instruments can be calibrated to identify and quantify a particular substance, the field team will most likely encounter mixtures of substances in the SWMUs. In these cases, the instruments are used as survey tools, and the measurements represent a gross indication of the materials present. As more information on SWMU contents becomes available, chemical-specific devices and laboratory analyses can be used for qualitative and quantitative purposes. It is not expected that volatile toxic materials will be encountered during the investigations of SWMUs in OU 1078.

6.4.1 Photoionization Detectors

A photoionization detector is a portable, nonspecific vapor and gas detector that uses a source of ultraviolet radiation to ionize chemical constituents. This detector can detect a variety of organic and inorganic chemicals, depending on the chemical-specific ionization potential of each constituent. Guidance is available in the ER Program's SOP, "Monitoring Organic Vapors with a Photoionization Detector."

For most SWMUs, the photoionization detector will be used as a survey tool to indicate total volatile organics and inorganics in air. The data will be used to monitor operations such as drilling, soil borings, and sampling monitor wells and to aid in decisions on PPE. Because the exact concentrations of each constituent in the mixture will not be known, the generic guidelines recommended by EPA for the selection of protective equipment under unknown conditions will be used. These guidelines are discussed in Section 9.1 of the H&S program plan. Volatile organic compounds are not expected at OU 1078 because the site has been abandoned for more than 27 years.

6.4.2 Flame Ionization Detectors

A flame ionization detector ionizes organic materials via a hydrogen flame. This instrument is capable of detecting a wide range of organic constituents, including methane. As in the case of the photoionization detector, it is useful to know the relative response factor for suspected contaminants. A flame ionization detector can be used both in the survey and quantitative modes. The ER Program's SOP, "Monitoring of Organic Vapors with a Flame Ionization Detector," can be consulted for further details.

6.4.3 Colorimetric Tubes

A colorimetric tube is a glass tube that is typically packed with a reagent impregnated with a chemical gas. This chemical reagent is specific for a given chemical or group of chemicals. When a specified volume of air is drawn through the tube, the airborne contaminant reacts with the reagent to produce a stain. The tubes are calibrated so that the length of the stain corresponds to an approximate concentration. These tubes may be used in cases in which the presence of a chemical is suggested by the site's history or in which the chemical has been identified by other means. Colorimetric tubes are especially useful for chemicals such as cyanides or carbon monoxide that are not easily detected by a photoionization or a flame ionization detector. One type of tube available on the market is the Draeger tube. These tubes are discussed in the ER Program's SOP, "Draeger Tubes."

6.5 Personal Monitoring

Personal exposure data will supplement the results of monitoring the ambient air. Monitors will be provided to field team members whose functions make them likely to receive the highest doses. TLDs will be issued to all field team members as a means of monitoring the radiation exposure of individual team members. DOE Order No. 5480.11 gives the action level for the TLDs as 5 rem/yr for stochastic effects, which include internal and external radiation sources. The TLDs issued to the field team members will be read on a monthly basis. Personal monitoring devices will be used as necessary for other materials identified during the course of the sampling efforts.

6.6 Air Samplers

High- and low-volume air samplers may be used to measure ambient atmospheres and personal breathing zone concentrations of particulates, vapors, and gases. Air samplers will be selected as follows:

- radioactive particulates—A personal monitoring pump will deliver air from the breathing zone for collection on fiberglass cartridges, and gross alpha activity will be counted with a portable measuring device. The guidelines set in DOE Order No. 5480.11 (DOE 1990, 0732) and HS-1 recommendations will be followed;
- volatile organic compounds— HS-5 recommendations on monitoring ambient air will be followed; and
- metals— HS-5 recommendations on monitoring ambient air will be followed.

7.0 PERSONNEL PROTECTION AND SAFETY REQUIREMENTS

This section establishes the protective measures for site workers during the OU 1078 investigation. These controls are categorized as engineering controls, work practices, and PPE. Guidelines for safety procedures are contained in the Laboratory's ER Program's SOPs, Section 2, "Health and Safety in the Field."

OSHA regulations state that, whenever feasible, engineering controls and work practices will be instituted to reduce and maintain employee exposure levels to a point below the permissible exposure limit. Engineering controls are mechanical means for reducing the hazards to workers; work practices are administrative controls for minimizing exposure. If engineering controls and work practices are not successful in bringing exposure below permissible limits, PPE must be used. The OU 1078 investigation will require Level D protection. The field team leader, with advice from the HS-1 and HS-5 monitors, will modify the PPE as needed.

7.1 Engineering Controls and Work Practices

7.1.1 Oxygen Deficiency

An oxygen-deficient atmosphere is defined as an atmosphere in which the percentage of oxygen by volume is less than 19.5. The most common means of restoring normal oxygen levels is ventilation, which can be achieved and maintained mechanically or naturally. Logistics in the field may make it difficult to use mechanical devices. Natural ventilation is effective but depends on current wind conditions. Field team members will not be permitted to work in oxygen-deficient atmospheres. Air-purifying respirators will be worn when oxygen concentrations are between 19.5% and 21%.

7.1.2 Fire and Explosion Hazards

Explosive or flammable atmospheres are defined as atmospheres in which the concentration of combustible vapors is greater than 20% of the lower explosive limit. Site workers will not be permitted to work in any area in which this condition exists. Ventilation can be used to reduce the concentrations of explosive and flammable gases and will be used at OU 1078 whenever possible.

7.1.3 Radiation Safety Requirements

In any ER Program work involving areas of known or potential radioactive contamination, the OUPL and field team leader must prepare a *Special Work Permit for Radiation Work*, HS Form 1-3D(4/87), using information specific to the site, and must submit it to HS-1, the Health Physics Operation Group, for review. The description of this work request appears in the ER Program's SOP, "Personal Protective Equipment." HS-1 will approve the form by signing it in the appropriate block. The OUPL must obtain full approval for this permit before initiating work at the site.

The measures implemented to protect site workers from the harmful effects of radiation will include a training program for all radiation workers, a detailed monitoring program, use of personal protective equipment when necessary, and an ALARA program. Additional training will be provided for women of child-bearing age to ensure that they are fully informed of the hazards associated with radiation exposure. Specific monitoring will be conducted for external penetrating radiation, contamination on skin and clothing, and airborne radionuclide concentrations. Intake of radionuclides is determined through bioassay measurements.

Gamma exposure rates in the environment will be measured routinely with high-sensitivity gamma scintillation detectors and/or Geiger-Muller detectors. The results of these surveys will be compared with an action level of 1 mR/hr as recommended in the EPA Standard Operating Safety Guides (EPA 1988, 0609). When exposure rates exceed 1 mR/hr, the area will be evacuated and isolated until assistance is obtained from an HS-1 monitor.

The HS-1 monitor will minimize personnel exposure to direct penetrating radiation by applying the principles of time, distance, and shielding. Doses to individuals will be minimized by limiting their exposure time and by maximizing their distance from sources of penetrating gamma radiation. The use of shielding is impractical in most environmental situations and probably will not be required.

Additional monitoring will be provided for each team member with TLDs that record an individual's accumulated dose from exposure to gamma radiation. The results from the TLDs will be used to ensure that the dose equivalent received by an individual team member does not exceed the annual limit of 5 rem.

All workers will be surveyed for skin and clothing contamination before leaving the radiation control zone for breaks or at the end of the day. Surveys will be performed for alpha radiation using a zinc sulfide scintillation detector and for beta/gamma radiation using a Geiger-Muller pancake probe. These surveys will always cover the hands and feet and will periodically check other areas that have a high probability of contamination (e.g., knees and buttocks). Any contamination discovered on the skin will be removed by thorough washing (avoiding abrasion of the skin) with soap and water, followed by a second survey to verify removal of all contamination. Contaminated clothing (overalls, etc.) will not be allowed to leave the work site. To minimize the potential for skin contamination, all workers will be required to wear, at a minimum, coveralls and gloves. Additional skin protection may be implemented at the discretion of the site safety officer and HS-1.

Air monitoring will be performed as outlined in Section 6.3, and respiratory protection will be implemented if the sample results indicate that such protection is appropriate. The results of the air-monitoring program will ensure that limits for prospective internal exposure, as specified in AR 3-1, are not exceeded.

A bioassay program will be initiated for all workers exposed to potential radioactive contaminants to ensure that retrospective estimates of internal dose do not exceed the 5-rem limit of DOE Order 5480.11. All such workers will be enrolled in the plutonium urinalysis program, as specified in AR 3-6. Additional urine samples will be collected and analyzed for uranium if gross alpha concentrations in air exceed twice the DAC for uranium, 4×10^{-11} μCi/ml, in areas suspected to have uranium contamination. These bioassay measurements will be performed in accordance with the requirements of AR 3-6.

7.1.4 Chemical Hazards

Chemical hazards are to be monitored by HS-5 employees or their designees during the performance of duties in the contaminated zone. If concentrations of toxic materials exceed the action limit (which is one-half the permissible exposure limit or threshold limit value), personnel will be removed from the area until natural or mechanical ventilation reduces the levels to background values. Volatile chemicals are not expected at OU 1078 during surface soil sampling.

Airborne dust or particulates pose two problems: (1) nuisance dust for which standards have been established at 10 mg/m^3 and (2) the adsorption of hazardous substances into soil particles. During drilling and other dust-generating activities, water can be sprayed to suppress the dust. The effectiveness of dust control measures depends on the size of the area to be sprayed and the rate of evaporation. Frequent applications may be required to achieve optimal results.

7.1.5 Biological Hazards

7.1.5.1 Animals and Insects

Site workers may be exposed to a variety of snakes, insects, and rodents. Rattlesnakes may be encountered in the high grasses on the mesas and near outfalls and wastewater treatment plants. When field team members need access to grassy areas, they will either wear snake leggings or cut the grass.

Insect repellents can be used to avoid bites from some insects; however, field team members should be aware that repellents may affect sample analyses. Field team members will check for ticks after working in grassy and wooded areas.

Controls for exposure to rodents are limited. Workers should be aware of potential habitats for rats and mice. If an individual is bitten by a rodent, the animal should be captured, if possible, to be tested for rabies, and the victim should be transported to a medical facility.

7.1.5.2 Poisonous Plants

Field team members should be able to identify poisonous plants, such as poison ivy, poison oak, and poison sumac. Contact with these plants will be avoided. If these plants are present at the sampling location, they will be removed in an appropriate fashion.

7.1.5.3 Standard Field Safety Practices

If the area of the sampling location is littered with debris such as sharp objects, broken glass, and items with jagged edges, field team members will clear the area before proceeding with work. Cuts, abrasions, and puncture wounds will be treated immediately by an individual certified in first aid. Medical personnel will be consulted in the case of more severe wounds and will determine the necessity for tetanus inoculation.

Hygienic practices will also be followed on the site at all times. Eating, drinking, smoking, and chewing gum and tobacco will be prohibited. The hands and face must be washed upon leaving a contaminated area, as well as before drinking, eating, and smoking. These practices are consistent with Section 9.4 of the H&S program plan.

7.1.6 Physical Hazards

This section outlines the controls necessary to reduce the severity of the physical hazards listed in Section 5.1.7 of this H&S project plan.

7.1.6.1 General Physical Exposures

Failure of field project management staff and site workers to recognize, evaluate, and control site hazards can result in exposure to contaminants via skin contact or inhalation; burns; blowouts; slips, trips, and falls; and other hazards. The project's goal is to avoid accidents completely.

Potential physical exposures will be identified and evaluated for consistency with Laboratory and OSHA requirements. To the extent feasible, physical exposures will be reduced to an acceptable level through engineering and work practice controls. Additionally, personnel will be properly protected in accordance with Laboratory and OSHA requirements concerning PPE. PPE will be provided to effectively eliminate the potential for skin contact and to reduce potential inhalation to less than the permissible exposure limit.

The minimum protection for any person who enters the job site consists of

- a hat;
- safety glasses;
- appropriate work clothing, including shirt with sleeves and durable pants such as jeans;
- gloves whenever materials are being handled: chemical-resistant gloves whenever there is a potential for contact with site contaminants (e.g., residue) and cotton gloves for manual tasks such as loading and unloading supplies or handling or moving equipment and materials; and
- steel-toed safety shoes made either of leather or a chemical-resistant material.

All field team members will work together to establish and maintain site control. Field team leaders or managers will prohibit entry to personnel who lack minimum acceptable training and medical and safety equipment.

Chemical and physical hazards associated with this project will be eliminated as much as possible by engineering controls before work activities begin. These controls will include, as appropriate, barricading, guarding, posting signs, and verbally warning site personnel. None of the planned operations is inherently dangerous when performed by trained and experienced personnel working under safe conditions. The work crews will endeavor to maintain good working conditions through organization and recognition of hazards before they result in injury and loss. Laboratory SOPs provide guidance to employees executing specific operations. When possible, all field team members will recognize, evaluate, and control physical hazards.

7.1.6.2 Noise

Hearing protection will be worn in areas in which noise levels are suspected or shown to exceed 85 dB. Field managers will be responsible for identifying areas with high noise levels (continuous or intermittent), and on-site personnel will wear hearing protection devices in these areas. Warning signs will be posted.

7.1.6.3 Working Around Heavy Equipment and Machinery

All heavy equipment will have a functioning back-up alarm, which must be capable of producing sound at a frequency and intensity sufficient to overcome background noise and to be clearly audible to employees wearing hearing protection. Heavy stationary equipment will be barricaded at a distance sufficient to permit ground personnel to avoid swinging cabs, counter weights, and booms.

The number of passengers will not exceed the number of functional seat belts available. Seat belts will be used at all times. Personnel will not ride on or in vehicles or equipment not designed for conveying people, nor will they ride in an inappropriate manner. All equipment will be used in the manner for which it was intended. Drivers will operate equipment in accordance with manufacturers' instructions and in adherence to federal, state, and local regulations.

Weights for all items lifted will be calculated before the item is lifted. The boom angle, cable, and auxiliary lines will have a rated load margin of at least 20% greater than the weight of any lift. All rigging material used for a particular lift will represent a 50% margin of lift capability greater than the weight of the particular load.

Hand signals instead of a radio will be used to signal the operator of a crane. All heavy equipment will carry at least a 5-lb, multipurpose, dry-chemical fire extinguisher.

7.1.6.4 Housekeeping

Work areas will be kept sufficiently clean and orderly so that work can proceed efficiently, safely, and in a manner that will produce and maintain quality. The work areas will be adequately lighted, ventilated, protected, and accessible as appropriate for the activity. Machinery and equipment will be arranged and stored in a manner that permits work to be conducted safely and efficiently and that provides ease in cleaning. Tools and accessories will be safely stored out of traffic areas.

Sufficient waste containers and receptacles will be provided in appropriate locations and will be emptied frequently and regularly. Work areas and floors will be maintained free of debris, obstructions, foreign materials, or slippery substances, such as oil, water, and grease.

Traffic areas and exits will be maintained free of materials and debris. Combustible materials will be stored in approved containers and properly disposed. Waste rags will be stored in metal containers. All flammable liquids will be stored in safety cans. Dangerous materials will be stored outside the work area.

Site workers will be held accountable for keeping their work areas free of housekeeping hazards.

7.1.6.5 Materials Handling

Gloves will be worn whenever materials are lifted. Two or more workers may be required to lift heavy or bulky items. A firm grip on material being moved and secure footing when lifting or handling a load are required. Fingers and toes should be in the clear before an item is set down. Material must be transported and stored in a stable manner to prevent falls, rolls, and slips. Material should be lifted with the legs and not the back. The movement of long objects must be controlled when they are carried through congested areas, on stairways, in passageways, or around blind corners. Pinch points should be avoided. Whenever practical, heavy items should be handled by mechanical or powered equipment. Workers should stay clear of material-handling equipment and the load.

7.1.6.6 Temperature Extremes

High temperatures require personnel to be closely monitored for signs of heat exhaustion or heat stroke. Shaded areas and cool water will be provided. In winter, it may be necessary to protect personnel from the effects of cold temperatures and wind, as well as from becoming wet during field operations. Throughout each day, field managers will evaluate the impacts of exposure to the elements on personnel and operations. Special care will be taken during the first days of operation to allow site workers to become acclimated.

One or more of the following control measures can be used to help control heat-related disorders:

- providing adequate liquids to replace lost bodily fluids. Employees must replace water and salt lost in perspiration; therefore, they must be encouraged to drink more than the amount required to satisfy thirst, which is not an accurate indicator of adequate salt and fluid replacement. Replacement fluids can be a 0.1% salt water solution. Commercial beverages that replace fluid and nutrients are also effective.
- establishing a work regimen that provides adequate rest periods for cooling down, which may require adding shifts and using cooling devices, such as Vortex tubes or cooling vests worn beneath protective garments. All breaks are to be taken in a cool rest area (77°F is best).
- informing all employees of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

Procedures for recognizing and avoiding cold stress must be implemented when the ambient temperature is less than 40°F. These procedures are given in the ER Program's SOP, "Heat and Cold Stress and Natural Hazards." If cold stress symptoms are observed, the patient should be moved to a warm, dry place, and any wet clothing should be removed. The affected extremities should be warmed with moist, lukewarm compresses, gradually increasing the temperature until normal circulation and temperature return. If the patient is conscious and alert, he/she should gradually drink warm liquids, but no caffeine. Medical attention should be sought for all but minor cases of cold stress.

7.1.6.7 Excavations

All excavations will be performed from a stable position on the ground. A person trained in excavation safety will inspect the excavation daily. The inspector will determine the likelihood of cave-in, and remedial action, such as sloping or shoring, will be taken if the walls appear unstable.

All spoil will be placed at least 2 ft from the edge of the excavation so that it does not fall back into the excavation. Barricades or caution tape will enclose the excavation on all sides at least 2 ft from the edges.

All field team members will participate in daily tailgate safety meetings and will be instructed on the following requirements:

- Before excavation begins, the location of underground pipes, electrical equipment, and gas lines will be determined, if possible, by contacting the appropriate utility company and/or property owner to mark the location of the lines. If the property owner's knowledge of the area is incomplete, an appropriate device, such as a cable-avoiding tool, will be used to locate the service line.
- Combustible gas readings of the general work area will be made regularly.
- No ignition sources will be permitted if the ambient airborne concentration of flammable vapors exceeds 10% of the lower exposure limit during excavation. A combustible gas indicator will be used to make this determination.
- Operations must be suspended and the area must be vented if the concentration of airborne flammable substances reaches 10% of the lower exposure limit in the area of an ignition source (e.g., internal combustion engine, exhaust pipe).
- If excavating equipment is located near overhead power lines, a horizontal distance of 15 ft must be maintained between the lines and any point on the equipment. If the lines have appreciable sag or if windy conditions exist, this distance will be 20 ft.

Trenches in the SWMUs must be excavated to a depth of less than 5 ft whenever possible; trenches with depths greater than 5 ft require protection, such as sloping, benching, or shoring. In addition, trenches at depths of 4 ft or more must have a means of egress every 25 ft. The air in the trench must be monitored. Tools and soil piles and other debris must be stored at least 2 ft from the edge of the excavation. All excavations must be marked to restrict access when the area is not occupied. Field team members must be aware of conditions inside the trench, as well as any activities taking place outside the excavation.

7.1.6.8 Underground Hazards

Field management must take any steps necessary to ensure that all underground utilities are located; in addition, steps must be taken to absolutely ensure that all utilities to the site area have been neutralized. Drilling and/or digging in areas in which there may be buried utilities is an unacceptable risk.

Every effort will be made to notify utility companies and to obtain their assistance, along with that of Laboratory personnel, to identify subterranean hazards. Additionally, drilling and digging operations will progress only if there is reasonable assurance that objects, utilities, product lines, and other obstacles in the excavation have been identified and located. A magnetometer or similar device will be used to assist in identifying subterranean hazards that are not adequately identified by other means. Drillers will dig the first 5 ft of postholes manually before inserting the drill auger. These measures should minimize the potential for encountering buried physical hazards.

If unmapped or unneutralized utilities are discovered or encountered during drilling and digging, work will stop immediately and will not resume until the hazard has been eliminated.

The various manholes, ventilation pipes, and entrances to underground areas represent hazards to personnel and vehicles traveling across the site. All of these hazards will be marked with stakes and warning tape as necessary to prevent personnel and equipment from standing on or driving over manholes or running into vertical vent pipes. Open manholes or similar openings will be effectively roped off or barricaded.

7.1.6.9 Traffic

Traffic control will be maintained in and around the job site at all times to avoid personnel injuries and prevent equipment damage. So that equipment operators will not run into pedestrians or workers, work areas will be delineated by barricades, warning signs, warning lights, traffic cones, etc. Personnel will wear fluorescent orange and/or reflective clothing, vests, etc., when working in and around traffic areas.

Pedestrians have the right-of-way. When working around heavy equipment, ground personnel should always make eye contact with operators of moving vehicles and wait for a signal to proceed before passing close to or in front of operating equipment.

All drivers and operators will adhere to speed limits, signs, and road markings. Equipment operators and ground personnel will be especially careful when air line respirators are in use because of the potential for injury if an air line were to become tangled in the track or wheel of a vehicle or equipment. Under no circumstances will breathing air systems that supply air to the respirators of ground employees be attached to vehicles or equipment.

Sufficient parking will be provided. Vehicles not in active use will be parked so that they do not interfere with traffic. When a vehicle is being maneuvered in a confined area in which visibility is limited, personnel positioned outside the vehicle will assist the operator.

7.1.6.10 Breaking Concrete

Continuous real-time air monitoring must be provided throughout the operation. Controls will be used as necessary to establish and maintain an acceptable level of exposure to concrete dust. If monitoring is inconclusive, PPE will be provided to exposed employees.

The operation will be kept wet to reduce dust. Eye, face, and respiratory protection will be used as necessary. Eye and face protection includes goggles, safety glasses with side shields, and/or a face shield that extends past the throat and attaches to a hard hat.

Hearing protection will be worn as needed. If earplugs do not offer enough protection, earmuff-type hearing protectors and plugs will be used.

To combat the damaging effects of jackhammer vibration, rubber hand grips and gloves that are padded to absorb vibration will be used. Low back protection, such as a belt designed for this purpose, will be required.

Pressure hoses that supply jackhammers will have a conductive pressure hose to limit the potential for electrical shock injuries to personnel in the event that an active electrical source is unexpectedly encountered.

7.1.6.11 Topography

To reduce hazards associated with topography, the site safety officer will inspect each site for potential hazards. Some of these hazards can be alleviated by removing any obstacles in immediate work areas, clearing icy surfaces, and placing tools in an accessible but protected area. Boundaries surrounding excavations, trenches, and boreholes will be marked. Field team members who conduct site activities near the edge of the mesa or near cliffs in Los Alamos Canyon will not be permitted to work closer to the edge than 5 ft. Barrier tape will be used to designate this restricted area. One exception to this requirement is sampling outfalls. Personnel working closer than 5 ft to the edge of the mesa or on the cliff side will be secured by safety lines. In this instance, the worker will be tied off before descending over the edge. All field team members will be informed of potentially hazardous locations and the appropriate controls. Field team members will also be expected to observe good housekeeping practices for the duration of the work in each area.

7.1.6.12 Lightning

Lightning strikes the tallest object in an area and takes the fastest route to the ground via the best conductor; therefore, buildings or vehicles provide better protection than being in the open. A large building with a metal structure is the safest shelter because electric current runs along the outside metal frame and into the ground. An automobile with a metal roof serves the same purpose; however, convertibles or fabric-topped cars are not safe because lightning can burn through the fabric.

Wood or brick buildings that are not protected by lightning rods have high potential for conducting a strike, which travels down natural conductors such as wiring or pipes. Any contact with an ungrounded conductor can be dangerous. Telephones, faucets, electrical equipment, and metal fences are examples of ungrounded conductors.

A person in the open during a lightning storm should crouch to avoid being the tallest object. A tingling sensation or hair standing on end signals that lightning is about to strike and that a crouching position must be assumed immediately. The safest crouching position is to place the hands on the knees and keep the knees and feet together while remaining as low as possible. Stretching out flat on damp soil could cause the body to attract current running into the ground from a nearby tree. Keeping feet and knees spread or placing the hands on the ground could complete a circuit and cause high-voltage current to run through the body. A grove of trees affords more protection than remaining in the open or taking shelter under a single tree. Lower ground is also safer; however, ditches and ravines present the danger of floodwaters.

Side strikes injure more people than direct strikes. Side strikes occur when electric current jumps from its present conductor to a more effective conductor. The human body is a better conductor than a tree trunk; therefore, a person should stay 6 ft from a tree to avoid a side strike. A group of people taking shelter under a grove of trees should stand 6 ft apart to avoid side strikes from one person to another.

The force of electrical current temporarily disrupts the nervous system; therefore, even if breathing and heartbeat have stopped, a lightning victim may not be dead. Many victims can be revived by artificial respiration and cardiopulmonary resuscitation. Once the lightning flash is over, current is no longer running through the body; therefore, it is safe to touch a lightning victim. Even a victim who seems only slightly stunned should receive immediate medical attention because internal organs may have been damaged.

7.2 Personal Protective Equipment

If engineering controls and work practices do not provide complete protection against hazards in OU 1078, field team members will be required to use PPE. PPE shields or isolates individuals from chemical, physical, biological, and some radiological hazards that may be encountered on the site. PPE protects the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing. Two important criteria to be followed in selecting this equipment are the potential hazards on the site and the type of work to be performed. The choices are also influenced by the hazards associated with the equipment itself, such as reduced mobility, dexterity, vision, and communication and increased heat stress. Field team members must be able to communicate when wearing hearing protection.

The EPA has established four levels of protection for workers involved with potentially hazardous materials. These levels are based on the degree of dermal and respiratory protection appropriate to the hazards at the site. Levels D and C (occasionally) will be used at OU 1078. Level C provides respiratory protection via an air-purifying respirator. Level D is a basic work uniform.

Further information on the components of Levels of Protection C and D, and the selection criteria and limitations of each, are presented in the next section. OU 1078 investigations will be conducted according to Laboratory AR 12-1, Personal Protective Equipment; and LANL TB 1201, Eye and Face Protection; TB 1202, Protective Clothing; and TB 1203, Respiratory Protective Equipment. The site-specific special work permit for work in radioactive areas will specify the appropriate protective clothing and equipment to be used on sites with known or suspected radioactive contamination.

7.2.1 Selection of Personal Protective Equipment

Selecting the appropriate PPE is a complex process that takes into consideration a variety of factors, including identification of hazards or suspected hazards, their routes of transmission to employees (inhalation, skin absorption, ingestion, and injection), and the performance of the PPE materials (and seams) in providing a barrier. The amount of protection provided by PPE varies—the materials used in protective equipment will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, materials that provide continuous protection from a particular hazardous substance cannot be found. In these cases, the time it takes for the material to show signs of wear should exceed the time the PPE is in use.

The PPE selected must protect employees from the specific hazards that they are likely to encounter during their work on the site. The site safety officer will be advised by the HS-1 and HS-5 monitors on the PPE requirements for each sampling of SWMU aggregates.

Other factors in this selection process include matching the PPE to the employee's work requirements and to task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are also a factor in selecting and using PPE.

In some cases, layers of PPE may be necessary to provide sufficient protection or to protect expensive PPE inner garments, suits, or equipment. The more that is known about the hazards at the site, the easier it is to select PPE. As more information about the hazards and conditions becomes available, the field team leader can decide to upgrade or downgrade the level of PPE to match the tasks at hand.

The following are guidelines that the field team leader can use to select the appropriate PPE; however, they do not fully address the performance of specific PPE materials in relation to specific hazards at the job site. PPE selection, evaluation, and reselection are a process that goes on until sufficient information about the hazards and PPE performance is obtained. The two levels of protection afforded by PPE to be used at OU 1078 are described below.

7.2.1.1 Level C

Level C protection will be considered in instances in which a known chemical contaminant has exceeded the specific permissible exposure limit. An air-purifying respirator will be selected if the following criteria are met:

- oxygen levels are greater than 19.5%,
- chemical concentrations do not exceed levels immediately dangerous to life and health,
- the chemical container has adequate warning labels, and
- cartridges and canisters are designed for the chemicals and concentrations of interest.

Level C protection will include

- full-face, air-purifying respirator (approved by NIOSH and the Mine Safety and Health Administration) with combination organic vapor/particulate cartridges or canisters capable of filtering out the chemicals of concern;
- contaminant-resistant clothing made of such materials as Saranex or polyvinyl chloride for dust and splash protection against chemicals of concern;
- inner gloves of latex surgical material;
- outer gloves of rubber, polyvinyl chloride, or nitrile, depending on suspected contaminants;
- rubber, steel-toed safety boots with disposable boot covers for use in wet conditions;
- leather safety boots with disposable boot covers for use in dry conditions;
- hard hat for protection against overhead hazards; splash shields are optional, depending on the activity and conditions;
- hearing protection when the noise level exceeds 85 dB; and
- escape mask for respiratory protection in the event of a release or respirator failure.

7.2.1.2 Level D

Level D protection will consist of

- cotton or Tyvek coveralls;
- outer gloves made of rubber, polyvinyl chloride, or nitrile for protection against chemicals and particulates;
- leather gloves for protection against abrasions;
- steel-toed safety boots for protection against punctures and crushing;
- optional boot covers for dusty or muddy conditions;
- a hat for protection against the rays of the sun and insects (ticks); a hard hat may be required under certain conditions;
- hard hat with optional splash shield for protection against overhead splash hazards;
- safety glasses for protection against splashes and particulates; and
- hearing protection (earplugs or earmuffs) if the noise level exceeds 85 dB.

7.2.2 Personal Protective Equipment for Task-Specific Hazards

The guidelines given in this section apply to all work performed in OU 1078. Specific health and safety considerations for the activities conducted under the sampling plans in Chapter 7 of this RFI work plan are discussed in the following text. Levels of protection for activities at each SWMU are outlined in Table III-3.

7.2.3 Field Surveys

Level D protection will be provided for all field surveys for the SWMUs in OU 1078.

7.2.3.1 Surface Sampling

With the exception of SWMU 1-006e, Phase I surface sampling will involve the collection of soil or sediment samples from the first 6 in. of soil. Site workers may wear Level D protection. Safety harnesses will be used by any member who is working at or off the edges of the mesa or on steep canyon slopes. Under extremely dusty conditions during drilling or trenching, site workers will spray water to suppress the dust.

Near-surface soil samples in Phase I will be obtained at depths of up to 3 ft in several SWMU aggregates. Among the suspected contaminants are low levels of metals and radionuclides. These samples will be collected in Level D protection as previously described during the initial phase of the sampling. Air monitoring with a photoionization detector or flame ionization detector will be conducted at each sampling location. The site safety officer will determine whether the level of protection should be upgraded or downgraded during the project.

7.2.3.2 Subsurface Sampling

The subsurface sampling program consists of a variety of activities that involve drilling and excavation. Field team members will wear Level C or D protection during this activity. Regardless of the level of protection used, field team members will wear gloves, safety boots, hard hats, eye protection, and hearing protection, as required, during drilling operations.

Air monitoring for oxygen and flammable or toxic gases will be performed before drilling and excavation. Continuous monitoring for flammable or toxic gases will be conducted at the borehole during drilling or coring. Excavation and trenching will be monitored in areas where soil is being disturbed. Completed excavations and trenches will be periodically monitored for oxygen and flammable and toxic gases. The field team leader is responsible for selecting the appropriate level of protection based on the results of the air-monitoring information and recommendations from HS-1 and HS-5 monitors.

7.2.3.3 Special Sampling—Ashley Pond

Sampling of SWMU 1-006e, Ashley Pond, may involve the use of a boat for sampling surface water and sediment. While aboard the boat, workers will wear appropriate personal floatation devices at all times. In addition, site workers may wear Level D protection.

7.3 Hazard Communication

In accordance with the provisions of 29 CFR Part 1910.120 that implement right-to-know legislation, workers must be informed of potential hazards associated with the site before work begins. Because TA-1 is principally located in public areas, the public must be made aware of potential hazards. Barrier tape will be used to prevent visitors from entering the work zone. The following sections describe the provisions for hazard communication to be observed during work at TA-1.

7.3.1 Safety Meetings

Pre-entry briefings will be held before initiating any site activity, as described in the ER Program's SOP, "Pre-Entry Briefings for Site Personnel." Safety meetings and safety inspections will also be conducted to ensure that this H&S project plan is being followed. These procedures and the documentation required are described in the ER Program's SOP, "Safety Meetings and Inspections."

7.3.2 Employee Information

The site safety officer will ensure that the following DOE and Laboratory forms are available where field team leaders and field team members can easily read them:

- Form F 5480.2, Occupational Safety and Health Protection;
- Form F 5480.4, Occupational Safety and Health Complaint Form;
- the Laboratory's special work permit (if appropriate); and
- OSHA job safety and health protection form.

The Laboratory's health and safety standard concerning employees' right to know will also be available at the work site. Employees will be required to sign the Acknowledgment of On-Site Briefing form in the ER Program's SOP, "Pre-Entry Briefings for Site Personnel," before beginning field work activities.

7.3.3 Material Safety Data Sheets

Material safety data sheets provide exposure information and describe the chemical and physical properties, toxicological effects, and appropriate protection for chemicals used in the course of site work. These sheets are contained in Attachment III-1, Material Data Safety Sheets.

8.0 SITE CONTROL

The objectives of site control are to protect employees and the general public from exposure to hazardous substances and conditions and to prevent the spread of contamination. Site control entails the establishment of boundaries based on the nature and extent of contamination at the site as well as on safe access. Three general areas are defined in this H&S project plan: the exclusion zone, the contamination reduction zone, and the support zone. Site access issues are also addressed in Section 7 of the H&S program plan.

8.1 Exclusion Zone

The exclusion zone is the area inside the SWMU in which contamination does or could occur. Because of the types of areas in which SWMUs are located in OU 1078, the position of the boundaries for the exclusion zones will vary. The designation of the exclusion zone for each SWMU depends on the following factors:

- the number and distribution of sampling locations,
- types and amounts of contaminants expected,
- air-monitoring results,
- use of mechanical equipment and heavy equipment (including drill rigs and backhoes),
- proximity to overhead and underground utility lines, and
- topography.

Access to the exclusion zone will be restricted to those field team members who have direct responsibilities for sampling in this area and who are wearing the appropriate PPE.

The "hotline" is the outer boundary of the exclusion zone. Depending on the location of the SWMU (e.g., isolated areas versus residential or commercial), the hotline will be marked in the most appropriate fashion. Barriers such as fences, barrier tape, and signs can be used, depending on the circumstances.

8.2 Contamination Reduction Zone

The contamination reduction zone is the transition area between the contaminated area and the clean area. This zone serves as a buffer and prevents further spread of contamination from the site by providing a specified area for decontamination activities.

The contamination reduction zone will be located upwind of the exclusion zone, if possible. The outer boundary of the zone is the contamination control line and will be indicated, if appropriate. All workers will wear Level D protection in this zone.

8.3 Support Zone

The support zone is the location of administrative and other support functions. This zone is also located upwind of the exclusion zone, if possible. Best-management practice at OU 1078 is to wear Level D protection in this area.

8.4 Site Control Procedures

To promote adequate security, personnel safety, and smooth operations at the site, the following measures will be instituted, as necessary:

- All information regarding work to be performed, emergency procedures, and health and safety hazards will be reviewed at a daily tailgate safety meeting, which will occur before work begins.
- A copy of the site-specific H&S plan will be available at the work site.
- Only authorized personnel will be permitted in the work area. These individuals must have successfully completed a medical exam and must have been properly trained in specific health and safety hazards and in the use of respiratory protective equipment. All visitors must report to the field team leader.
- All personnel who enter the site will be thoroughly briefed on hazards, equipment requirements, safety practices, emergency procedures, and communication methods.
- Protective clothing and respiratory protective equipment will be used for various stages of the operation, as needed. The levels of protection are described in Section 7.2 and will depend on the degree of hazard.
- Food, beverages, and tobacco will not be allowed in contaminated areas or potentially contaminated areas. Taking medication, smoking, and applying cosmetics are also prohibited. These activities are allowed only in the established clean areas.
- Before eating, drinking, or smoking, employees will wash their hands and remove outer protective garments.
- At the end of each work shift and before leaving the site, personnel who worked in contaminated zones will thoroughly wash themselves to remove any contaminants.
- Containers will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.
- Emergency equipment will be located in readily accessible, uncontaminated locations. A complete first-aid kit will be readily available on the site. An eyewash capable of washing both eyes at once and delivering at least 0.4 gal./min for at least 15 min will be readily available.
- Employee entrance and exit routes will be planned, and emergency escape routes will be designated. A map that shows emergency escape routes will be available at the site.

- All operators of equipment used on the site will be familiar with the requirements for inspection and operation of such equipment. Unfamiliar operations will be discussed with affected employees before work begins. The field team leader will be responsible for checking the proficiency of the operator. Perimeter barricades will be placed around the particular equipment used in a fixed location. Audio and/or visual back-up alarms will be used on all heavy equipment on the site.
- Personnel will be transported only by means prescribed for moving personnel. When trucks or other heavy equipment enter or leave the site, an individual will direct the driver.

Material data safety sheets will be obtained for every chemical product used on the site; however, the only chemical planned to be used during the RFI at OU 1078 is nitric acid, which is needed for preserving water samples from Ashley Pond. This information will be stored in a central location and will be made readily available to all employees upon request. Material data safety sheets or other applicable information will be available with regard to materials used in collecting soil and drilling. All containers of chemical products will be properly labeled to comply with the Occupational Safety and Health Administration hazard communication standard (29 CFR 1910.1200).

All on-site personnel will use the buddy system whenever they are working in an OU 1078 location. Buddies will maintain visual contact with each other. Personnel must observe each other for signs of heat stress or toxic exposure, such as

- changes in complexion,
- changes in coordination or demeanor,
- excessive salivation and pupillary response, and
- changes in speech pattern.

Personnel will inform the field team leader of any nonvisual effects of toxic exposure, such as

- headaches, dizziness, or blurred vision;
- nausea or cramps; and
- irritation of eyes, skin, and respiratory tract.

Walking and working surfaces may become wet and slippery during these tasks, requiring extra caution. Visible barriers will be erected around any open excavations. Employees will keep the work and support areas neat and orderly and free of trash.

If appropriate, there will be a designated break area upwind of the excavation area and outside the contamination reduction zone. The area must be clearly marked, and no contaminated personnel or equipment will be permitted to enter.

If the facility does not have a water supply, potable water will be carried to the site for use in decontamination and employee cleanup. All refuse on the site will be deposited in designated containers. It is the responsibility of the field team leader to ensure that the area is kept clean.

9.0 DECONTAMINATION PROCEDURES

This section outlines the procedures for developing an effective decontamination plan. Decontamination is the process of sequentially removing or neutralizing contaminants that have accumulated on equipment and personnel. The objectives of the decontamination process are to protect workers from exposure to contaminants and to minimize the transfer of contaminants to clean areas.

The degree of contamination expected is based on the tasks to be conducted under the sampling plans in this RFI work plan. Contact with hazardous substances is possible; therefore, it is assumed that all personnel and equipment engaged in sampling activities are potentially contaminated. The only material to be addressed by decontamination procedures for OU 1078 is contaminated soil in the form of dust or mud.

General guidelines for decontamination are provided in Sections 7 and 10 of the H&S program plan. Decontamination procedures are contained in the ER Program's SOPs, "General Equipment Decontamination" and "Personnel Decontamination." A decontamination plan will be developed and implemented before personnel are permitted to enter areas in which the potential for contamination exists. The elements of this plan must be documented under the ER Program's SOP, "Records." Personnel who perform decontamination for the ER Program must certify that they have read and understood decontamination procedures, as well the procedures in the current version of the IWP.

9.1 Preventing Contamination

Effective decontamination is promoted by minimizing contamination at the outset. The following preventive measures are included in the ER Program's SOPs for decontamination:

- avoiding contact with hazardous substances as much as possible,
- encasing instruments and equipment in bags or coatings,

- bagging or coating the exterior of sample containers, and
- using disposable garments and equipment, when appropriate.

9.2 Decontaminating Equipment

The necessary supplies for equipment decontamination are listed in the ER Program's SOP, "General Equipment Decontamination." This check list includes solutions for decontamination and the appropriate cleaning supplies and protective gear for decontamination personnel. The level of protection required for decontamination support personnel will be adjusted according to the degree of contamination that is expected or determined.

All equipment used during field procedures, except disposable items, will be subject to decontamination procedures. The types of equipment to be used during sampling include monitoring equipment, sampling tools, heavy equipment, and vehicles. In addition, contamination must be removed from the exterior of sample containers to prevent exposure to field team members and laboratory personnel. Plastic bags must be sealed with a zip lock to minimize the potential for gross contamination on the site. The decontamination process must be designed to avoid contaminating the sample.

The steps for the decontamination process are presented in the ER Program's SOP, "General Equipment Decontamination." All heavy equipment and vehicles that are suspected of contamination must be steam-cleaned using high-pressure washers. All decontamination rinsate must be collected in approved containers.

9.3 Decontaminating Personnel

The necessary supplies and equipment for decontaminating personnel are listed in the ER Program's SOP, "Personnel Decontamination." These check lists correspond to the level(s) of protection in use on the site.

Personnel decontamination procedures will accommodate personnel who must use Levels C and D protection. The steps for personnel decontamination are outlined for Levels C and D in the SOP. The degree of decontamination required depends on the nature and magnitude of contamination. The HS-1 and HS-5 monitors will advise the site safety officer of the nature of personnel decontamination required at OU 1078.

9.4 Decontamination Support

If the sampling crews need assistance with decontamination, field team members will serve as support. Support team responsibilities include setting up the decontamination line, maintaining supplies, briefing the sampling crews in the decontamination line, and implementing emergency decontamination plans. All personnel will wear Level D PPE.

During the briefing sessions for the decontamination process, the support team will apprise the sampling crew of the proper steps and activities at each station.

Emergency decontamination may be necessary for persons who must evacuate the site under emergency conditions or because of injury. These procedures are described in Section 10 of the H&S program plan. It is imperative that the support team be prepared to perform these procedures.

9.5 Disposal Procedures

All decontamination solutions and rinse water will be contained, collected, and disposed as suspected hazardous waste. These items will be placed in the proper containers and handled by EM-7.

9.6 Verifying Decontamination

HS-1 must approve and oversee the decontamination of any equipment or protective gear to be removed from a contaminated area to a controlled or uncontrolled area. Protective gear and equipment will be visually inspected for the effectiveness of decontamination. Screening procedures will be performed with a radiation detector in accordance with the ER Program's SOPs for "Sampling for Removable Alpha Contamination" and "Total Alpha Surface Contamination Measurements."

10.0 EMERGENCY RESPONSE PROCEDURES

This section presents the emergency response plan, describes contingency plans for specific types of emergencies, describes the actions required by the Laboratory in the event of a release of radioactive or toxic materials, and outlines pertinent requirements for notification and documentation of emergencies. Additional references for this section include Sections 6 and 13.2 of the H&S program plan; Laboratory AR 1-1, Accident/Incident Reporting; AR 1-2, Emergency Preparedness; AR 1-8, Working Alone; and Laboratory TB 101, Emergency Preparedness.

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

10.1 Emergency Response Plan

This section describes the elements of the emergency response plans for OU 1078. These plans will be adjusted for conditions specific to each SWMU.

10.1.1 Emergency Contacts

The names of persons and services to contact in case of emergencies are provided in Attachment III-2. This emergency contact form will be copied and posted in prominent locations at the site. Two-way radio communication and mobile telephones will be maintained at each site.

10.1.2 Site Mapping

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

- hazardous areas (especially atmospheres that could be immediately dangerous to life and health);
- site terrain (topography, buildings, barriers);
- site accessibility by road (indicating current detours);
- locations of work zones and work crews;
- surrounding population and land use (residences, businesses, etc.);
- shelters and safe areas; and
- evacuation routes.

10.1.3 Site Security and Control

In an emergency, the field team leader (or a designee) is responsible for controlling the entry of personnel into hazardous areas and accounting for all individuals on the site. Depending on the nature and size of the SWMU, a muster area will be established in advance. The buddy system will remain in effect at all times for all personnel working on the site.

10.1.4 Communications

Internal communication refers to communication between field team members. The objectives of internal communication are to alert workers of danger, convey safety information, and maintain site control. Routine communications for OU 1078 will depend on the area represented by the work zones and the tasks associated with that area. When there is substantial distance between the workers who provide support and the workers who conduct sampling activities, two-way radio and mobile-phone communication will be used.

Emergency communication will also be established for the site. An air horn will be used to notify field team members of the following conditions:

- minor release—one long blast, and
- physical injury—two long blasts.

External communication will be necessary to request assistance or to notify the appropriate authorities about hazardous conditions that may impact public or environmental safety. The names and phone numbers of appropriate contacts will be made available. Mobile telephones will be available on site.

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

10.1.5 Evacuation Routes and Procedures

If a release of potentially hazardous materials occurs, field team members may need to retreat to a safe area or to evacuate the site. The evacuation procedures will depend on the nature and extent of the SWMU under investigation.

If the area is relatively small and/or unconstrained, field team members will be able to exit the exclusion zone at the most convenient point, preferably in the upwind direction. Areas that are expected to be safe will be indicated on the site map. At sites in which a relatively large exclusion zone exists or in areas that are constrained in some way (for example, restricted by a fence or bordered by steep cliffs), evacuation routes will be established in advance and will be illustrated on the site map. In either case, all field team members will report to a muster area to be accounted for by the field team leader. All field team members will be informed of the evacuation procedures specific to each SWMU. Before RFI field work begins at OU 1078, the Laboratory's Emergency Mobilization Office will be notified.

10.1.6 Emergency Equipment and Supplies

The site safety officer (or a designee) will be responsible for maintaining emergency equipment and re-stocking supplies. The type and amount of emergency equipment will be selected based on the potential hazards.

10.2 Specific Emergencies

10.2.1 Radiation and Chemical Exposures

A minor release of potentially hazardous materials will be indicated by one long blast with the air horn. All personnel will assemble at the muster area and will be counted by the field team leader (or a designee). The site safety officer will issue further instructions.

Exposure to radiation and/or chemicals should be reported to the Occupational Medicine Group (HS-2). The Los Alamos County Medical Center should be notified of life-threatening or serious exposures. The Laboratory Fire Department provides emergency transport services.

10.2.2 Injuries

Minor injuries may be treated on the site by trained personnel. Seriously injured victims will be transported to a medical facility as soon as possible. The Los Alamos County Fire Department provides emergency transport services. Two long blasts will warn field team members of a serious injury on the site.

10.2.3 Vehicle Accidents and Property Damage

In addition to the required police report, a vehicle accident report must be filed in accordance with DOE requirements. These requirements are described in Section 10.4 of this H&S project plan. Injuries sustained in an accident will be treated in the manner described in Section 10.2.3 of this H&S project plan.

10.3 Provisions for Public Health and Safety

The Laboratory's Environment, Safety, and Health Manual, identifies four types of emergencies. Only one, identified as an unusual event, could occur at OU 1078. An unusual event is defined as an event that has occurred or is in progress that normally would not be considered an emergency but that could reduce the safety of site workers. No potential exists for significant releases of radioactive or toxic materials off the site. The appropriate emergency response action is summarized in Section 6 of the H&S program plan (LANL 1991, 0553).

10.4 Notification Requirements

Field team members will notify the field team leader of emergency situations. The field team leader is responsible for notifying the appropriate emergency assistance personnel (e.g., fire, police, ambulance), the OUPL, and the Laboratory's HS Division office in accordance with DOE Order 5500.2B (DOE 1991, 0736), DOE-Albuquerque Operations Office (AL) Order 5500.3 (DOE/AL 1986, 0734), and DOE/AL Order 5500.2A (DOE/AL 1984, 0735). The HS Division Office is responsible for implementing notification and reporting requirements in accordance with DOE Order 5484.1 (DOE 1990, 0733).

10.5 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental protection, safety, or health protection significance. Proper reporting procedures are described in Section 13.2 of the H&S program plan.

The OUPL or his designated representative will submit the appropriate completed DOE Order Form 5484._ for any of the following accidents and incidents, in accordance with Laboratory AR 1-1, Accident/ Incident Reporting:

- Occupational injury is any injury, such as a cut, fracture, sprain, or amputation, that results from a work accident or from an exposure involving a single incident in the work environment. Conditions resulting from animal bites, such as insect or snake bites or from one-time exposure to chemicals, are considered injuries.
- Occupational illness of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, that is caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- Regardless of fault, accidents that cause damage to DOE property, including damage to facilities, inventories, equipment, and properly parked motor vehicles, or accidents in which DOE may be liable for damage to a second party are reportable when damage is $1,000 or more. Damage to or by a DOE vehicle is excluded.

- Accidents involving government motor vehicles that result in damages of $150 or more or that involve an injury are reportable to the DOE unless the government vehicle is not at fault and the occupants are uninjured. Accidents are also reportable to DOE if

  - damage to a government vehicle not properly parked is greater than or equal to $250,

  - damage to DOE property is greater than or equal to $500 and the driver of a government vehicle is at fault,

  - damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault, and

  - any person is injured and the driver of a government vehicle is at fault.

The H&SPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the appropriate Laboratory group as required by DOE orders. The pertinent orders are

- DOE Order 5000.3, Unusual Occurrence Reporting System;

- DOE Form F 5484.3, Supplementary Record of Occupational Injuries and Illnesses, Attachment 1, DOE Order 5484.1 (DOE 1990, 0733);

- DOE Form F 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1;

- DOE Form F 5485.4, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1;

- DOE Form F 5484.7, Annual Summary of Exposures to Resulting in Internal Body Depositions of Radioactive Materials, Attachment 14, DOE Order 5484.1;

- DOE Form F 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1;

- OSHA (Form) No. 200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1;

- DOE Form EV-102A, Summary of Department of Energy and Department of Energy Contractor Occupational Injuries and Illnesses, Attachment 8, DOE Order 5484.1; and

- DOE Form F 5821.1, Radioactive Effluent/Onsite discharges/Unplanned Releases; Attachment 12, DOE Order 5484.1.

Copies of these reports will be stored at the Records-Processing Facility. Specific reporting responsibilities are given in Chapter 1, General Administrative Requirements, of the Laboratory's H&S manual.

REFERENCES

DOE/AL (US Department of Energy, Albuquerque Operations Office), December 13, 1982. "Environmental Protection, Safety, and Health Protection Program for AL Operations," DOE/AL Order 5480.1A, Change 1, Albuquerque, New Mexico. (DOE/AL 1982, 0729)

DOE/AL (US Department of Energy, Albuquerque Operations Office), September 24, 1984. "AL Emergency Planning, Preparedness and Response for Operations," DOEAL/ Order 5500.2A , Albuquerque, New Mexico. (DOE/AL 1984, 0735)

DOE/AL (US Department of Energy, Albuquerque Operations Office), October 24, 1986. "Unusual Occurrence Reporting System," DOE/AL Order 5000.3, Albuquerque, New Mexico. (DOE/AL 1986, 0734)

DOE (US Department of Energy), November 16, 1987. "Contractor Occupational Medical Program," DOE Order 5480.8, Washington, DC. (DOE 1987, 0731)

DOE (US Department of Energy), June 29, 1990. "Radiation Protection for Occupational Workers," DOE Order 5480.11, Change 2, Washington, DC. (DOE 1990, 0732)

DOE (US Department of Energy), October 17, 1990. "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," DOE Order 5484.1, Change 7, Washington, DC. (DOE 1990, 0733)

DOE (US Department of Energy), April 30, 1991. "Emergency Categories, Classes, and Notification and Reporting Requirements," DOE Order 5500.2B, Washington, DC. (DOE 1991, 0736)

EPA (US Environmental Protection Agency) 1988, "Standard Operating Safety Guides," S0S6,Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team, Washington, DC. (EPA 1988, 0609)

LANL (Los Alamos National Laboratory), March 16, 1992. "Environmental Restoration Standard Operating Procedures," Vols. I and II, Los Alamos, New Mexico. (LANL 1992, 0688)

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)

OSHA (Occupational Safety and Health Administration), July 1, 1991. "Hazardous Waste Operations and Emergency Response," Code of Federal Regulations,Title 29, Part 1910, Washington, DC. (OSHA 1991, 0610)

ATTACHMENT III-1

MATERIAL DATA SAFETY SHEETS

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

From Genium's MSDS Collection, to be used as a reference.

MSDS # G 354
METHYL ALCOHOL
Revision C
Issued:
Revised: September, 1985

SECTION 1. MATERIAL IDENTIFICATION

17

MATERIAL NAME: METHYL ALCOHOL

OTHER DESIGNATIONS: Methanol, Wood Alcohol, Carbinol, Wood Naphtha, Methyl Hydroxide, Monohydroxy Methane, CH_3OH, CAS #67-56-1

MANUFACTURER/SUPPLIER: Available from several suppliers, including; E.I. DuPont DeNemours & Co. (302- 774-2290
Chemicals & Pigments Dept (800) 441-9442
1007 Market St. Wilmington, DE 19898

3
1 0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	HAZARD DATA
METHYL ALCOHOL CH_3-OH • Current OSHA Standard; ACGIH (1985-86) TLV adds (skin) notation. NIOSH has recommended a TWA standard of 200 ppm with a fifteen minute ceiling of 800 ppm. This ceiling is well above the TLV STEL of 250 ppm.	ca 100	8 hr TWA: 200 ppm, or 260 mg/m^3* (Skin) STEL: 250 ppm, or 310 mg/m^3 HUMAN Eye: 5 ppm, primary irritation dose Oral: LDLo: 340 mg/kg Inhalation: TCLo: 86,000 mg/m^3 - Toxic irritant effects (systemic)

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm .... 148.5°F (64.7°C)
Vapor density (Air=1) 1.11
Vapor pressure @ 21°C, mmHg ... 100
@ 50°C, mmHg ... 400
Water Solubility .... Totally Miscible

Viscosity @ 20°C, cps 0.59
Specific gravity, 20°/4°C ... 0.791
Melting point .... -144°F (-97.8°C)
Volatiles, % .... ca 100
Evaporation rate (BuAc=1) ... 5.9
Molecular weight 32.04

APPEARANCE & ODOR: Clear, colorless, highly polar liquid with a characteristic alcohol odor. The odor recognition threshold (100% of test panel) is 53.3 ppm

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
60.8°F (12°C) Closed Cup	725°F (385°C)	% by Volume	6	36.5

EXTINGUISHING MEDIA: Use carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Fires involving Methyl Alcohol are Class IB; use a blanketing effect to smother fire.
Methyl Alcohol is a moderate explosion hazard and a dangerous fire hazard when exposed to heat, sparks, flame or oxidizers. Its vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving Methyl Alcohol.

SECTION 5. REACTIVITY DATA

Methyl Alcohol is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material may react violently with chromic anhydride; iodine plus ethyl alcohol, and mercuric oxide; lead perchlorate; perchloric acid plus ethyl alcohol; dimethyl formamide plus phosphorous; potassium hydroxide plus chlorloform; sodium hydroxide plus chloroform. It may also react with metallic aluminum at high temperatures.
Methyl Alcohol is incompatible with strong oxidizing agents (eg., nitrates, perchlorate or sulfuric acid), active metals, acetaldehyde, ethylene oxide, isocyanates, beryllium dihydride, chloroform, and potassium tert-butoxide. It may attack some forms of plastics and rubber. Thermal decomposition or burning will produce carbon monoxide, carbon dioxide and possible toxic formaldehyde and unburned methanol.

Revised: 9/85

MSDS # G 354. Issued ______ METHYL ALCOHOL (Rev. C)

SECTION 6. HEALTH HAZARD INFORMATION

TLV 200 ppm (skin) or 260 mg/m^3

Methanol is a poisonous, narcotic chemical that may exert its effects through inhalation, skin absorpti: or ingestion. Elimination of Methanol from the body is slow, and the toxic effects can be compounded by repeated excessive exposures over several days. Toxic effects are exerted upon the CNS, especially the optic nerve and possibly the retinae. Symptoms of overexposure include dizziness, visual impairment, nausea, respiratory failure, muscular incoordination and narcosis. Visual disturbances may clear temporarily then re-occur and progress to blindness. Prolonged or repeated contact with the skin may cause dermatitis, erythema, and scaling. Vapors of Methanol are mildly irritating to the eyes, while direct contact with the liquid may cause irritation, pain and transient corneal opacity. Ingestion of Methanol can cause blindness and death. The fatal dose is 100-250 ml, although death from ingestion of less than 33 ml has been reported.

FIRST AID: EYE CONTACT: Immediately flush eyes, including under eyelids, with plenty of running water for at least 15 minutes. Get medical attention if irritation persists. SKIN CONTACT: Flush exposed area with water while removing contaminated clothing. Wash with soap and water. Get medical attention if irritation persists. INHALATION: Remove victim to fresh air. Restore and/or support breathing as needed. Get medical help (Inplant Paramedic, community). INGESTION: Give victim 3-4 glasses of water or milk and induce vomiting by sticking finger to back of throat. Contact a Poison Control Center or physician. Transport victim to a medical facility immediately. Do not induce vomiting or give anything to drink if victim is unconscious or having convulsions. Get medical attention (Inplant, paramedic, community).

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Evacuate all personnel from the area except for those involved in clean-up. Remove leaking container to safe place if feasible. Clean-up personnel should wear protective clothing, gloves, boots, and a self-contained breathing apparatus. Absorb small quantities on paper towel, vermiculite, or other absorbent and place in closed container for disposal. Dike large spills and collect for reclamation or disposal. Water spray may be used to knock down vapor and to dilute and flush spill away from sensitive areas. Do not flush to sewer. Keep out of watersheds and waterways.

DISPOSAL: Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Waste solvent may be reclaimed via filtration and distillation procedures. Methyl Alcohol has been designated as a hazardous waste by the EPA (RCRA CFR 261.33). The EPA Hazardous Waste No. is U154. Aquatic Toxicity Rating: TLm96: Over 1000 ppm.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements. For emergency or non-routine exposures where the TLV may be exceeded, wear an appropriate NIOSH-approved respirator. All electrical service in use or storage areas should have an explosion-proof design.

Prevent skin and eye contact by wearing rubber gloves and splash goggles or safety glasses. Use protective aprons, boots and face shield as necessary when splashing may occur.

Eyewash stations and safety showers should be available in areas of use and handling. Provide suitable training to those working with Methanol. Monitor the workplace and keep accurate records.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers in a dry, well-ventilated area away from strong oxidizing agents, heat, sparks and open flame. Protect container from physical damage. When transferring or pouring Methyl Alcohol, ground and bond containers and equipment to prevent static sparks. Use non-sparking tools.

Do not smoke in areas of use or storage. Use with adequate ventilation. Do not breathe vapors. Avoid contact with eyes and skin. This material is poisonous when introduced into the body metabolism. DO NOT INGEST!!!

Provide preplacement medical exams and periodic medical surveillance for industrially exposed workers with emphasis on neurological and visual functions, liver, and kidney systems.

DOT CLASSIFICATION: Flammable liquid, UN1230 DOT LABEL: Flammable liquid.

DATA SOURCE(S) CODE (See Glossary) 1, 2, 4-12, 16, 19, 20, 23-26, 31, 34, 37-39, 43, 47, 63, 79. R.

APPROVALS [signature], 11/85

INDUST. HYGIENE/SAFETY [signature] 11-85

MEDICAL REVIEW: [signature] Dec 85

G-96-05

APACHE POWDER COMPANY
MATERIAL SAFETY DATA SHEET

DATE PREPARED: 11/12/85 BY: S. A. Varnum, Jr.
REVISION # 0 DATE: -

SECTION I - PRODUCT IDENTIFICATION

[redacted] → Nitric Acid

SYNONYMS: Aqua fortis, Hydrogen nitrate, Azotic acid, Engraver's Acid

CHEMICAL FAMILY: Inorganic Acid
FORMULA: HNO_3

MANUFACTURERS NAME: Apache Powder Company
ADDRESS: P.O. Box 700
Benson, AZ 85602

INFORMATION AND EMERGENCY:
CONTACT: R. C. Sittig
PHONE: (602) 586-2217

SECTION II - HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

	OSHA PEL	ACGIH TLV
Nitric [redacted]	5 mg/m^3	TWA = 5 mg/m^3 STEL = 10 mg/m^3

SECTION III - PHYSICAL DATA

BOILING POINT: 187 - 251 (Degrees F.)

SPECIFIC GRAVITY: 1.33 - 1.50 (Where: Water = 1)

VAPOR PRESSURE: 7-42 mm Hg
VAPOR DENSITY: 1.4 - 2.2
SOLUBILITY IN WATER: Complete
OTHER: N/A

PERCENT VOLATILE: 100
EVAPORATION RATE: 21 (Where: Water = 1)

APPEARANCE AND ODOR: Clear, colorless to yellow to red liquid. Pungent, suffocating odor.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED): N/A (non-flammable)
FLAMMABLE LIMITS: LEL: N/A UEL: N/A

EXTINGUISHING MEDIA: For fires in area use water.

SPECIAL FIRE FIGHTING PROCEDURES: Avoid spraying water on nitric acid. Wear self-contained breathing apparatus, full acid protective clothing when possibility of acid contact exists.

blindness.

INGESTION: It causes immediate pain and corrosive burns. As little as a few milliliters may prove fatal and even a few drops ar hazardous if aspirated into the larynx.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Primary danger from acute poisoning is development of pulmonary edema--symptoms may be delayed.

EMERGENCY AND FIRST AID PROCEDURES:

INHALATION: Call a physician. Remove victim from contaminated area. This material is irritating to the mucous membranes and respiratory tract. Oxygen should be given if patient has any symptoms. Observation for 24 hours for pulmonary edema is indicated when victim has been exposed to nitrous (brown) fumes.

EYES: Flush eyes with running water for at least 15 minutes while forcibly holding eyelids open to permit water to irrigate all surfaces. Prompt action will minimize injury. Call a physician. Note: It is helpful to have someone other than the victim hold the eyes open.

SKIN: Clothing must be removed and affected skin area decontaminated by soaking or showering for at least 15 minutes. Physician should be called if there is any evidence of irritation or burn.

INGESTION: Seek medical attention immediately.

In all cases prompt action will minimize injury. Seek medical attention immediately in all cases.

SECTION VII - PRECAUTIONS FOR SAFE HANDLING AND USE

SPILL OR LEAK PROCEDURES: Stay upwind of spill or leak. Evacuate enclosed areas until gases have dispersed. Flush with plenty of water applied quickly to the entire spill or leak. Soda ash or lime should be spread around to neutralize any remaining acidity on the surface of the ground or concrete. Large spills should be contained with earthern dikes.

WASTE DISPOSAL METHOD: Neutralize with soda ash or lime. Comply with all federal, state and/or local regulations.

HANDLING AND STORAGE PRECAUTIONS: Do not breathe vapor or mist. Use only with adequate ventilation. Wash thoroughly after handling. Keep container closed. Store in well ventilated area away from combustibles. Keep out of sun and away from heat. Store in accordance with applicable federal, state or local laws and regulations. Loosen closure carefully and replace securely after each withdrawal.

OTHER PRECAUTIONS: Comply with all federal, state and/or local rules and regulations in the use of Nitric Acid.

SECTION VIII - CONTROL MEASURES

RESPIRATORY PROTECTION (SPECIFY TYPE): None needed under normal

ATTACHMENT III-2

EMERGENCY CONTACTS

Site Safety Officer

Name TBD Call TBD

Environmental Restoration Health and Safety Project Leader

Name Ted Norris Call 665-5136

24-hr LANL Health/Safety Coordinator

Call 9-911

FIRE

Call 9-911

AMBULANCE

Call 9-911

POISON CENTER

Call 9-911

SECURITY

Call 9-911 OR 7-4673

POLICE

Call 9-911 OR 7-4437 (Protective Force) OR 9-662-8222 (City)

YOU ARE LOCATED AT

TBD

THE NEAREST TELEPHONE IS LOCATED AT

TBD

THE NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT

Los Alamos County Medical Center

3917 West Road, Los Alamos, NM

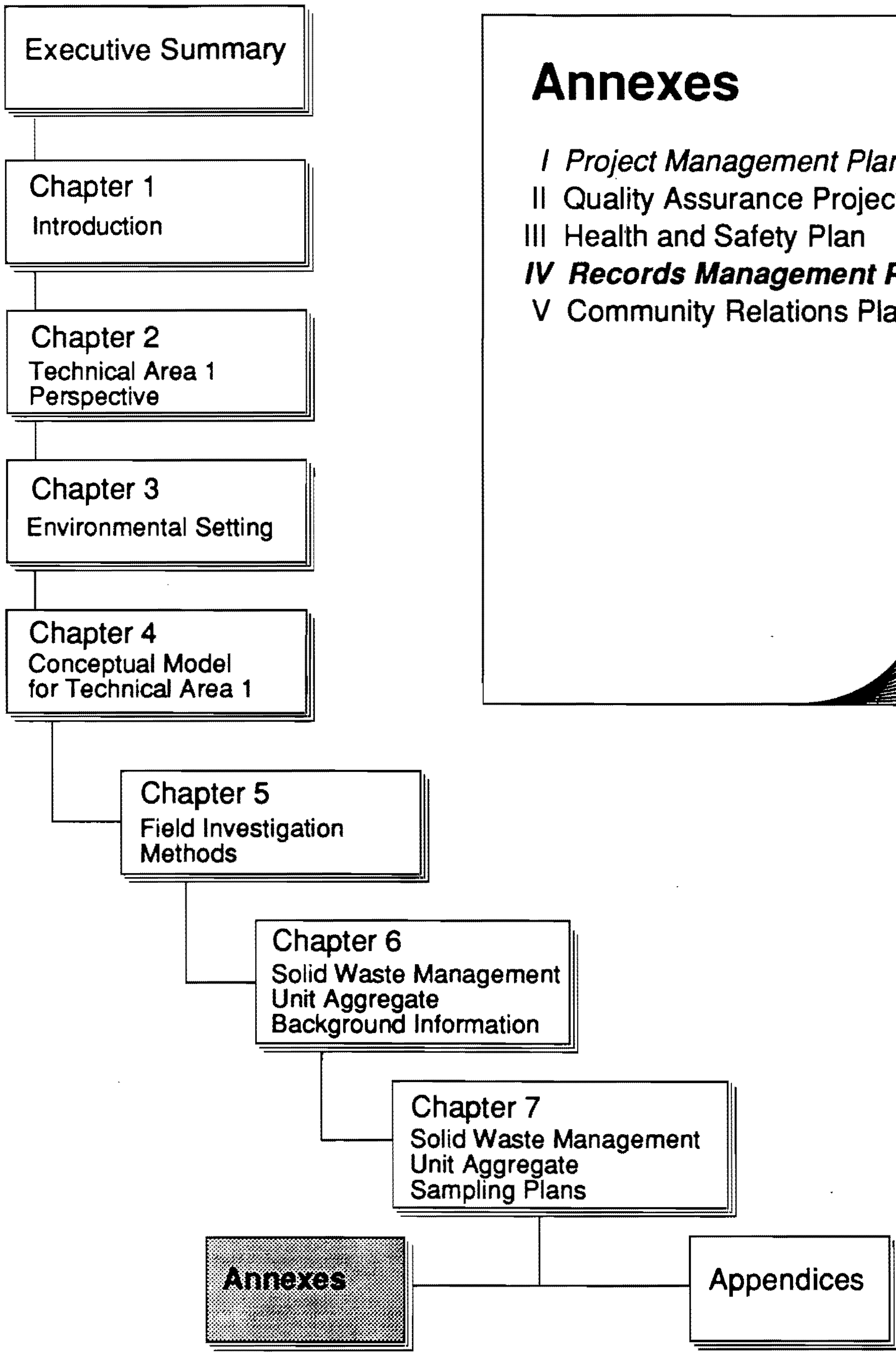
DIRECTIONS TO HOSPITAL: EXIT TA-1 ONTO TRINITY DRIVE. FOLLOW TRINITY DRIVE TO THE INTERSECTION OF TRINITY DRIVE AND DIAMOND DRIVE. HOSPITAL IS ON THE LEFT.

TRAVEL TIME FROM TA-1 OU (minutes): approx. 5

DISTANCE TO HOSPITAL (miles): 1

Annexes

I Project Management Plan
II Quality Assurance Project Plan
III Health and Safety Plan
IV Records Management Plan
V Community Relations Plan



1.0 INTRODUCTION

The Records Management Program Plan (program plan) for the Environmental Restoration (ER) Program at Los Alamos National Laboratory (the Laboratory) is described in Annex IV of the Installation Work Plan (IWP) (LANL 1991, 0553). The purposes of the program plan are to meet the requirements for protecting and managing records (including technical data), to provide an ongoing tool to support the technical efforts of the ER Program, and to function as a support system for management decisions throughout the existence of the ER Program.

The ER Program uses the following statutory definition of a record (44 USC 3301):

> Records are defined as "...books, papers, maps, photographs, machine-readable materials, or other documentary materials, regardless of physical form or characteristics,...appropriate for preservation...because of the informational value of the data in them."

The program plan establishes general guidelines for managing records, regardless of their physical form or characteristics, that are generated and/or used by the ER Program. The program plan will be implemented consistently to meet the requirements of the Quality Assurance Program Plan (Annex II of the IWP) and to provide an auditable and legally defensible system for records management. Another important function of the program plan is to maintain the publicly accessible documentation composing the administrative record required by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

2.0 IMPLEMENTATION OF THE RECORDS MANAGEMENT PROGRAM PLAN

Section 2.0 of the program plan describes the implementation of the records management program. Records management activities at Operable Unit (OU) 1078 will follow the guidelines summarized in that section. As the program plan develops to support OU needs, additional detail will be provided in annual updates of the IWP.

The program plan incorporates a threefold approach based on records control and commitment to quality guidelines: a structured work flow for records, the use of approved procedures, and the compilation of a referable information base. ER Program records are those specifically identified in quality procedures (QPs), administrative procedures (APs), standard operating procedures (SOPs), ER program and project plans; management guidance documents, and records identified by ER Program participants as being essential to the program. The records management procedure (LANL-ER-AP-02.1) governs records management activities, which include records identification, submittal, review, indexing, retention, protection, access, retrieval, and correction (if necessary). Other procedures, such as LANL-ER-AP-01.3 (Review and Approval of Environmental Restoration Program Plans and Reports), LANL-ER-AP-01.4 (Distribution of Controlled Documents Prepared for the Environmental Restoration Program), and LANL-ER-AP-01.5 (Revision or Interim Change of Environmental Restoration Program Controlled Documents), are also followed.

Records (including data) will be protected in and accessed through the referable information base. The referable information base includes all the information systems maintained at the Records-Processing Facility (RPF) and the Facility for Information Management, Analysis, and Display (FIMAD). RPF personnel receive ER Program records, assign an ER identification number, and process records for delivery to the FIMAD. The RPF will complement FIMAD in certain aspects of data capture, such as scanning. The RPF also functions as an ER Program reference library for information that is inappropriate either in form (e.g., old records) or in content (e.g., Federal Register) for storage at the FIMAD. FIMAD provides the hardware and software necessary for data capture, display, and analysis. The information will be readily accessible through a network of work stations. Configuration management accounts for, controls, and documents the planned and actual design components of FIMAD.

3.0 USE OF ER PROGRAM RECORDS MANAGEMENT FACILITIES

The RPF and FIMAD will be used for managing records resulting for work conducted at OU 1078. Interaction with these facilities is described in LANL-ER-AP-2.01, the program plan, and other program procedures and management guidance documents, as appropriate.

4.0 COORDINATION WITH THE QUALITY PROGRAM

Records will be protected throughout the process, as described in Section 4.0 of the program plan and in LANL-ER-AP-02.1. The originator is responsible for protecting records until they are submitted to the RPF. The level of protection afforded by the originator will be commensurate with the value of the information contained in the record. Upon receipt of a record, the RPF will temporarily store the original of the record in one-hour, fire-rated equipment and will provide a copy of the record to the FIMAD. The RPF will then send the original record to a dual-storage area for long-term storage in a protected environment.

5.0 COORDINATION WITH THE HEALTH AND SAFETY PROGRAM

The Laboratory's Occupational Medicine Group (HS-2) will maintain medical records because of their confidential nature. Training records will be maintained by appropriate custodians in coordination with Laboratory/DOE policy and will take into account the specific needs of the ER Program. The FIMAD will contain information about the completion of training, dates of required refresher training, and similar information, as well as the specific location of training records for program participants.

6.0 COORDINATION WITH THE ER PROGRAM'S MANAGEMENT INFORMATION SYSYTEM

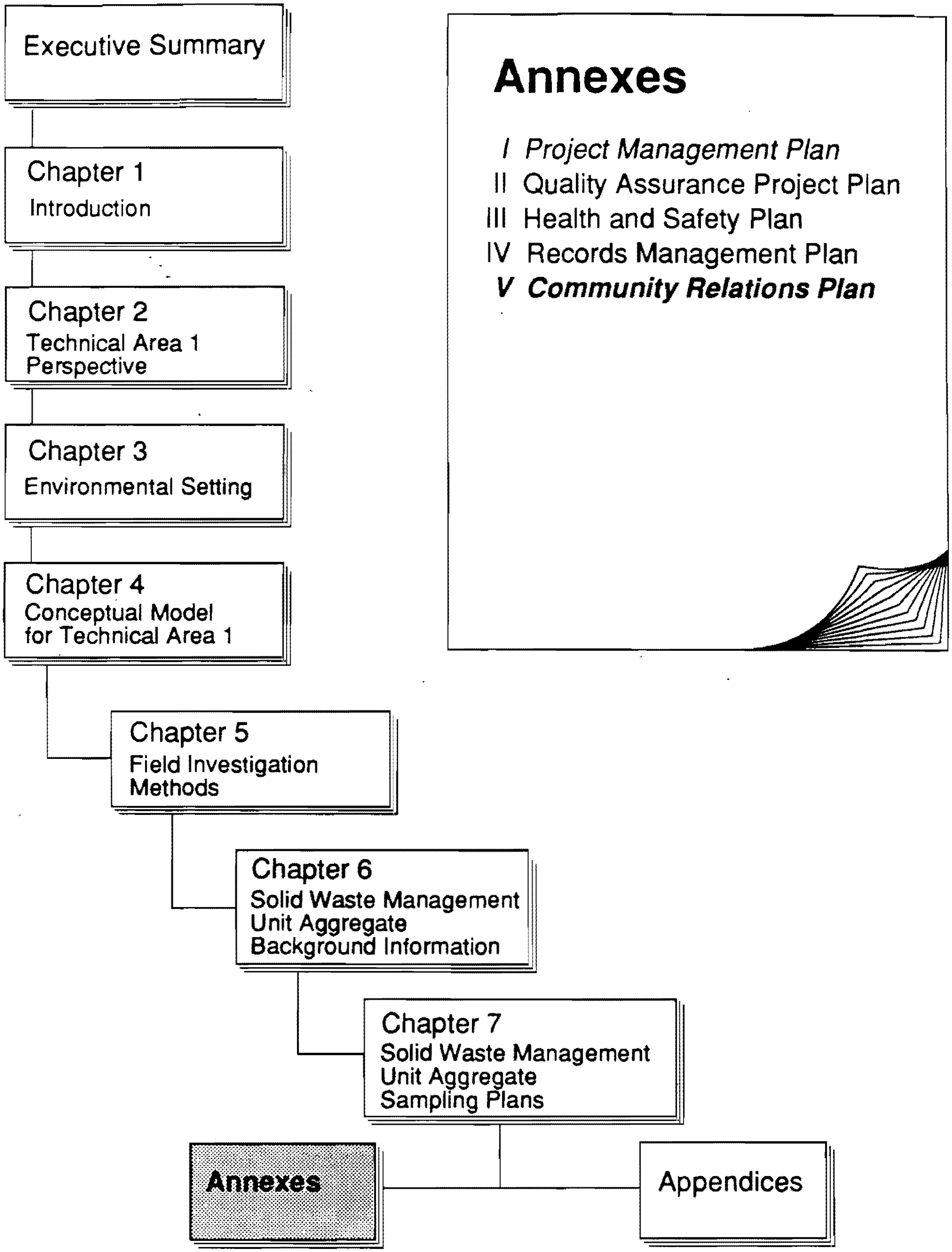
Specific reporting requirements are ER Program deliverables and, as such, are monitored through the ER Program's management information system. Records resulting from work conducted at OUs contribute to the development of these deliverables.

7.0 COORDINATION WITH THE COMMUNITY RELATIONS PROGRAM

RCRA requires that records be made available to the public; CERCLA requires that administrative records be made available to the public. Two complementary methods of providing information to the public—hard copy and electronic access—are being implemented. The community reading room allows public access to hard copies of key documents. A work station and necessary data links are being prepared to allow public access to the FIMAD data base.

REFERENCES

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).


Executive Summary
Chapter 1
Introduction
Chapter 2
Technical Area 1
Perspective
Chapter 3
Environmental Setting
Chapter 4
Conceptual Model
for Technical Area 1
Chapter 5
Field Investigation
Methods
Chapter 6
Solid Waste Management
Unit Aggregate
Background Information
Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans
Annexes
Appendices
Annexes
I Project Management Plan
II Quality Assurance Project Plan
III Health and Safety Plan
IV Records Management Plan
V Community Relations Plan

1.0 OVERVIEW OF COMMUNITY RELATIONS PROJECT PLAN

The Community Relations Project Plan specific to Operable Unit (OU) 1078 follows the directives, goals, and regulatory requirements set forth in the Community Relations Program Plan in Annex V of the Installation Work Plan (IWP) for Environmental Restoration (ER) (LANL 1991, 0553). This annex describes the community relations activities for OU 1078 during the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI). The activities are based on current knowledge of public information needs and resources available to the Los Alamos National Laboratory (Laboratory) ER Program staff.

As shown in Figure V-1, public participation is required by regulation during the corrective action process; therefore, the Laboratory will provide opportunities for public participation during the five-year RFI process as described in this project plan and as illustrated in Figure V-2. The Hazardous and Solid Waste Amendments (HSWA) Module of the Laboratory's RCRA facility permit (EPA 1990, 0306) requires that the following be addressed in community relations plans:

- establishing a mailing list of interested parties;
- providing to the public news releases, fact sheets, approved RFI work plans, RFI final reports, special permit conditions reports, phase reports, and quarterly progress reports that explain the progress and conclusions of the RFI;
- creating a repository for public information and a reading room at which up-to-date information is provided;
- conducting informal meetings for the public and local officials, including briefings and workshops, as appropriate;
- conducting public tours and briefings to address individual concerns and questions; and
- establishing procedures for immediate notification of neighboring pueblos and other affected parties of any newly discovered off-site release(s).

These items are addressed in Sections 2.1 through 2.6 of this plan.

All information concerning ER Program activities at OU 1078 will originate with or be provided to the public through the community relations project leader:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
2101 Trinity Drive, Suite 20
Los Alamos, New Mexico 87545
(505) 665-2127

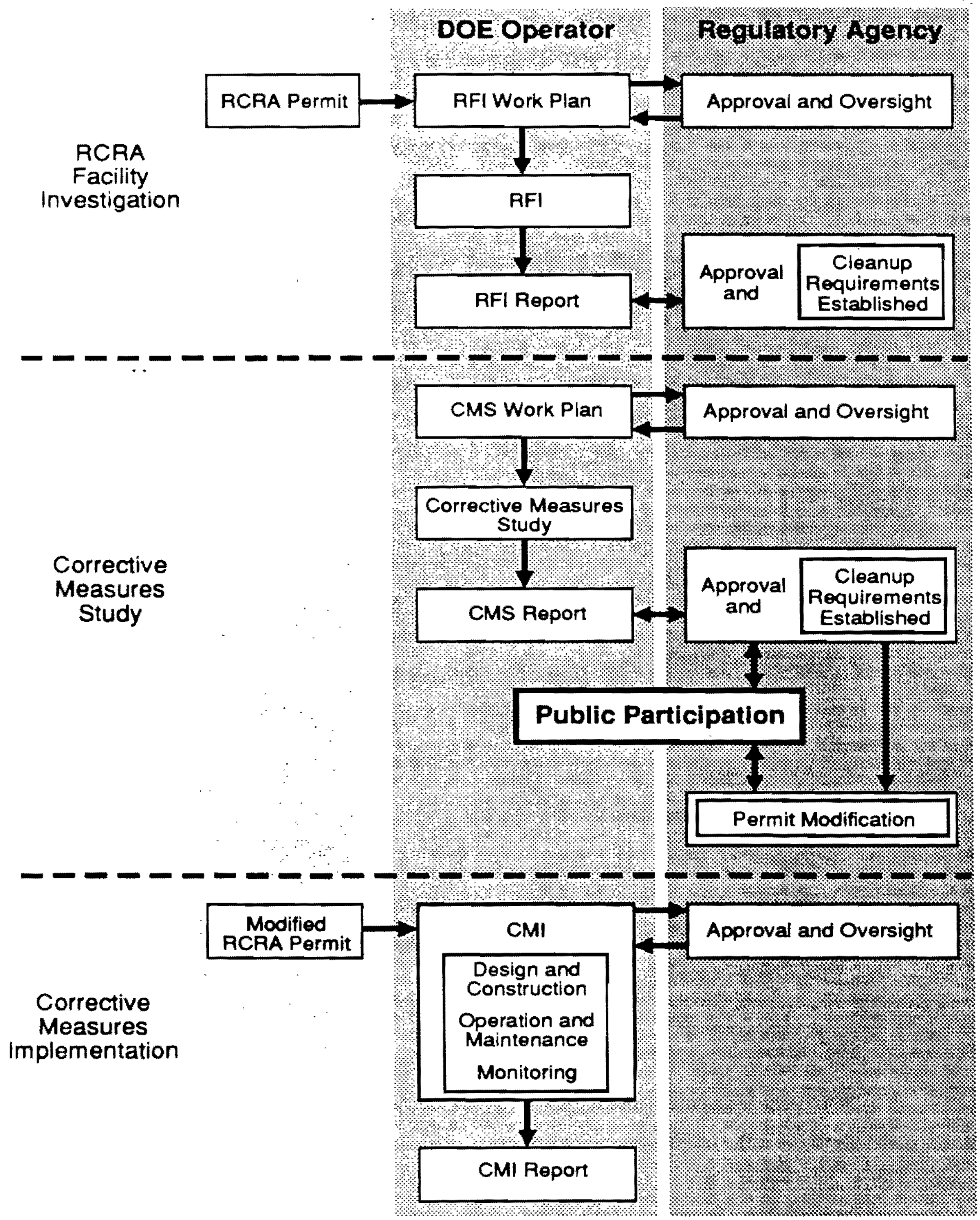


Figure V-1. Opportunities mandated by regulation for public participation during the corrective action process.

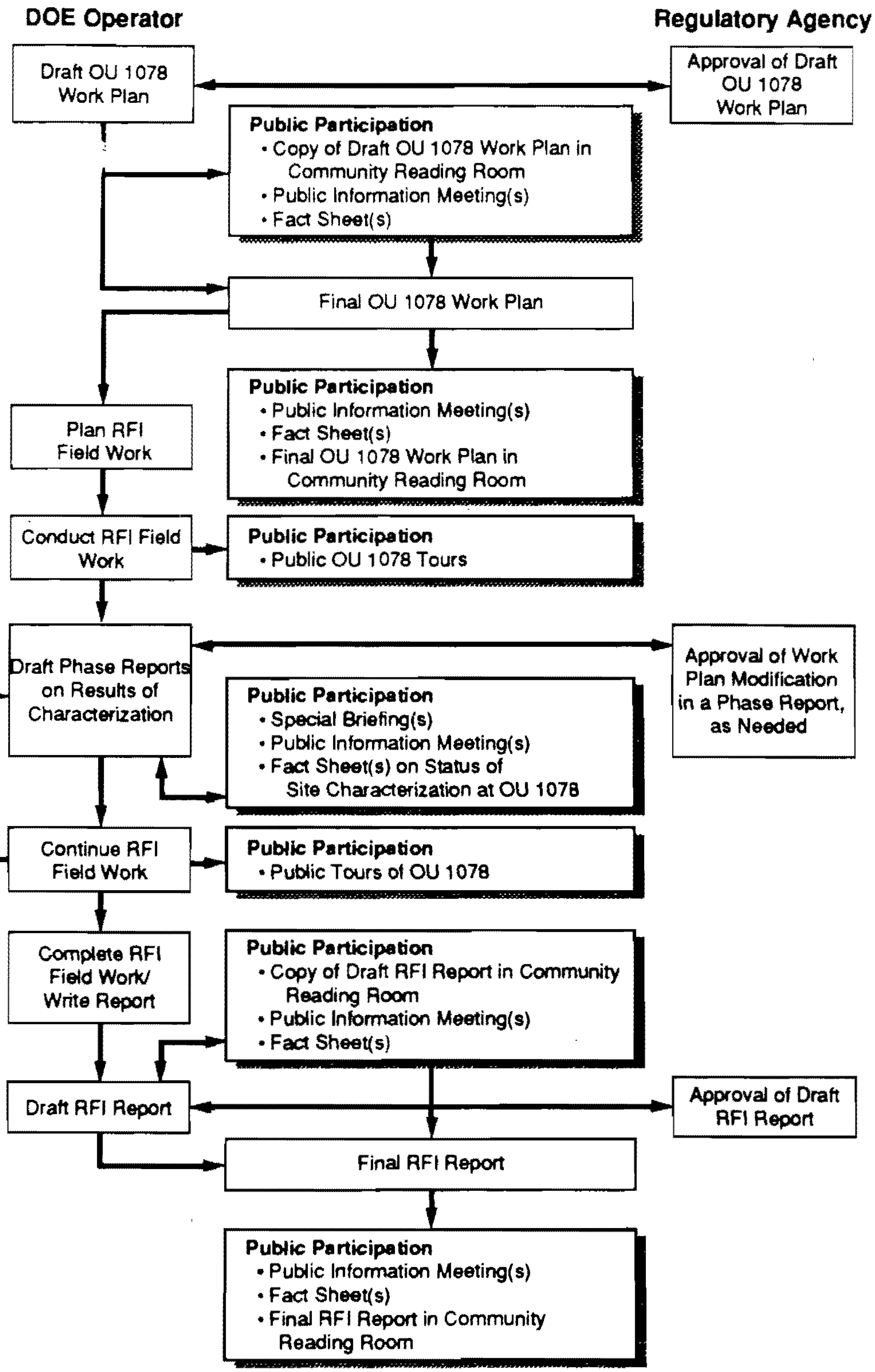


Figure V-2. Opportunities for public participation during the OU 1078 RFI.

2.0 COMMUNITY RELATIONS ACTIVITIES

The following subsections provide a brief description of community relations activities to be conducted at OU 1078 during the RFI activities. The scope of each activity can be tailored to respond to public information needs.

2.1 Mailing List

The Community Relations office will add to the ER Program mailing list any residents and businesses identified as owning property on or adjacent to OU 1078 and current and former workers at OU 1078 to keep them informed of meetings, activities, and schedules pertaining to the OU.

2.2 Fact Sheets

A fact sheet developed by the Community Relations Office shows OU 1078 in a map inset and summarizes site history and use, known contaminants of concern, and planned activities (Attachment I). The fact sheet was mailed to all affected property owners in August 1991. The fact sheet will be updated to reflect changes in public needs and progress made during the remediation process. A map showing SWMU locations in OU 1078 will be available for public review in the ER Program's Public Reading Room.

2.3 ER Program Reading Room

As they are developed, documents and data associated with OU 1078 (such as the RFI work plan, quarterly technical progress reports, and the RFI report) will be made available to the public at the ER Program Reading Room from 9 am to 4 pm on Laboratory business days. A draft copy of the RFI work plan for OU 1078 will be available at the reading room in May 1992.

2.4 Public Information Meetings, Briefings, Tours, and Responses to Inquiries

Public information meetings have been held in Los Alamos to introduce the community to the ER Program and to present a brief overview of OUs in the townsite. The Laboratory and Department of Energy plan to hold quarterly public information meetings to discuss specific activities and significant milestones during the RFI. Tours will be conducted for interested parties upon request.

If an issue of concern but of limited interest is raised at a public information meeting, a subsequent special briefing or a one-to-one meeting may be necessary. The community relations project leader and the OU project leader will coordinate responses to such inquiries.

2.5 Quarterly Technical Progress Reports

As the RFI for OU 1078 is implemented, the Laboratory will summarize technical progress in quarterly technical progress reports, as required by the HSWA Module (Task V, C, p. 46). These reports will be available at the ER Program Reading Room.

2.6 Procedures for Public Notice

The ER Program is preparing an administrative procedure to provide for notifying property owners and residents of any releases that might move off the Laboratory site. In addition, the ER Program is preparing an administrative procedure pertaining to requesting and obtaining property access agreements for RFI sampling activities on properties not owned by the Department of Energy.

2.7 Informal Public Review and Comment on the Draft RFI Work Plan for OU 1078

The Laboratory will encourage public comment on the field sampling proposed in the draft work plan for OU 1078 after the Environmental Protection Agency has formally approved this document, which was submitted in May 1992. Public comment regarding numbers of samples, types of samples, and quality assurance samples (e.g., duplicate samples) will be incorporated, as appropriate, in the final RFI work plan for OU 1078.

REFERENCES

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

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)

ATTACHMENT I

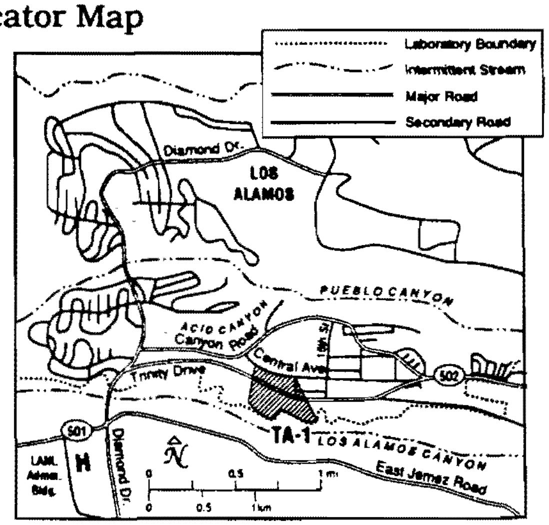
FACT SHEET FOR 1078

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM

FACT SHEET FOR OPERABLE UNIT 1078 (TECHNICAL AREA 1)

- An Operable Unit is a logical grouping of potential contaminated release sites called Solid Waste Management Units (SWMUs). Operable Unit 1078 consists of SWMUs identified in Technical Area 1 (TA-1) which was the first Technical Area at Los Alamos, established in March 1943. TA-1 was situated adjacent to and south of Ashley Pond.
- TA-1 was formerly part of the Los Alamos Ranch School.
- This was the site of early physical and chemical experiments on plutonium and where purification and recovery chemistry on plutonium and uranium was performed.
- Work at TA-1 included the development and fabrication of explosive devices which resulted in the first plutonium and uranium fission bombs.
- TA-1 was also the location of early research and development work on thermonuclear devices or fusion bombs containing radioactive tritium.
- Area decontamination and decommissioning began in the 1950s and was completed by 1965 as Laboratory operations were moved mainly to South Mesa (TA-3). Additional cleanup was performed in the mid-1970s to comply with health standards in place at that time. The cleanup included removal of building foundations, pipelines, septic tanks and soil.
- Major property ownership transfer to Los Alamos County began in 1965.
- Little information is available on hazardous non-radioactive constituents remaining in the area.
- For many years, the Laboratory has conducted a comprehensive environmental monitoring and surveillance program in Los Alamos County and throughout Northern New Mexico.

Operable Unit 1078 Locator Map



The program is designed to identify releases from Laboratory operations which could pose a health risk to individuals living in the communities surrounding the Laboratory. No contamination is known to exist on private property which threatens the health and safety of local residents. This finding is based on assessment of technical data gathered from this program. If an imminent health threat is found, immediate action will be taken by the Department of Energy (DOE) and the Laboratory.

- Contamination of the drinking water supply is unlikely as the main aquifer is at least 700 feet below site surfaces.

BACKGROUND OF OPERABLE UNIT 1078

Beginning in March 1943, TA-1 was the home of Project Y, under the Manhattan Engineering District of the U.S. Corps of Engineers. The top-secret task set forth for TA-1 personnel was to design, develop and test explosive devices using radioactive uranium and plutonium metal as the source of energy. After World War II, TA-1 was utilized to develop more efficient fission bombs and much more powerful fusion or thermonuclear devices. By the early 1950s, Laboratory activities began to move to South Mesa or TA-3 (the present hub of Laboratory operations).

Wastes which were present in TA-1 include radioactive materials such as plutonium and uranium, various hazardous chemicals such as solvents and heavy metals, and possibly asbestos from building debris.

Sixty nine potential contaminated release sites (SWMUs) have been identified at TA-1. These include inactive canyon rim outfalls or discharge points, locations of old drains and waste lines that formerly carried radioactive and hazardous waste, hillside solid waste disposal sites and ground-surface contaminated areas associated with original process buildings or fugitive discharges.

PREVIOUS CLEANUP IN OPERABLE UNIT 1078

Decommissioning of structures at TA-1 began in 1950 and was totally completed by 1965. For instance, Building D, where plutonium was purified, recovered or converted to metallic form, was demolished and transported to waste disposal areas on-site in 1954. Typically, after a building was demolished and removed for disposal, the soil underneath and surrounding the building was monitored for radioactivity. If the underlying soils indicated radioactivity, the soil was excavated and transported to a material disposal area. This remediation effort continued until little or no radioactivity was evident in the soil. Those areas that had been excavated were then backfilled with clean soil. The Laboratory (via the Department of Energy [DOE] or its predecessor) would then certify that a particular area was clean and could be transferred to the county.

A survey was undertaken in 1974 to ascertain the completeness of previous cleanup activities. These findings led to additional cleanup actions in 1975 and 1976. These latter decontamination efforts centered around but were not limited to the site of the former chemistry and metallurgy building (Building D) and the technical area laundry, both of which were located near the south boundary of the Los Alamos Inn parking lot. Several other contaminated areas were located principally along the rim of Los Alamos Canyon and in the Bailey Bridge drainage. The soils, tuff, or debris that were accessible were excavated and removed to a material disposal area and the excavations were backfilled with clean soil. All known septic tanks that were suspected to have been contaminated were removed.

FUTURE ACTION AND PROPOSED TIME FRAME

Additional activities scheduled for TA-1 come under the auspices of the Environmental Restoration (ER) Program. These include determining the extent of any radiological or hazardous waste contamination remaining at TA-1, especially along the canyon walls and drainages, and defining the risk to the public due to any residual contamination. Depending on whether contamination is found, corrective measures may include excavation and removal, capping and stabilization in place, or institutional controls. This investigation and remediation process is driven by the Laboratory's Resource Conservation and Recovery Act (RCRA) or hazardous waste permit.

The master plan to investigate TA-1 is called the RCRA Facility Investigation (RFI) Work Plan. This work plan is to be submitted to EPA in final form by May 1992. RFI characterization is scheduled to be initiated in 1992 and be completed by 1998. The Corrective Measures Study (CMS), which develops the set of remediation alternatives, is scheduled to begin in 1999 and be completed in 2001.

Ensuring the safe management of past, present, and future waste requires cooperation of government, industry, and the public. The Laboratory's commitment is to provide information to the public, such as this fact sheet, concerning actions taken during investigation and throughout the entire cleanup process. If you have additional questions about Operable Unit 1078 or about the Laboratory's Environmental Restoration Program, please do not hesitate to visit, call, or write:

Martin J. Janowski
Environmental Restoration Program
Los Alamos National Laboratory
Box 1663, MS M314
2101 Trinity Drive, Suite 20
Los Alamos, NM 87545
505-665-2127

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1
Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model
for Technical Area 1

Chapter 5
Field Investigation
Methods

Chapter 6
Solid Waste Management
Unit Aggregate
Background Information

Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans

Annexes

Appendices

Appendices

A. Environmental Fate of Contaminants
B. NEPA Documentation
C. Location Map of Former TA-1 Buildings and Structures
D. Principal Contributors

ENVIRONMENTAL FATE OF CONTAMINANTS AT TA-1

Submitted by

Nancy N. Sauer

INC-4

LOS ALAMOS NATIONAL LABORATORY

December 4, 1991

1.0 INTRODUCTION

The purpose of this report is to describe the factors which affect the fate of contaminants in soils at TA-1 LANL. Because of the range of activities that occurred at TA-1 during and just after WW II, the types of contaminants potentially introduced into the surrounding environment are quite broad (Ahlquist, 1977). Three classes of contaminants will be considered in this section: actinide contaminants with particular emphasis on plutonium and uranium, toxic metal contaminants, including cadmium, barium and lead, and organic contaminants.

This report will briefly review the type of contaminants introduced into the environment and then describe the different processes that could effect changes in the form, concentration or mobility of the three types of contaminants. These changes could occur as a result of environmental, biological or physical processes. A description of the adsorption of metals and organics in soils will be included.
The geochemistry of the actinides, including stability of materials in soils and the mechanisms whereby they could be mobilized, is of particular interest. The binding of actinides to soils is of critical importance to a number of ongoing DOE restoration programs. As such, investigations into the factors causing or having an effect on the binding of the actinides in various soil types are being described in the literature. A number of excellent general (Drugan, 1988; Environmental, 1981; Hansen, 1980; Manahan, 1990; Sawhney and Brown, 1989; White, 1977) and LANL-specific (Purtymun, 1974, Purtymun and Peters, 1980, Purtymun et al. 1974, 1983, 1986, 1990) references are available.

1.1 Contaminant Introduction

Radiological contaminants, primarily uranium and plutonium, were introduced into soils at TA-1 as a result of processing, site characterization and demolition activities at the site between 1943-1976. Remediation activities in the 1970s detected both U and Pu in areas below site sanitary systems and in site drainage areas. Some contaminated equipment and building debris were also found. The majority of this contamination was not process waste from the TA-1 operations because the industrial process wastes were discharged into Pueblo Canyon either with or without chemical treatment. Although some small amounts of industrial process waste may have been discharged onto the site as leaks or spills, it is estimated that much of the actinide contamination was introduced at near-neutral pH aqueous solutions, in powder form, or through contaminated equipment and building debris.
The same processes that introduced actinide contaminants into TA-1 soils would have also been responsible for discharges of toxic metals, such as barium, lead or cadmium and organic compounds. Processing activities at TA-1 used aromatic compounds such as toluene, benzene and xylene, chlorinated organic compounds such as trichloroethylene, carbon tetrachloride and methylene chloride, as well as

simple organic compounds like hexanes alcohols and ethers. Binding, mobility and retention of these contaminants will also be discussed.

1.2 Soil Characteristics Affecting Contaminant Binding and Mobility

The surfaces of soils are very chemically active with a vast capacity to assimilate and neutralize contaminants (Evans et al., 1989). A number of different processes operate on both inorganic and organic contaminants introduced into soils (Watters et al., 1983). These include acid-base and reduction-oxidation reactions, sorption, biochemical mobilization, volatilization, and photolytic and biochemical degradation. The first five of these are pertinent to the metals including uranium and plutonium; the latter five affect organic contaminants. The Los Alamos region has been surveyed to identify the kinds of soils in the area and where they are located. Los Alamos has a tremendous range of soil types (Nyhan, et al., 1978). These differences will affect contaminant binding.

One of the primary mechanisms for metal incorporation into soils is ion exchange. Soils are comprised primarily of silicates containing aluminum and silicon oxides or hydrous oxides which contain numerous charged sites capable of ion exchange or acid-base reactions (Lindsey, 1979). The electronic charges on mineral surfaces and their spatial distribution arise from ionic substitution, broken bonds, and adsorbed species such as protons, water and hydroxides. Structural or constant charges are associated with the surfaces of phyllosilicate (clay) minerals, whereas the pH dependent or variable charges are associated with protons at the edges and surfaces of oxide and (oxy)hydroxide minerals and with humic substances containing carboxylate functionalities (Evans, 1989).

The capacity of these surfaces to accept or donate protons will dominate the alkalinity and/or acidity of soils. When an acidic or aqueous process waste containing metals flows onto natural soils, the processes described above occur, with the soil serving to buffer the pH. Negatively charged sites on soils (hydroxyl) allow for the buffering of acidic wastes through proton dissociation or association reactions (Manahan, 1990). This buffering capacity is dependent upon the type of constituents in the soil. Acidic solutions can also be neutralized by carbonate minerals, eg. calcium carbonate, which are present in the soils.

The reduction-oxidation capacity of soils will also affect sorption of metal contaminants. The Eh, or potential of the soil system measured with a platinum electrode represents the concentration ratio of oxidized and reduced metal forms. Eh values in aqueous systems range from 0.8 to 1.2 V.

1.3 Metal Adsorption Processes

Metal adsorption in soils occurs primarily through cation exchange processes and coordination by ligating species in the soils such as hydroxide or humic acids. The formation of stable carbonate salts is particularly important in the retention of actinides in soils. All these processes are pH-dependent. Hydrolyzable transuranic or toxic metals (ie. plutonium, uranium or lead) entering the environment in solutions sufficiently acidic to maintain soluble ions and in concentrations exceeding that of natural complexing agents will be rapidly hydrolyzed on dilution and subsequently precipitated on particle surfaces. The sorption of cations on solid geologic material starts when hydrolysis reactions (coordination of metals by hydroxides) become significant and reach a maximum in the pH range where neutral species would dominate (Hansen, 1980 and Allard, 1984).

At higher pH values, soluble anionic metal complexes such as carbonates can form which are bound much less tightly to the soil. The solubility of hydroxides and oxide materials formed as acidic wastes are neutralized will also affect transport of metals from soils (Watters et al., 1983, Edgington et al., 1979). This solubility is dramatically affected by the metal oxidation state; actinides in their lower oxidation states are strongly sorbed on exposed geologic media under most environmental conditions because of their high charge and tendency to hydrolyze to sparingly soluble forms (Allard, 1984 and Watters, 1983). These materials are much less accessible for chemical or biological migration processes. The metal oxidation state within a soil system can change if the soil Eh is very oxidizing or reducing. This will also affect the binding of the metal to soil. The metal may be introduced in its highest oxidation state, however, if the soil environment is very reducing, the metal can be reduced, and thus its binding to the soil altered.

1.3.1 Uranium Adsorption In Soils

For the operations at TA-1, uranium would be one of the most common species potentially contaminating the soils. Unlike plutonium, significant quantities of natural, depleted and enriched uranium were available for research and development purposes. The binding of these materials in soils is particularly relevant to ER activities at this site.

Uranium adsorption in soils has been extensively studied as a result of commercial uranium mining operations in many western states. For uranium, the predominant oxidation states in the environment are (IV) and (VI) (Bondietti and Tumara, 1980). Figure 1 shows an Eh-pH diagram for uranium under environmental conditions (Watters et al., 1983). The stability of these oxidation states and the solubility of the species formed under different environmental conditions (Eh from 0.6 V to -0.2 V and pH from 4-9, (Baas Becking et al., 1960) are dependent upon the presence of complexing agents such as carbonates, phosphates or humics present in soils (Longmire, 1991 and Allard 1984).

A comparison of sorption rates for different actinide oxidation states shows that relative sorption of metals decreases in the following order: (IV)>(III)>(VI)>(V). Thus, uranium in the +4 oxidation state (found in reducing soils) is much more strongly bound in soils than uranium in the +6 oxidation state. For both oxidation states, sorption is pH dependent. Laboratory studies have shown that adsorption of U (IV) by soils is poor at pH 2 or lower, but increases as the pH is raised above 5. Maximum adsorption is reached at about pH 8 in CO_2-free systems. A decrease in sorption is seen above pH 8 as a result of the formation of soluble anionic carbonate complexes.

The sorption behavior of U (VI) is dominated by the competition between hydrolysis (complexation by OH^-) which is pH dependent, and complexation by solubilizing groups such as carbonates. Uranium (VI) is much more readily complexed and thus solubilized than U (IV). Thus, U (VI) is much more readily leached from soils into natural waters than U (IV) (Bondietti and Tumara, 1980). The hydroxides of U (VI) are also much more soluble than those of U (IV). Above pH 7.5, pH sorption to particulates readily occurs in the absence of competing coordinating anions (Bondietti and Tumara, 1980). Reduction from U (VI) to U (IV), which is facilitated by reducing minerals in soils such as pyrite or by microbial activity, increases uranium sorption by several orders of magnitude at near neutral pHs (Bodek et al. 1988, Manahan 1989 and Allard et al., 1984). In natural systems, when solutions of the more soluble U (VI) contact reducing soils, U (IV) is formed which is much more strongly sorbed (Allard et al., 1984).

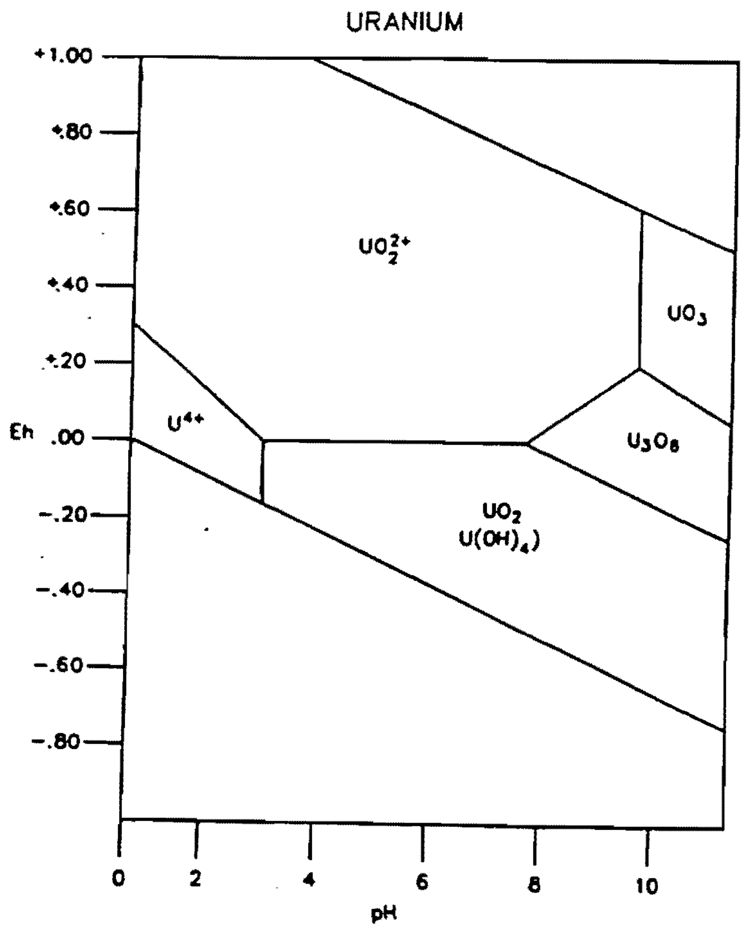


Figure 1. Eh -pH Diagram for Uranium

1.3.2 Plutonium Adsorption in Soils

Only gram quantities of plutonium were available for the work ongoing at TA-1 for development of the "bomb". From 1944 until 1946, shipments of plutonium from the Hanford reactors were roughly 50 g every two weeks. While this precious material was handled as carefully as possible, some contamination could have been introduced into buildings and the surrounding area. Demolition of the site in the early 1950s could have place contaminated equipment or structural materials in contact with the soils, thus providing a further mechanism for contamination.

Complex equilibria exist among plutonium species in solution; multiple oxidation states can exist simultaneously in solution which will influence adsorption characteristics (Allard et al., 1984). Significant difficulties in assessing the effect of oxidation state on adsorption of Pu result from the ease with which Pu dissociates in solution. Plutonium (III and IV) under reducing conditions, and (V) and (VI) under oxidizing conditions can be present under environmental conditions (Hansen book, Chapter 1., Allard et al., 1984). An Eh vs. pH diagram is shown in Figure 2. Early studies by Jacobson and Overstreet (1948) indicate that Pu (III) is adsorbed more readily than Pu (IV). However, later studies indicate that the effect of oxidation state on scrption is (IV)>(III)>(VI) (Bondietti et. al 1976, and Bondietti, 1980). Plutonium (IV) is very insoluble in water in the absence of complexing agents. Studies of sorption of plutonium on humic free soils have also been reported (Bondietti et al. 1976). For Pu (III) and (IV), kinetics for adsorption were much slower for soils treated to remove humic acids. The total amount of Pu adsorbed did approach that seen for clays with humic acids with time.

The pH dependence of plutonium solubility and sorption is particularly important. In general, plutonium is strongly sorbed on most geologic materials in the environmental pH range under both oxidizing and reducing conditions. Studies of pH effects of plutonium binding by soils show that in the environmentally important pH range from 2 to 8, the adsorption of Pu into the soils is essentially quantitative (Bondietti and Tumara, 1980). Maximum sorption was seen at pH 5.5. Soluble plutonium concentrations increased substantially above pH 8, presumably as a result of the formation of dispersed plutonium colloids. Studies where the ionic strength of solutions was also controlled showed that Pu in soils decreased as the solution ionic strength was increased. Charged colloidal particles would be more readily suspended under these conditions (Bondietti and Tamura, 1984).

The form of the plutonium as it is introduced into the environment is important in determining its solubility and mobility characteristics. Plutonium oxides which have been produced at high temperature (>1200°C) or high-fired materials have been shown to be particularly strongly bound to soils. The intractable nature of these materials makes leaching unlikely. Mobility of this form of plutonium is limited to physical processes rather than chemical processes. Chemical transport processes can work on oxides formed as a result of hydrolysis and precipitation (Bondietti and Tamura, 1984 and Allard et al., 1984).

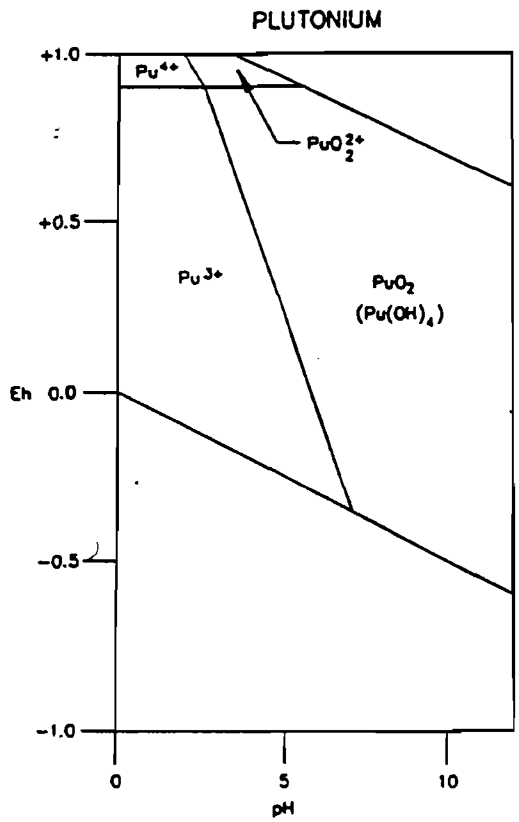


Figure 2. Eh-pH Diagram for Plutonium

Like many other metals, the actinides in their lower oxidation states, eg. (III) or (IV), have a tendency to from polymeric hydroxides or colloids (Allard et al., 1984 and Kepak, 1971). Colloids represent thermodynamically stable hydroxy polymers and metastable species formed in the course of hydrolysis and precipitation (Allard et al., 1984). Colloid formation is particularly important for plutonium in natural systems, as it will dramatically affect metal sorption and mobility. In the low to intermediate pH range, positively charge colloids are formed which can sorb strongly to silicates and oxides, as well as to suspended materials such as clays (Allard et al. , 1984). Negatively charged colloids form at higher pH in the course of hydroxide precipitation. These slowly and spontaneously convert to the much less soluble metal oxide, PuO_2. "It is important to note that the transport of actinide in the environment as pseudocolloidal species sorbed on mobile nature colloid particles or soils is undoubtedly one major migration mechanism into the aqueous environment" (Allard et al., 1984). Clearly, rain or snowfall runoff and other natural processes which move solids in the environment will affect the migration of plutonium.

1.3.3 Toxic Metals

Many of the factors which affect actinide metal sorption to and leaching from soils, such as pH, Eh and complexing agents, also affect toxic metal sorption to soils (Amoozegor-Fard et al., 1984). Because of their size-to-charge ratios, the metals of particular interest for TA-1, lead, barium, mercury, beryllium and cadmium are readily incorporated into soil particle interstices. These metals readily displace other sorbed alkali metals on metal oxides under typical environmental conditions through ion exchange processes. (Bodek et al., 1988).

For natural systems which contain large amounts of iron, coprecipitation of toxic metals can also occur. Iron hydroxides which form in neutral pH are gelatinous, and will pull other metal ions out of solution as they precipitate. Iron hyroxide precipitation systems are often used commercially to remove heavy metals. Metals can also be incorporated into the organic component of soils. Studies on the retention of toxic metals by organic phases in soils, humic and fulvic acids show that mercury and lead are the most strongly bound even at pH 5. Cadmium is somewhat less strongly bound (Evans, 1989). Soils which contain a higher concentration of thioether linkages (-SH-), which are particularly soft Lewis bases, will form strong complexes with many of the toxic metals, especially mercury and cadmium (Evans, 1989).

As with the actinides, sorption of toxic metals in solution to soils is strongly tied to pH. Below pH 6, little precipitation or sorption of dissolved metals onto soils is observed. Upon hydrolysis, dissolved metals in natural environments precipitate from solution as hydroxides, oxyhydroxides or carbonates.

The extent of hydrolysis increases with increasing pH (Evans, 1984). For example, precipitation and sorption of cadmium from solution increases in the pH range from 6–8 (Bodek et. al). Formation of and rapid precipitation of barium carbonate limits barium concentrations in natural waters. As $BaCO_3$ is quite insoluble, the most likely transport mechanism for Ba is through transport of the soils to which it is bound. The lower oxophilicity of these metals with respect to the actinides renders them less likely to form soluble anionic oxo complexes at higher pH's.

There is less information on the sorption of Be (II) by soils. Researchers have found that Be can be strongly sorbed on montmorillonite and illite-like clay minerals, but not on kaolinte. More comprehensive studies will be necessary to better understand the potenetial for Be migration in contaminated systems. However, the low solubility of Be hydroxides makes it likely that Be will precipitate under environmental conditions. Similarly, the insolubility of the hydroxides and carbonates of Hg, Cd, Ba, Be and Pb is quite low (Stumm, 1979). Once sorbed onto soil surfaces, these metals are not readily desorbed in neutral-pH natural waters.

1.4 Transport Mechanisms for Actinides and Toxic Metals

The processes affecting mobility of actinides and other metals in the environment can be broken down into three categories: physical processes, biological processes, and chemical processes. While the movement of metals in the environment is typically attributed to chemical and physical processes, there is clear evidence that biological processes, specifically microbial activities, can affect mobilization (Francis et al., 1991, Watters, 1983, Hughes and Poole, 1989, Brainard, 1990).

For transport, the stability with which the actinides and toxic metals are bound to sediments and soil particles determines their concentration in natural waters, the relative importance of leaching and erosional processes in their movement in watersheds, and the ease with which they can be affected by microbial activities. If a metal is only weakly bound to soil, it will be more readily transported by chemical and microbial processes. The movement of water through soils will leach (chemically) or physically transport contaminant metals.

Because most metals are strongly bound to soils, it is generally believed that the soluble fraction available for chemical transport is small in comparison to the amounts adsorbed on solid matter, for which physical processes predominate (Watters et. al, 1983). Physical transport of geologic materials, such as clays, with adsorbed actinides, and/or natural colloids constitutes the major actinide transport mechanism in flowing water systems such as streambeds or from precipitation or runoff. (Allard et al., 1984). Chemical processes for metal sorption and dissolution, which are dictated by pH and the presence of complexing agents, have been described above. Specific chemical transport is difficult to predict without a detailed knowledge of soil properties such as acidity, mineralogy, organic acid content and the presence of complexing agents.

Physical processes such as runoff, erosion, sediment transport and transport by wind can distribute contaminated soils in the environment. Physical processes have been shown to be particularly important for actinide distribution at LANL. Continuous monitoring by the laboratory, as documented in a range of LANL reports, shows that physical transport of plutonium and uranium from contaminated soils has occurred at several ER sites at the laboratory, including TA-1 (Purtymun, 1974, Purtymun and Peters, 1980, Purtymun et al. 1974, 1983, 1986, 1990).

Plutonium bound to sediments in active stream channels can be transported during periods of high water flow. Studies by Purtymun show that large summer thunderstorms and annual snow runoff transport radionuclides bound to suspended solids like clays and sediments (Purtymun et al., 1990, 1974). TA-1 is located adjacent to Los Alamos Canyon; demolition activities during initial closure of the site pushed much of the debris and surface soils onto the side of this canyon. Leveling activities for construction of existing buildings could also be responsible for distribution of the soils over the canyon edge. The hillside at that location is particularly steep, and thus, rain and snow runoff and other physical processes distributing contaminated soils down into the canyon would be quite important.

Microbes can play a major role in the mobilization of metals in nature. Enhancement of metal mobility can result from microbial changes of pH, by oxidation or reduction of metals, or by complexation of the metal by solubilizing compounds synthesized by microbes. Microbiological methods have been used increasingly as a means for metal mobilization or recovery (Hughes and Poole, 1989). Bacterial leaching of metals has been used extensively in the mining industry on such metals as copper and gold. Microbes can also catalyze a variety of chemical reactions which affect metal solubility.

Bacteria are capable of oxidizing contaminant metals compounds in the environment, with the concomitant production of acids, which can serve to leach metals out of the soils. The oxidation of iron (II) sulfide to iron (III) sulfates with the concomitant formation of sulfuric acid is an example of this. In addition to producing pH and Eh changes which affect metals, microbes can also synthesize complex organics as metal sequestering agents. One class of compounds, siderophores, has been used to dissolve hydrous plutonium oxides off a variety of surfaces (Brainard, 1990).

1.5 Organics In Soils

At TA-1, most organic contamination would have been associated with the release of radioactive materials. The types of organics that were potentially introduced were organic solvents such as acetone, ethers, hydrocarbons and chlorocarbons, heavier hydrocarbons, such as those found in fuels, and possibly PCB's ((TA-21 work plan 11-3). Table A-1 shows a list of plutonium processing and separation techniques (Christenson and Maraman 1969). Many of these processes used organic compounds as extractants.

Adsorption of organics by soils can occur at both the mineral and organic components of soils (Chiou, 1989, Dragun, 1988, Transport, 1989). Nonpolar organics bind more strongly to the humic acids in soils because they cannot overcome the strong dipolar interactions between water and soil mineral phases. In contrast, polar organics are able to displace water at mineral binding sites. Thus a partitioning of polar organics from nonpolar organics is observed in soils (Chiou, 1989).

TABLE A-1
PLUTONIUM SEPARATION OPERATIONS

Year Process Initiated	Process
1947	HCl Dissolution Oxalate Precipitation Fluoride Precipitation Ethyl Ether Extraction
1947	HI Dissolution Aluminum Nitrate Precipitation Ammonium Hydroxide Precip. Sulfur Dioxide Precipitation Sodium Hydroxide Precipitation Thenoyl-trifluoracetone Extraction
1951	HNO_3-HF Dissolution
1953	Tri-n-butyl Phosphate Extraction

In soils with extremely low natural organic contents, adsorption to mineral surfaces becomes increasingly more dominant. The moisture content of the soil also affects organic uptake. When soil systems are saturated with water, the adsorption of more polar organics onto mineral phases is suppressed, and the adsorption by soil organic matter becomes more important (Chiou, 1989, Dragun, 1988). The strength of the interaction of different organic compounds with soils varies with type of compound; however, most organic molecules are only weakly bound to soils through interactions such as charge transfer processes and hydrogen bonding.

The nature/strength of the binding of the organic contaminant to soils is extremely important. Processes which alter the form, concentration, or mobility of organics in soils, like vapor or aqueous phase transport, operate on compounds that are only weakly bound to soils (Zielke et al., 1989). The solubility and binding of the organic in the different soil phases will determine the persistence of the organic in the soils. Even nonpolar organics which are not miscible with soil waters, and thus not as readily transported water, will migrate into soils due to capillary forces, gravity, and vapor phase transport.

Volatilization of organics from soils and vapor transport of organics in soils are extremely important transport pathways for organic chemicals. The volatilization of organics is directly related to the vapor pressure of the organic that is bound, the miscibility with other soil phases, and the surface area available for volatilization (Transport, 1989). Both elevated soil moisture and temperature have been found to enhance volatilization (Dragun, 1988). Dry soils can bind organics on sites which would normally be occupied by sorbed water. Concentrations of higher boiling organics compounds, such as PCB's or components in diesel fuels would be less affected by this process (Bodek, 1988). Polar compounds like acetone may persist longer in the soils than anticipated, as they are readily soluble in pore waters. Diffusion of organic compounds into the soil por structure not only competes with the volatilization process, but may also transport contaminants to interior soil surfaces where volatilization is more difficult (Transport). The diffusion of organics away from soil particle surfaces will decrease the importance of volatilization transport mechanisms. Nonpolar organics are less effected by soil solubility, and are more readily volatilized than polar organics.

The conversion of organics in soils to other compounds can be accomplished via several different processes. Simple protonation and hydrolysis reactions such as the conversion of an alkene to an alcohol can occur at the surface of clays and soils (Zielke, 1989). An important feature of these reactions, particularly the hydrolysis reactions, is that the transformed product often has vastly different transport and decomposition properties. Organics present in the uppermost layers of soils are also subject to degradation by photolysis processes, the most common being photooxidation. Photochemically produced radicals can readily react with organics to give oxidized products. The presence of humics and oxygen assist this process. (Miller, 1989). Humics have been shown to photocatalyze the formation of singlet oxygen, which reacts with numerous organics to give organoperoxides which rapidly convert to alcohols. All these processes, protonation, hydrolysis, and photolysis introduce changes into the organic substrate which can make it more readily degraded by microbes. In particular, the introduction of an oxygen-containing moiety, such as carbonyl, C=O, and OH, renders organics more susceptible to microbial attack (Brainard, 1990).

Microbial degradation of organics in soils is well documented. In biodegradation, microbes use organic contaminants as carbon or energy sources. In the process, the organics are chemically transformed into metabolic intermediates which the microbes use for production of energy and biosynthesis of cellular material (Brainard, 1990), with the bi-products being carbon dioxide, water and minerals. A simple diagram indicating these processes is shown in Figure 3 (Brainard, 1990). The biodegradation of waste organics is highly correlated to their structure. The actual rates at which organic compounds in the soils are degraded is dependent upon specific chemical functional groups in the organic, such as C-OH, and their availability to microbes, and upon the microbes present in the soil. Microbes can use the contaminant organic as their sole source of carbon or may use an alternate soil organic as their primary carbon source and use the contaminant as an alternate nutrient source, eg. for nitrogen or sulfur (Alexander, 1989). The choice of carbon sources used by the microbe is dependent upon the ease with which the microbe can metabolize the organic. If a readily degraded carbon source is naturally available in the soils, microbes may not use a more recalcitrant organic such as chlorinated hydrocarbons until this other carbon source is depleted.

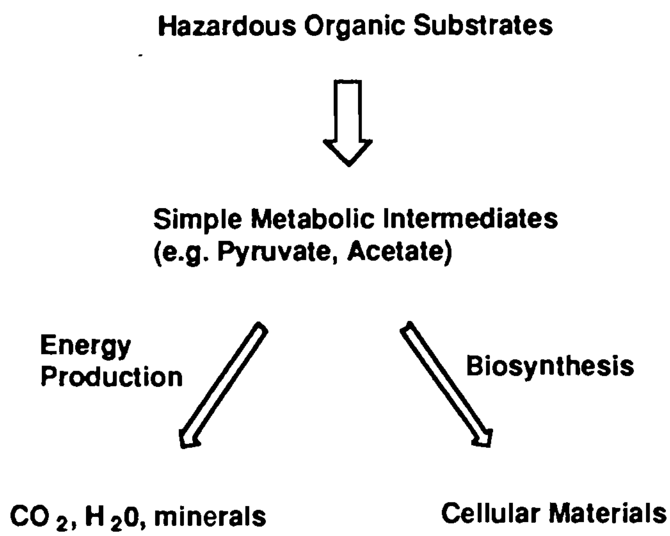


Figure 3. Biological processes affecting Hazardous Organic Contaminants. (taken with permission from Brainard, 1990).

Most soil bacteria have optimized their metabolisms for the degradation of naturally occurring organics is soils. Contaminant organics which are not often found in nature are more difficult to degrade. Compounds with functional groups similar to those found in naturally occurring soil organics like humics are more readily accepted into the microbial metabolic process; dissimilar compounds such as heavy halogenated compounds such as PCBs are not. Until recently, many compounds were viewed as recalcitrant to biodegradation. Increasingly however, microbes which are capable of degrading even the most difficult compounds such as chlorinated hydrocarbons and nitrated aromatics have been identified (McCarty, 1988, and Unkefer, 1991). It is important to note that microbial cultures in soils have the ability to adapt their metabolisms to utilize other carbon sources not commonly found in nature. This would most likely occur under natural conditions when another carbon source is not readily available (Brainard, 1990).

1.6 Persistence of Co-contaminants at TA-1

Radioacitive, organic and metal contaminants were introduced into TA-1 soils roughly 25-50 years ago. Unfortunately, few studies are available on the differences in persistence of mixed metal and organic or organic and actinide contaminants in the environment. Leaching studies on soils contaminated with both

TABLE A-2
PERSISTENCE OF CONTAMINANTS AT TA-1

Contaminant	Persistence	Rationale
Ammonium sulfate	no	soluble
Benzene	no	volatile
Carbon tetrachloride	no	nonvol/non-biodeg
HCl	no	neutralized
LiH	no	neutralized
HF	no	neutralized
Methylene chloride	yes/no	volatile
o-Phosphoric acid	yes	nonvolatile-biodeg?
Perchloric acid	no	neutralized
Nitric acid	no	neutralized
Petroleum hydrocarbons	yes/no	volatile/biodeg
Tributylphosphate	yes	nonvolatile
Toluene	yes/no	low volatility
Xylene	yes/no	low volatility

volatile organics and metals have shown that migration of organics is assisted by surfactant solutions, like detergents which can interact chemically with both the organic compound and water, thus assisting in drawing the organic into the aqueous phase. In these same studies, metals were best removed with dilute acid leaching. These findings are consistent with the known sorption differences between organics and metals in soils. Metals bind through ion and proton exchange and on hydroxyl sites. They are removed by protonating their binding sites.

Organics sorb more weakly to soils so that surfactants or citrate solutions are able to solubilize even PCB contaminants (Kunze and Gee, 1989). For organics, the potential for biodegradation, and other mobilizing or destructive processes which effect organics in soils (eg, volatilization and aqueous transport) make it likely that a majority of the organic contaminants, particularly the volatile organics, introduced at TA-1 are gone. It could also be anticipated that simple organics readily degraded are would not persist at TA-1 after 40 years. Some recalcitrant organics like PCB's may still be present, but this could only be ascertained though sampling and analysis.

With the information contained in this report, it is possible to make a judgment on which chemical contaminants may still persist at TA-1. Table A-2 summarizes several of these contaminants and their possible fate at TA-1. Conclusive evidence for the continued presence or absence of both chemical or radioactive contamination at TA-1 will *only* be available by a comprehensive sampling at the undisturbed areas on the mesa top, and sampling those areas of the hillsides where liquid discharges and solid waste disposal has occurred.

Finally, the location of the site must be considered further. As was indicated in this document, physical processes are important in the transport of both metals and organics in the environment. TA-1 is located on a site which slopes toward a steep canyon. This will certainly effect the magnitude of the effect that physical processes will have on contaminant migration. Runoff channels are evident at the site now. Prior to leveling and construction on the site, it could be anticipated that sediment runoff and physical transport from the mesa top would be even more substantial. No significant concentrations of organics or heavy metals have been found at Los Alamos Canyon sampling stations at the merger of this canyon with the Rio Grande, which would be consistent with the dilution anticipated with a large rainstorm or snowmelt adequate to initiate significant physical transport of contaminants or with the possibility that the majority of these contaminants have already been washed away from TA-1.

REFERENCES

Abeele, W. V., Wheeler, M. L., Burton, B. W., 1981, "Geohydrology of Bandelier Tuff", LANL Report No. LA-8962, Los Alamos, New Mexico.

Ahlquist, A. J., Stoker, A. K., Trocki, L. K., 1977, "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," LA-6887.

Alexander, M., Scow, K. M., 1989, "Kinetics of Biodegration in Soil," in "Reactions and Movement of Organic Chemicals in Soils," Soil Science Society of America Pub. Madison, Wisconsin.

Allard, B., 1982, "Solubilities of Actinides in Neutral or Basic Solutions", in N. M. Edelstein, "Actinides in Perspective", Pergamon Press, New York.

Allard, B., Olofsson, U., Torstenfelt, B., 1984, "Environmental Actinide Chemistry," Inorganica Chimica Acta, 94, 205.

Amoosegar-Fard, A., Fuller, W. H., Warrick, A. W., 1984, "An Approach to Predicting the Movement of Selected Polluting Metals is Soil," J. Environ. Qual., 13, 290.

Baas Becking, L., G. M., Kaplen, I. R., Moore, D., 1960, "Limits of the Natural Environment in Terms of pH and Oxidation-Reduction Potentials". J. Geol. 68, 243.

Baes, C. F., Mesmer, R. E., 1976, "The Hydrolysis of Cations," Wiley-Interscience Pub.: New York.

Becker, N. M., Purtymun, W. D., Maes, 1985, "Movement of Depleted Uranium by Storm Runoff," Environmental Surveillance at Los Alamos During 1984, Los Alamos National Laboratory Report, LA-10421.

Becker, N. M., 1986 " Heavy Metals in Runoff" Environmental Surveillence at Los Alamos during 1985, Los Alamos National Laboratory Report,LA-10721-ENV.

Bodek, I., Lyman, W. J., Reehl, W. F., Rosenblatt, D. H., 1988, "Environmental Inorganic Chemistry, Properties, Processes, and Estimation Methods," Pergamon Press: New York, 1988.

Bondietti, E. A., Reynold, S. A., Shanks, M. H., 1976, "Interaction of Plutonium with Complexing Substances in Soils and Natural Waters," in "Transuranium Nuclides in the Environment," Symposium Proceedings, Gatlinburg, Tenn., Oct. 5, 1976 (M. G. White and P. B. Dunaway, eds.).

Bondietti, E. A., Tamura, A., 1980, "Physicochemical Associations of Plutonium and Other Actinides in Soils," in "Transuranic Elements in the Environment", DOE/TIC 22800 (W. C. Hansen ed) U. S. Department of Energy, NTIS, Springfield, Va..

Brainard, J. R., 1990, "Applicability of Biodegradation for Treatment of LDR Wastes at Rocky Flats Plant", Golden, Colorado. Los Alamos National Laboratory Report, LA-UR-90-3468.

Chiou, C. T., 1989, " Theoretical Considerations of the Partition Uptake of Nonionic Organic Compounds by Soils and Sediments," in "Reactions and Movement of Organic Chemicals in Soils," Soil Science Society of America Pub. Madison, Wisconsin, Chpt. 1.

Christensen, E. L., Maraman, W. J., 1969, "Plutonium Processing at the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory Report, LA-3542.

Dragun, J., 1988, "The Soil Chemistry of Hazardous Materials," Hazardous Materials Control Research Institute: Maryland, Chpt. 2-4, and 6-9.

Edgington, D. N., Karttunen, J., O., Nelson, D. M., Larsen, R. P., 1979 "Influence of Dissolved Organic Carbon on the Sorption of Plutonium to Natural Sediments", Radiological and Environmental Research Deviison Annual Report, LANL-79-65, Part III. Argonne National Laboratory, NTIS Springfield, VA.

"Environmental Migration of Long-lived Radionuclides," 1981 Proceedings of the International Symposium on Migration in the Terrestrial Environment of Long-Lived radionuclides. July 1981, Knoxville, TN.
Evens, L. J., 1989, "Chemistry of Metal Retention by Soils," Environ. Sci. Tech., 23, 1046.

Francis, A. J., Dodge, C. J., Gillow, J. B., Cline, J. E., 1991, "Microbial Transformations of Uranium in Wastes," Radiochemica Acta, 53, 311.

Hansen, W. C. (editor), 1980, "Transuranic Elements in the Environment," Technical Information Center, U. S. Dept. of Energy: Springfield, VA.

Hughes, M. N., Poole, R. K., 1989, "Metals and Micro-organisms," Chapman and Hall Pub.: New York, chpt. 1&7.

Jacobson, I., Overstreet, R., 1948, "The Uptake of Plants and Plutonium and Some Products of Nuclear Fission Absorbed to Soil Colloids," Soil Sci. 65, 129.

Kepak, F., 1971, Chem Rev., 71, 357.

Linsey, W. L. "Chemical Equilibria in Soils, Wiley-Interscience Pub.: New York, 1979.
Manahan, S. E., 1990, "Environmental Chemistry," Lewis Publishers.: Chelsea Michigan.

McCarty, P. L., 1988 "In situ Remediation of Contaminated Soils and Ground Water" Basic Life Sci. 45, 143.

Miller, G. C., Herbert, V., Miller, W. W., 1989, "Effects of Sunlight on Organic Contaminants at the Atmosphere-Soil Interface," in "Reactions and Movement of Organic Chemicals in Soils," Soil Science Society of America, Pub., Madison, Wisconsin, 1989.

Nyhan, J. W., Hacker, L. W., Calhoun, T. E., Young, D. L., 1978, "Soil Survey of Los Alamos County, New Mexico," La-6779-MS, June 1978.

Patterson, J. W., Passino, R., 1990, "Metals Speciation, Separation and Recovery," Lewis Publishers, Chelsea, Michigan.

Purtymun, W. D., Peters, R. J., 1980, "Geohydrology of White Rock Canyon of the Rio Grande from Otowi to Frijoles Canyon," Los Alamos National Laboratory Report, LA-8635-MS.

Purtymun, W. D., West, F. G., Adams, W. H. 1974, "Preliminary Study of the Quality of Water in the Drainage Area of the Jemez River and Rio Guadalupe",Los Alamos National Laboratory Report, LA-5595-MS.

Purtymun, W. D., 1974 "Storm Runoff and Transport of Radionuclides in DP Canyon, Los Alamos County, New Mexico", Los Alamos National Laboratory Report, LA-5744.

Purtymun, W. D., Hansen, W. R., Peters, R. J., 1983. "Radiochemical Quality of Water in the Shallow Aquifer in Mortandad Canyon, 1967-1978" Los Alamos National Laboratory Report, LA-9675-MS.

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

Purtymun, W. D.; Peters, R., Maes, M. N., 1990, "Transport of Plutonium in Snowmelt Run-Off,." Los Alamos National Laboratory Report, LA-11795-MS.

Sawhney, B. L.; Brown, K., 1989, "Reactions and Movement of Organic Chemicals in Soils," Soil Science Society of America Pub., Madison, Wisconsin, 1989.

Stumm, W., Morgan, J. J.,1979, "Aquatic Chemistry," Wiley Publishers: New York.

"Transport and Fate of Contaminants in the Subsurface," US EPA Seminar Publication, Center for Environmental Research Information, Cincinnati, OH, and Robert S. Kerr Environmental Research Laboratory, Ada, OK, EPA/625/4-89/019.

Unkefer, P. INC-4 Los Alamos National Laboratory, personal communication.

Watters, R. L., Hakonson, T. E., Lane, L. J., 1983, "The Behavior of Actinides in the Environments," Radiochima Acta, 32, 89.

White, M. G.; Dunaway, P. B., 1977, " Transuranics in Natural Environments," NTIS: Springfield , VA..

Zielke, R. C., Pinnavaia, T. J., Mortland, M. M., 1989, "Adsorption and Reactions of Selected Organic Molecules on Clay Mineral Surfaces," in "Reactions and Movement of Organic Chemicals in Soils," Soil Science Society of America Pub., Madison, Wisconsin, 1989.

The most important processes acting on organics in soils are volatilization, diffusion into the subsurface, hydrolysis, biodegradation and solar degradation. Many if not all of these processes are in competition with each other.

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1
Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model
for Technical Area 1

Chapter 5
Field Investigation
Methods

Chapter 6
Solid Waste Management
Unit Aggregate
Background Information

Chapter 7
Solid Waste Management
Unit Aggregate
Sampling Plans

Annexes

Appendices

Appendices

A. Environmental Fate of Contaminants

B. NEPA Documentation

C. Location Map of Former TA-1 Buildings and Structures

D. Principal Contributors

Date 3-4-92 LJN –

TA 1

TO: Ron Conrad Group EM-8 MS K490

FROM: EM-8, Beverly Larson, EM-8, MS K490

SUBJECT: E S & H PROJECT CHECK LIST DATED 2/14/92 RESPONSE FOR ARCHAEOLOGICAL/HISTORICAL ASSESSMENT, ES&H QUESTIONNAIRE 91-0231,

PROJECT: Site Characterization OU # 1078

In compliance with Section 106 of the National Historic Preservation Act of 1966 as implemented by Title 36 Code of Federal Regulations (CFR) Part 800, the project above has been reviewed for possible impact to archaeological resources. The following determination has been made:

_____ An archaeological survey is scheduled for _____________.

_____ An archaeological survey was conducted in the area of potential project impact on __________. No cultural resources were located. The siting can be approved without affecting any cultural resources. If any buried archaeological artifacts are uncovered during construction, work should stop and EM-8 archaeologists should be notified immediately

X An archaeological survey was conducted in the area of potential project impact on __________. An archaeological site (Site No. 86546 + 86547) exists in the area of potential project impact. ~~Siting approval should be postponed until ENG and/or user group personnel have contacted EM-8 archaeologists concerning possible minor project relocation.~~

_____ An archaeological survey was conducted in the area of potential project impact on __________. An archaeological site (Site No. __________) exists in the area of potential project impact. Impacts to the archaeological site can be mitigated through site excavation. Approval from the State Historic Preservation Office (SHPO) and Advisory Council on Historic Preservation must be obtained before excavation can begin. Contact EM-8 archaeologists concerning time table.

X Both sites should be avoided. The Final Report was sent to DOE on 2-7-92 for DOE's submittal to the SHPO for concurrence in a determination of no effect to these sites.

_____ If you have not received a follow-up response form by __________, contact EM-8 archaeologists at 7-2276.

cc CPM __________ Group __________ MS __________

NEPA file

Rosal 3/-19 ...

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Jim Aldrich, EES-1, MS D462
Ronald Conrad, EM-8, MS K490
Sandy Wagner, EM-13, MS M992

THRU Doris Garvey, EM-8, MS K490

DATE: February 26, 1992

MAIL STOP/TELEPHONE: K490/5-6442

FROM: Diane Medford, EM-8

SYMBOL: EM-8:92-510

SUBJECT **NATIONAL ENVIRONMENTAL POLICY ACT PROJECT REVIEW INFORMATION**

PROJECT TITLE: Site Characterization of Operable Units 1071, 1078, and 1079.

LAB JOB NUMBER: None
EM-8 ACCESSION NUMBER: 3111
ES&H QUESTIONNAIRE NUMBER: 91-0229, -0231, and -0238
DEC NUMBER: 92-0019

The Department of Energy (DOE) reviews Laboratory projects to determine the documentation required by the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*; 40 CFR 1500-1508) and DOE implementing regulations (DOE Order 5440.1D). The enclosed DOE Environmental Checklist (DEC), which was prepared by EM-8 and submitted to the DOE, is the initial document in the review process. The DOE will determine which of the following alternatives applies to your project:

1) an Environmental Impact Statement (EIS) is required,
2) an Environmental Assessment (EA) is required, or
3) no further NEPA documentation is required.

The enclosed copies of the DEC and transmittal letter are for your information only.

You may not proceed with any construction (including site preparation) or project operations until DOE notifies the Laboratory of its decision and until all NEPA requirements are satisfied, as stated in DOE Order 4700.1. We will let you know of DOE's determination as soon as we are informed.

Please direct any questions about the NEPA requirements to the preparer listed on the enclosed DEC or to Doris Garvey, at MS K490, 665-2380.

DG/DM:smm

Enclosures: a/s

Cy: D. Helmer, HS-3, MS K489
D. Garvey, EM-8, MS K490, w/o enc
R. Vocke, EM-13, MS M992, w/o enc
Circ. File

ENVIRONMENTAL CHECKLIST
U.S. Department of Energy
Albuquerque Operations Office

Project/Activity Title: Site Characterization of Operable Units 1071, 1078, and 1079	LJN: None ACC NO:3111 DEC-92-0019	Date 1/30/..
Program Office: Environmental Management	B/R Code:	
A/O Contractor: Los Alamos Natl Lab	AL Tracking Number: LAN-92-019	
A/O Contractor Contact: LANL EM-8 David Kraig 665-4815 Signature: David Kraig	Preparer (alt contact): LANL EM-8 Diane Medford 665-6442 Signature: Diane Medford	
Project Line Management: Robert Vocke, EM-13, 667-0808, M992 Signature: Robert W Vocke		

A. BRIEF PROJECT/ACTIVITY DESCRIPTION:
Category: RCRA Facility Investigation
Location: Los Alamos County
Schedule: Start FY 92, Duration 3 - 5 years
Cost: Approximately $68 Million
Project/Activity Description is expanded in Block A, Page 2.

B. ENVIRONMENTAL CONCERNS:

	Yes	No		Yes	No
1. Air emissions		x	14. Activity outside area fence/wildlife	x	
2. Liquid effluent		x	15. Archaeological/cultural resources		x
3. Solid waste	x		16. Noise levels	x	
4. Radioactive waste/soil	x		17. Radiation/toxic chemical exposures	x	
5. Hazardous waste	x		18. Pesticide/herbicide use		x
6. Mixed waste (rad + haz)	x		19. High explosives	x	
7. Chemical storage/use		x	20. Transportation	x	
8. Petroleum storage/use		x	21. Special status habitat		x
9. Asbestos waste	x		22. Special status species		x
10. Water use/diversion		x	23. Identified ER site	x	
11. Drinking water system		x	24. Other	x	
12. Sewage system		x			
13. Clearing or excavation	x				

Explanations of all questions answered Yes are provided in Block B, Page 2

C. **PERMITS**: Does or may the proposed project/activity require any local, state, or federal permits or notifications? Yes _____ No x
If response is Yes, an explanation is provided in Block C.

THE "DETERMINATION/CLASSIFICATION" AND "EH OBJECTION" BLOCKS (D AND E) THE FINAL PAGE OF THIS DOCUMENT.

ENVIRONMENTAL CHECKLIST
DOE Albuquerque Operations Office
Site Characterization of Operable Units 1071, 1078, 1079
DEC-92-0019, ACC NO. 3111

Block A: PROJECT/ACTIVITY DESCRIPTION

Project Contacts: Jim Aldrich, EES-1, 667-1495, MS D462
Ronald Conrad, EM-8, 667-0950, MS K490
Sandy Wagner, EM-13, 665-2126, MS M992

Proposed Action:
Implementation of site characterization and possible, limited removal activities at Operable Unit (OU) 1071 (comprises former Technical Areas (TAs) -0, -19, -26, -73, and -74), Operable Unit 1078 (comprises former TA-1 and adjacent canyon sides), and Operable Unit 1079 (comprises former TAs -10, -31, -32, and -45), Los Alamos National Laboratory.

Location of Action:
Los Alamos County, New Mexico.

Description of Proposed Action:
On May 23, 1992, Los Alamos National Laboratory (LANL) will submit a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for each Operable Unit (1071, 1078, and 1079). The Work Plans will serve two purposes: (1) to satisfy the requirements established by the Environmental Protection Agency Region VI as described in the Hazardous and Solid Waste Amendments (HSWA) Module VIII of the LANL RCRA Part B operation permit (effective April 10, 1990 through December 22, 1999), and (2) to serve as a field sampling plan for the personnel who will implement the RFI activities. Consequently, LANL is proposing to implement the RFI activities through a rigorous site characterization program expected to last approximately three to five years.

Because of the possible contaminants associated with Operable Units 1071, 1078, and 1079; the proposed activities include a relatively broad spectrum of sample collection and analyses, as well as the possibility of limited waste removal. The prospective investigations include mesa top characterization; analysis of canyonside disposal areas; analysis of outfalls and associated septic systems, waste lines, and canyonsides; and final disposition of those units proposed for no further investigation. Waste removal will be performed, if determined to be necessary, to satisfy LANL's Voluntary Corrective Action Program. The major purposes of this program are to decrease the possibility of public and worker exposure to contaminated materials and to be responsive to publicly perceived risk. In some cases removal activities will facilitate adequate site characterization. As an example, a septic tank may be removed so that soil around and under the tank can be sampled. The decision to include possible removal activities during the site characterization was based on meetings between the Operable Unit project leaders, DOE, and the EPA. Waste materials will be evaluated for contaminants prior to removal. Each possible removal is expected to meet the CERCLA regulatory cost and time limits of $2 million and 12 months respectively, and will be consistent with ultimate remedial actions to be taken under the Corrective Measures phase of the Environmental Restoration (ER) program.

Analysis of samples will vary depending on the suspect contaminants and the results of field screening. The full suite of analytes typically includes gamma spectrometry, tritium, total uranium, isotopic plutonium, strontium-90, volatile organic compounds (by Method SW 8240), semivolatile organic compounds (by Method SW 8270), and the RCRA-regulated metals (by Method 6010). None of the proposed characterization and possible removal activities described above will threaten a violation of applicable statutory, regulatory, and permit requirements, including DOE Orders; require siting and construction or major expansion activities; adversely affect any environmentally sensitive areas; adversely affect natural areas such as wilderness areas or National Parks; adversely affect prime agricultural land; or adversely affect special sources of water such as sole-source aquifers and wellhead protection areas. The total cost for the site characterization activities is estimated to be 68 million dollars. The project is planned to start in October 1992 and last approximately three to five years.

Field Sampling Plan:
Initial investigations will be designed to determine the type and location of contaminants. Additional sampling will be performed, if necessary, to determine the areal extent of contamination. Field screening during sampling activities will include radiological screening (gross-alpha, gross-beta, gross-gamma, low-level gamma) and screening for volatile organic vapors, as appropriate for decision making and worker safety. A modified van will be utilized on site to aid in this process.

The general types of Solid Waste Management Units (SWMUs) associated with the three Operable Units can be classified into seven categories as follows: (1) surface disposal; (2) landfills and disposal pits; (3) waste treatment facilities and actions; (4) septic and disposal tanks; (5) wastelines, drainlines, leachfields, and outfalls; (6) firing ranges and impact areas; and (7) other contamination including PCB transformers, soil contamination under existing and former buildings, and other miscellaneous SWMUs. The possible contaminants that may be encountered during the site characterization activities include radionuclides[1], hazardous chemicals[2], heavy metals, high explosives, waste oils and fuels, PCB's, sanitary waste, and construction debris. Table 1 summarizes the types of activities that will be performed.

---

1. Including, but not limited to, the following: ^{3}H, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{234}U, ^{235}U, ^{236}U, ^{90}Sr, ^{226}Ra, ^{241}Am, ^{137}Cs, ^{109}Cd, ^{210}Po, ^{14}C, ^{135}Li, ^{96}Cm, ^{232}Th, ^{103}Ru, ^{106}Ru.

2. Including, but not limited to, the following: benzene, carbon tetrachloride, nitric acid, hydrochloric acid, hydrofluoric acid, sulfuric acid, other organics and inorganics.

ENVIRONMENTAL CHECKLIST
DOE Albuquerque Operations Office
Site Characterization of Operable Units 1071, 1078, 1079
DEC-92-0019, ACC NO. 3111

TABLE 1

Field study tasks summarized for each SWMU type.

INVESTIGATIONS	SWMU TYPES							
Tasks	Sur-face Dis-posal	Land-fills & Dis-posal Pits	Septic & Dis-posal Tanks	Waste & Drainlines, Leach-fields, & Outfalls	Waste Treat-ment	Storage Drums, Tanks, & Fac-ilities	Firing Ranges & Impact Areas	Other Conta inati
Field Surveys								
Geophysical	X	X	X	X	X	X	X	X
Radiological	X	X	X	X	X	X	X	X
Soil Gas		X	X			X		
Surface Sampling								
Site Grid	X	X	X	X	X	X	X	X
Channel Sediment	X	X	X	X	X	X	X	X
Stream Bank				X			X	
Cliff Face				X				
Subsurface Sampling								
Boreholes								
12" - 10'	X	X	X	X	X			X
10' - 50'		X	X		X	X		
50' - 100'		X	X		X			
VZMW*		X						
Suction Lysimeters		X						
Trenching	X	X		X				X
Excavation & Removal	X	X	X	X	X		X	X

* Vadose Zone Monitor Wells

Block B: ENVIRONMENTAL CONCERNS

The intent of the Laboratory is to perform all activities in compliance with all applicable local, state, and federal regulations and orders. Wastes will be handled according to established Laboratory procedures that are intended to ensure compliance with regulations.

3. Solid Waste
Some of the old sanitary lines and other material that could possibly be removed may not be contaminated. All waste materials will be evaluated for contaminants prior to removal. Uncontaminated solid waste will be disposed of in the Los Alamos County landfill.

4. Radioactive waste/soil
Some of the material recovered during sampling may be radioactive. Liquid low-level radioactive waste is treated at the TA-50 facility and the sludge is stored at TA-54, Area G. Solid low-level waste (LLW) is taken by EM-7 personnel to the LLW management burial area at TA-54. Solid transuranic waste (TRU) is taken, by EM-7 personnel, to TA-54, placed in drums, certified, and stored for ultimate disposal off-site. Oversized TRU waste (i.e. piping) is taken by EM-7 personnel to the Size Reduction Facility at TA-50 for processing before being transported to TA-54.

5. Hazardous waste
Some of the material recovered during sampling may be hazardous waste or contain hazardous constituents. Personnel from EM-7 collect hazardous waste and transport it to TA-54 where it is segregated, treated, and or packaged and then shipped off-site.

6. Mixed waste (radioactive and hazardous)
Some of the material recovered during sampling may contain both hazardous and radioactive materials. Mixed waste is collected by personnel from EM-7 and is stored at TA-54 until treatment or disposal alternatives become available.

9. Asbestos waste
Some of the material recovered from OU-1078 during sampling may contain asbestos waste. Non-radioactively contaminated asbestos waste is taken by Johnson Controls Incorporated (JCI) to Area J for shipment off LANL land to a permitted asbestos disposal site. Radioactively contaminated asbestos wastes are taken by EM-7 personnel to a monofill at TA-54, Area G.

13. Clearing/excavations
Minor excavations will be required for the surface and subsurface sampling activities. Some dust will be created during operations of clearing and excavating and will be mitigated by standard dust control measures. Any clearing/excavation activity has the potential to encounter previously buried materials. Activities will be monitored and appropriate action will be taken under applicable programs, if required.

14. Activity outside area fence/wildlife
Some activities will be preformed outside fenced areas. If appropriate, restricted-access or exclusion zones will be established before work begins at contaminated sites.

16. Noise levels
Drilling operations will elevate noise levels temporarily in the areas of drilling. Heavy equipment will increase noise levels temporarily during trenching. Worker safety is addressed in each of the Operable Unit Health and Safety Plans.

17. Radiation/toxic chemical exposures
Restricted-access or exclusion zones will be established before work begins at contaminated sites to protect workers and the public from unnecessary exposure to toxic and radioactive materials and to prevent the spread of contamination. Worker safety is addressed in each of the Operable Unit Health and Safety Plans.

19. High Explosives
Explosive hazards may potentially exist at some sites within OU-1071 and OU-1079. Areas that may contain high explosives will be clearly outlined and described to workers and appropriate precautions will be taken with respect to explosive hazards while conducting field work.

20. Transportation
All samples will be packaged in accordance with the EPA's sample preservation protocols as specified in SW-846 and transported under chain-of-custody procedures. Samples to be shipped off-site will also be packaged in accordance with the Department of Transportation shipping requirements, while those transported on-site will be packaged in accordance with LANL's On-site Transportation Manual. Samples that contain radioactivity above background may require special handling.

23. Identified ER site
The proposed action may result in the disturbance of an area listed as a SWMU. To ensure the protection of the workers throughout the process, all activities will be performed consistent with the requirements specified in 29 CFR 1910.120. This regulation primarily consists of ten elements:

1) Hazard Analysis
2) Employee Training
3) Personal Protective Equipment
4) Medical Surveillance
5) Site Monitoring
6) Site Control
7) Decontamination
8) Emergency Response
9) Confined Space
10) Spill Containment

In addition to meeting the requirements of 29 CFR 1910.120, all activities will be performed consistent with the radiologic dose guidelines presented in DOE Order 5480.11. All activities will be performed to maintain worker exposure as low as reasonably achievable and below 5 rem annually in any case. Worker safety is also addressed in the Operable Unit Health and Safety Plans which are part of the Operable Unit Work Plans.

24. Other
Public safety will be a primary consideration at sites near and around residential and commercial areas. Negotiations between the ER program office, private property owners, and Los Alamos County will be implemented. Sampling areas will be fenced wherever necessary. As in all of the field study, the Installation Work Plan and Health and Safety Plan will be followed.

Block C: PERMITS
The intent of the Laboratory is to conduct the project/activity in accordance with all applicable statutory and regulatory requirements, permits, and DOE Orders. The ER program is being conducted under the requirements and according to the terms of the LANL Hazardous Waste Permit (effective April 10, 1990 through December 22, 1999) as specified under the Hazardous and Solid Waste Amendments, Corrective Action Requirements. No other required permits have been identified.

D. DETERMINATION/CLASSIFICATION:

____

____

Signature: ______________________________
Title: ____________________ Date: __________

E. EH OBJECTION: No _____ Yes _____

Signature: ______________________________
Title: ____________________ Date: __________

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: RON CONRAD, EM-8/ ~~MS-E518~~ K-490
DATE: February 14, 1992

FROM: Doris Garvey, EM-8
MAIL STOP/TELEPHONE: K490/5-2380

SYMBOL: HSE-Q-91-0231

SUBJECT: ES&H PROJECT CHECK LIST

SITE CHARACTERIZATION OPERABLE UNIT #1078
ES&H QUESTIONNAIRE # 91-0231
ENG PROJECT ID # 91-NONE

As per Environment, Safety, and Health (ES&H) Administrative Requirement 1-10, the Laboratory ES&H Questionnaire Committee has reviewed your ES&H Questionnaire to identify potential environment, safety, and/or health requirements. It is your responsibility as line management to make the contacts specified on the attached ES&H Project Check List and to ensure that ES&H issues brought up by the committee are resolved. You must also develop and maintain a permanent file meeting DOE requirements that documents the resolution of these issues.

Costs for services specific to your undertaking which exceed those normally provided by indirect funding will be charged to the project.

When making the contacted requested on the Check List, please specify that you are calling in reference to an ES&H Project Check List and mention the ES&H Questionnaire number and the ENG project identification (PI) number for your project.

Please note that each check list contact has an individual status description which is defined on the attached sheet.

CHECK LIST STATUS DESCRIPTION

REQUIRED

ES&H activities related to the check list will begin only after you contact the listed representitive. Items requiring approval by external agencies may take 3-4 months.

CONCERN

The listed contact(s) have ES&H, concerns that must be considered during the first stages of design if the project is going to proceed.

UPDATE

Please call the contact listed who will instruct you regarding review of existing safety documentation.

IN PROCESS

Action is being taken be the appropriate personnel. If you need further assistance, please direct your questions to the listed individual.

COMPLETE

The ES&H concern listed is complete, and no action is required on your part. Documentation will be sent by the listed individual.

E S & H PROJECT CHECK LIST
SITE CHARACTERIZATION OPERABLE UNIT #1078

I. EXTERNAL (NON-LABORATORY) APPROVAL REQUIRED

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REVIEW IN PROCESS
Approval: DOE
Contact : Peggy Powers, EM-8, 5-5717

FLOODPLAIN/WETLAND ASSESSMENT IN PROCESS
Approval: DOE; publication in Federal Register
Contact : Terry Foxx, EM-8, 7-3024

ARCHAEOLOGICAL/HISTORICAL ASSESSMENT COMPLETE
Approval: New Mexico State Historical Preservation Office, National Advisory Council for Historic Preservation
Contact : Beverly Larson, EM-8, 7-2276

THREATENED/ENDANGERED SPECIES ASSESSMENT IN PROCESS
Approval: U.S. Fish and Wildlife Service
Contact : Terry Foxx, EM-8, 7-3024

AIRBORNE RADIOACTIVE EMISSIONS
REVIEW FOR PERMIT/REGISTRATION REQUIRED
Approval: Environmental Protection Agency (EPA)
Contact : Larry Hoffman, EM-8, 7-4715

RESOURCE CONSERVATION AND RECOVERY/ HAZARDOUS SOLID WASTE AMMENDMENTS RCRA/HSWA CORRECTIVE ACTIONS
Environmental Program Activities (Module VIII)
RCRA/HSWA DOCUMENTATION IN PROCESS
Approval: Environmental Protection Agency (EPA), & DOE
Contact : Robert L. Gonzales, EM-13, 5-0226
David J. McInroy, EM-8, 7-0819

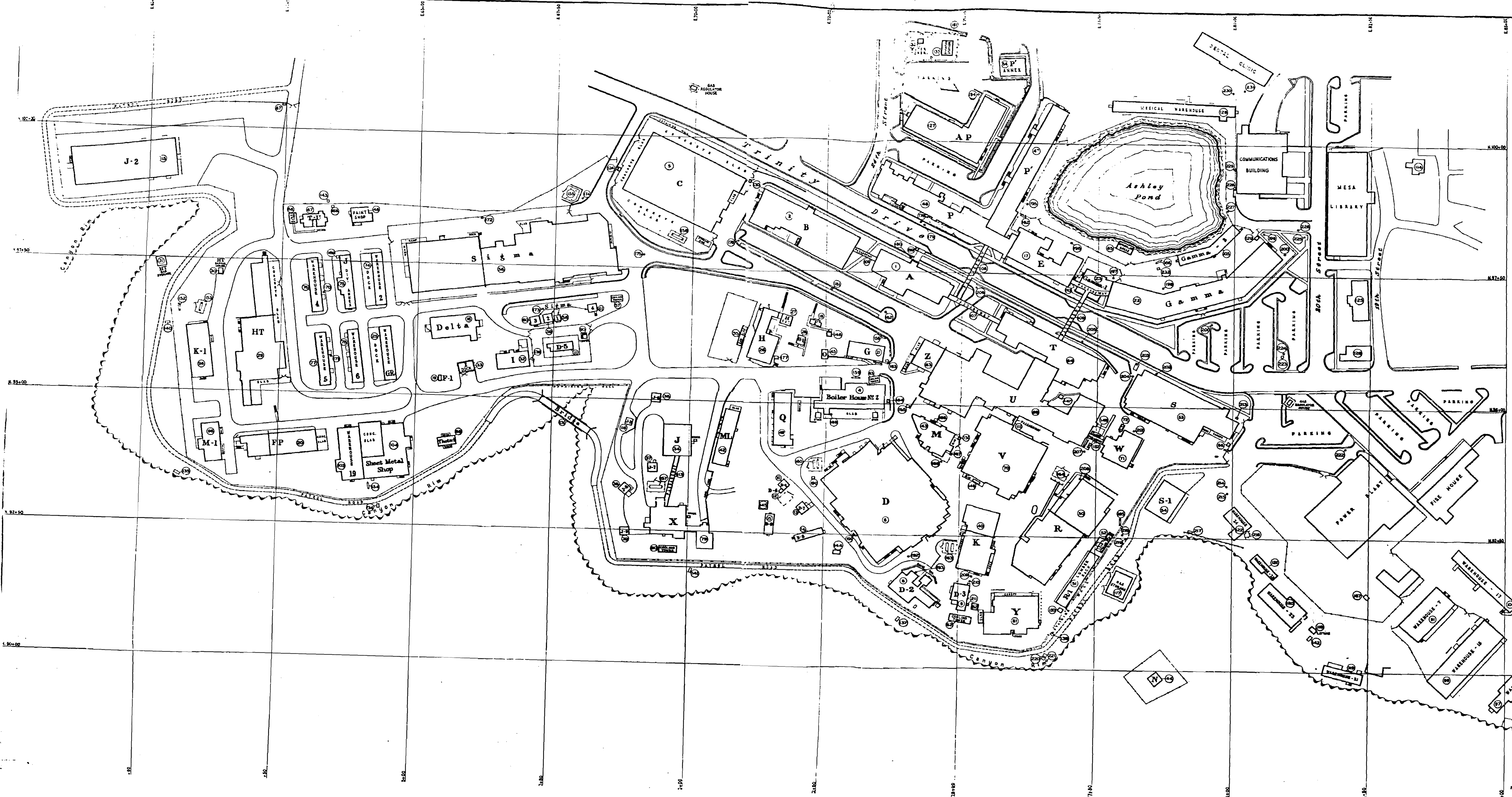
II. LABORATORY ACTION REQUIRED

OCCUPATIONAL RADIOLOGICAL HAZARD ASSESSMENT IN PROCESS
Contact: Glenn Neely, HS-12, 7-5296

WASTE MANAGEMENT REVIEW REQUIRED
Contact : Bob Weeks, EM-7, 7-7391

REVIEW FOR WASTE MINIMIZATION PLAN REQUIRED
Contact : Hilary Noskin, EM-DO, 7-4301

INDUSTRIAL HYGIENE REVIEW IN PROCESS
Contact : Brad Gallimore, HS-5, 7-2419



STRUCTURE NUMBER	DESIGNATION	APPROXIMATE GRID LOCATION		REMARKS
TA-1-1	BUILDING A	N. 97+50	E. 75+00	
TA-1-2	BUILDING B	N. 97+50	E. 72+50	
TA-1-3	BUILDING B-1			REMOVED
TA-1-4	BOILER HOUSE NO. 2	N. 95+00	E. 72+50	
TA-1-5	BUILDING C	N. 100+00	E. 70+00	
TA-1-6	BUILDING D	N. 92+50	E. 72+50	
TA-1-7	BUILDING D-1			REMOVED
TA-1-8	BUILDING D-2	N. 92+50	E. 75+00	
TA-1-9	BUILDING D-3	N. 92+50	E. 75+00	
TA-1-10	BUILDING D-4	N. 92+50	E. 72+50	
TA-1-11	BUILDING D-5	N. 95+00	E. 67+50	
TA-1-12	BUILDING D-6	N. 92+50	E. 72+50	
TA-1-13	BUILDING D-7	N. 92+50	E. 72+50	
TA-1-14	BUILDING D-8	N. 92+50	E. 72+50	
TA-1-15	BUILDING D-9	N. 92+50	E. 72+50	
TA-1-16	BUILDING DELTA	N. 95+00	E. 65+00	
TA-1-17	BUILDING E	N. 97+50	E. 77+50	
TA-1-18	BUILDING F	N. 97+50	E. 72+50	
TA-1-19	BUILDING F-1	N. 95+00	E. 65+00	
TA-1-20	BUILDING FP	N. 95+00	E. 62+50	
TA-1-21	BUILDING G	N. 95+00	E. 72+50	
TA-1-22	BUILDING GAMMA	N. 97+50	E. 80+00	
TA-1-23	BUILDING GAMMA-1	N. 97+50	E. 77+50	
TA-1-24	BUILDING GC			REMOVED
TA-1-25	WAREHOUSE GR	N. 95+00	E. 65+00	
TA-1-26	BUILDING H	N. 97+50	E. 72+50	
TA-1-27	BUILDING H-EXT.	N. 97+50	E. 72+50	
TA-1-28	BUILDING H-1	N. 97+50	E. 72+50	
TA-1-29	BUILDING HT	N. 95+00	E. 62+50	
TA-1-30	HT BARREL HOUSE	N. 97+50	E. 62+50	
TA-1-31	HT GAS STORAGE	N. 97+50	E. 60+00	
TA-1-32	BUILDING I	N. 95+00	E. 67+50	
TA-1-33	PLATFORM I	N. 95+00	E. 65+00	
TA-1-34	BUILDING J	N. 95+00	E. 70+00	
TA-1-35	BUILDING J-5			REMOVED
TA-1-36	BUILDING J-6	N. 95+00	E. 70+00	
TA-1-37	BUILDING J-7	N. 92+50	E. 70+00	
TA-1-38	BUILDING J-8	N. 92+50	E. 70+00	
TA-1-39	BUILDING J-9	N. 92+50	E. 70+00	
TA-1-40	BUILDING K	N. 92+50	E. 75+00	
TA-1-41	BUILDING L			REMOVED
TA-1-42	BUILDING ML	N. 95+00	E. 70+00	
TA-1-43	BUILDING M	N. 95+00	E. 75+00	
TA-1-44	BUILDING N	N. 90+00	E. 77+50	ABANDONED
TA-1-45	BUILDING O	N. 95+00	E. 72+50	
TA-1-46	BUILDING P	N. 100+00	E. 75+00	
TA-1-47	BUILDING P-PRIME	N. 100+00	E. 77+50	
TA-1-48	PAINT SHOP	N. 97+50	E. 65+00	
TA-1-49	BUILDING Q	N. 95+00	E. 72+50	
TA-1-50	BUILDING R	N. 92+50	E. 77+50	
TA-1-51	BUILDING R-1	N. 92+50	E. 77+50	
TA-1-52	BUILDING R-2	N. 92+50	E. 77+50	
TA-1-53	BUILDING S	N. 95+00	E. 80+00	
TA-1-54	BUILDING S-1	N. 92+50	E. 77+50	
TA-1-55	SAW BUILDING	N. 95+00	E. 70+00	
TA-1-56	BUILDING SIGMA	N. 97+50	E. 67+50	
TA-1-57	TOWER NO. 57	N. 97+50	E. 67+50	
TA-1-58	BUILDING SIGMA-1	N. 97+50	E. 67+50	
TA-1-59	BUILDING SIGMA-2	N. 97+50	E. 67+50	
TA-1-60	BUILDING SIGMA-3	N. 97+50	E. 67+50	
TA-1-61	BUILDING SIGMA-4	N. 97+50	E. 67+50	
TA-1-62	MANHOLE NO. 62	N. 90+00	E. 75+00	
TA-1-63	TOWER NO. 63	N. 95+00	E. 72+50	
TA-1-64	BUILDING Γ	N. 95+00	E. 77+50	
TA-1-65	BUILDING THETA			REMOVED
TA-1-66	BUILDING THETA-1	N. 95+00	E. 65+00	
TA-1-67	BUILDING TU	N. 97+50	E. 62+50	
TA-1-68	BUILDING TU-1	N. 97+50	E. 62+50	
TA-1-69	BUILDING U	N. 95+00	E. 77+50	
TA-1-70	BUILDING V	N. 95+00	E. 75+00	
TA-1-71	BUILDING W	N. 95+00	E. 77+50	
TA-1-72	TOWER NO. 72	N. 95+00	E. 77+50	
TA-1-73	WAREHOUSE 1			REMOVED
TA-1-74	WAREHOUSE 2	N. 97+50	E. 65+00	
TA-1-75	J-DIV. ANNEX	N. 97+50	E. 65+00	WHSE. - 3
TA-1-76	WAREHOUSE 4	N. 97+50	E. 62+50	
TA-1-77	WAREHOUSE 5	N. 95+00	E. 62+50	
TA-1-78	WAREHOUSE 6	N. 95+00	E. 65+00	
TA-1-79	BUILDING X	N. 92+50	E. 70+00	
TA-1-80	TOWER NO. 80	N. 92+50	E. 70+00	
TA-1-81	BUILDING Y	N. 90+00	E. 75+00	
TA-1-82	TOWER NO. 82	N. 90+00	E. 75+00	
TA-1-83	BUILDING Z	N. 95+00	E. 75+00	
TA-1-84	P-PRIME ANNEX	N. 102+50	E. 75+00	
TA-1-85	SPRINKLER HOUSE	N. 97+50	E. 77+50	
TA-1-86	PLATFORM			REMOVED
TA-1-87	BUILDING 87	N. 100+00	E. 62+50	GRD. STA. 327
TA-1-88	BUILDING 88	N. 95+00	E. 80+00	GRD. STA. 303
TA-1-89	BUILDING 89	N. 97+50	E. 75+00	GRD. STA. 302
TA-1-90	TOWER NO. 90	N. 95+00	E. 67+50	GRD. STA. 314
TA-1-91	WAREHOUSE 7	N. 90+00	E. 82+50	
TA-1-92	TOWER NO. 92			REMOVED
TA-1-93	TOWER NO. 93			REMOVED
TA-1-94	TOWER NO. 94			REMOVED
TA-1-95	TOWER NO. 95			REMOVED
TA-1-96	BUILDING M-1	N. 95+00	E. 60+00	
TA-1-97	WAREHOUSE 13	N. 90+00	E. 85+00	
TA-1-98	BUILDING K-1	N. 95+00	E. 60+00	
TA-1-99	WAREHOUSE 15	N. 90+00	E. 85+00	
TA-1-100	WAREHOUSE 16	N. 90+00	E. 87+50	

STRUCTURE NUMBER	DESIGNATION	APPROXIMATE GRID LOCATION		REMARKS
TA-1-101	WAREHOUSE 17	N. 92+50	E. 85+00	
TA-1-102	WAREHOUSE 18	N. 90+00	E. 87+50	
TA-1-103	WAREHOUSE 19	N. 92+50	E. 65+00	
TA-1-104	SHEET METAL SHOP	N. 95+00	E. 65+00	
TA-1-105	BUILDING GAMMA-2	N. 97+50	E. 80+00	
TA-1-106	PASSAGEWAY 106	N. 97+50	E. 72+50	
TA-1-107	PASSAGEWAY 107	N. 97+50	E. 75+00	
TA-1-108	PASSAGEWAY 108	N. 97+50	E. 75+00	
TA-1-109	PASSAGEWAY 109	N. 97+50	E. 77+50	
TA-1-110	PASSAGEWAY 110	N. 97+50	E. 77+50	
TA-1-111	PASSAGEWAY 111	N. 95+00	E. 75+00	
TA-1-112	PASSAGEWAY 112	N. 95+00	E. 77+50	
TA-1-113	PASSAGEWAY 113	N. 92+50	E. 70+00	
TA-1-114	MICROSCOPY LAB.	N. 100+00	E. 82+50	ABANDONED
TA-1-115	BUILDING J-2	N. 100+00	E. 60+00	
TA-1-116	BUILDING J-3	N. 95+00	E. 70+00	
TA-1-117	GAS STORAGE	N. 92+50	E. 77+50	
TA-1-118	BUILDING 118	N. 90+00	E. 82+50	
TA-1-119	WAREHOUSE 21	N. 90+00	E. 82+50	
TA-1-120	WAREHOUSE 22	N. 90+00	E. 80+00	
TA-1-121	WAREHOUSE 23	N. 92+50	E. 80+00	
TA-1-122	WAREHOUSE 24	N. 92+50	E. 80+00	
TA-1-123	TOWER NO. 123			REMOVED
TA-1-124	BUILDING 124	N. 100+00	E. 87+50	GRD. STA. 304
TA-1-125	BUILDING 125	N. 97+50	E. 82+50	309 19TH ST.
TA-1-126	OLD MESA LIBRARY	N. 95+00	E. 82+50	
TA-1-127	BUILDING AP	N. 100+00	E. 75+00	
TA-1-128	MEDICAL WAREHOUSE	N. 100+00	E. 80+00	
TA-1-129	BUILDING 129	N. 97+50	E. 80+00	GRD. STA. 325
TA-1-130	BUILDING 130	N. 100+00	E. 70+00	GRD. STA. 319
TA-1-131	BAILEY BRIDGE	N. 95+00	E. 87+50	
TA-1-132	WATER TOWER	N. 102+50	E. 75+00	
TA-1-133	BOOSTER STATION	N. 102+50	E. 75+00	
TA-1-134	TANK NO. 134	N. 92+50	E. 65+00	
TA-1-135	TANK NO. 135	N. 92+50	E. 80+00	
TA-1-136	PLATFORM 136	N. 90+00	E. 87+50	
TA-1-137	TANK NO. 137	N. 90+00	E. 75+00	
TA-1-138	TANK NO. 138	N. 90+00	E. 77+50	
TA-1-139	TANK NO. 139	N. 95+00	E. 87+50	
TA-1-140	TANK NO. 140	N. 97+50	E. 80+00	
TA-1-141	TANK NO. 141	N. 92+50	E. 70+00	
TA-1-142	TANK NO. 142	N. 90+00	E. 82+50	
TA-1-143	TANK NO. 143	N. 97+50	E. 62+50	
TA-1-144	BUILDING 144	N. 92+50	E. 72+50	
TA-1-145	BUILDING 145	N. 92+50	E. 72+50	
TA-1-146	INCINERATOR 146	N. 97+50	E. 72+50	
TA-1-147	INCINERATOR 147	N. 95+00	E. 77+50	
TA-1-148	PLATFORM 148	N. 92+50	E. 75+00	
TA-1-149	TANK NO. 149	N. 95+00	E. 77+50	
TA-1-150	BUILDING 150	N. 90+00	E. 77+50	
TA-1-151	BUILDING 151	N. 95+00	E. 75+00	GRD. STA. 322
TA-1-152	TRANSFORMER STA. 152	N. 97+50	E. 80+00	
TA-1-153	TRANSFORMER STA. 153	N. 97+50	E. 80+00	
TA-1-154	TRANSFORMER STA. 154	N. 92+50	E. 65+00	
TA-1-155	TRANSFORMER STA. 155	N. 100+00	E. 67+50	
TA-1-156	TRANSFORMER STA. 156	N. 97+50	E. 70+00	
TA-1-157	TRANSFORMER STA. 157	N. 92+50	E. 70+00	
TA-1-158	TRANSFORMER STA. 158	N. 95+00	E. 72+50	
TA-1-159	TRANSFORMER STA. 159	N. 95+00	E. 72+50	
TA-1-160	TRANSFORMER STA. 160	N. 92+50	E. 72+50	
TA-1-161	TRANSFORMER STA. 161	N. 102+50	E. 75+00	
TA-1-162	TRANSFORMER STA. 162	N. 97+50	E. 75+00	
TA-1-163	TRANSFORMER STA. 163	N. 92+50	E. 75+00	
TA-1-164	TRANSFORMER STA. 164	N. 92+50	E. 77+50	
TA-1-165	TRANSFORMER STA. 165	N. 92+50	E. 77+50	
TA-1-166	TRANSFORMER STA. 166	N. 97+50	E. 77+50	
TA-1-167	TRANSFORMER STA. 167	N. 92+50	E. 82+50	
TA-1-168	THRU TA-1-232	MISC. MANHOLES		ALL AREA

GRID VARIATION FROM TRUE NORTH 2° 28'

MAG. DECLINATION FROM TRUE NORTH 13° 30'

AUTHORIZED FOR	LOS ALAMOS SCIENTIFIC LABORATORY ENGINEERING DEPARTMENT
HEALTH SAFETY FIRE PR. COMM. SEC.	TECH. AREA NO. 1 MAIN TECHNICAL AREA 50-SCALE PLOT PLAN

Appendices

A. Environmental Fate of Contaminants

B. NEPA Documentation

C. Location Map of Former TA-1 Buildings and Structures

D. Principal Contributors

Executive Summary

Chapter 1
Introduction

Chapter 2
Technical Area 1 Perspective

Chapter 3
Environmental Setting

Chapter 4
Conceptual Model for Technical Area 1

Chapter 5
Field Investigation Methods

Chapter 6
Solid Waste Management Unit Aggregate Background Information

Chapter 7
Solid Waste Management Unit Aggregate Sampling Plans

Annexes

Appendices

LIST OF CONTRIBUTORS

Name and Affiliation	Education/Expertise	ER Program Assignment
Marcy Backsen (IS-11)	B.A. English A.A.S. Computer Science 1.5 years experince as a technical writer-editor; 2 years combined experience as a copywriter and proofreader	Editor
Betsy Barnett (IS-11)	B.A. Languages 11 years experience writing and editing documents pertaining to the environment and radioactive waste disposal	Technical Team Leader, Document Production
Ron Conrad (EM-8)	Ph.D. Chemistry 14 years experience in groundwater protection, waste management, sampling and delineation of environmental contaminants, regulatory compliance, and program management	Operable Unit Project Leader
Alison Dorries (HS-5)	Ph.D. Chemistry M.P.H. Public Health 5 years experience in toxicology, pulmonary health research, regulation development, and environmental health risk assessment	Risk Assessment, Author
Phil Fresquez (EM-8)	M.S. Soil Science, Ph.D. Environmental Soil Science 10 years experience in the characterization of hazardous waste sites	Soil sampling
Bruce Gallaher (EM-8)	M.S. Hydrology 15 years experience in contaminant hydrology and regulatory compliance, including management of waste site characterization studies	Technical Team Leader, Hydrology

Doris Garvey (EM-8)	M.S. Economics 25 years experience in economic and environmental regulatory analysis, including 15 years in environmental assessments and impact analysis, 3 years of environmental regulatory compliance management, and 2 years as manager for the Laboratory's National Environmental Policy Act program	Technical Team Leader, Environmental Assessment
Keith Jacobsen (EM-8)	M.S. Health Physics 7 years experience at the Laboratory in surveillance of inactive waste sites	Health Physics
Bill Kopp (EM-8)	M.S. Environmental Engineering P.E. State of New Mexico 20 years experience in liquid, solid, hazardous, and radioactive waste management, regulatory compliance environmental sampling, and project management	Mapping and Land Surveys
Patricia Leyba (IS-5)	B.B.A. (Business Administration) 10 years experience in office/ information/ management systems	Document layout and production
Sallie McNulty	Ph.D. Statistics 2 years experience in devising plans and data analysis techniques for environmental studies, including surface covers and site integrity for ER programs	Sampling Plan
Consuelo Montoya (EM-8)	14 years experience at the Laboratory. Computer graphic representation, environmental sampling and field environmental QA/QC	Graphics
Linda Nonno (A-1)	B.S. Computer Science B.A. Anthropology 4.5 years experience in environmental restoration and RFI work plans, computer graphics, researching new computer technologies	Work Plan Coordinator, Author

Dave McInroy (EM-8)	B.S. Biology 9 years experience in waste management activities, including project management	Technical Team Leader, Regulatory compliance
Richard Romero (EM-8)	B.S. Chemistry 19 years experience at the laboratory in field supervision and project management, environmental sampling, site safety, field radioactive surveys, and radiation monitoring	Sampling
Nan Sauer (INC-4)	Ph.D. Inorganic Chemistry 3 years experience at the Laboratory in research and development of treatment and remediation technologies of hazardous waste	Geochemistry
Scott Den-Baars (IT) Dick Filemyr Jeff Tucker	International Technology Corporation 557 Oppenheimer, Suite 200 Los Alamos, New Mexico 87544	Work Plan Support
Larry Ticknor (A-1)	M.S. Statistics 2 years experience in devising sampling plans for environmental sampling activities	Sampling Plan