**U.S. Department of Energy
Washington, DC 20585**

**Environment, Safety and Health
Office of Environmental Audit**

**Environmental Survey
Preliminary Report**

**Los Alamos National Laboratory
Los Alamos, New Mexico**

January 1988

MASTER

88

PREFACE
TO
THE DEPARTMENT OF ENERGY
LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of an Environmental Survey at the Department of Energy (DOE) Los Alamos National Laboratory (LANL), located in Los Alamos, New Mexico. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The LANL Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary John S. Herrington, to strengthen the environmental, safety and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1989.

The findings in this report are subject to modification based on the results from the Sampling and Analysis phase of the Survey. The findings are also subject to modification based on comments from the Albuquerque Operations Office concerning the technical accuracy of the findings. The modified preliminary findings and any other appropriate changes will be incorporated into an Interim Report. The Interim Report will serve as the site-specific source for environmental information generated by the Survey, and ultimately as the primary source of information for the DOE-wide prioritization of environmental problems in the final Survey report.

January 1988
Washington, D.C.

CONTENTS

<u>SECTION</u>	<u>PAGE</u>
EXECUTIVE SUMMARY	ES-1
1.0 INTRODUCTION	1-1
2.0 GENERAL SITE INFORMATION	2-1
2.1 Site Setting	2-1
2.2 Overview of Major Site Operations	2-14
2.3 State/Federal Concerns	2-16
3.0 MEDIA-SPECIFIC SURVEY FINDINGS AND OBSERVATIONS	3-1
3.1 Air	3-1
3.1.1 Background Environmental Information	3-1
3.1.1.1 Air Quality	3-3
3.1.1.2 Background Radiation	3-5
3.1.1.3 Meteorology	3-7
3.1.2 General Description of Pollution Sources and Controls	3-8
3.1.2.1 Steam Boilers	3-8
3.1.2.2 Burning of High Explosives	3-12
3.1.2.3 Asphalt Plant	3-13
3.1.2.4 Test Firings	3-13
3.1.2.5 Beryllium Machining	3-15
3.1.2.6 Lead-Pouring Facility	3-15
3.1.2.7 Radioactive Emissions	3-16
3.1.3 Environmental Monitoring Programs	3-20
3.1.3.1 Emissions Monitoring	3-20
3.1.3.2 Ambient Air Sampling	3-22
3.1.3.3 Meteorological Monitoring	3-25
3.1.3.4 Radiation Dose Calculations	3-30
3.1.4 Findings and Observations	3-34
3.1.4.1 Category I	3-34
3.1.4.2 Category II	3-34
3.1.4.3 Category III	3-34
3.1.4.4 Category IV	3-34
3.2 Soils	3-36
3.2.1 Background Environmental Information	3-36
3.2.2 General Description of Pollution Sources and Controls	3-42
3.2.2.1 Surface Test-Firing of High Explosives	3-42
3.2.2.2 Subsurface Test-Firing of High Explosives	3-48
3.2.3 Environmental Monitoring Program	3-53
3.2.4 Findings and Observations	3-59
3.2.4.1 Category I	3-59
3.2.4.2 Category II	3-59
3.2.4.3 Category III	3-59
3.2.4.4 Category IV	3-62

CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
3.3 Surface Water	3-63
3.3.1 Background Environmental Information	3-63
3.3.2 General Description of Pollution Sources and Controls	3-68
3.3.2.1 Cooling Tower Blowdown	3-71
3.3.2.2 Once-Through Cooling Water	3-71
3.3.2.3 Wastewater from HE Facilities	3-74
3.3.2.4 Photographic Laboratory Rinsewater	3-74
3.3.2.5 Power-House Discharges	3-74
3.3.2.6 Sanitary Wastewater Treatment Plants	3-77
3.3.2.7 Liquid Radioactive Waste Treatment	3-79
3.3.2.8 Miscellaneous Discharge	3-82
3.3.3 Environmental Monitoring Program	3-82
3.3.3.1 NPDES Monitoring Program	3-82
3.3.3.2 Potable Water System	3-92
3.3.3.3 Surface Runoff	3-92
3.3.3.4 Surface-Water Monitoring	3-95
3.3.3.5 Fish Monitoring	3-98
3.3.3.6 Sediments	3-98
3.3.4 Findings and Observations	3-103
3.3.4.1 Category I	3-103
3.3.4.2 Category II	3-103
3.3.4.3 Category III	3-104
3.3.4.4 Category IV	3-108
3.4 Hydrogeology	3-109
3.4.1 Background Environmental Information	3-109
3.4.1.1 Regional Geology	3-109
3.4.1.2 Hydrogeology	3-112
3.4.2 General Description of Pollution Sources and Controls	3-114
3.4.3 Environmental Monitoring Program	3-115
3.4.4 Findings and Observations	3-129
3.4.4.1 Category I	3-129
3.4.4.2 Category II	3-129
3.4.4.3 Category III	3-129
3.4.4.4 Category IV	3-130
4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS	4-1
4.1 Waste Management	4-1
4.1.1 General Description of Pollution Sources and Controls-Hazardous Waste	4-1
4.1.1.1 Hazardous Waste Generation	4-1
4.1.1.2 Hazardous Waste Facilities	4-5
4.1.2 General Description of Pollution Sources and Controls-Mixed Waste	4-12

CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
4.1.3 General Description of Pollution Sources and Controls-Radioactive Waste	4-14
4.1.3.1 Radioactive Waste Generation	4-14
4.1.3.2 Radioactive Waste Storage and Treatment Facilities	4-20
4.1.3.3 Radioactive Waste Disposal Facilities	4-32
4.1.4 General Description of Pollution Sources and Controls-Nonhazardous Nonradioactive Waste	4-36
4.1.5 Findings and Observations	4-38
4.1.5.1 Category I	4-38
4.1.5.2 Category II	4-38
4.1.5.3 Category III	4-41
4.1.5.4 Category IV	4-46
4.2 Toxic and Chemical Materials	4-49
4.2.1 General Description of Pollution Sources and Controls	4-49
4.2.1.1 Polychlorinated Biphenyls	4-49
4.2.1.2 Pesticides/Herbicides	4-57
4.2.1.3 Asbestos	4-59
4.2.1.4 Chemical Storage	4-62
4.2.1.5 Underground Storage Tanks	4-65
4.2.1.6 Aboveground Product Storage Tanks	4-75
4.2.1.7 Outdoor Drum Storage	4-83
4.2.2 Findings and Observations	4-87
4.2.2.1 Category I	4-87
4.2.2.2 Category II	4-87
4.2.2.3 Category III	4-94
4.2.2.4 Category IV	4-102
4.3 Radiation	4-106
4.3.1 Background Environmental Information	4-106
4.3.2 General Description of Pollution Sources and Controls	4-108
4.3.2.1 Dose Assessment for Releases to the Atmosphere	4-108
4.3.2.2 Dose Assessment for Releases to Liquids	4-109
4.3.2.3 Dose Assessment for Exposure to Direct Radiation	4-110
4.3.2.4 Summary of Exposures	4-110
4.3.3 Findings and Observations	4-111
4.3.3.1 Category I	4-111
4.3.3.2 Category II	4-111
4.3.3.3 Category III	4-111
4.3.3.4 Category IV	4-111
4.4 Quality Assurance	4-112
4.4.1 General Description of Laboratory Analyses	4-112
4.4.1.1 Air Monitoring Data	4-114
4.4.1.2 Water Analyses	4-116
4.4.1.3 Soils and Sediment Analyses	4-117

CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE</u>
4.4.2 Findings and Observations	4-118
4.4.2.1 Category I	4-118
4.4.2.2 Category II	4-118
4.4.2.3 Category III	4-118
4.4.2.4 Category IV	4-118
4.5 Inactive Waste Sites and Releases	4-120
4.5.1 General Description of Pollution Sources and Controls	4-120
4.5.1.1 Former Liquid Waste Disposal Sites	4-123
4.5.1.2 Spills and Unplanned Releases	4-138
4.5.1.3 Abandoned and Removed Tanks	4-143
4.5.1.4 Open Dumps and Boneyards	4-158
4.5.1.5 Inactive Landfills	4-167
4.5.1.6 Inactive Firing Sites	4-187
4.5.1.7 Contaminated Structures	4-194
4.5.1.8 Miscellaneous	4-200
4.5.2 Findings and Observations	4-200
4.5.2.1 Category I	4-200
4.5.2.2 Category II	4-200
4.5.2.3 Category III	4-200
4.5.2.4 Category IV	4-234
REFERENCES	RF-1
BIBLIOGRAPHY	BL-1
APPENDICES	
A Survey Participants	
B Environmental Survey Plan Los Alamos National Laboratory	
C Summary of Survey Activities	
D Pollution Sources and Control Tables for Inactive Waste Sites and Releases Section 4.5	

TABLES

<u>NUMBER</u>		<u>PAGE</u>
2-1	Land Use Surrounding the LANL in 1975	2-9
2-2	Summary of Land Transactions at the LANL through 1976	2-11
2-3	Developed Acreage by Technical Area (1981 Data)	2-13
2-4	1986 Population Estimates Within 80 Kilometers of the LANL	2-15
2-5	Description of Programs in Technical Areas at the LANL	2-17
3-1	Federal and New Mexico Ambient Air Quality Standards	3-2
3-2	Total Suspended Particulates Measurements for 1986	3-4
3-3	Average Background Concentrations of Radioactivity in the Atmosphere, 1985	3-6
3-4	Regulated and Hazardous Pollutant Emissions, 1986	3-9
3-5	Airborne Radioactive Emissions Totals, 1986	3-11
3-6	Estimated Aerial Concentrations of Toxic Elements Aerosolized By Dynamic Experiments	3-14
3-7	Gaseous Activation Product Emissions from the LAMPF Main Stack, 1986	3-18
3-8	Average Atmospheric Concentrations for 1986	3-26
3-9	Meteorological Towers and Number of Sensors on Each Tower	3-29
3-10	Summary of Annual Doses Due to 1986 LANL Operations	3-33
3-11	Estimates of Soil Properties at the LANL Site for Selected Soil Types	3-40
3-12	List of Firing Sites, LANL	3-43
3-13	List of Constituents Used and History of Use at Active Firing Sites, LANL	3-46
3-14	List of Materials and Amounts Used in Underground Experiments, LANL	3-51
3-15	1986 Soil Sampling Results at the LANL	3-57

TABLES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
3-16	Analytical Results, Water Year 1985 (October 1984 to September 1985), Rio Grande at Otowi Bridge near San Ildefonso, New Mexico	3-65
3-17	Analytical Results, Water Year 1985 (October 1984 to September 1985), Cochiti Reservoir near Cochiti, New Mexico	3-67
3-18	Category 3A Outfall Data, LANL	3-72
3-19	Category 4A Outfall Data, LANL	3-73
3-20	Category 5A Outfall Data, LANL	3-75
3-21	Category 6A Outfall Data, LANL	3-76
3-22	Sanitary Waste Treatment Plants, LANL	3-78
3-23	NPDES Discharge Criteria for TA-50	3-81
3-24	NPDES Monitoring Requirements, LANL	3-83
3-25	NPDES Permit Effluent Quality Monitoring of Industrial Outfalls, 1986	3-88
3-26	NPDES Permit Effluent Quality Monitoring of Sanitary Sewage Treatment Outfalls, 1986	3-89
3-27	Maximum Radioactivity and Chemical Concentration, Potable Water Distribution System, 1985	3-93
3-28	Average Plutonium Concentrations in Summer Runoff in Effluent Receiving Canyons	3-96
3-29	Maximum Concentrations of Radioactivity in Surface and Groundwaters from Off-Site and On-Site Locations	3-99
3-30	Maximum Concentrations of Radioactivity in Sediments from Regional, Perimeter, and On-Site Stations, 1986	3-102
3-31	LANL Groundwater Data Summary, 1986	3-117
3-32	Samples Exceeding Primary or Secondary Drinking Water Standards, 1986 for Nonradiological Constituents	3-124
3-33	Organic Analyses, LANL, 1986	3-128

TABLES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
4-1	Annual Hazardous Waste Generation at the LANL	4-2
4-2	Contents of Shafts in Area L	4-10
4-3	Low-Level Mixed Waste Stored at Los Alamos through FY 1986	4-13
4-4	Solid Radioactive Waste Buried and/or Stored, as Reported for Fiscal Year 1986, LANL	4-19
4-5	Summary Data for Radioactive Waste Tanks at TA-2	4-23
4-6	Summary Data for Radioactive Waste Tanks at TA-3	4-24
4-7	Summary Data for Radioactive Waste Tanks at TA-21	4-26
4-8	Summary Data for Radioactive Waste Tanks at TA-50	4-28
4-9	Summary Data for Radioactive Underground Waste Tanks at TA-53	4-30
4-10	Soil Concentration Guidelines (Above Background) Conforming to De Minimis Levels	4-33
4-11	Soil Concentration Guidelines (Above Background) Based on 500 mrem/yr Organ Limit	4-34
4-12	Lead Storage Locations at LANL	4-45
4-13	PCB Transformers	4-50
4-14	LANL PCB Capacitors	4-51
4-15	PCB-Contaminated Transformers	4-53
4-16	PCB Transformer Ages as of 1985	4-54
4-17	PCBs in Machines MEC Division 3/87	4-56
4-18	Pesticides and Herbicides Used at the LANL	4-60
4-19	Quantities of Volatile Chemicals and Compressed Gases Used at the LANL (kg)	4-63

TABLES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
4-20	Chemical Storage Facilities Reviewed at Operating Divisions	4-66
4-21	Summary Data for Active Underground Product Storage Tanks	4-67
4-22	Summary Data for Underground Storage Tanks of Unknown Operational Status	4-70
4-23	Summary Data for Active Aboveground Product Storage Tanks	4-77
4-24	Number of Drums Observed for Various Drum Storage Practices at Different Technical Areas	4-84
4-25	Leaking PCB Transformers	4-90
4-26	Underground Tanks Not Tested and Without Inventory Control	4-97
4-27	Tanks Lacking Secondary Containment	4-99
4-28	Tanks with Minor Secondary Containment	4-100
4-29	Combustible Materials Near PCB Transformers	4-105
4-30	Average Annual Effective Dose Equivalent to Humans from Natural Background Radiation	4-107
4-31	Analytical Methods for Various Stable Constituents	4-115
4-32	Summary Data for Abandoned Underground Tanks	4-146
4-33	Summary Data for Underground Storage Tanks That Have Been Removed	4-149
4-34	Summary Data for Removed and Abandoned Aboveground Storage Tanks, LANL	4-154
4-35	Summary Data for Abandoned and Removed Tanks with Unknown Ground-Level Position, LANL	4-156

FIGURES

<u>NUMBER</u>		<u>PAGE</u>
2-1	Regional Location of the Los Alamos National Laboratory	2-2
2-2	Nearby Land Ownership at the LANL	2-3
2-3	Surface Hydrology at LANL	2-5
2-4	Vegetation Cover at the LANL	2-8
2-5	Active Technical Areas LANL	2-12
3-1	Location of Major Air Pollution Sources at LANL	3-10
3-2	Air Sampler Locations on or near LANL	3-23
3-3	Meteorological Towers and Rain Gauge Locations	3-28
3-4	Cumulative Wind Roses at LANL Stations in 1985	3-31
3-5	Mesas and Canyons	3-37
3-6	Topographic Survey Map Los Alamos National Laboratory	3-38
3-7	Soils Survey Map of Los Alamos National Laboratory	3-39
3-8	Location of Underground Experiments in TA-49	3-49
3-9	Sediment Sampling Locations in TA-49 at LANL	3-52
3-10	Regional Soil Sampling Locations at the LANL	3-54
3-11	Perimeter and On-Site Soil Sampling Locations at LANL	3-55
3-12	Location of the Radioactive Waste Management Areas Included in the LANL Environmental Surveillance Program	3-58
3-13	Regional Surface Water, LANL	3-64
3-14	Physiographic Setting of Los Alamos County	3-69
3-15	Location of Reservoirs, Well Fields, Supply Wells, and Gallery Water Supply at LANL	3-70
3-16	Sampling Stations for Surface Water Near the Fenton Hill Site - LANL	3-90

FIGURES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
3-17	Surface-Water Sampling Locations on and near the LANL Site	3-91
3-18	Location of Surface Runoff Sampling Stations at State Road 4	3-94
3-19	Regional Surface-Water Sampling Locations at the LANL Site	3-97
3-20	Sediment Sampling Locations in and near the LANL Site	3-101
3-21	Generalized Cross-Section of Stratigraphic Relations of the Bandelier Tuff to Older Rocks in the Los Alamos Area	3-110
3-22	Groundwater Sampling Locations On and Near the LANL Site	3-116
4-1	TA-54, Area L Hazardous Waste Management Area, LANL	4-9
4-2	Flow Sheet for Los Alamos Radioactively Contaminated Solid Waste	4-15
4-3	TA-54, Area G at LANL	4-35
4-4	PCB Disposal Area at TA-54, Area G	4-58
4-5	Health and Environmental Chemistry Group	4-113
4-6	Location of Active and Inactive Technical Areas at LANL	4-121
4-7	Location and Layout of MDA-T in TA-21	4-125
4-8	Cross-Section of MDA-T Absorption Beds	4-126
4-9	Location and Sketch of Former Liquid Disposal Area ("Tank Farm") in TA-10	4-130
4-10	Location of Stormwater Collection Basins in TA-35	4-131
4-11	Location of Three Inactive Liquid Waste Disposal Sites in TA-16	4-133
4-12	Location of Plating Shop Outfall From Building 52 in TA-22	4-134

FIGURES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
4-13	Location of Sumps 69 and 70 in TA-46	4-136
4-14	Location of Septic Tank 59 in TA-8	4-137
4-15	Location and Sketch of HE Processing Outfall from Building 34 of TA-22	4-139
4-16	Location of Areas of Dark, Stained Soil South of Building 207 in TA-35	4-141
4-17	Location of Spills Around Building 31 in TA-46	4-142
4-18	Location of Spills near Shed 197 in TA-46	4-144
4-19	Location and Sketch of Spill at Former TA-32 Moving Onto DOE Property	4-145
4-20	Location and Sketch of Inactive Open Dump MDA-M	4-161
4-21	Location and Sketch of Open Dump MDA-Z in TA-15	4-162
4-22	Location and Sketch of Open Dump and Boneyard Near Buildings Q-34 and -40 in TA-14	4-164
4-23	Location and Sketch of Boneyard in TA-36	4-165
4-24	Location and Sketch of Incinerator Ash Dump in TA-00L, Los Alamos, New Mexico	4-166
4-25	Location of Suspected Dump at G Point in TA-15	4-168
4-26	Location and Sketch of the Inactive Landfill MDA-C in TA-0, South of TA-50	4-172
4-27	Location and Sketch of Inactive Landfill at Eastern End of County Municipal Airport	4-176
4-28	Location of Two Waste Disposal Pits in TA-39	4-178
4-29	Location and Sketch of Suspect Burial Area 1 in TA-20	4-180
4-30	Location and Sketch of Suspected Landfill in TA-33	4-181
4-31	Location of Suspected Landfill in TA-46	4-182

FIGURES (Continued)

<u>NUMBER</u>		<u>PAGE</u>
4-32	Location of Landfill MDA-F in TA-6	4-184
4-33	Location of the Inactive Landfill MDA-N in TA-15	4-185
4-34	Location of Suspected Landfill, Known as the "Cold Dump," in TA-21	4-186
4-35	Location of Suspected Burn Pit in TA-10	4-188
4-36	Location of Three Suspected Pits in TA-6	4-189
4-37	Location and Sketch of Inactive Firing Site in TA-5	4-193
4-38	Location and Sketches of Inactive Firing Sites at TA-6	4-195
4-39	Location and Sketch of Suspected Firing Site in TA-8	4-196
4-40	Location of Former GMX2 Site in TA-16, Los Alamos National Laboratory	4-198
4-41	Location and Sketch of Old Trim Building in TA-12	4-199

EXECUTIVE SUMMARY

Introduction

This report presents the preliminary findings from the first phase of the Environmental Survey of the United States Department of Energy's (DOE) Los Alamos National Laboratory (LANL), conducted March 29, 1987 through April 17, 1987.

The Survey is being conducted by an interdisciplinary team of environmental specialists, led and managed by the Office of Environment, Safety and Health's Office of Environmental Audit. Individual team components are outside experts being supplied by a private contractor. The objective of the Survey is to identify environmental problems and areas of environmental risk associated with the LANL. The Survey covers all environmental media and all areas of environmental regulation. It is being performed in accordance with the DOE Environmental Survey Manual. The on-site phase of the Survey involves the review of existing site environmental data, observations of the operations carried on at the LANL, and interviews with site personnel.

The Survey team developed a Sampling and Analysis Plan to assist in further assessing certain of the environmental problems identified during its on-site activities. The Sampling and Analysis Plan will be executed by the Idaho National Engineering Laboratory. When completed, the results will be incorporated into the LANL Environmental Survey Interim Report. The Interim Report will reflect the final determinations of the Survey for the LANL.

Site Description

The LANL is located on a 28,186-acre site in north-central New Mexico. The site is approximately 25 miles northwest of Sante Fe, New Mexico. It is operated by the University of California with support services provided by the Pan Am Corporation. The main mission at LANL is nuclear weapons research and development. Program areas in support of this mission include weapons development, magnetic and inertial fusion, nuclear fission, nuclear safeguards and security, laser separation, and basic research in physics, chemistry, and engineering. Other efforts include applied

photochemistry, astrophysics, earth sciences, energy resources, nuclear fuel safeguards, laser technology, computer sciences, solar energy, geothermal energy, biomedical and environmental research, and nuclear waste management research. DOE and its predecessor agencies have been responsible for the site since its inception in 1943.

There was a significant interest by the Federal and state regulators in the Survey at the LANL. The U.S. Environmental Protection Agency's primary interest was with LANL's solid and hazardous waste disposal practices. The state raised many issues covering the full scope of the Survey. The most significant issues focused on 1) hazardous waste storage and disposal, including the potential for migration from the disposal facilities and other concerns with past and current practices; and 2) liquid discharges, including National Pollutant Discharge Elimination System (NPDES) violations and uncharacterized discharges.

Summary of Findings

The major preliminary findings of the Environmental Survey for the LANL are the following:

- Ineffective waste segregation has resulted in instances of commingling and improper disposal of hazardous waste,
- Inadequate drum management practices have resulted in releases of oil and hazardous materials from a large number of chemical drums with the potential for additional releases as the practices continue,
- Numerous polychlorinated biphenyl (PCB) transformers have pinhole leaks and/or have the potential to leak and contaminate the environment,
- Releases of radionuclide contamination into several canyons have caused soil and sediment contamination that in one instance resulted in off-site plutonium contamination at the Rio Grande, and

- More than 200 inactive waste disposal, spill, release, and firing sites are considered potential sources of contamination to soils, biota, and/or perched groundwater.

Overall Conclusions

The Survey found no environmental problems at the LANL that represent an immediate threat to human life. The identified problems vary in terms of their magnitude and risk, as described in this report. Although the Sampling and Analysis performed by the LANL Survey will assist in further identifying environmental problems at the site, a complete understanding of the significance of some of the environmental problems identified requires a level of study and characterization that is beyond the scope of the Survey. Actions currently under way or planned at the site, particularly the Phase II activities of the Comprehensive Environmental Assessment and Response Program (CEARP) as developed and implemented by the Albuquerque Operations Office, will contribute toward meeting this requirement.

Transmittal of Results

The findings of the Environmental Survey for the LANL were shared with the DOE Albuquerque Operations (AO) Office, the DOE Los Alamos Area Office, and the University of California at the Survey closeout briefing held on April 17, 1987. Since that time, informal coordination with the site and with representatives of the Albuquerque Operations Office have been ongoing in an effort to keep this report current. Those problems that involve extended studies and multiyear budget commitments will be the subject of the DOE-wide Environmental Survey Summary Report and DOE-wide prioritization.

Within the Office of Environment, Safety and Health, the Office of Environmental Guidance and Compliance has immediate responsibility for monitoring environmental compliance and the status of the LANL Survey findings. The Office of Environmental Audit will continue to assess the environmental problems through the program of systematic environmental audits that will be initiated toward the conclusion of the DOE Environmental Survey in 1989.

1.0 INTRODUCTION

The purpose of this report is to present the preliminary findings made during the Environmental Survey, March 30 through April 17, 1987, at the Department of Energy's (DOE) Los Alamos National Laboratory (LANL), Los Alamos, New Mexico (Figure 2-1). The University of California operates the LANL for DOE.

The LANL Survey is part of the larger DOE-wide Environmental Survey effort announced by Secretary John S. Herrington on September 18, 1985. The purpose of this effort is to identify, via "no-fault" baseline Surveys, existing environmental problems and areas of environmental risk at DOE facilities, and to rank them on a DOE-wide basis. This ranking will enable DOE to more effectively establish priorities for addressing environmental problems and allocate the resources necessary to correct these problems. Because the Survey is "no fault" and is not an "audit," it is not designed to identify specific isolated incidents of noncompliance or to analyze environmental management practices. Such incidents and/or management practices will, however, be used in the Survey as a means of identifying existing and potential environmental problems.

The LANL Environmental Survey was conducted by a multidisciplinary team of technical specialists headed and managed by a Team Leader and Assistant Team Leader from DOE's Office of Environmental Audit. A complete list of the LANL Survey participants and their affiliations is provided in Appendix A.

The Survey team focused on all environmental media, using Federal, state, and local environmental statutes and regulations, accepted industry practices, and professional judgment to make the preliminary findings included in this report. The team carried out its activities in accordance with the guidance and protocols of the Environmental Survey Manual. Substantial use of existing information and of interviews with knowledgeable field office and site-contractor personnel accounted for a large part of the on-site effort. The Survey Plan is presented in Appendix B, and a summary of the site-specific Survey activities is presented in Appendix C.

The preliminary Survey findings are presented in Chapters 3 and 4 in the form of existing and potential environmental problems. Chapter 3 includes those findings that pertain to a specific environmental medium, e.g., air or soil, while Chapter 4

includes those that are non-media-specific, e.g., waste management, direct radiation, and quality assurance. Because the findings vary greatly in terms of magnitude, risk, and characterization, and consequently require different levels of management attention and response, they are further divided into four categories within each of the sections in Chapters 3 and 4.

The criteria for placing a finding into one or more of the four categories are as follows:

Category I includes only those findings which, based upon the information available to the Team Leader, involve immediate threat to human life. Findings of this type shall be immediately conveyed to the responsible Environmental Safety and Health personnel at the scene or in control of the facility or location in question for action. Category I findings are those environmental problems where the potential risk is highest, the confidence in the finding, based on the information available, is the strongest, and the appropriate response to the finding is the most restrictive in terms of alternatives.

Category II findings encompass one or more of the following situations:

- Multiple or continuing exceedances, past or present, of a health-based environmental standard where there is immediate potential for human population exposure, or a one-time exceedance where residual impacts pose an immediate potential for human population exposure.
- Evidence that a health-based environmental standard may be exceeded, as discussed in the preceding situation, within the timeframe of the DOE-wide Survey.
- Evidence that the likelihood is high for an unplanned release due to, for example, the condition or design of pollution abatement or monitoring equipment or other environmental management practices.
- Noncompliance with significant regulatory procedures, i.e., those substantive technical regulatory procedures designed to directly or

indirectly minimize or prevent risks, such as inadequate monitoring or failure to obtain required permits.

Category II findings include those environmental problems where the risk is high but the definition is broader than in Category I. The information available to the Team Leader is adequate to identify the problem but may be insufficient to fully characterize it. In this category, more discretion is available to the Operations Offices and Program Offices as to the appropriate response; however, the need for that response is such that management should not wait for the completion of the entire DOE-wide Survey to respond. Unlike Category I findings, a sufficient near-term response by the Operations Office may include further characterization prior to any action taken to rectify the situation.

Category III findings encompass one or both of the following criteria:

- The existence of pollutants or hazardous materials in the air, water, groundwater, or soil resulting from DOE operations that pose or may pose a hazard to human health or the environment.
- The existence of conditions at a DOE facility that pose or may pose a hazard to human health or the environment.

Category III findings are those environmental problems for which the broadest definition of risk is used. As in Category II, the information available to the Team Leader may not be sufficient to fully characterize the problem. Under this category, the range of alternatives available for response and the corresponding timeframes for response are the greatest. Environmental problems included within this category will typically require lengthy investigation and remediation phases as well as multiyear budget commitments. These problems will be included in the DOE-wide prioritization effort to ensure that DOE's limited resources are used effectively.

In general, the levels of pollutants or materials that constitute a hazard or potential for hazard are those that exceed some Federal, state, or local regulations for release of, contamination by, or exposure to such pollutants or materials. However, in some cases, the Survey may determine that the presence of some nonregulated material is

in a concentration that presents a concern for local populations or the environment that is sufficient to be included as an environmental problem. Likewise, the presence of regulated materials in concentrations, even though below those established by regulatory authorities, that nevertheless present a potential for hazard or concern may be classified as an environmental problem. In general, however, conditions that meet regulatory or other requirements, where such exist, should not present a potential hazard and will not be identified as an environmental problem.

Conditions that pose or may pose a hazard are generally those which are violations of regulations or requirements (e.g., improper storage of hazardous chemicals in unsafe tanks). Such conditions present a potential hazardous threat to human health and the environment and should be identified as an environmental problem. Additionally, potentially hazardous conditions are those where the likelihood of the occurrence of release is high.

The definition of the term "environmental problem" is broad and flexible to allow for the wide differences among the DOE sites and operations. Therefore, a good deal of professional judgment must be applied to the identification of environmental problems.

Category IV findings include instances of administrative noncompliance and management practices that are indirectly related to environmental risk but are not appropriate for inclusion in Categories I through III. Such findings can be based upon any level of information available to the Team Leader, including direct observations by the team members. Findings in this category are generally expected to lend themselves to relatively simple, straightforward resolution without further evaluation or analysis. These findings, although not part of the DOE-wide prioritization effort, will be passed along to the Operations Offices and appropriate Program Office for action.

Based on the professional judgment of the Team Leader, the findings within the categories are arranged in order of relative significance. Comparing the relative significance of one finding to another, either between categories within a section or within categories between sections, is neither appropriate nor valid. The categorization and listing of findings in order of significance within this report

constitute only the first step in a multistep, iterative process to prioritize DOE's problems.

The next phase of the LANL Survey will include Sampling and Analysis (S&A). EG&G-Idaho, Inc., the S&A team for the LANL, will collect samples over a 10-week period beginning in March 1988. Prior to sampling, an S&A plan was prepared by DOE and EG&G Idaho in accordance with the protocols in the Environmental Survey Manual. The S&A plan was designed to fill existing data gaps or weaknesses. The results generated by the S&A effort will be used to assist the Survey team in further defining the existence and extent of potential environmental problems identified during the Survey.

An Interim Report will be prepared 4 months after the completion of the S&A effort. The Interim Report will incorporate the results of the S&A effort as well as any changes or comments resulting from the review of the Preliminary Report. Based on the S&A results, the preliminary findings and observations made during the on-site Survey may be modified, deleted, or moved within or between categories. The Interim Report will serve both as the site-specific repository for information generated by the Survey, and ultimately as the site-specific source of information for the DOE-wide prioritization of environmental problems.

It is clear that certain of the findings and observations contained in this report, especially those in Category II, can and should be addressed in the near term, i.e., prior to the DOE-wide prioritization effort. It is also clear that the findings and observations in this report vary greatly in terms of magnitude, risk, and characterization. Consequently, the priority, magnitude, and timeliness of near-term responses will require careful planning to ensure appropriate and effective application. The information in this Preliminary Report, albeit provisional, will assist the Albuquerque Operations Office (AO) in the planning of these near-term responses.

2.0 GENERAL SITE INFORMATION

Section 2.1 briefly describes the site, including the location, of the Los Alamos National Laboratory (LANL), the land use of the surrounding area, and the demographics and climate of the region. Section 2.2 presents an overview of major operations and programs performed on the site. Section 2.3 discusses Federal and state regulatory concerns.

2.1 Site Setting

This section provides a discussion of both the physical and socioeconomic setting of the LANL. The physical setting includes location and the general aspects of geology, hydrology, climatology, and vegetation cover. Land use (both adjacent and on-site), demographics, and public access are also discussed.

Location

The LANL is located on an approximately 28,000-acre site in Los Alamos County in north-central New Mexico. Los Alamos County is a small incorporated county located on the Pajarito Plateau between the Jemez Mountains to the west and the Rio Grande Valley to the east. Los Alamos County is 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (see Figure 2-1). Within the county are the LANL and two adjacent communities, Los Alamos and White Rock. The LANL also occupies a small portion of Santa Fe County. Figure 2-2 presents the land ownership surrounding the LANL. The LANL is bordered on the south and west by the Bandelier National Monument, to the west and north by the Santa Fe National Forest, and on the north by private and county land. Some small tracts of General Service Administration land and Santa Fe National Forest land are also on the north side of LANL. To the east, the LANL is bordered by the San Ildefonso Pueblo and the communities of Pajarito Acres and White Rock.

Geology

The Pajarito Plateau forms a topographically high area along the western margin of the Rio Grande depression. The Pajarito Plateau is 10 to 15 miles wide and 25 to 30

REGIONAL LOCATION OF
THE LOS ALAMOS NATIONAL LABORATORY

FIGURE 2-1

NEARBY LAND OWNERSHIP
AT THE LANL

FIGURE 2-2

miles long. It slopes eastward from an altitude of 7,800 feet to 6,200 feet, ending above the Rio Grande at the Puye Escarpment and the rim of White Rock Canyon. The Rio Grande depression began to form about 21 million years ago as a result of faulting. Sediments were eroded from the highland mesas to the east and west. These sediments formed the basin-fill sedimentary rock of the Tesuque Formation of the Santa Fe Group. Volcanic activity that occurred during the formation of the Santa Fe Group deposited many basalt flows and plugs through the sediments. These basalt eruptions in the area laid down a series of basalts that flowed northwest into the White Rock area.

The volcanic rocks of the Jemez Mountains began to form during the Pliocene epoch with a series of eruptions along the western margin of the depression southwest of Los Alamos. The volcanic rocks built a high mountain mass northward from the original vents. The volcanoes covered an area of over 1,000 square miles and attained a thickness of at least 4,500 feet. The volcanic activity climaxed about 1.1 to 1.4 million years ago with two explosions that deposited 100 cubic miles of rhyolite tuff and pumice around the flanks of the volcanic mass. This ejection of tuff and pumice preceded the collapse of the center of the highlands. The collapse formed a large caldera (a large basin-shaped depression).

Surface Hydrology

Sixteen drainage areas, with a total of 52,500 acres, pass through or start with the LANL site. Streamflow in these canyons is intermittent. Figure 2-3 shows the surface hydrology on the site. Springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some canyons. The amount of water is insufficient to maintain surface flows across the LANL site before depletion. Runoff from heavy thunderstorms or heavy snowmelt reaches the Rio Grande several times a year. Effluents from sanitary sewage, industrial waste treatment plants, and cooling tower blowdown provide enough flow to some canyons to maintain surface water for about 1 mile. The intermittent flow in the streams has deposited alluvium that ranges from less than 3 feet to as much as 100 feet thick. The alluvium is quite permeable, in contrast to the underlying volcanic tuff and sediments. Intermittent runoff in canyons infiltrates the alluvium until its downward movement is impeded by the less permeable tuff and volcanic sediment. This results in a shallow alluvial

SURFACE HYDROLOGY AT LANL

FIGURE 2-3

groundwater body that moves downgradient in the alluvium. As water in the alluvium moves downgradient, it is depleted by evapotranspiration and movement into the underlying volcanic sediment.

The main aquifer in the LANL area is located within the Tesuque Formation beneath the entire plateau and Rio Grande Valley. The lowest part of the Puye Conglomerate and the Tesuque Formation are within the main aquifer beneath the central and western portions of the plateau. The depths to water below the mesa tops range from 1,200 feet along the western margin of the plateau to about 600 feet along the eastern part. The thickness of potable water in the aquifer is estimated to be at least 3,900 feet. The hydraulic gradient of the aquifer averages about 60 ft/min within the Puye Conglomerate and increases to about 100 ft/min along the eastern edge of the Pajarito Plateau. The average movement rate within the aquifer is 1 ft/day toward the Rio Grande.

Climate

Los Alamos has a semiarid, temperate mountain climate. Average annual precipitation is nearly 18 inches. Forty percent of the annual precipitation occurs during July and August in the form of thunderstorms. The rest of the precipitation is from winter storms. Winter precipitation falls primarily as snow, with accumulations of about 51 inches. Winter temperatures typically range from 15° to 25°F during the night and from 30° to 50°F during the day. Summers are sunny with moderate, warm days and cool nights. Maximum temperatures are usually below 90°F. Brief afternoon and evening thunderstorms are common. The high altitude, light winds, clear skies, and dry atmosphere allow night temperatures to drop below 60°F.

Surface winds in Los Alamos often vary dramatically with time of day and with location because of the complex terrain. With light, large-scale winds and clear skies, a distinct daily wind cycle often exists. A light southeasterly to southerly upslope wind occurs during the day. During the night, a light westerly to northwesterly drainage wind occurs. However, several miles to the east toward the edge of the Pajarito Plateau, near the Rio Grande Valley, a different daily wind cycle

is common. A moderate southwesterly wind occurs up-valley during the day. Either a light northwesterly to northerly drainage wind or a moderate southwesterly wind occurs at night. On the whole, the predominant winds are southerly to westerly over Los Alamos County.

Vegetation Cover

The ecosystem on the LANL site is diverse because of the 5,000-foot gradient between the Jemez Mountains and the Rio Grande. Variations in precipitation and temperature and the difference in solar radiation reaching the north-facing and south-facing canyon walls result in a great diversity of plants. Figure 2-4 presents a map of the vegetation cover on the LANL. Six major vegetative complexes or community types occur in Los Alamos County. These are juniper-grassland, pinyon-juniper, ponderosa pine, mixed conifer, spruce-fir and subalpine grassland. The juniper-grassland, pinyon-juniper, and ponderosa pine are the three predominant community types on the site. Each occupies about one-third of the site. Areas of sparse or no vegetation occur only in scattered locations.

Adjacent Land Use

The isolation of Los Alamos was ideal for an atomic weapons laboratory during World War II. The surrounding area, including all of Los Alamos County and large portions of Sandoval, Rio Arriba, and Santa Fe Counties, remains largely undeveloped. The U.S. Forest Service (USFS) held large tracts of land in the Jemez Mountains to the north, west, and south. Indian lands border the LANL to the east and northeast. Table 2-1 presents a summary of the land use in the area surrounding the LANL site. Grazing lands and commercial timber are the two predominant land uses, accounting for 95.6 percent of the total land use.

Laboratory Land Use

Established in 1943, the LANL had as its initial mission the development of the world's first nuclear fission weapon. This project lasted until the duration of World War II. From the start, the University of California operated the LANL under contract. However, in its early years, Los Alamos was under Army control. The

VEGETATION COVER AT THE LANL

FIGURE 2-4

TABLE 2-1
LAND USE SURROUNDING THE LANL IN 1975

County	Land (km ²)						
	Grazing Land	Commercial Timber	Built-up ^a	Agriculture	Recreation	Miscellaneous	Total
Los Alamos	111	0	32	0	26	111	280
Rio Arriba	10,486	4,215	175	207	86	67	15,236
Santa Fe	4,230	406	149	150	5	4	4,944
Sandoval	8,025	1,285	143	76	93	5	9,627
Total	22,852	5,906	499	433	210	187	30,087
Percent of Total	76.0	19.6	1.7	1.4	0.7	0.6	

Source: DOE, 1979

- a Built-up includes urban areas, lands subdivided for residential and industrial uses, and roads.
b Miscellaneous includes defense lands, and lakes and reservoirs with surface area of 0.16 km² or more.

Army located Project Y, the code name for Los Alamos, at the Los Alamos Ranch School for Boys. This school comprised some 50 log buildings on a 790-acre site. In 1942, the Undersecretary of War directed acquisition of the site. The acquisition ultimately included the Ranch School property, 2,900 acres in homesteads and grazing lands, and 45,666 acres of public domain land supervised by the USFS. During 1947 and 1948, the Atomic Energy Commission (AEC), which controlled the site after the Army, acquired additional lands totaling 19,725 acres. The size of the laboratory has, with one exception, been decreasing since 1958. Beginning in 1958, 7,500 acres of land located in the Los Alamos and White Rock communities were transferred to private control. In 1959 and 1963, a total of 6,482 acres were transferred to the Park Service for extension of the northern and northwestern boundaries of Bandelier National Monument. In 1963, 3,925 acres (portion of Otowi Section) were placed under administrative control of the AEC by Presidential Proclamation. Land totaling 27,370 acres that formed the western and northern boundaries of Los Alamos County was transferred to the USFS in 1969. In 1973, the AEC exceded to the General Services Administration (GSA) 3,464 acres that adjoined the Western and Northern Community and Barranca Mesa areas. The GSA transferred 2,254 acres to the USFS in 1976. Also in 1976, a tract in the Los Alamos townsite (4 acres) was transferred to the GSA for eventual disposal to another government agency. Table 2-2 documents these land transactions.

Building sites, test areas, waste disposal locations, roads, and utility rights-of-way occupy the developed land at the LANL. The LANL divides the site into 33 Technical Areas (TAs). Figure 2-5 depicts the locations of the active Technical Areas within the LANL. However, these Technical Areas and other developed land uses account for only a small fraction (5.2 percent or 1,439 out of 27,800 acres) of the total land use (see Table 2-3). Most of the land provides isolation for security and safety or for future structures. TA-57 is 28 miles west of Los Alamos on the southern edge of the Valles Caldera.

Demographics

Los Alamos County in 1986 had an estimated population of approximately 18,250 (based on the 1980 census, and adjusted for 1986) (LANL, 1987a). The Los Alamos

TABLE 2-2
SUMMARY OF LAND TRANSACTIONS AT THE LANL
THROUGH 1976

Year	Acreage Involved	Cumulative Site Acreage	Comment
1942	+ 790 + 2,900 + 45,666	49,356	Original acquisition by Department of War
1947-1948	+ 19,725	69,081	Additional land acquired by AEC
1958-1965	-7,500	61,581	Community Disposal Act sold land and houses to private individuals
1959	-3,600	57,981	Land transferred to Park Service; extended northern boundary of Bandelier National Monument
1963	-2,882	55,099	Land transferred to Park Service; extended northwestern boundary of Bandelier National Monument
1963	+ 3,925	59,024	Otowi section placed under AEC control
1969	-27,370	31,654	Land forming western and northern boundaries of Los Alamos County transferred to Forest Service
1973	-3,464	28,190	Land adjoining Western and Northern Community and Barranca Mesa, excessed to GSA. In 1976, GSA transferred 2,254 acres to Forest Service
1976	-4	28,186	Land transferred to GSA

Source: DOE, 1979

ACTIVE TECHNICAL AREAS AT LANL

FIGURE 2-5

TABLE 2-3
DEVELOPED ACREAGE BY TECHNICAL AREA
(1981 Data)

Technical Area	Developed Area (Acres)
0	462.2
2	1.5
3	213.3
6	99.0
8	11.3
9	10.8
11	5.8
14	7.3
15	26.5
16	93.4
18	6.3
19	35.1
21	NA ^a
22	24.2
28	4.7
33	12.2
35	30.2
36	15.2
37	63.2
39	12.1
40	7.5
41	4.4
43	5.1
46	21.1
48	13.4
49	22.6
50	10.7
51	.9
52	15.5
53	148.3
54	67.0
55	100.0
58	2.4
59	12.6
Total	1,565.8 ^b

Source: LANL, 1982a

a. Data omitted from reference material

b. Total does not included estimate for TA-21

townsite, the original area of development, has a population of 11,400 (LANL, 1987a). The White Rock area, including White Rock, La Senda, and Pajarito Acres, has about 6,790 residents. About one-third of those employed at the LANL commute from other counties. Population estimates for 1986 indicate that about 180,000 people live within a 50-mile radius of the LANL (LANL, 1987a). Table 2-4 shows the distribution of this population around the LANL. The majority of the population is between the northeast and southeast and at distances of between 20 and 40 miles from the LANL.

Public Access

The LANL allows limited public access to certain areas of the site. An area north of Ancho Canyon between the Rio Grande and State Road 4 is open to hikers, rafters, and hunters. No woodcutting or vehicles are allowed in this area. Portions of Mortandad and Pueblo Canyons are also open to the public. An archaeological site (Otowi Tract), northwest of State Road 4 at the White Rock Y, is open to the public, but cultural resource protection regulations restrict public use. Two roads (Pajarito and East Jemez) that cross the LANL site are open to the public, but DOE has the authority to close the roads if necessary.

2.2 Overview of Major Site Operations

Since its start in 1943, the LANL's primary mission has been nuclear weapons research and development. Current programs include weapons development, magnetic and inertial fusion, nuclear fission, nuclear safeguards and security, and laser separation. There is also basic research in the areas of physics, chemistry, and engineering that supports such programs. Other programs include applied photochemistry, astrophysics, earth sciences, energy resources, nuclear fuel safeguard, laser technology, computer sciences, solar energy, geothermal energy, biomedical and environmental research, and nuclear waste management research.

TABLE 2-4
1986 POPULATION ESTIMATES
WITHIN 80 KILOMETERS OF THE LANL a,b

Direction	1-2	2-4	4-8	8-15	15-20	20-30	30-40	40-60	60-80
N	--	--	--	--	--	--	1100	--	356
NNE	--	--	--	548	--	525	1677	1742	214
NE	1	--	--	--	307	14549	978	1108	3758
ENE	--	--	--	1681	1515	2353	2538	1151	2236
E	--	--	72	22	482	992	603	--	1440
ESE	--	--	--	--	--	253	20058	1046	1448
SE	--	--	6780	--	--	--	46370	2117	7
SSE	--	--	--	--	--	--	369	3767	82
S	--	--	--	50	--	210	406	4589	--
SSW	--	--	--	20	--	540	133	5446	22136
SW	--	--	--	--	--	--	208	2748	--
WSW	--	--	--	--	--	208	207	1682	137
W	--	--	--	--	--	--	--	108	87
WNW	--	1440	6556	--	--	--	--	--	2037
NW	--	525	1727	--	--	--	--	1393	--
NNW	--	580	581	--	--	--	--	62	60

Source: LANL, 1987a

- a This distribution represents the resident, non-workforce population with respect to the Los Alamos Meson Physics Facility's stack at TA-53.
- b Total estimated 1986 population within 80 kilometers of Los Alamos is 178,118.

The operations of the laboratory are conducted in the 32 active TAs. Table 2-5 presents the primary functions of the major active TAs.

TA-3 is the main administrative and technical center of the LANL. TA-3 has a dense configuration of buildings, including some of the oldest structures at the Laboratory. The Chemical and Materials Research (CMR) Building and the Sigma Building account for a significant portion of the radioactive waste generated at the LANL.

TA-16 is the center for research into high explosives (HE) at the LANL. The site contains areas for synthesis, formulation, and testing of HE.

TA-21 engages in chemistry and high-temperature research. In addition, tritium research facilities are located in there. HE research activities are conducted at firing sites within TA-39, which is located in the southern portion of the LANL site. TA-48 is the Radiochemistry Laboratory, at which highly radioactive samples from research and development (R&D) activities at the LANL and other DOE facilities are studied. TA-50, the main liquid radioactive waste management center at the LANL, includes TA-50-1, the Liquid Radioactive Waste Treatment Plant, the Controlled Air Incinerator, and the Size Reduction Facility. TA-53 contains the Los Alamos Meson-Physics Facility (LAMPF), with its large research accelerator. The LAMPF engages in nuclear physics research and is a world-renowned center for these studies. TA-54 is the main solid waste management center for the LANL. It contains an active radioactive waste burial area (Area G), a hazardous waste treatment and storage area (Area L), as well as landfills for asbestos and classified wastes. Plutonium processing occurs in TA-55, which is one of the largest generators of radioactive waste at the LANL.

2.3 State/Federal Concerns

Representatives of the Survey team met with the U.S. Environmental Protection Agency (EPA), Region VI, and the State of New Mexico environmental agencies on February 11, 1987, as part of the pre-Survey information exchange. At this meeting,

TABLE 2-5

DESCRIPTION OF PROGRAMS IN TECHNICAL AREAS AT THE LANL

Technical Number	Area Name	Program Description
TA-2	Omega Site	Omega West Reactor, an 8-megawatt nuclear research reactor, is located here. It serves as a research tool in providing a source of neutrons for fundamental studies in nuclear physics and associated fields.
TA-3	South Mesa Site	In this main technical area, the Administration Building contains the Director's Office and administrative offices and laboratories for several divisions. Other buildings house the Central Computing Facility, administrative offices, the Materials Department, the science museum, chemistry and materials science laboratories, physics laboratories, technical shops, cryogenics laboratories, a Van de Graaf accelerator, and a cafeteria.
TA-6	Two Mile Mesa Site	This is one of three sites (TA-22 and TA-40 are the other two) used in development of special detonators for initiation of high-explosive systems. Fundamental and applied research in support of this activity includes investigation of phenomena associated with initiation of high explosives, and research in rapid shock-induced reaction with shock tubes.
TA-8	GT Site of Anchor Site West	This is a nondestructive testing site operated as a service facility for the entire Laboratory. It maintains capability in all modern nondestructive testing techniques for ensuring quality of material, ranging from test weapon components to checking of high-pressure dies and molds. Principal tools include radiographic techniques (X-ray machines to 1 million volts, a 24-MeV betatron), radioactive isotopes, ultrasonic testing, penetrant testing, and electromagnetic methods.
TA-9	Anchor Site East	At this site, fabrication feasibility and physical properties of explosives are explored. New organic compounds are investigated for possible use as explosives, and storage and stability properties are studied.
TA-11	K-Site	Facilities are located here for testing explosives components and systems under a variety of extreme physical environments. The facilities area is arranged so that testing may be controlled and observed remotely, and so that devices containing explosives or radioactive materials, as well as those containing nonhazardous materials, may be tested.

TABLE 2-5

DESCRIPTION OF PROGRAMS IN TECHNICAL AREAS AT THE LANL (Continued)

Technical Number	Area Name	Program Description
TA-14	Q-Site	This firing site is used for conducting various tests on relatively small explosive charges and for fragment impact tests.
TA-15	R-Site	This is the home of PHERMEX- a multiple-cavity electron accelerator capable of producing a very large flux of X-rays for certain weapons development problems and tests. This site is also used for the investigation of weapon function and weapon system behavior in nonnuclear tests, principally by electronic recording means.
TA-16	S-Site	Investigations at this site include development, engineering design, pilot manufacture, environmental testing, and stockpile production liaison for nuclear weapon warhead systems. Development and testing of high explosives, plastics, and adhesives and process development for manufacture of items using these and other materials are accomplished in the extensive facilities here.
TA-18	Pajarito Laboratory Site	The fundamental behavior of nuclear chain reactions with simple, low-power reactors called "critical assemblies" is studied here. Experiments are operated by remote control and observed by closed-circuit television. The machines are housed in buildings known as kivas and are used primarily to provide a controlled means of assembling a critical amount of fissionable materials. This is done to study the effects of various shapes, sizes, and configurations. These machines are also used as a source of fission neutrons in large quantities for experimental purposes.
TA-21	DP-Site	This site has two primary research areas, DP West and DP East. DP West is concerned with chemistry research. DP East is the high-temperature chemistry and tritium site.
TA-22	TD-Site	See TA-6.
TA-28	Magazine Area "A"	This site is an Explosives storage area.
TA-33	PH-Site	A major high-pressure tritium-handling facility is located here. Laboratory and office space for Geoscience Division related to the Hot Dry Rock Geothermal Project is also here.

TABLE 2-5

DESCRIPTION OF PROGRAMS IN TECHNICAL AREAS AT THE LANL (Continued)

Technical Number	Area Name	Program Description
TA-35	Ten Site	Nuclear safeguard research and development, which is conducted here, is concerned with techniques for nondestructive detection, identification, and analysis of fissionable isotopes. Research in reactor safety and laser fusion is also done here.
TA-36	Kappa Site	Various explosive phenomena, such as detonation velocity, are investigated here.
TA-37	Magazine Area "C"	Explosives storage area.
TA-39	Ancho Canyon Site	Nonnuclear weapon behavior is studied here, primarily by photographic techniques. Investigations are also made into various aspects of explosives, interaction of explosives, and explosions with other material.
TA-40	DF-Site	See TA-6
TA-41	W-Site	Personnel in this site are engaged primarily in engineering design and development of nuclear components, including fabrications and evaluation of test materials for weapons.
TA-43	Health Research Laboratory	The Biomedical Research Group does research here in cellular radiobiology, biophysics, mammalian radiobiology, and mammalian metabolism. A large medical library, special counters used to measure radioactivity in humans and animals, and animal quarters for dogs, mice, and monkeys are located in this building.
TA-46	WA-Site	Applied photochemistry, which includes development of technology for laser isotope separation and laser enhancement of chemical processes, is investigated. Solar energy research, particularly in the area of passive solar heating for residences, is conducted.
TA-48	Radio-chemistry Site	Laboratory scientists and technicians at this site study nuclear properties of radioactive materials by using analytical and physical chemistry. Measurements of radioactive substances are made, and "hot cells" are used for remote handling of radioactive materials.

TABLE 2-5

DESCRIPTION OF PROGRAMS IN TECHNICAL AREAS AT THE LANL (Continued)

Technical Number	Area Name	Program Description
TA-50	Waste Management Site	Personnel at this site have responsibility for treating and disposing of most industrial liquid waste received from Laboratory technical areas, for development of improved methods of solid waste treatment, and for containment of radioactivity removed by treatment. Radioactive liquid waste is piped to this site for treatment from many technical areas.
TA-51	Animal Exposure Facility	Here, animals are exposed to nonradioactive toxic materials to determine biological effects of high and low exposures.
TA-52	Reactor Development Site	A wide variety of activities related to nuclear reactor performance and safety are done here.
TA-53	Meson-Physics Facility	At the Los Alamos Meson-Physics Facility (LAMPF), a linear particle accelerator is used to conduct research in the areas of basic physics, cancer treatment, materials studies, and isotope production.
TA-54	Waste Disposal Site	This is a disposal area for solid radioactive waste and a storage area for hazardous waste.
TA-55	Plutonium Processing Facilities	Processing of plutonium and research in plutonium metallurgy are done here.
TA-57	Fenton Hill Site	This is the location of the Laboratory's Hot Dry Rock Geothermal Project. Here scientists are studying the possibility of producing energy by circulating water through hot, dry rock located hundreds of feet below the earth's surface. The water is heated and then brought to the surface to drive electric generators.
TA-58	Twomile Mesa	This is an undeveloped technical area.
TA-59	Occupational Health Site	Occupational health and environmental science activities are conducted here.

Source: LANL, 1987a

the Survey team representatives asked the Federal and state representatives to identify and discuss their environmental concerns about the LANL so that these could be reviewed during the DOE Survey. These concerns are summarized below.

EPA's primary interest was with LANL solid waste disposal practices in Areas L, G, P, and H, and the holding ponds near the LAMPF. All of these areas are discussed in the Waste Management section of this report.

The major issues raised by the state are summarized below:

Air - There were no pressing noncompliance issue mentioned, although the state has only a limited understanding of stack emissions, which may become a concern should the state issue hazardous air emissions regulations. In addition, state representatives are following the progress on the LANL incinerator.

Surface Water - The state representatives expressed a concern over repeated NPDES violations. In addition, they felt that there was not an exhaustive analysis of the outfalls, particularly for organics. They suggested that the Survey team look at discharge parameters beyond those included in the NPDES.

A second concern was the possibility that hazardous materials may have been disposed of at the LANL through sanitary sewers and storm drains. In addition they mentioned that septic tanks, some without bottoms, could constitute underground injection.

Finally, they expressed a concern over the potential for hazardous materials to enter surface-water courses in the area.

Groundwater - Although the state agree that the depth to groundwater is extreme in this location, they differ with the LANL on the migration potential. They also suggested that the Survey look at the seeps.

Hazardous Waste - The state felt that the LANL must be at maximum capacity for storing hazardous waste. They see little waste going off-site and are interested in finding out what is being done with it.

Relative to disposal, they expressed a concern that innovative means of disposal may have been used at the LANL that do not agree with the regulations. They also felt that boring into the tuff and placing drums into the boreholes may constitute underground injection under the Safe Drinking Water Act (SDWA). They were also concerned that these boreholes may contain hazardous wastes in addition to the low-level radioactive waste for which they were designed. They pointed out that large quantities of lead are not accounted for at the LANL. They are interested in where this lead may have been disposed of. In addition, they had heard rumors of poor disposal practices in the arroyos. In general, they would like to see waste reduction at the site.

The state also questioned if the LANL was mixing hazardous materials into its radioactive waste treatment facility at TA-50 and, if so, they are concerned about what might be coming out of that facility's outfall.

The state mentioned that materials never come out of the explosives research areas. They were interested in finding out the fate of these materials including scrap, the ash from burning, runoff, disposal of buildings contaminated with high explosives, and the oil that was used in those buildings that may have been contaminated with polychlorinated biphenyls (PCBs). They asked the Survey team to look into whether flashing material contaminated with high explosives is the best method of handling such waste materials.

Solid Waste - The state was interested in finding out where asbestos was being disposed of. They suggested that the Survey team check the radioactive waste landfills. They mentioned that the state may be issuing asbestos rules in the future.

PCBs - The state asked if any shipments were going out and if so how much.

Quality Assurance - The state suggested that the Survey team look at the analysis of organic solvent wastes.

Inactive Sites - The state suggested that the Survey team look into employee interviews conducted during the CEARP.

General - The state expressed an interest in being involved in any emergency preparedness efforts at the LANL.

PRELIMINARY

3.0 MEDIA-SPECIFIC SURVEY FINDINGS AND OBSERVATIONS

The discussions in this section pertain to existing or potential environmental problems in the air, soil, water, and groundwater media. The discussions include a summary of the available background environmental information related to each medium, a description of the sources of pollution and their control techniques, a review of the environmental monitoring program specific to each medium, and a categorization and explanation of the environmental problems found by the Survey team as they relate to each medium.

3.1 Air

3.1.1 Background Environmental Information

The Los Alamos National Laboratory (LANL) is located in the Upper Rio Grande Valley, Intrastate Air Quality Control Region 157, which includes the counties of Los Alamos, Santa Fe, and Taos (See Figure 2-1). This area is administered by U.S. Environmental Protection Agency (EPA) Region VI and the New Mexico Environmental Improvement Division (EID) for compliance with National Ambient Air Quality Standards (NAAQS) and New Mexico Air Quality Standards, respectively. Table 3-1 lists the NAAQS and the New Mexico standards for the regulated pollutants. The Federal standards establish limits for the protection of public health (Primary Standards) and welfare (Secondary Standards); New Mexico has only one class of standard, but these standards are more restrictive than the Federal standards and include additional pollutants. The air quality in AQCR 157 has been designated by EPA as either being better than the national standards or not classified for each of the criteria pollutants (BNA, 1984). Additional Federal and New Mexico regulations covering the emissions of radioactive and other toxic compounds include the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (Title 40 CFR Part 61) and New Mexico Air Quality Control Regulation (AQCR) 751. New Mexico also regulates open burning (AQCR 301) and visible emissions (AQCR 401).

The Clean Air Act amendments of 1977 include requirements on the Prevention of Significant Deterioration (PSD) of air quality conditions in designated PSD areas.

TABLE 3-1

FEDERAL AND NEW MEXICO AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	Units	New Mexico	Federal	
				Primary	Secondary
Sulfur Dioxide	Annual Arithmetic Mean	ppm	0.02	0.03	
	24 hours ^a	ppm	0.1	0.14	0.5
	3 hours ^a	ppm			
Total Suspended Particulates	Annual Geometric Mean	$\mu\text{g}/\text{m}^3$	60	75	60
	30 days	$\mu\text{g}/\text{m}^3$	90		
	7 days	$\mu\text{g}/\text{m}^3$	110		
	24 hours ^a	$\mu\text{g}/\text{m}^3$	150	260	150
Carbon Monoxide	8 hours ^a	ppm	8.7	9	
	1 hour ^a	ppm	13.1	35	
Ozone	1 hour ^b	ppm	0.06	0.12	0.12
Nitrogen Dioxide	Annual Arithmetic Mean	ppm	0.05	0.05	0.05
	24 hours ^a	ppm	0.10		
Lead	Calendar Quarter	$\mu\text{g}/\text{m}^3$	1.5	1.5	1.5
Beryllium	30 days	$\mu\text{g}/\text{m}^3$	0.01		
Asbestos	30 days	$\mu\text{g}/\text{m}^3$	0.01		
Heavy Metals (total combined)	30 days	$\mu\text{g}/\text{m}^3$	10		
Non-Methane Hydrocarbons	3 hours	ppm	0.19		

Source: LANL, 1987a

^a Maximum concentration not to be exceeded more than once per year.^b Standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the limit is equal to or less than 1.

The areas designated Class I have the most stringent requirements on the allowable impact from major new sources. These requirements include preconstruction review, best available control technology for emissions, permissible increments in pollutants, visibility protection, and air quality monitoring. Bandelier National Monument and wilderness area is a Class I Area adjacent to the southern boundary of the LANL. Construction of any significant sources of air pollutants at the LANL would require extensive regulatory review under the PSD requirements.

Radioactive materials discharged to the atmosphere at the LANL consist of many different isotopes either as particulates or as gases. Gaseous emissions of regulated/hazardous pollutants consist primarily of combustion products emanating from the steam plants and from the burning of waste high explosives (HE) and other wastes contaminated with HE material. Information on the general air quality and background radiation levels for the area around Los Alamos is presented below.

3.1.1.1 Air Quality

Measurements of total suspended particulates, ozone, and sulfur dioxide were made during 1986 in the vicinity of the LANL. Total suspended particulates (TSP) were measured in Los Alamos and White Rock once every 6 days by the NMEID. Additional TSP data were collected for the first two quarters of 1986 at a special air quality monitoring station operated by the LANL near TA-49 at the southern boundary of the site (Figure 2-5). This station is not part of the regular monitoring program at the LANL and operations there were discontinued after two quarters, owing to lack of funding. The results of the 1986 TSP sampling programs are summarized in Table 3-2. TSP measurements were well below the state and Federal 24-hour standards. However, measurements were not made frequently enough to determine the 7- and 30-day concentrations for comparison with the state standards. Based on the relatively low concentrations of the collected samples, the state standards are expected to be met (LANL, 1987a).

The station also collected hourly data on ozone and sulfur dioxide concentrations. All sulfur dioxide measurements were below the minimum detection limit. However, the New Mexico standard for ozone of 0.060 ppm, hourly average, was

TABLE 3-2

TOTAL SUSPENDED PARTICULATES MEASUREMENTS FOR 1986

Federal and State Ambient Air Quality Standards ($\mu\text{g}/\text{m}^3$)		Measurements ($\mu\text{g}/\text{m}^3$)		
Type	Concentration	Los Alamos	White Rock	LANL
24-Hour Average ^a		44 ^c (60 ^d)	50 ^c (60 ^d)	5 to 39
State ^b	150			
Federal				
Primary	260			
Secondary	150			
7-Day Average ^b	110	e	e	e
30-Day Average ^b	90	e	e	e
Annual Geometric Mean		18 ^d	20 ^d	16 ^f
Primary	75			
Secondary	60			

Source: LANL, 1987a

^aNot to be exceeded more than once per year.^bNew Mexico state standard only.^cSecond highest^dHighest.^eInsufficient data.^fMean for two quarters.

exceeded once during the second quarter of 1986. The exceedance was most likely caused by distant urban sources rather than to sources within the LANL (LANL, 1987a). The monitoring station was positioned upwind of the LANL and the City of Los Alamos relative to the predominant wind direction. In the first two quarters of 1986, hourly ozone concentrations ranged between 0.009 and 0.076 ppm, with a mean of 0.040 ppm.

3.1.1.2 Background Radiation

Worldwide background atmospheric radioactivity is composed largely of fallout from past atmospheric nuclear weapons tests, natural radioactive constituents from the decay chains of thorium and uranium in dust, and materials resulting from interactions with cosmic radiation (e.g., natural tritiated water vapor produced by interactions of cosmic radiation and stable water). Atmospheric particulates result primarily from soil particles that are blown by the wind. Consequently, changing meteorological conditions often cause large daily and seasonal fluctuations in airborne radioactivity levels. Windy, dry days can result in relatively high concentrations of airborne particulates, whereas precipitation (rain or snow) can wash out many particles from the atmosphere.

The EPA determines airborne radiation levels at major cities throughout the U.S. to monitor fallout from nuclear devices and other forms of radioactive contamination of the environment. The closest EPA monitoring station to the LANL is in Santa Fe, 25 miles to the southeast. Additional monitoring stations encompassing LANL include El Paso, Texas; Oklahoma City, Oklahoma; Denver, Colorado; and Las Vegas, Nevada. Table 3-3 presents the 1985 average gross beta, uranium, plutonium, and gamma radiation levels at each of these cities. Measured ambient levels of uranium and plutonium are significantly less than the Derived Concentration Guide (DCG) values for off-site uranium-238 and for plutonium-239 of 1×10^5 and 2×10^4 attocuries per cubic meter, respectively, promulgated by the DOE. (One attocurie equals 10^{-18} curies.) A DCG is the concentration of a radionuclide in air that results in a whole-body or organ dose equal to the DOE Radiation Protection Standard of 100 millirem per year above background. The higher elevations of Santa Fe and Denver account for a larger exposure to external gamma radiation than at lower elevations.

TABLE 3-3

**AVERAGE BACKGROUND CONCENTRATIONS OF RADIOACTIVITY IN THE
ATMOSPHERE, 1985**

Radioactive Constituent	Units ^a	Santa Fe, NM	El Paso, TX	Oklahoma City, OK	Denver, CO	Las Vegas, NV
Gross beta	pCi/m ³	0.01	0.015	0.01	0.01	0.01
Uranium - 234, 235, 238	aCi/m ³	50	134	51	69	190
Plutonium - 238, 239	aCi/m ³	0.09	2.3	1.5	1.1	3.4
External gamma	Millirem	128	NA	76	128	71

Source: EPA, 1986c

a. pCi, picocurie (10^{-12} curie); aCi, attocurie (10^{-18} curie); millirem (10^{-3} rem).

3.1.1.3 Meteorology

The climate for Los Alamos is typical for a semiarid continental region. The elevation of the LANL and of the adjacent communities of White Rock and Los Alamos City (6,200 to 7,800 ft) and the rugged terrain around the towns influence the local weather and wind conditions to a greater degree than is the experience at most towns.

Surface movements of air in the Los Alamos region are strongly influenced by the mesa, which slopes away from the Jemez Mountains to the west. The mesa is divided by canyons that drain eastward into the Rio Grande Valley some 1,000 to 1,500 feet below. After sunset, cooler air from the mountains flows across the mesas and channels through the canyons into the river valley. During the day, the flow is reversed with upslope winds. The winds at Los Alamos are generally light, with the average speed nearly 7 mph. Wind direction varies by specific location at the LANL and by time of day primarily because of the terrain features. An analysis of the winds by time of day shows the westerly flow to be most dominant at night, giving way to a southeasterly breeze after sunrise, and with predominantly south through southwesterly winds in the afternoon (DOE, 1979). A description of the meteorological monitoring program at the LANL is provided in Section 3.1.3.3.

The strong solar radiation and predominantly southerly winds provide good conditions for dispersion of airborne releases during the day. However, the nighttime drainage winds exhibit stable thermal stratification and a reduced level of turbulence. Therefore, these flows, present during about 10 percent of nighttime hours, have the poorest capacity for dilution of any airborne pollutants that may be released (DOE, 1979). Flows within the canyons are further restrained by the presence of the canyon walls. At night, air flows through Pajarito Canyon past several technical areas and exits onto the community of White Rock.

Another complicated transport process has been identified that is relevant to potential dispersion of emissions from Technical Areas (TAs) located in the bottom of canyons. Two mechanisms have been documented that can lead to an exchange of air between canyon and mesa tops. The first is convective mixing in an unstably stratified atmosphere. This is basically a daytime phenomenon, probably most prevalent in the warmer seasons. The second mechanism occurs under all stabilities

when the cross-canyon wind exceeds 4.5 mph. There is a separated flow giving rise to a major roll eddy down one side of the canyon, across the bottom, and up the other side. Under these conditions, emissions within a canyon could be readily transported from the canyon bottom to the mesa top (DOE, 1979).

3.1.2 General Description of Pollution Sources and Controls

There are several facilities within the laboratory that emit radionuclides and regulated effluents to the atmosphere. Many of these facilities have more than one emission point and emit more than one type of radionuclide or gaseous pollutant. Table 3-4 presents a summary of the major regulated air pollutants emitted during 1986 by TA. Figure 3-1 shows the location of the major air pollution sources at LANL. Table 3-5 presents by TA a summary of radionuclide emissions during 1986. The largest contributors of regulated/hazardous pollutants include the steam boilers, HE burnings, the asphalt plant, test firings, beryllium machining, and the lead-pouring facility. The largest sources of radionuclides include the Los Alamos Meson-Physics Facility (LAMPF), the Omega West Reactor, and the High-Pressure Tritium Facility.

3.1.2.1 Steam Boilers

On a mass basis, the majority of LANL emissions come from the burning of natural gas for space heating at the steam plants in TA-2, 3, 16, and 21 (see Figure 3-1). Emission estimates for the steam plants are reported in Table 3-4. The NO_x emissions from the TA-3 plant were estimated based upon boiler exhaust gas measurements (LANL 1987a). Exhaust gas measurements also indicated that SO_x levels in the exhaust gases were below minimum detectable levels. Emission factors from the EPA were used by the LANL in making the other emission estimates (EPA, 1984a). Approximately half the total air emissions at the LANL come from the TA-3 steam plant.

The New Mexico AQCR 604 requires gas-burning equipment built prior to January 10, 1973, to meet an emission standard for NO_x of 0.3 lb/10⁶ Btu when natural gas consumption exceeds 10¹² Btu/yr/unit. The TA-3 power plant's boilers have the potential to operate at heat inputs which exceed the 10¹² Btu/yr/unit criterion,

TABLE 3-4

REGULATED AND HAZARDOUS POLLUTANT EMISSIONS, 1986 (kg/yr)

Location	Source	Particulates	Oxides of Nitrogen	Carbon Monoxide	Hydrocarbons	Beryllium	Uranium	Lead
TA-2	Steam Plant ^a	10	<300	<65	<17			
TA-3	Steam Plant Asphalt Plant Machine Shops CMR and Sigma Lead Facility	3,600 100	13,700	21,400	900	<23 x 10 ⁻⁶	1.9 ^b	2
TA-16	Steam Plant HE Burning	363 359	17,780 602	4,445 155	725 2			
TA-21	Steam Plant Main Stacks (FE-3,6)	90	5,000	1,300	180		0.64 ^b	
TA-35	Building 213					<28 x 10 ⁻⁶		
Firing Sites (TA: 14, 15, 36, 39)						.042	20	97

Source: LANL, 1987a

^aFuel consumption estimated at less than 7.2 x 10⁶ Btu/yr.^bMass emissions based on reported emissions in curies from Table 3-5 and a conversion factor of 2,000 kg/Ci.

LOCATION OF MAJOR AIR POLLUTION SOURCES
AT LANL

FIGURE 3-1

TABLE 3-5

AIRBORNE RADIOACTIVE EMISSIONS TOTALS^a, 1986

Location	238, 239, 240Pu ^b (μ Ci)	235, 238U ^c (μ Ci)	Mixed Fission Products (μ Ci)	131I (μ Ci)	41Ar ^d (Ci)	32P (μ Ci)	3H (Ci)	Activation Products	
								Gaseous (Ci)	Particulate/ Vapor ^f (Ci)
TA-2					276				
TA-3	194	531	47.9	38.0			1,230		
TA-9									
TA-15									
TA-18									
TA-21	3.6	212	0.3				448		
TA-33							6,660		
TA-35	0.4						48		
TA-41							1,320		
TA-43	2.9					70			
TA-46		<0.1							
TA-48	2.8	0.6	2,500						
TA-50	2.9		20.1						
TA-53					336		6	112,000	0.1
TA-54	0.2								
TA-55	0.2						1,010		
Totals	207	844	2,570	38.0	276	70	10,700	112,000	0.1

Source: LANL, 1987a

^aAs reported on DOE Forms F-5821.1.^bPlutonium values contain indeterminate traces of ²⁴¹Am, a transformation product of ²⁴¹Pu.^cDoes not include aerosolized uranium from explosives testing (Table 3-4).^dDoes not include 336 Ci of ⁴¹Ar included in gaseous, mixed activation products.^eIncludes the following constituents: ¹⁶N - 0.9%; ¹⁰C - 2.0%; ¹⁴O - 1.2%; ¹⁵O - 35.6%; ¹³N - 21.7%; ¹¹C - 38.2%; ⁴¹Ar - 0.4%.^fIncludes 38 nuclides, including 0.07 Ci of ¹⁸³Os (particulate) and 0.02 Ci of ⁸²Br (vapor).

but they have not done so. Thus, these boilers have not been subject to the requirements of this regulation. In 1986, the power plant's boilers, numbered 1, 2 and 3, consumed 0.5, 0.7, and 0.1×10^{12} Btu of natural gas, respectively. The TA-3 power plant easily meets the emission standard under New Mexico AQCR 604, although it is not required to do so. The emission standard is equivalent to a flue gas concentration of 248 ppm, based on the average air consumption rate per 10^{12} Btu. The TA-3 boilers meet the standard with measured flue gas concentrations of between 14 and 22 ppm NO_x (LANL, 1987a).

3.1.2.2 Burning of High Explosives

Additional sources of the NAAQS criteria pollutants include the burning of HE and HE-contaminated wastes at the TA-16 burn grounds and the open burn cage, respectively (see Figure 3-1). Emissions from these operations vary from year to year, depending on program requirements. During 1986, a total of 20 tons of HE wastes were disposed of by open burning at the TA-16 burn ground (LANL, 1987a). Estimates of emissions resulting from this burning were developed by the LANL and are reported in Table 3-4. These estimates were made by using data from HE burn tests carried out by Mason and Hanger-Silas Mason Co., Inc. (MHSM, 1977).

Under New Mexico AQCR 301, the open burning of explosive materials is permitted when the transportation of such materials to other facilities could be dangerous. The DOE and the LANL are permitted to burn waste explosives and explosive-contaminated wastes. The burning of potentially HE-contaminated wastes is carried out at the TA-16 burn cage.

There are plans to replace the burn cage with an enclosed two-stage incinerator, in which complete combustion would occur. The incinerator has been purchased, and plans call for it to be delivered and installed during 1987. An air pollution health and regulatory compliance review has been completed at the LANL for the incinerator. The review concluded that ambient air concentrations of any pollutant would not be a health concern and that neither a permit nor registration with the NMEID would be required (LANL, 1987a).

3.1.2.3 Asphalt Plant

The asphalt plant is located on East Jemez Road, just east of TA-3 (see Figure 3-1). Annual estimates by the LANL of the particulate emissions from the asphalt plant are given in Table 3-4. The particulate emission estimate was based upon stack testing data (Kramer, 1977) and production data. The particulate emissions from the plant are low because the dryer is heated with natural gas, and the asphalt mixer is heated with steam from the TA-3 power plant. A multicyclone and a wet scrubber are used to clean the exhaust gas stream before it is released into the atmosphere.

The New Mexico AQCR 501 sets emission standards according to process rate and requires the control of fugitive emissions from asphalt processing equipment. The asphalt plant meets the stack emission standard for particulates as specified in this regulation. The plant, which has a 75 ton/hr capacity, is required to meet an emission limit of 35 pounds of particulates per hour. A stack test of the asphalt plant in 1977 indicated an average emission rate of 1.8 lb/hr and a maximum rate of 2.2 lb/hr over three tests (Kramer, 1977). The asphalt plant, operated by Pan Am World Services, is old and subject to leaking; it is inspected semiannually. During one of the two inspections that took place during 1986, leaks causing fugitive emissions were discovered, and Pan Am repaired the leaks.

3.1.2.4 Test Firings

Dynamic experiments employing conventional explosives are routinely conducted at certain test firing sites at the LANL (see additional discussion in Section 3.2 and Figure 3-1). In some experiments these explosives contain toxic metals including uranium, beryllium, and lead. As shown in Table 3-6, estimates by the LANL of average concentrations of these toxic metals downwind from the detonations are that they were less than 0.01 percent of applicable standards. These estimates are based upon information concerning the proportion of material aerosolized as determined from limited field experiments involving aircraft sampling, and the amounts of toxic metals used in the 1986 experiments.

TABLE 3-6
ESTIMATED AERIAL CONCENTRATIONS OF TOXIC ELEMENTS
AEROSOLIZED BY DYNAMIC EXPERIMENTS

Element	1986 Total Usage (kg)	Fraction Aerosolized (%)	Annual Average Concentration (ng/m ³)		Applicable Standard (ng/m ³)
			(4 km)	(8 km)	
Uranium	200	10	0.02	0.008	9,000 ^a
Be	2.1	2	6 x 10 ⁻⁵	12 x 10 ⁻⁵	100
Pb	97	100 ^c	0.11	0.04	1,500 ^d

Source: LANL, 1987a

a DOE, 1981.

b Thirty day average. New Mexico Air Quality Control Regulation 201.

c Assumed percentage aerosolized.

d Three-month average 40 CFR 50.12.

3.1.2.5 Beryllium Machining

Beryllium machining operations are located in shop 4 at TA-3-39, in shop 13 at TA-3-102, and in the beryllium shop at TA-35-213 (see Figure 3-1). Beryllium machining takes place only a few days per year at each of the shops. At the time of the Survey a new beryllium processing facility located at TA-3-141 was being completed to begin operation in late 1987. Exhaust air from each of these operations passes through air pollution control equipment before exiting from a stack. A baghouse type of filter is used to control emissions from shop 4. The other operations use HEPA filters to control emissions. The air pollution control systems have rated particulate removal efficiencies greater than 99.9 percent.

Stack emission tests, using methods approved by the EPA and the New Mexico EID, were performed for each of the beryllium machining shops during 1986. As shown below, these tests confirmed that the measured maximum emissions were far below the emission limits specified in the air quality permits issued by the New Mexico EID.

Beryllium Emission Tests

<u>Location of Beryllium Shop</u>	<u>Beryllium Emissions</u>			
	<u>Measured Maximum</u>		<u>Permit Limits</u>	
	<u>10-8 lb/hr</u>	<u>10-8 tons/yr</u>	<u>10-8 lb/hr</u>	<u>10-8 tons/yr</u>
TA-35-213	3	3.1	40	40
TA-3-39, Shop 4		<1.4	400	400
TA-3-102, Shop 13	<5.9	<1.1	40	7

Source: LANL, 1987a

3.1.2.6 Lead-Pouring Facility

Pan Am World Services operates a lead-pouring facility at TA-3-38 (see Figure 3-1) for the production of lead castings. During 1986 approximately 10,000 pounds of lead were heated in a gas-fired oven until molten, and then poured into molds. LANL estimated 1986 annual lead emissions from this facility at 4.4 lb (LANL, 1987a).

The emission estimates were based upon the amounts of lead poured and the EPA emission factor for lead-casting operations (EPA, 1984a).

Both Federal and state ambient air quality standards for lead are $1.5 \mu\text{g}/\text{m}^3$ averaged over a calendar quarter. Air dispersion procedures recommended by the EPA (EPA, 1986a) were used by the LANL to estimate the maximum quarterly average of lead concentrations caused by emissions from the lead-pouring facility. These procedures provide conservative concentration estimates. The maximum quarterly concentration for 1986 was estimated by LANL to be $0.03 \mu\text{g}/\text{m}^3$, or 2 percent of the standard (LANL, 1987a).

3.1.2.7 Radioactive Emissions

Radioactive pollutants emitted at the LANL consist primarily of argon-41, tritium, and other gaseous activation products from the Los Alamos Meson-Physics Facility (LAMPF). Much smaller quantities of other radionuclides are also emitted as shown in Table 3-5. Microcurie amounts of uranium, plutonium, and mixed fission products are released from several technical areas. Mixed fission products are lighter elements that are produced from the fissioning, or splitting, of heavier elements. Released quantities of mixed fission products have ranged from 1,200 μCi per year to 2,600 μCi per year between 1983 and 1986. The majority of these emissions came from the radiochemistry laboratory at TA-48. Additionally, very small amounts of iodine-131 and phosphorus-32 were emitted from the Chemistry Metallurgy (CMR) Building in TA-3 and from the Health Research Laboratory (HRL), TA-43, respectively.

Although the approximately 112,000 curies of gaseous activation products emitted from the LAMPF (TA-53) constitute the largest single source of airborne radioactive emissions at the LANL, these emissions are all short-lived isotopes; the longest half-life being only 110 minutes for argon-41. The half-lives of radioactive emissions are important in determining the dose to the public, especially for those elements that may be retained in the body. Additional information on the assessment of exposure and dose is provided in Section 3.1.3.4, Radiation Dose Calculations, and in Section 4.3, Direct Radiation. The remainder of this section describes the three most prominent forms of airborne radiation at the LANL: argon-41, tritium, and gaseous activation products.

Los Alamos Meson-Physics Facility

The LAMPF consists of a linear proton accelerator approximately 0.5-mile long located in TA-53 (see Figure 3-1). The LAMPF is designed to produce an 800-million electron volt proton beam. The energetic protons strike a target to produce subnuclear particles called pi mesons. A consequence of the beam's impinging on the target is the generation of activation products from the interaction of the protons with the materials in the target area. In the same area the remainder of the beam is dissipated upon striking a water-cooled copper plate. The activation products are generated within this beam stop area, which contains some lead shielding blocks in addition to the copper and ambient air. The beam stop area space is ventilated, and the cooling air is exhausted through a single stage of High-Efficiency Particulate Air (HEPA) filters and out to the atmosphere via a 60-foot stack.

The radionuclides emitted from the LAMPF operation cover a wide spectrum. Proton activation of the normal isotopes of the ambient air constitutes nearly all of the emissions, consisting principally of argon-41 and short-lived isotopes of oxygen, carbon, and nitrogen, as shown in Table 3-7. The proton interactions with copper and lead present in the beam stop area generate a relatively insignificant but detectable amount of particulate and vapor activation products. Most of these products are extremely short-lived nuclides with half-lives ranging from several minutes to several days. Gamma spectroscopy measurements of these activation radionuclides have resulted in the identification of 42 radionuclides, including beryllium-7 at the light end and mercury-203 at the heavy end. The LAMPF is the source of the largest amount of airborne radioactivity at the LANL and contributes the largest off-site dose. Although the emissions are presented in Table 3-7 as annual emissions, for the past few years the LAMPF has operated for approximately 6 months each year, from the end of June into December.

Emissions from the LAMPF have been significantly higher in the past, due to conditions in the beam stop area. As the LAMPF reached full beam power in 1983 and 1984, emission rates and off-site dose at the site boundary rose significantly. Emissions in 1984 totaled 734,000 curies and resulted in a dose of 44 mR (Guevara and Dvorak, 1986). A series of repairs and design changes were implemented to

TABLE 3-7

GASEOUS ACTIVATION PRODUCT EMISSIONS FROM THE LAMPF MAIN
STACK, 1986

Radionuclide	Half-Life (seconds)	Emission (Ci/yr)	Concentration (Ci/m ³)
³ H	3.87×10^8	6.07×10^0	3.12×10^{-8}
⁴¹ Ar	6.59×10^3	3.36×10^2	1.72×10^{-6}
¹⁰ C	1.95×10^1	6.72×10^2	3.45×10^{-6}
¹¹ C	1.22×10^3	3.92×10^4	2.01×10^{-4}
¹⁴ O	7.09×10^1	5.60×10^2	2.87×10^{-6}
¹⁵ O	1.23×10^2	4.70×10^4	1.07×10^{-4}
¹³ N	5.98×10^2	2.08×10^4	1.07×10^{-4}
¹⁶ N	7.14×10^0	3.36×10^3	1.72×10^{-4}

Source: Guevara and Dvorak, 1986

reduce radioactive emissions. Repairs to the water cooling system and improved maintenance have decreased the production of the activation products. Another change consisted of enclosing the target area in a 12-cubic-meter steel box with low volume ventilation. The slow exchange of air allows sufficient time for some radionuclides to decay in the box. Also, most of the lead was removed from the beam stop area since it was being vaporized. These changes have resulted in an 800-percent decrease in emissions per operating ampere-hour since 1984 (Guevara and Dvorak, 1986).

Omega West Reactor

The Omega West Reactor is an 8-megawatt, water-cooled, tank-type reactor located at TA-2 (see Figure 3-1). It serves as a research tool in providing a source of neutrons for fundamental studies in nuclear physics. The components of the reactor include a 6-foot-diameter thermal column (so called because its purpose is to reduce the energy of fission neutrons to thermal energy by absorption) made up of graphite blocks in addition to its aluminum casing. Air that is vented from this column to the atmosphere is the only emission source, and it contains detectable quantities of argon-41. Argon-41 is a neutron activation product of the argon-40 normally present in the air. Cooling air from the thermal column is vented through an underground pipe. The pipe crosses the canyon and continues up the canyon wall to a 150-foot stack on top of South Mesa. In 1986, 276 curies of argon-41 were released from the Omega West Reactor (see Table 3-5).

High-Pressure Tritium Facility

Annual emissions of tritium from 1983 through 1986 have ranged between 7,900 and 14,800 curies (LANL, 1984, 1985, 1986a, and 1987a). These release rates include both the gaseous and water vapor (HTO) forms of tritiated hydrogen. The tritium is released from eight facilities in seven technical areas, but the largest source each year (48 to 62 percent) has been the high-pressure tritium-handling facility at TA-33. During 1986 operations, approximately 6,700 curies were released from this remotely located site. During normal operations, the ventilation exhaust from this area is passed through a silica gel desiccant unit to remove any entrained tritiated water. However, the bulk of the tritium emitted is in the form of molecular gas, which requires expensive catalyst-enhanced oxidation for removal. Therefore,

except for abnormal occurrences, the ventilation air from the test chamber is exhausted directly to the atmosphere, with only the dryer unit online. Routine releases from the changing of tanks, and unplanned releases due to operator error or equipment malfunction, are exhausted directly to the main stack without going through the dryer. Unplanned releases contributed a significant portion (2,345 curies) of the TA-33 annual emissions during 1986 (Bowen, 1987; Dewart and Buhl, 1986, 1987).

A new tritium processing facility at TA-16 has been built, but it was not operational at the time of the Survey. The facility was expected to start operating in late 1987, at which time operations at TA-33 are to be phased out. The new facility will employ an automated system that monitors the tritium concentrations and activates the cleanup systems at preset concentrations. The cleanup system will convert hydrogen gas to water vapor, and then remove the water vapor from the air before being exhausted (Guevara and Dvorak, 1986).

3.1.3 Environmental Monitoring Programs

The atmospheric monitoring program at the LANL has three major components: stack emissions monitoring for radionuclides, ambient air monitoring for particulate radionuclides and tritiated water vapor, and a meteorological monitoring network. Direct radiation is also monitored within and around the LANL. Data on stack emissions and meteorological conditions are modeled to estimate the off-site dose to the public on an annual basis and for any unusual or unplanned releases that might occur. Monitoring data are used to calculate the maximum individual doses over a 50-year period attributable to the inhalation exposure for the year. The ambient air monitoring program also provides confirmatory data on the emissions monitoring program and the effectiveness of emission controls. The following sections present information on the stack monitoring methods, the ambient air sampling program, the meteorological monitoring system, and the calculation of radiation doses from airborne emissions.

3.1.3.1 Emissions Monitoring

Radioactive airborne emissions are discharged and monitored from 87 stacks at the LANL. These emissions consist primarily of filtered exhausts from glove boxes and

other laboratory operations, tritium in both hydrogen gas and water vapor, argon-41 from Omega West Reactor, and other gaseous emissions from the LAMPF. Details on these emission sources and quantities emitted are provided in Section 3.1.2. Monitoring for particulate emissions is accomplished by drawing an aliquot of stack effluent through a probe to a fixed collector system containing a 2-1/8-inch-diameter filter media disc of fiberglass composition. These discs are collected weekly for analysis at the Health Physics Analysis Laboratory. The system includes a weatherized enclosure, a positive displacement air pump connected to a 1-hp electric motor, and a float-type rotameter. Sample flow rates are maintained at 2 or 3 ft³/minute as measured by the rotameter. The flow meter is calibrated quarterly with a standardized venturi gauge with a calibration traceable to the National Bureau of Standards. The error of the sampling flow rate is estimated to be ± 15 percent (Guevara and Dvorak, 1986).

Tritium emissions are monitored continuously at buildings where tritium is used. A portion of the exhaust is passed through an ionization chamber, and the measured current in the chamber is integrated over the 4- or 5-week reporting period. Health and Safety technicians calculate the tritium emissions from the integrated current readings according to specific procedures for each facility. The monitoring systems are calibrated annually with a secondary transfer standard according to procedures, and the monitors have an accuracy of ± 20 percent.

The Omega West Reactor exhaust stack is monitored for argon-41 by using a commercial beta-gamma continuous air monitor (CAM). The stack is on South Mesa, several hundred feet from and above TA-2. The travel time for the exhaust is approximately 45 minutes through the underground pipes to the stack. Since the half-life of argon-41 is approximately 110 minutes, there is a reduction in the emitted radioactivity due to the transport time. A 2-ft³/minute sample of the stack flow is drawn through a moving-belt-type particulate filter that is counted in the detection chamber of the CAM. An NaI scintillation detector measures the disintegration of the argon-41. The argon-41 activity is simultaneously displayed in counts per second on an analog meter on the CAM and remotely in the reactor control room, where the counts are recorded. A cesium-137 test source is used to calibrate the CAM on a quarterly basis.

Emissions from the LAMPF are determined continuously by measurement with an ionization detector. However, since there are several radionuclides formed at the beam stop, the determination of the isotopic composition of the emissions complicates the analysis. The composition of the gaseous emissions is determined infrequently (between one and four times during a 6-month operating period), depending on the time available to the analyst and the operating conditions at the LAMPF. There appears to be little variation, though, in the relative proportion of the radionuclides produced. Draft procedures have been developed for the analysis of the isotopes and for measurement of the quantities emitted.

The stack flow rates must be known at all monitored stacks in order to calculate the mass emissions. The stack flow rates are measured by a 12-point traverse, using a standard pitot tube and an electronic digital microanemometer (EDM). The EDM is calibrated against an inclined-gauge manometer to verify its accuracy. The measurements satisfy the standard EPA Method 1 requirements for accuracy (EPA, 1984b), and are estimated to be accurate to within ± 20 percent (Guevara and Dvorak, 1986). The LAMPF stack is an exception, since its exit velocity is monitored continuously. The signal from the in-stack monitor is processed by the meteorological system at the LAMPF, and an average flow rate is calculated based on the stack's cross-sectional area.

In addition to the measurement of stack emissions, LANL has 12 thermoluminescent dosimeters (TLDs) located so as to monitor LAMPF emissions. These are discussed in the following section.

3.1.3.2 Ambient Air Sampling

Airborne particulates and water vapor are collected at 26 continuously operating air sampling stations: 3 regional background samplers, 11 perimeter stations within 2.5 miles of the LANL boundary, and 12 on-site stations within the LANL boundary. Figure 3-2 shows the locations of the perimeter and on-site stations. The three regional stations are located in Santa Fe, Espanola, and Pojoaque (see Figure 2-1).

AIR SAMPLER LOCATIONS ON OR NEAR LANL

FIGURE 3-2

At each station, air pumps with flow rates of about 3 liters per second collect airborne particles on polystyrene filters 79 millimeters in diameter. Each filter is mounted on a cartridge that contains charcoal. This charcoal is not routinely analyzed for radioactivity, but if an unplanned release occurs, it can be analyzed for any iodine-131 that may have been collected. Part of the total airflow (2.4 to 3.1 mL/sec) is passed through a cartridge containing silica gel to adsorb atmospheric water vapor for tritium analysis. Airflow rates through both sampling cartridges are measured with rotameters, and sampling times are measured by an elapsed-time meter. The entire air sampling train at each station is cleaned, repaired, and calibrated as necessary.

Two clean control filters are used to detect any possible contamination of the 26 sampling filters while they are in transit. The control filters accompany the 26 sampling filters when they are placed in the air samplers and when they are retrieved. Then the control filters are analyzed for radioactivity just like the 26 sampling filters. Analytical results for the control filters are subtracted from the appropriate gross analytical results to obtain net analytical data.

At one on-site location at TA-59, airborne radioactivity samples are collected weekly rather than monthly. Airborne particulate matter on each weekly filter is counted for gross alpha and gross beta activities, which help trace temporal variations in radionuclide concentrations in ambient air. The same measurements are made on a monthly filter from the Espanola (Station 1) regional air sampler.

On a quarterly basis, the three monthly filters for each station are cut in half. The filter halves are combined to produce two quarterly composite samples for each station. The first group is analyzed for plutonium-238, 239, and 240 and for americium-241 on selected filters. The second group is analyzed for uranium.

Silica gel cartridges from the 26 air sampling stations are analyzed monthly for tritiated water. The cartridges contain blue indicating gel to indicate the degree of desiccant saturation. During cold months with low absolute humidity, sampling flow rates are increased to ensure collection of enough water vapor for analysis. Water is distilled from each silica gel cartridge, and an aliquot of the distillate is analyzed for tritium by liquid scintillation counting. The amount of water absorbed

by the silica gel is determined by the difference between weights of the gel before and after sampling.

Table 3-8 presents summary data for the particulate samples and tritiated water samples from the air monitoring stations for 1986. The highest concentrations of radioactive particulates were measured at TA-54, where active waste disposal operations bury radioactive and toxic waste. TA-54 also had one of the larger tritium concentrations, along with TAs-2, 21, and 33, where tritium is part of the operational process. In general, the concentrations on-site are greater than those at the perimeter stations. However, all measured concentrations are less than 0.1 percent of the applicable DCGs. The guides for controlled and uncontrolled areas are listed in the footnotes to Table 3-8.

As an additional check on the emissions from the LAMPF, a network of TLDs has been established at the LAMPF.

This network monitors radiation from airborne activation products (gases, particles, and vapors) released by the LAMPF. The prevailing winds are from the south and southwest, and 12 TLD sites are located downwind at the laboratory boundary north of the LAMPF along 800 m (2,600 feet) of canyon rim. An additional 12 background TLD sites are about 9 km (5.5 miles) from the facility along a canyon rim near the southern boundary of the laboratory. This background location is not influenced by any laboratory radiation sources.

The 24 TLDs are changed each calendar quarter, or sooner depending upon the LAMPF's operating schedule. The radiation measurement (above background) for this network was 18 ± 3 mrem for 1986. This value was obtained by subtracting the annual measurement at the background sites from the annual measurement at the laboratory's boundary north of the LAMPF. This 18-mrem increment translates to an estimated 11.5-mrem whole-body dose to an individual living along State Road 4 north of the LAMPF (LANL, 1987a).

3.1.3.3 Meteorological Monitoring

The meteorological monitoring network is operated to support emergency response, routine environmental assessment, atmospheric dispersion research,

TABLE 3-8
AVERAGE ATMOSPHERIC CONCENTRATIONS FOR 1986

Station Location ^a	^{239,240} Pu (10 ⁻¹⁸ μ Ci/mL) ^{b,c}	²⁴¹ Am (10 ⁻¹⁸ μ Ci/mL) ^d	U (pg/m ³) ^e	Tritiated Water (10 ⁻¹² μ Ci/mL) ^f
Regional Stations (24-44 km)				
1. Espanola	1.5 $\pm$ 1.6	NA	62.6 $\pm$ 9.0	2.5 $\pm$ 5.8
2. Pojoaque	1.1 $\pm$ 0.4	NA	73.4 $\pm$ 27	5.0 $\pm$ 13
3. Santa Fe	1.9 $\pm$ 1.5	3.3 $\pm$ 2.7	45.4 $\pm$ 27	5.9 $\pm$ 13
Regional Group Summary	1.5 $\pm$ 1.2		60.4 $\pm$ 24	5.0 $\pm$ 12
Perimeter Stations (0-40 km)				
4. Barranca School	0.4 $\pm$ 0.4	--	20.3 $\pm$ 6.5	3.8 $\pm$ 3.4
5. Arkansas Avenue	4.9 $\pm$ 7.3	--	15.3 $\pm$ 2.0	3.2 $\pm$ 2.6
6. East Gate	1.8 $\pm$ 2.0	5.2 $\pm$ 2.0	29.2 $\pm$ 8.4	6.8 $\pm$ 5.7
7. 48th Street	1.6 $\pm$ 1.3	--	20.6 $\pm$ 6.7	3.7 $\pm$ 2.9
8. LA Airport	2.1 $\pm$ 0.5	4.5 $\pm$ 2.5	31.5 $\pm$ 7.7	6.3 $\pm$ 4.7
9. Bayo STP	2.4 $\pm$ 1.2	4.1 $\pm$ 1.8	24.0 $\pm$ 9.1	3.0 $\pm$ 2.3
10. Exxon Station	3.5 $\pm$ 2.2	--	40.2 $\pm$ 10.8	10.9 $\pm$ 18.9
11. Royal Crest	0.5 $\pm$ 0.4	--	51.2 $\pm$ 49.4	16.9 $\pm$ 16.6
12. White Rock	0.5 $\pm$ 0.4	3.3 $\pm$ 1.4	16.5 $\pm$ 4.7	4.5 $\pm$ 4.8
13. Pajarito Acres	0.5 $\pm$ 0.1	--	28.4 $\pm$ 23.6	4.8 $\pm$ 6.0
14. Bandelier	0.5 $\pm$ 0.3	--	11.6 $\pm$ 3.7	7.5 $\pm$ 6.0
Perimeter Group Summary	1.7 $\pm$ 2.6	4.2 $\pm$ 1.8	26.2 $\pm$ 19.2	6.5 $\pm$ 9.7
On-Site Stations **				
15. TA-21	1.4 $\pm$ 0.4	--	34.8 $\pm$ 11.0	16.2 $\pm$ 19.7
16. TA-6	1.2 $\pm$ 0.6	3.1 $\pm$ 1.3	37.3 $\pm$ 24.9	3.6 $\pm$ 5.1
17. TA-53 (LAMPF)	0.8 $\pm$ 0.6	3.0 $\pm$ 0.8	30.8 $\pm$ 10.1	9.6 $\pm$ 9.9
18. Well PM-1	0.6 $\pm$ 0.6	--	15.4 $\pm$ 2.8	10.4 $\pm$ 12.8
19. TA-52	1.0 $\pm$ 0.8	--	26.6 $\pm$ 5.1	9.8 $\pm$ 7.3
20. TA-16	0.6 $\pm$ 0.2	2.7 $\pm$ 1.4	17.4 $\pm$ 5.6	3.1 $\pm$ 3.1
21. Booster P-2	1.3 $\pm$ 1.0	3.6 $\pm$ 0.6	26.1 $\pm$ 10.6	10.3 $\pm$ 9.0
22. TA-54	22.6 $\pm$ 11.9	18.3 $\pm$ 6.4	61.6 $\pm$ 27.8	27.8 $\pm$ 16.2
23. TA-49	1.0 $\pm$ 0.6	--	20.7 $\pm$ 10.1	2.5 $\pm$ 3.9
24. TA-33	0.6 $\pm$ 0.4	--	14.5 $\pm$ 6.8	31.3 $\pm$ 26.3
25. TA-2	1.5 $\pm$ 2.3	--	19.6 $\pm$ 4.4	24.7 $\pm$ 26.0
26. TA-16-490	0.6 $\pm$ 0.8	--	9.3 $\pm$ 3.9	6.3 $\pm$ 17.9
On-Site Group Summary	2.8 $\pm$ 6.9	6.3 $\pm$ 7.0	26.5 $\pm$ 17.9	12.5 $\pm$ 16.7

Source: LANL, 1987a

^aSee Fig. 3-2 for map of station locations.

^bMinimum detectable limit = 3×10^{-18} μ Ci/mL.

^cControlled Area DOE Concentration Guide = 2×10^{-12} μ Ci/mL.

Uncontrolled Area Derived Concentrations Guide = 2×10^{-14} μ Ci/mL.

^dControlled Area DOE Concentration Guide = 6×10^{-12} μ Ci/mL.

Uncontrolled Area Derived Concentration Guide = 2×10^{-14} μ Ci/mL.

^eControlled Area DOE Concentration Guide = 2×10^8 pg/m³.

Uncontrolled Area Derived Concentration Guide = 1×10^5 pg/m³.

^fControlled Area DOE Concentration Guide = 2×10^{-6} μ Ci/mL.

Uncontrolled Area Derived Concentration Guide = 2×10^{-7} μ Ci/mL.

weather forecasting, and engineering design. Emergency response, long-term monitoring for modeling routine releases, atmospheric dispersion research, and routine environmental assessment require wind speed and direction, temperature, and solar radiation data. These data are input to atmospheric dispersion models which determine the path of routine or unplanned releases of toxic materials to the atmosphere and calculate the downwind concentrations. Calculations are made for periods of 15 minutes, 24 hours, and 1 year.

Wind, temperature, relative humidity, precipitation, and pressure data are used in making weather forecasts. These forecasts primarily support the airport and the airport taxi service, snow removal, construction, and LANL experiments. Wind, temperature, relative humidity, precipitation, and solar data are also collected to develop long-term climatic averages to assist engineering design at the LANL and planning for stabilization of the waste disposal areas.

Meteorological data are continuously monitored on instrumented towers at five LANL locations. A sixth tower has been installed but had not been instrumented at the time of the Survey. Precipitation data are collected at four additional locations. Figure 3-3 shows the locations of the six towers (Sites 1 through 6) and the four precipitation stations (Sites 7 through 10).

Parameters monitored include wind speed and direction, standard deviations of wind speed and direction, vertical wind speed and its standard deviation, air temperature, dew-point temperature, relative humidity, solar radiation, and precipitation. These parameters are measured at discrete levels on the towers at heights ranging from ground level to 300 feet. Not all parameters are measured at all sites, and for some towers a parameter may be measured at several heights. Table 3-9 lists the height of each tower and the number of sensors for each parameter on the tower. Each parameter is measured every 3 to 5 seconds and averaged or summed over 15-minute intervals. Data are recorded on digital cassette tapes or transmitted by phone line to a microcomputer at the Occupational Health Laboratory at TA-59.

METEOROLOGICAL TOWERS AND RAIN GAUGE LOCATIONS FIGURE 3-3

TABLE 3-9

METEOROLOGICAL TOWERS AND NUMBER OF SENSORS ON EACH TOWER

Figure 3.1-2 Reference	Site	Tower Height	Instrument Heights (meters)	Wind	Vertical Wind	Solar	Temperature	Precipitation	RH	Data Log	Hygro- therm.
1	TA-59	21.3 m	22	1	1	1	2	1	1	1	1
2	TA-50	92 m	11.5, 23, 45 & 92	4	4	--	4	--	--	1	--
3	TA-54	12.2 m	1.2, 3.5 & 10.5	3	2	1	3	1	1	1	--
4	TA-53	12.2 m	24 ^a	1	1	--	--	--	--	1	--
5	East Gate	12.2 m	1.3, 4 & 12	3	2	1	2	1	1	1	--
6	Bandelier	48.7 m	11.5, 23 & 46	3	3	1	4	1	1	1	--
7	White Rock	--	--	--	--	--	--	1	--	--	1
8	LA Can.	--	--	--	--	--	--	1	--	--	--
9	TA-16	--	--	--	--	--	--	1	--	--	--
10	W. area	--	--	--	--	--	--	1	--	--	--
	Totals	--	--	15	13	4	15	8	4	6	2

Source: LANL, 1986b

^aInstrument height is relative to TA-53 ground level. Tower is positioned atop a large earthen mound at east end of TA-53.

Data validation is accomplished by automated and manual screening techniques. One computer code compares measured data with expected ranges and makes comparisons based on known meteorological relationships. Another code produces daily plots of data from each tower. These graphics are reviewed to provide another check of the data. This screening also helps to detect problems with the instrumentation that might develop between the annual or semiannual (depending upon the instrument) calibrations.

The distribution of the winds at LANL varies across the laboratory site because of the terrain features. A description of the general wind patterns is provided in Section 3.1.1.3. Figure 3-4 presents summary information on the relative wind speeds and directions at four of the meteorological towers at LANL during 1985. The four wind roses depict the cumulative proportion of wind direction by the 16 primary compass directions in three wind-speed categories. Winds at the towers on the western side of the LANL -- OHL (TA-59) and TA-50 blow -- predominantly from the west. Towers on the eastern side -- at east gate and Area G (TA-54) -- are exposed for the most part to winds from the southwest.

3.1.3.4 Radiation Dose Calculations

The impact of airborne releases of radioactivity is evaluated by estimating doses received by the public from exposure to these releases. These doses are then compared with applicable standards. EPA regulation 40 CFR 61 limits the effective dose equivalent to any individual to 100 mrem/yr for all pathways of exposure. However, whole-body doses received via the air pathway alone are limited to 25 mrem/yr and individual organ doses to 75 mrem/yr via this pathway. The principal pathway of exposure at Los Alamos has been the release of radionuclides into the air, resulting in external radiation doses to the whole body. Other pathways contribute finite but negligible doses.

For compliance with 40 CFR Part 61, Subpart H, the EPA requires that radiation doses be determined with the computer code AIRDOS-EPA (EPA, 1985). The AIRDOS-EPA code was run by the LANL with 1986 meteorology data from TA-59, and the radioactive emissions data are given in Table 3-5. Over 99 percent of the maximum individual dose resulted from external exposure to the air activation products from the LAMPF.

FIGURE 3-4

CUMULATIVE WIND ROSES AT LANL STATIONS IN 1985

The maximum individual whole-body dose as determined by AIRDOS-EPA was 10.4 mrem corrected to include shielding due to presence in buildings (20-percent reduction) (LANL, 1987a). This dose, which would occur in the off-site area north of the LAMPF, is 41 percent of EPA's air emission standard of 25 mrem/yr (whole body). This dose compares favorably with the maximum dose north of the LANL boundary of 11.5 mrem as determined from TLD monitoring.

The maximum individual organ dose was calculated by AIRDOS-EPA to be 11 mrem to the lung, or 15 percent of the EPA's air emission standard of 75 mrem/yr to any organ. This dose would also occur in the off-site area north of the LAMPF. Of the 11 mrem, approximately 91 percent is due to external penetrating radiation from LAMPF air emissions, and 9 percent from other Laboratory emissions (LANL, 1987a).

The average dose to residents in the Los Alamos townsite attributable to LANL operations was 0.13 mrem (whole body), while to White Rock residents it was 0.09 mrem (whole body). These doses are 0.5 and 0.4 percent, respectively, of the EPA's 25 mrem air emission standard (LANL, 1987a). These doses are also dominated by external radiation from airborne releases at the LAMPF. Table 3-10 summarizes the doses estimated by modeling LANL operations. For comparison, estimates of the background external radiation levels are provided. These estimates are based on measurements that were adjusted to account for shielding, cosmic radiation, and radon-222 decay.

Measured airborne concentrations of tritium, uranium, plutonium, and americium are used to determine the maximum dose commitment over 50 years due to the inhalation of radioactive material for the year. The air concentrations are factored by a standard breathing rate and an appropriate dose conversion factor from the International Commission on Radiological Protection (ICRP). Doses are calculated for all sampling sites for each radionuclide. The largest dose due to inhalation during 1986 was 0.29 mrem to the bone surface at the Arkansas Avenue monitoring station, station 5 (LANL, 1987a).

TABLE 3-10

SUMMARY OF ANNUAL DOSES DUE TO 1986 LANL OPERATIONS

	Maximum Dose to an Individual ^a	Maximum Dose to Individual Organ	Average Dose to Nearby Residents	
			Los Alamos	White Rock
Dose	10.4 mrem (whole body)	11 mrem (lung)	0.13 mrem (whole body)	0.09 mrem (whole body)
Location	Residence N. of TA-53	Residence N. of TA-53	Los Alamos	White Rock
Radiation Protection Standard	25 mrem	75 mrem	25 mrem	25 mrem
% of Radiation Protection Standard	41%	15%	0.5%	0.4%
Background	127 mrem	127 mrem	127 mrem	117 mrem
% of Background	8%	9%	0.1%	0.08%

Source: LANL, 1987a

^aMaximum individual dose is the dose to an individual at or outside the laboratory where the highest dose rate occurs and where there is a person. It takes into account occupancy (the fraction of time a person is actually at that location), self-shielding, and shielding by buildings.

3.1.4 Findings and Observations

3.1.4.1 Category I

None

3.1.4.2 Category II

None

3.1.4.3 Category III

None

3.1.4.4 Category IV

1. LAMPF (TA-53) NESHAPs exposure limitation. Emission of gaseous mixed activation products from the LAMPF constitutes the major source of airborne radioactivity at the LANL, with an emission rate greater than 100,000 curies/yr. The method for determining these emissions has not been subject to normal quality assurance review for analytical methods. Although the detection system has been calibrated with standards once, there has been no formal review of the calibration procedure, of the procedure for isotope identification, or of the method for routine calculation of the emissions. The accuracy of the reported emissions is not at question; however, the lack of a quality assurance program for the LAMPF emissions analysis is inconsistent with other LANL programs for collection and analysis of stack emissions. Guidance on quality assurance requirements is provided in the draft DOE document on design and performance criteria for measurements that demonstrate compliance with the NESHAP (DOE, 1986).
2. Improper air monitoring locations. Ambient air stations at 14 of the 20 sampling locations observed during the Survey are so close to buildings that the air flow around the building influences the flow of air to the sampling location. Many of the sampling locations are under roof overhangs or eaves, as well as being less than 1 foot from a building wall. Additionally, seven

sampling locations are on the downwind side of the building from the prevailing winds, and are thus sheltered from the natural air flow in the area. Although the discrepancy in the measured concentrations is not expected to be significant in terms of the DOE Derived Concentration Guide, the current placement of the stations could cause measured concentrations to be smaller than actual ambient concentrations. Since the measured ambient concentrations are used for assessing the 50-year dose commitment from inhalation of airborne particulates, the resultant dose calculation (0.29 mrem to the bone surface due to 1986 exposure) would be slightly lower than the actual dose.

PRELIMINARY

3.2 Soils

3.2.1 Background Environmental Information

The topography of the LANL site consists of a series of finger-like mesas separated by deep east-west-oriented canyons, some up to several hundred feet deep, cut by intermittent streams. The major canyons, from southwest to northeast, are Chaquehui, Ancho, Water, Pajarito, Canada del Buey, Mortandad, Sandia, Los Alamos, Pueblo, Acid, and Bayo. The major named mesas, from southwest to northeast, are Burnt, Frijoles, Mesita del Potrillo, Threemile, Twomile, Mesita del Buey, South, and Mesita de Los Alamos. Figure 3-5 shows the location of these mesas and canyons within the LANL site, and Figure 3-6 illustrates the topography of the LANL area.

Ashfall, ashfall pumice, and rhyolite tuff form the surface of the Pajarito Plateau. Figure 3-7 presents the soil types, of which there are 25, for most of the site. These range from rock outcroppings to sandy loam to clay. Table 3-11 lists the type, depth, U.S. Department of Agriculture (USDA) texture, permeability, and water-capacity properties of selected soils (excluding rock outcroppings). Most of the finger-like mesas on the site are formed of Bandelier Tuff, which was deposited by a major eruption of a volcano in the Jemez Mountains to the west. Bandelier Tuff ranges in character from nonwelded to welded, and is more than 1,000 feet thick in the western part of the Pajarito Plateau, thinning to about 260 feet thick toward the east above the Rio Grande.

In the intermittent streams that flow in canyons of the Pajarito Plateau, the streambeds consist of alluvium ranging in depth from less than 3 feet to 100 feet. The alluvium is quite permeable, in contrast to the underlying volcanic tuff and sediments. Intermittent runoff in the canyons infiltrates the alluvium until its downward movement is impeded by the less permeable tuff and volcanic sediment. This results in a shallow alluvial groundwater body that moves downgradient in the alluvium. As water in the alluvium moves downgradient, it is depleted by evapotranspiration and movement into underlying volcanics.

MESA AND CANYONS

FIGURE 3-5

Source: LASL 1278

PHOTOMIC MAP OF THE LANL SITE

FIGURE 3-6

Y MAP OF THE LANL SITE

FIGURE 3-7

TABLE 3-11

ESTIMATES OF SOIL PROPERTIES AT THE
LANL SITE FOR SELECTED SOIL TYPES

Soil Type	Depth (cm)	USDA Texture	Permeability (cm/hr)	Available Depth Water Capacity (cm/cm)
Carjo	0-10	loam, very fine sandy loam	1.5-5.0	0.15-0.18
	10-50	clay loam, clay	0.15-0.5	0.14-0.21
	50-63	very fine sandy loam	1.5-5.0	0.14-0.17
Frijoles	0-5	loam, very fine sandy loam	1.5-5.0	0.15-0.18
	5-30	very gravelly clay loam	1.5-5.0	0.08-0.10
	46-152	gravel	> 51	0.02-0.04
Hackroy	0-8	sandy, very sandy loam	1.5-15	0.11-0.21
	8-30	clay loam, clay	0.15-0.50	0.13-0.20
Nyjack	0-8	sandy, very fine sandy loam	1.5-15	0.11-0.21
	8-61	clay loam	1.5-15	0.19-0.21
	61-99	sandy loam, gravelly sandy loam	5.0-15	0.07-0.13
Penistaja	0-10	fine sandy loam, sandy loam, loamy fine sand	1.5-15	0.09-0.15
	10-71	sandy clay loam	1.5-5.0	0.14-0.16
	71-152	sandy loam, fine sandy loam, sandy clay loam	1.5-15	0.12-0.14
Pogna	0-15	fine sandy loam, sandy loam	5.0-15	0.11-0.15
Potrillo	0-15	gravelly sandy loam	5.0-15	0.09-0.11
	15-152	loam, fine sandy loam, sandy loam	1.5-5.0	0.12-0.18
Prieta	0-10	stony silt loam	5.0-15	0.11-0.13
	15-152	loam, fine sandy loam, sandy loam	1.5-5.0	0.12-0.18

TABLE 3-11

ESTIMATES OF SOIL PROPERTIES AT THE
LANL SITE FOR SELECTED SOIL TYPES (Continued)

Soil Type	Depth (cm)	USDA Texture	Permeability (cm/hr)	Available Depth Water Capacity (cm/cm)
Seaby	0-13	loam	1.5-5.0	0.16-0.18
	13-30	gravelly clay loam, very gravelly clay loam	1.5-5.0	0.18-0.17
	30-66	gravel	>51	0.02-0.04
Servilleta	0-8	loam	1.5-5.0	0.16-0.18
	8-64	clay, silty clay loam, clay loam	0.15-1.5	0.15-0.20
	64-86	silty clay loam, loam	0.50-1.5	0.19-0.21
Total	0-13	very fine sandy loam	1.5-5.0	0.14-0.21
	13-28	clay, clay loam	0.50-1.5	0.13-0.20
	28-36	silt loam	1.5-5.0	0.19-0.21
Totavi	0-152	gravelly loamy sand	>51	0.06-0.08
Typic Eutroboralfs Clayey-Skeletal	0-15	silt loam	1.5-5.0	0.19-0.21
	15-30	very gravelly loam	1.5-5.0	0.10-0.12
	30-122	very gravelly clay, very gravelly clay loam	0.15-0.50	0.07-0.08
Typic Eutroboralfs	0-8	loam, sandy loam, very sandy loam	1.5-15	0.14-0.17
	8-36	silt loam	1.5-5.0	0.19-0.21
	36-64	clay loam	0.50-1.5	0.19-0.21
	64-91	gravelly clay loam	0.50-1.5	0.15-0.17
	91-203	clay loam, clay	0.50-1.5	0.19-0.21
Typic Eutroboralfs Fine	0-18	sandy loam, very fine sandy loam	1.5-15	0.11-0.17
	18-51	clay	0.15-0.50	0.14-0.16
	51-94	sandy clay	0.15-0.50	0.15-0.17

Source: LASL, 1978

3.2.2 General Description of Pollution Sources and Controls

This section concerns those areas that have, or may have, been contaminated by LANL experiments, tests, or research and development activities conducted directly on the surface or subsurface soils. The activities are characterized as those that pertain to surface and subsurface test-firing of explosives. The surface experiments have been organized into groups based on the kinds and quantities of materials tested. The subsurface experiments are discussed based on their locations.

3.2.2.1 Surface Test-Firing of High Explosives

LANL personnel conduct or have conducted test-firings of HEs for experimental purposes at 88 on-site locations named "firing sites." A firing site consists of a firing pad and a control building. Most of the experiments completely consume the HEs. However, an experiment could "go low-order," meaning that the HEs did not completely detonate, thereby dispersing particles into the surrounding area. Some test-firing experiments include depleted uranium and/or thorium to simulate fissionable materials; beryllium and other metals such as lead, mercury, copper, cadmium, and nickel are also used. In addition, some of the HEs (e.g., baratol and baronal) contain barium.

For the purposes of this report, the drop tower and gun sites are included as firing sites. Table 3-12 presents a list of all 88 firing sites at the LANL, consisting of 26 active and 62 inactive sites (two of which have been combined into one site). Only the active firing sites are discussed in this section (inactive firing sites are discussed in Section 4.5).

In this report, the 26 active firing sites are divided into 7 groups, based on the type of HE used, constituents tested, and history of HE use at the site (Table 3-13). The HE used and constituents tested determine the substances contaminating the surrounding soils. At the sites in the first group no radioactive material has been used in any tests. Tests at the second group of sites use large quantities of HE. Active sites where tests use medium amounts of HE form the third group. The fourth group of sites are now used infrequently but are still considered active and

TABLE 3-12
LIST OF FIRING SITES, LANL

Site Designation	Type of Site	Current Status
TA-3-3	Firing Site	Removed, 1949
TA-3-4	Firing Site	Removed, 1949
TA-3-5	Firing Site	Removed, 1949
TA-3-6	Firing Site	Removed, 1949
TA-3-7	Firing Site	Removed, 1949
TA-4-18	Firing Site	All structures removed, 1985
TA-5-9	Firing Site	All structures and main firing area cleaned, 1985
TA-5 (Far Firing Pit)	Firing Site	Not found in 1985 Survey
TA-6-37	Firing Site	Inactive
TA-6-Asphalt Pad	Firing Site	Inactive
TA-7-A	Firing Site	Inactive
TA-7-B	Firing Site	Inactive
TA-8	Gun Site	Inactive since 1945
TA-9 (AE)-4	Firing Site	Removed, 1963
TA-9 (AE)-5	Firing Site	Removed, 1963
TA-9 Anchor Ranch Range	Firing Site	Inactive
TA-10 Firing Point 1	Firing Site	Cleaned up, 1963 and 1976
TA-10 Firing Point 2	Firing Site	Cleaned up, 1963 and 1976
TA-10 Firing Point 3	Firing Site	Cleaned up, 1963 and 1976
TA-10 Firing Point 4	Firing Site	Cleaned up, 1963 and 1976
TA-11 (Between TA-11-2 and 3)	Firing Site	Inactive
TA-11-24	Gun Site	Inactive
TA-11-26	Drop Tower	Active
TA-11 Air Gun Site	Gun Site	Inactive
TA-11 Mortar Impact Area (West of TA-11-2 and 3)	Mortar Site	Inactive
TA-12-4	Firing Site	Abandoned, 1960
TA-13 (Between TA-13-3 and 4)	Firing Site	Inactive
TA-14-5	Firing Site	Removed, 1982
TA-14-25	Firing Site	Active
TA-14-26	Firing Site	Active

TABLE 3-12
LIST OF FIRING SITES, LANL (Continued)

Site Designation	Type of Site	Current Status
TA-14-27	Firing Site	Active
TA-14-28	Firing Site	Active
TA-14-29	Firing Site	Active
TA-14-34	Gun Site	Active
TA-15-14 Site A	Firing Site	Inactive
TA-15-74 Site B	Firing Site	Inactive
TA-15-35 Site C	Firing Site	Inactive
TA-15-34 Site D	Firing Site	Inactive
TA-15-26 Site E	Firing Site	Combined with F to form EF site
TA-15-36 Site F	Firing Site	Combined with E to form EF site
TA-15-26 Site EF	Firing Site	Inactive
TA-15-28 Site G	Firing Site	Inactive
TA-15-17 Site H	Firing Site	Inactive
TA-15-44	Firing Site	Active
TA-15-45	Firing Site	Active
TA-15-184 PHERMEX	Firing Site	Active
TA-15-280 ECTOR	Firing Site	Active
TA-16 P Site	Firing Site	Inactive
TA-16 K Site	Firing Site	Inactive
TA-18-3	Firing Site	Inactive
TA-18-4	Firing Site	Inactive
TA-18-7 or 8	Firing Site	Inactive
TA-20-6	Firing Site	Inactive
TA-20-29	Firing Site	Inactive
TA-20 Gun Sites (Cliffs)	Gun Site	Inactive
TA-23	Firing Site	Inactive
TA-27 (5 Sites)	Firing Site	Inactive
TA-33-24	Firing Site	Inactive, Rad Cleanup, 1984
TA-33-26	Firing Site	Inactive, Rad Cleanup, 1984
TA-33-64	Gun Site	Inactive, Rad Cleanup, 1984

TABLE 3-12
LIST OF FIRING SITES, LANL (Continued)

Site Designation	Type of Site	Current Status
TA-33-65	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-66	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-85	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-97	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-98	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-116	Gun Site	Inactive, Rad Cleanup, 1984
TA-33-117	Gun Site	Inactive, Rad Cleanup, 1984
TA-36 Eenie	Firing Site	Active
TA-36 Meenie	Firing Site	Active
TA-36 Minie	Firing Site	Active
TA-36 Lower Slobbovia	Firing Site	Active
TA-36-I	Firing Site	Combined with J to form IJ Site
TA-36-J	Firing Site	Combined with I to form IJ Site
TA-36-IJ	Firing Site	Active
TA-39-6	Firing Site	Active
TA-39-7	Firing Site	Inactive
TA-39-8	Firing Site	Inactive
TA-39-56	Gun Site	Active
TA-39-57	Firing Site	Active
TA-39-69	Gun Site	Active
TA-39-88	Firing Site	Active
TA-40-4	Firing Site	Active
TA-40-5	Firing Site	Active
TA-40-8	Firing Site	Active
TA-40-12	Firing Site	Active
TA-40-15	Firing Site	Active
TA-40 (450 feet east of TA-40-15)	Firing Site	Inactive

Source: DOE-AO, 1986

TABLE 3-13
LIST OF CONSTITUENTS USED AND HISTORY OF USE
AT ACTIVE FIRING SITES, LANL

Site Designation	Type of HE Used	Annual Amount of HE Used	Other Materials Used
Group 1			
TA-11-26	Various	45 lb/yr	Occasional use of mock explosives
TA-40-4	TNT, HMX, RDX, baratol	100 kg/hr	None
TA-40-5	See TA-40-4	Few lb/yr	None
TA-40-8	See TA-40-4	2 kg/hr	None
TA-40-12	See TA-40-4	100 kg/hr	None
TA-40-15	See TA-40-4	2000 lb/yr	None
Group 2			
TA-36 Eenie	HMX, RDX, baratol	< 6000 lb/yr	Depleted uranium, lead, copper, aluminum
TA-36 Meenie	See Eenie	See Eenie	See Eenie
TA-36 Minie	See Eenie	See Eenie	See Eenie
TA-36 Lower Slobbovia	See Eenie	< 9000 lb/yr	See Eenie
TA-36 IJ	HMX, RDX, TNT, PETN, cycotol, baratol	Rarely used in past 25 years, but heavily used before that	Depleted uranium, lead, aluminum, mercury, cadmium, silver, tritium
Group 3			
TA-15-184 PHERMEX	HMX, RDX, baratol	1000-2000 lb/yr	Depleted uranium, thorium, aluminum, copper, nickel, lead, beryllium, mercury
TA-15-280 ECTOR	See PHERMEX	500-1500 lb/hr	Same as PHERMEX
Group 4			
TA-15-44	HMX, RDX, baratol	Rarely used now; heavily used in past	Depleted uranium, beryllium, aluminum, mercury, cadmium, tritium

TABLE 3-13

**LIST OF CONSTITUENTS USED AND HISTORY OF USE
AT ACTIVE FIRING SITES, LANL (Continued)**

Site Designation	Type of HE Used	Annual Amount of HE Used	Other Materials Used
TA-15-45	See TA-15-44	See TA-15-44	See TA-15-44
Group 5			
TA-39-6	HMX, baratol	4500 lb /yr baratol for TA-39 firing sites	Depleted uranium, beryllium, mercury, copper, chromium, thorium
TA-39-57	See TA-39-6	See TA-39-6	See TA-39-6
TA-39-88	See TA-39-6	See TA-39-6	See TA-39-6
Group 6			
TA-14-25	Various	12-25 lbs/yr for all TA-14 firing sites combined, mostly at 25	Depleted uranium, natural uranium
TA-14-26	See TA-14-25	See TA-14-25	See TA-14-25
TA-14-27	See TA-14-25	See TA-14-25	See TA-14-25
TA-14-28	See TA-14-25	See TA-14-25	See TA-14-25
TA-14-29	See TA-14-25	See TA-14-25	See TA-14-25
Group 7			
TA-14-34	Various	1-12 lb/yr	Depleted uranium, copper, lead
TA-39-56	Gun Site	Not applicable	Depleted uranium, beryllium, lead, aluminum, steel
TA-39-69	Gun Site	Not applicable	See TA-39-56

have a history of heavy use. The LANL conducts shock-wave experiments at the fifth group of firing sites; the experiments use small to medium amounts of HEs at these sites, which are located in a canyon. Small sensitivity studies are performed at the sixth group of sites; these studies involve detonating small amounts of HE to determine its characteristics. Unexploded HE may remain. The seventh group consists of gun sites, locations where the LANL fires projectiles at HE or into canyon walls.

3.2.2.2 Subsurface Test-Firing of High Explosives

Thirty-five hydronuclear experiments were conducted in Technical Area 49 (TA-49) between 1959 and 1961, involving a combination of conventional HEs and fissile material. The HE was usually in a nuclear configuration, though the amount of fissile material was reduced far below that required for a nuclear explosion. During this period, LANL personnel also conducted nine related equation-of-state and criticality experiments. Six additional experiments involved HEs but no fissile materials.

The experiments were conducted in either 3- or 6-foot-diameter shafts between 50 and 120 feet deep. Most of the shafts were bored on a 25-foot center in a 100-foot-square grid pattern. Four such areas (1, 2, 3, and 4) were prepared in TA-49 (Figure 3-8). These areas were arranged at the corners of a square about 2,000 feet on each side. Area 11 housed a radioactive chemistry laboratory used to provide analytical chemistry data. Effluent from the laboratory drained into a buried drain field in Area 11. Area 5 contained the control buildings, pump houses, and associated structures.

For the experiments, LANL personnel placed the experimental configuration at the bottom of the shaft. The shaft was then backfilled with sand to contain the physical force of the explosive detonation. After detonation, measurements and samples were taken through access tubes or pipes; then the access tubes were filled with sand and sealed with a concrete plug 2 to 3 feet thick.

FIGURE 3-8

LOCATION OF UNDERGROUND EXPERIMENTS IN TA-49

Most materials were left at the bottom of the shafts in which the experiments were conducted. The principal materials of interest include plutonium, uranium, and beryllium (Table 3-14 shows the materials used). In all, the experiments used an estimated total of 40.1 kilograms of plutonium, 93 kilograms of enriched uranium, 82 kilograms of depleted uranium, and 15 kilograms of beryllium. Lead may sometimes have been used as shielding for instrumentation. If lead was used, it remained in the hole. Because of their physical properties, the tuff and sand readily absorbed the energy of the explosions, and confined most of the materials to within 10 to 20 feet of the shafts.

Cuttings from a shaft drilled in the TA-49 experimental area during October and November 1960 showed a measurable surface concentration of plutonium. Apparently, plutonium had been dispersed through fractures in the tuff by the detonation of an experiment in an adjacent shaft. The personnel reportedly removed all surface-soil contamination and placed it back in the shaft, then filled the shaft with clean sand and capped it with a concrete plug (LANL, 1987b). Finally, they covered the entire surface of Area 2 in TA-49 with a layer of clay 4 feet thick, over which they placed a layer of asphalt 4 to 6 inches thick.

In 1975, the LANL established a sediment monitoring program near TA-49, consisting of 11 monitoring stations in the natural drainage from the 4 experimental areas and in three canyons downgradient from the areas. In 1981, a 12th station was added after the surface drainage of TA-49 was modified (Figure 3-9) to better contain the surface runoff. Data collected annually indicate that three on-site stations exhibit concentrations of plutonium in excess of worldwide fallout. These stations are downgradient from Areas 2 and 11. Station A3 had the highest concentrations of plutonium-239 with values ranging from 0.01 to 17 pCi/g, with a mean of 3.5 and a standard deviation of 5.2 pCi/g (LANL, 1987b). For reference, the background level of plutonium-239 in northern New Mexico is about 0.01 pCi/g (LANL, 1986b).

A series of underground experiments was performed at TA-15 from 1968 through 1972. Four holes were drilled to conduct the experiments, but only two of the holes -- each about 130 feet deep -- were used. The first (15A), used as a calibration hole, contained 4,000 pounds of flaked TNT. The second (15B) contained about 500

TABLE 3-14

LIST OF MATERIALS AND AMOUNTS USED IN UNDERGROUND
EXPERIMENTS, LANL

Materials Used	Estimated Amount Used
TA-49	
Plutonium-239	40.1 kg
Uranium-235	93 kg
Lead	Unknown
Beryllium	15 kg
High Explosive	Unknown
TA-15	
Tritium	200 Ci
Lead	Unknown
Beryllium	<200 grams
High Explosive	4500 lb
TA-33	
Polonium-210	3.1 Ci (a)
Lead	Unknown
Beryllium	Unknown

Source: LANL, 1987b and DOE-AO, 1986

- a) 3.1 Ci of polonium-210 is based on five experiments, with one experiment containing 620 mCi of polonium-210.

Source: LANL, 1987b

SEDIMENT SAMPLING LOCATIONS IN TA-49 AT LANL

FIGURE 3-9

pounds of PBX, less than 200 grams of beryllium, and approximately 200 grams of tritium. Lead, which was used as shielding for instrumentation, was left in the hole, as were used cables. In neither experiment was fissionable material used. Table 3-14 lists the materials and estimated amounts.

The TA-33 site began operation in 1947 as an alternative to the initiator test chambers at the Trinity site in southern New Mexico. The initiator tests were conducted in 46-foot-deep concrete-lined shafts. At the bottom and sides of each shaft was a 14-foot-wide octagonal room. Five underground chambers were built in this room, but only four experiments were conducted in three of the chambers. Changes in initiator design eliminated the need for the chambers. Chambers 1 and 3 were destroyed in the first shot. Chamber 2 was reopened in 1952 but was destroyed in reuse. These chambers now compose Materials Disposal Areas (MDA)-D and -E. MDA-D contains chambers 1 and 2; MDA-E contains chamber 3. The radioactivity released consisted of polonium-210. In addition, beryllium may have been used. Only one of the four shots released any radioactive contamination (polonium-210); however, that contamination was cleaned up (DOE-AO, 1986 files). In addition, due to the half-life of polonium-210 (138.4 days) and the length of time since the test (34 years), any contamination that may have remained has decayed away. Table 3-14 presents the materials known to have been used in TA-33. Lead may have been used as a shielding material for instrumentation. If it was, it remained in the hole.

3.2.3 Environmental Monitoring Program

The concentration of contaminants in soil is measured at the LANL routinely through the acquisition and analysis of soil samples. The soil sampling program at the LANL has three parts: on-site, perimeter, and regional. Figures 3-10 and 3-11 present the locations where soil is sampled annually. The LANL takes soil samples on-site at 10 locations. Perimeter samples (from six locations) are used to determine if LANL operations impact any public lands surrounding the site, while regional samples (seven locations) are taken to determine background data. All soil samples are analyzed for seven radioactive constituents: tritium; cesium-137; plutonium-238, 239, and 240; gross gamma; and total uranium. Background values for each of the constituents of the soil sampling program were determined from the regional sampling network from 1978 through 1985.

REGIONAL SOIL SAMPLING LOCATIONS
AT THE LANL

FIGURE 3-10

PERIMETER AND ON-SITE SOIL SAMPLING LOCATIONS
AT LANL

FIGURE 3-11

Table 3-15 presents the results of the soil monitoring program for 1986. The data show that concentrations at the Otowi regional station exceeded background levels for total uranium and gross gamma. In addition, levels at the S3 perimeter station exceeded background for cesium-137 and plutonium-239 and 240. All perimeter stations except S3 exceeded background levels for total uranium, and four stations (S1, S4, S5, and S6) exceeded background for gross gamma. For the on-site network, background levels for plutonium-239 and 240 were exceeded at stations S9 and S12, tritium at three stations (S8, S11, and S16 near the Tritium Facility at TA-33), total uranium at all locations except S10, and gross gamma at three locations (S8, S11, and S16). The uranium and gross gamma probably reflect the naturally occurring radiation in the soil and not contamination from the LANL.

In addition to monitoring soil contamination, the LANL monitors foodstuffs for potential radioactivity from its operations. The LANL monitors six stations for six radioactive constituents (tritium; strontium-90; plutonium-238, 239, and 240; and total uranium). In 1986, the LANL concluded that concentrations of strontium-90, plutonium-239 and 240, and total uranium in produce were statistically indistinguishable for the regional, perimeter, and on-site sampling networks. Plutonium-238 concentrations were slightly elevated for on-site produce. Tritium concentrations in produce were significantly higher on-site than at perimeter and regional sites. However, this may be due more to atmospheric releases of tritium being utilized by the produce than from uptake of soil contamination.

As part of a program sponsored by the DOE, the LANL is conducting radioactive waste site surveillance to monitor 11 inactive and 1 active radioactive waste management areas on the site. (More information for the inactive sites can be found in Section 4.5.) Figure 3-12 shows the locations of these areas. Sampling for this program began in late 1979 and included surface soil and associated biota. In 1982, additional sampling began that included external radiation at disposal site exclusion fences. Monitoring of the potential subsurface migration of contaminants from Area G, the currently active radioactive waste management area, also began in 1982. (Area G is discussed in more detail in Section 4.1.) The radioactive waste site surveillance program calls for intensive monitoring around two or three areas and perimeter monitoring around the remaining sites each

TABLE 3-15

1986 SOIL SAMPLING RESULTS AT THE LANL

Location	Map Number	H-3 (10-6 μ Ci/ml)	Cs-137 (pCi/g)	Total U (μ g/g)	PU-238 (pCi/g)	PU-239 (pCi/g)	Gross Gamma (cpm/g)
Background ^a		7.1	1.18	3.5	0.005	0.036	6.6
REGIONAL							
Chamita		6.4	0.25	1.7	0.001	0.003	1.2
Embudo		0.8	0.69	2.4	0.001	0.017	3.7
Otowi		4.5	0.71	4.3	0.002	0.016	6.9
Near Santa Cruz Lake		1.1	0.48	3.3	0.000	0.014	5.0
Cochiti		2.8	0.60	3.0	0.000	0.014	5.2
Bernalillo		2.0	0.22	1.3	0.001	0.002	1.0
Jemez		3.9	0.16	1.8	0.000	0.004	2.7
PERIMETER							
Sportsman Club	S1	1.5	0.17	5.1	0.000	0.013	7.7
North Mesa	S2	2.1	0.01	4.0	0.003	0.006	6.1
TA-8	S3	2.0	1.50	3.2	0.005	0.054	5.9
TA-49	S4	1.2	0.10	3.8	0.000	0.002	7.4
White Rock (East)	S5	2.8	0.35	4.3	0.001	0.005	7.9
Tsankawi	S6	4.3	0.63	5.9	0.005	0.017	11
ON-SITE							
TA-21	S7	4.1	0.07	3.9	0.003	0.006	5.8
East of TA-53	S8	8.7	0.23	3.8	0.002	0.014	6.7
TA-50	S9	4.9	0.19	3.8	0.002	0.063	6.3
Twomile Mesa	S10	2.8	0.03	3.5	0.000	0.008	5.4
East of TA 54	S11	8.1	0.13	5.4	0.001	0.001	8.3
R-Site Road East	S12	4.2	0.19	3.9	0.002	0.041	6.3
Potrillo Drive	S13	3.5	0.38	4.5	-0.001	0.010	5.2
S-Site	S14	3.7	0.22	3.7	0.000	0.011	5.6
Near Test Wall DT-9	S15	1.8	0.56	4.5	0.003	0.012	6.3
Near TA-33	S16	16	-0.11	3.6	0.000	0.004	7.1

Source: LANL, 1987a

^aAverage + twice the standard deviation based on regional soil samples from 1978 through 1985.

LOCATION OF THE RADIOACTIVE WASTE MANAGEMENT
AREAS INCLUDED IN THE
LANL ENVIRONMENTAL SURVEILLANCE PROGRAM

FIGURE 3-12

year. The LANL conducts the intensive monitoring in different areas each year, providing detailed information on all the areas over several years. The intensive monitoring includes soil measurements, biota sampling, and TLD measurements. The perimeter program consists of TLD readings.

3.2.4 Findings and Observations

3.2.4.1 Category I

None

3.2.4.2 Category II

None

3.2.4.3 Category III

1. Soil contamination by plutonium-239. Data from a LANL surface sediment monitoring program in TA-49 indicate that sediment contaminated with plutonium-239 is moving through surface drainage patterns onto the surface soils of Water Canyon and Ancho Canyon.

In 1975, the LANL established a sediment monitoring program near TA-49. The program now consists of 12 sediment monitoring stations in the natural drainages from the four underground experimental areas and in three canyons downgradient from the area. The data, collected annually, indicate that three on-site stations exhibit plutonium concentrations in excess of worldwide fallout. These stations are downgradient from Areas 2 and 11. For station A3, having the highest concentrations, the levels of plutonium-239 have ranged from 0.01 to 17 pCi/g, with a mean of 3.5 and a standard deviation of 5.2 pCi/g. (Background concentration of plutonium-239 in northern New Mexico is about 0.01 pCi/g.) The plutonium and the sediments transported by storm runoff into Water Canyon and Ancho Canyon are dispersed over a large area and do not leave the LANL site.

The plutonium has two possible sources. First, cuttings from a shaft drilled in the TA-49 experiments during October and November 1960 showed a measurable surface concentration of plutonium. Apparently, plutonium had been dispersed through fractures in the tuff by the detonation of an experiment in an adjacent shaft. The personnel reportedly removed all surface-soil contamination and placed it back in the shaft, then filled the shaft with clean sand and capped it with a concrete plug. Then they covered the entire surface of Area 2 with a layer of clay 4 feet thick, over which a layer of asphalt 4 to 6 inches thick was placed. However, trace amounts of the contamination remain. Second, Area 11 housed a radioactive chemistry laboratory used to provide analytical chemistry data. Effluent from the laboratory drained into a buried drain field in Area 11. The sediment monitoring program has detected radioactivity downstream from both Area 2 and Area 11.

A series of underground experiments were performed at TA-15 from 1968 through 1972. Four 130-foot holes were drilled, but only two were used. Only the second hole contained toxic elements, which included less than 200 grams of beryllium, approximately 200 curies of tritium, and lead shielding.

The TA-33 test chambers were 46 feet underground, and they were used from 1947 to 1952. Test materials consisted of polonium-210, which has decayed away, and possibly beryllium and lead.

During the Sampling and Analysis phase of the Survey, sampling will be performed at TA-49 to determine the existence of radionuclide and chemical contamination other than plutonium-239 on the surface soil downstream from the radioactive chemistry laboratory drain field, the areal extent of the existing contamination from Areas 2 and 11, and the levels of contamination in both areas.

2. Potential soil contamination from HEs and barium. As a result of past detonations, all 26 of the active firing sites have the potential for contamination from HEs and barium. In addition, at many of the sites there is a potential for contamination with radioactivity such as depleted uranium and other metals such as beryllium, lead, mercury, copper, cadmium, and

nickel. LANL personnel conduct test-firings of HEs for experimental purposes at firing sites. A firing site consists of a firing pad (usually consisting of a sandy flat area) and a control bunker which houses equipment and personnel.

Most of the experiments completely consume the HE. However, in some experiments the HE does not completely detonate, thereby dispersing HE into the surrounding area. Some experiments include depleted uranium and/or thorium to simulate fissionable materials; and beryllium and/or other metals such as lead, mercury, copper, cadmium, and nickel. Some of the HEs (baratol and baronal) contain barium. The 26 firing sites are divided into 7 groups based on the type of HE used, the constituents tested, and the history of HE use at the site. The type of HE used and the constituents tested determine the substances that could contaminate the surrounding soils.

The first group includes TA-11-26 and the sites at TA-40 (TA-40-4, 5, 8, 12, and 15). The high explosives consisted of various types of HE including TNT, HMX, RDX, and baratol. No radioactive material was used in any tests at these sites. TA-11 is the drop tower where HE is dropped onto a concrete pad as an aid to determine handling characteristics. At the TA-40 sites, small quantities of HE are used in the explosion of detonators.

The second group includes the TA-36 sites (TA-36 Eenie, Meenie, Minie, Lower Slobbovia, and IJ). These sites use large quantities of HE per test, and large quantities (up to 9,000 pounds) annually.

Active sites using medium amounts of HE per test form the third group, which includes TA-15-PHERMEX and ECTOR. At these two sites, up to 125 pounds of HE are used per test. Types of HE used at these two groups include HMX, RDX, baratol, PETN, and cycotol. Other potential contaminants include depleted uranium, thorium, tritium, lead, copper, aluminum, mercury, cadmium, silver, nickel, and beryllium.

The fourth group, infrequently used but nevertheless considered active, includes TAs-15-44 and 45. In the past, these two sites employed large amounts of HE per test as well as annually; today they are used occasionally

instead of PHERMEX or ECTOR if diagnostic needs can be satisfied thereby. Potential types of HE used at this group include HMX, RDX, and barato^l. Other potential contaminants include depleted uranium, tritium, aluminum, mercury, cadmium, and beryllium.

The LANL conducts shock-wave experiments at the fifth group of firing sites, all of which are at TA-39 (TAs-39-6, 57, and 88). Experiments conducted at these sites use small to medium amounts of HE. These sites are located in a canyon, which limits dispersion of the materials used. Types of HE used at TA-49 include HMX and barato^l. Other potential contaminants include depleted uranium, thorium, copper, chromium, mercury, and beryllium.

Small sensitivity studies are performed at the sixth group, which consists of five sites at TA-14 (TAs-14-25, 26, 27, 28, and 29). These studies involve detonation of small amounts of HE to determine its characteristics. Unexploded HE may remain. These sites also use small amounts of HE per test and per year. Other potential contaminants include depleted and natural uranium.

The seventh group is composed of gun sites TA-39-56 and 69 and TA-14-34. Gun sites are locations where the LANL fires projectiles at HE or into canyon walls. Various types of HE are used. Potential contaminants include depleted uranium, lead, copper, aluminum, steel, and beryllium.

During the Sampling and Analysis phase of the Survey, sampling will be performed at a selected representative firing site in each of the seven groups to determine average levels of contamination on the surface and the areal dispersion of the contamination. Results of sampling of the representative firing site will be applicable to that entire group.

3.2.4.4 Category IV

None

3.3 Surface Water

3.3.1 Background Environmental Information

The major surface-water body in the immediate vicinity of the LANL is the Rio Grande, which is to the east (see Figure 3-13). Nearby tributaries of the Rio Grande include the Rio Chama, which joins the Rio Grande north of Espanola and the LANL; the Santa Fe River, which converges with the Rio Grande at the Cochiti Reservoir approximately 15 miles south of the LANL; and the Jemez River, which converges with the Rio Grande north of Bernalillo approximately 50 miles south of the LANL.

The U.S. Geological Survey (USGS) gaging station nearest to the LANL is located at Otowi Bridge, which is on the Rio Grande approximately 10 miles east of the LANL. Water-flow data for water year 1985 (October 1984 to September 1985) at the Otowi Bridge (USGS Gaging Station 08313000) show a mean flow of 2,672 cubic feet per second (ft^3/s) with a maximum flow of 12,000 ft^3/s and a minimum flow of 403 ft^3/s .

Water quality data for the Rio Grande for water year 1985 are provided in Tables 3-16 and 3-17. Table 3-16 presents data from samples collected at the Otowi Bridge, which is just north of the intersection of the stream bed from Los Alamos Canyon and the Rio Grande. Table 3-17 presents data from the Cochiti Reservoir. The Otowi Bridge samples illustrate the water quality upstream of any influence of LANL operations, while the Cochiti Reservoir samples show any downstream contributions from the LANL that reach the Rio Grande and any other contributors between the Otowi Bridge and Cochiti Reservoir. The water in the Cochiti Reservoir comes from both the Rio Grande and the Santa Fe River. However, the Santa Fe River would exert minimum influence on water quality in the Cochiti Reservoir, since the flows in the Santa Fe are relatively small compared with those in the Rio Grande. A comparison of the various analytical parameters shows that the average concentrations of most of the elements in the Cochiti Reservoir were less than, or the same as, upstream concentrations at Otowi. The concentrations of iron and lead in the Cochiti Reservoir, however, were twice the concentrations found in the Otowi Bridge samples.

REGIONAL SURFACE WATER, LANL

FIGURE 3-13

TABLE 3-16
ANALYTICAL RESULTS, WATER YEAR 1985 (OCTOBER 1984 TO SEPTEMBER 1985), RIO
GRANDE AT OTOWI BRIDGE NEAR SAN ILDEFONSO, NEW MEXICO

Chemical and Physical Parameters	Average Concentration*	Maximum Concentration*	Minimum Concentration*	Applicable Standard*
pH, SU	-	8.6	7.6	6.0-8.6
Conductivity, $\mu\text{S}/\text{cm}$	341	390	199	--
Turbidity, NTU	31	80	2.6	< 50
Hardness as CaCO_3	124	160	75	--
Calcium as Ca	38	49	23	--
Magnesium as Mg	6.7	8.2	4.2	--
Sodium as Na	19	25	10	--
Bicarbonate as HCO_3	117	140	69	--
Carbonate as CO_3	4.3	20	0	--
Alkalinity as CaCO_3	95	120	56	--
Sulfate as SO_4	49	64	27	< 150
Chloride as Cl	5.5	7.9	2.9	< 25
Fluoride as F	0.4	0.6	0.2	--
Silica as SiO_2	25	52	17	--
Dissolved Solids	200	239	179	< 500
Nitrogen, $\text{NO}_2 + \text{NO}_3$ as N	0.13	0.2	< 0.1	--
Nitrogen, Ammonia as N	0.05	0.11	< 0.01	--
Phosphorus (Total) as P	0.11	0.17	0.07	--
Phosphorus (Ortho) as P	0.03	0.04	0.01	--
Cyanide as CN	< 0.01	< 0.01	< 0.01	--
Aluminum as Al	0.078	0.250	0.02	--
Arsenic as As	0.0015	0.002	< 0.001	--
Barium as Ba	0.077	0.110	0.037	--
Beryllium as Be	< 0.0005	< 0.0005	< 0.0005	--
Boron as B	0.03	0.05	0.01	--
Cadmium as Cd	< 0.001	0.001	< 0.001	--
Chromium as Cr	0.0015	0.003	< 0.001	--
Cobalt as Co	< 0.003	< 0.003	< 0.003	--
Copper as Cu	0.005	0.006	0.003	--
Iron as Fe	0.028	0.055	0.010	--
Lead as Pb	0.004	0.008	< 0.001	--
Lithium as Li	0.015	0.021	0.006	--
Manganese as Mn	0.007	0.014	0.002	--
Mercury as Hg	0.0001	0.0001	< 0.0001	--
Molybdenum as Mo	< 0.01	< 0.01	< 0.01	--
Nickel as Ni	0.0015	0.003	< 0.001	--
Selenium as Se	< 0.001	< 0.001	< 0.001	--
Silver as Ag	< 0.001	< 0.001	< 0.001	--
Strontium as Sr	0.263	0.350	0.160	--
Vanadium as V	0.007	0.008	< 0.006	--
Zinc as Zn	0.027	0.071	0.013	--

* In mg/L unless otherwise indicated

TABLE 3-16
ANALYTICAL RESULTS, WATER YEAR 1985 (OCTOBER 1984 TO SEPTEMBER 1985),
RIO GRANDE AT OTOWI BRIDGE NEAR SAN ILDEFONSO, NEW MEXICO (Continued)

Radiochemical Parameters	November 9, 1984	June 4, 1985
Gross Alpha, dissolved as U-nat, µg/L	4.9	< 3.3
Gross Alpha, total as U-nat, µg/L	5.8	4.9
Gross Beta, dissolved as Cs-137, pCi/L	< 2.6	3.1
Gross Beta, total as Cs-137, pCi/L	7.4	4.2
Gross Beta, dissolved as Yt-90, pCi/L	< 2.2	2.7
Gross Beta, total as Yt-90, pCi/L	6.4	3.6
Radium-226, dissolved, pCi/L	0.009	0.006
Uranium, Nat, dissolved, µg/L as U	2.7	1.1

Pesticide Parameters	June 4, 1985	September 17, 1985
PCB, total, µg/L	--	< 0.1
Aldrin, total, µg/L	--	< 0.01
Chlordane, total, µg/L	--	< 0.1
DDD, total, µg/L	--	< 0.01
DDE, total, µg/L	--	< 0.01
DDT, total, µg/L	--	< 0.01
Diazinon, total, µg/L	--	< 0.01
Dieldrin, total, µg/L	--	< 0.01
Endosulfan, total, µg/L	--	< 0.01
Endrin, total, µg/L	--	< 0.01
Ethion, total, µg/L	--	< 0.01
Heptachlorepoxide, total, µg/L	--	< 0.01
Lindane, total, µg/L	--	< 0.01
Malathion, total, µg/L	--	< 0.01
Methoxychlor, total, µg/L	--	< 0.01
Methyl parathion, total, µg/L	--	< 0.01
Methyl trithion, total, µg/L	--	< 0.01
Parathion, total, µg/L	--	< 0.01
Toxaphene, total, µg/L	--	< 1
Total trithion, µg/L	--	< 0.01
2,4-D, total, µg/L	< 0.01	--
2,4,5-T, total, µg/L	< 0.01	--
Silvex, total, µg/L	< 0.01	--
Perthane, total, µg/L	--	< 0.1
Naphthalene, polychlor, total, µg/L	--	< 0.1
Mirex, total, µg/L	--	< 0.01

Source: USGS, 1985

TABLE 3-17

**ANALYTICAL RESULTS, WATER YEAR 1985 (OCTOBER 1984 TO SEPTEMBER 1985),
COCHITI RESERVOIR NEAR COCHITI, NEW MEXICO**

Physical Parameters			
pH, SU	8.0	Radiochemical Parameters	
Specific conductance, μS	198	Gross alpha, diss., as U-Nat, $\mu g/L$	<3.3
		Gross alpha, susp., as U-Nat, $\mu g/L$	<1.4
		Gross beta, diss., as Cs-137, pCi/L	2.9
		Gross beta, susp., as Cs-137, pCi/L	<1.8
Chemical Parameters	mg/L	Gross beta, diss., as Yt-90, pCi/L	2.5
Hardness as $CaCO_3$	25	Gross beta, susp., as Yt-90, pCi/L	<1.7
Calcium as Ca	29	Radium-226, diss., pCi/L	0.07
Magnesium as Mg	5.3	Uranium, nat. diss. as U, $\mu g/L$	1.5
Sodium as Na	13	Pesticide Parameters	
Potassium as K	3.1	PCB, total, $\mu g/L$	<0.1
Bicarbonate as HCO_3	84	Aldrin, total, $\mu g/L$	<0.01
Carbonate as CO_3	0	Chlordane, total, $\mu g/L$	<0.1
Alkalinity as $CaCO_3$	69	DDD, total, $\mu g/L$	<0.01
Sulfate as SO_4	44	DDE, total, $\mu g/L$	<0.01
Chloride as Cl	3.7	DDT, total, $\mu g/L$	<0.01
Fluoride as F	0.20	Diazinon, total, $\mu g/L$	<0.01
Silica as SiO_2	17	Dieldrin, total, $\mu g/L$	<0.01
Nitrogen, $NO_2 + NO_3$ as N	0.12	Endosulfan, total, $\mu g/L$	<0.01
Nitrogen, ammonia as N	0.04	Endrin, total, $\mu g/L$	<0.01
Nitrogen, organic as N	0.26	Etion, total, $\mu g/L$	<0.01
Nitrogen, total, as N	0.40	Heptachlor, total, $\mu g/L$	<0.01
Phosphorus, total, as P	0.06	Heptachlorepoxyde, total, $\mu g/L$	<0.01
Phosphorus, ortho, as P	0.03	Undane, total, $\mu g/L$	<0.01
Organic Carbon as C	5.1	Malathion, total, $\mu g/L$	<0.01
Arsenic, as As	<0.001	Methoxychlor, total, $\mu g/L$	<0.01
Boron, as B	0.020	Methyl parathion, total, $\mu g/L$	<0.01
Cadmium as Cd	<0.001	Methyl trithion, total, $\mu g/L$	<0.01
Chromium as Cr	<0.010	Parathion, total, $\mu g/L$	<0.01
Copper as Cu	0.003	Toxaphene, total, $\mu g/L$	<1
Iron as Fe	0.054	Total trithion, total, $\mu g/L$	<0.01
Lead as Pb	0.009	2,4-D, total, $\mu g/L$	<0.01
Selenium as Se	<0.001	2,4,5-T, total	<0.01
Zinc as Zn	0.018	Silvex, total, $\mu g/L$	<0.01
		Perthane, total, $\mu g/L$	<0.1
		Naphthalene, polychlor, total, $\mu g/L$	<0.01
		Mirex, total, $\mu g/L$	<0.01

Source: USGS, 1985

The topography of the LANL site is a series of mesas reaching from the eastern flank of the Jemez Mountains to the Rio Grande. The mesas are separated by a series of named canyons, the largest of which include Pueblo, Los Alamos, Sandia, Mortandad, Canada del Buey, Pajarito, Water, Ancho, and Bayo. The site elevation at the western side is approximately 7,800 feet, dropping to 6,200 feet at the Rio Grande. All the canyons receive discharges from either sanitary waste treatment plants, industrial waste treatment plants, once-through cooling water, cooling tower blowdown, photographic laboratory rinsewater, HE production facilities, and/or stormwater runoff. Water discharged to Los Alamos, Pueblo, Pajarito, and Water Canyons could potentially reach the Rio Grande during snowmelt and heavy storm runoff. The Los Alamos and Pueblo Canyon discharges are combined at State Route 4 and could reach the Rio Grande at the Otowi Bridge. Pajarito Canyon discharges would join the Rio Grande at White Rock, and Water Canyon would discharge south of Pajarito Acres (see Figure 3-14).

Evapotranspiration and/or infiltration into the alluvium result in little flow leaving LANL property during most of the year. Due to the climatology of the site, the evaporation rate is high, approximately 85 inches/year. During spring snowmelt and late summer rainstorms, however, flows from the previously mentioned canyons can reach the Rio Grande.

Pan Am World Services operates the water supply system for the LANL. Drinking water for the site comes from a series of deep wells and a gallery of springs. Figure 3-15 shows the location of the well fields and the gallery. None of the sources of surface water in the vicinity of the site is used as a supply of drinking water. There are three well fields (Los Alamos, Pajarito, and Guaje). The aquifer that supplies the system is approximately 1,200 feet deep, with a thick layer of tuff overlying it. The system supplies water not only to the LANL, but also to the towns of Los Alamos and White Rock, and to the Bandelier National Monument. The Los Alamos and Guaje Reservoirs (also shown in Figure 3-15) are used as a source of irrigation water during the summer.

3.3.2 General Description of Pollution Sources and Controls

Major sources of wastewater at the LANL include power-house discharge (consisting of spent demineralizer regenerants, spent sodium zeolite regenerants, boiler

PHYSIOGRAPHIC SETTING OF LOS ALAMOS COUNTY

FIGURE 3-14

LOCATION OF RESERVOIRS, WELL FIELDS, SUPPLY WELLS, AND GALLERY WATER SUPPLY AT LANL FIGURE 3-15

blowdown, cooling tower blowdown, and filter backwash); cooling tower blowdown from other areas; once-through, noncontact cooling water; wastewater from HE facilities; photographic laboratory rinsewater, and miscellaneous discharges. Additionally, a number of sanitary wastewater treatment plants discharge treated effluent directly to the various canyons. These discharges are controlled by specified maximum concentrations in the National Pollutant Discharge Elimination System (NPDES) permit for LANL. There is no stormwater holding system at the LANL. Any stormwater runoff and/or snowmelt runs from the surface of the mesas to the canyon rims and then into the canyons.

3.3.2.1 Cooling Tower Blowdown

Cooling tower blowdown is one source of wastewater discharged to the canyons. Table 3-18 is a listing of TAs and buildings, NPDES outfall numbers, and canyons to which the outfalls are discharged. The cooling water is treated to prevent deposition of scale and corrosion of the cooling water systems. Polyacrylate polymer is used to disperse deposits, and polythiazole is used to prevent corrosion. To prevent the growth of slime and/or bacteria, a chlorine-containing material is used. Chemical treatment levels are controlled within specified concentrations. Cooling water is intentionally blown down from the cooling loop to prevent dissolved solids from increasing to a level where deposition might be a problem.

3.3.2.2 Once-Through Cooling Water

Noncontact, once-through cooling water is discharged to many streams and canyons from LANL operations. This water is from cooling of equipment and does not contact the materials being cooled. Table 3-19 lists these outfalls. These are very low-flow uses in areas where cooling tower systems are not installed and where clean, high-quality cooling water is required. For example, the reactor development component building at TA-35-46 and the technical shops at TA-3-102 are the largest users of noncontact cooling water at the LANL. The water is used to cool equipment for the machining of components, metals, and other materials needed in weapons research activities.

TABLE 3-18

CATEGORY 3A OUTFALL DATA, LANL
(Cooling Tower Blowdown, Evaporative Coolers, Condensers, Air Wash Blowdown)

Technical Area-Building	NPDES Outfall Number	Average Flow (MGD)	Period of Flow/Day; Canyon Receiving Discharge
TA 2-44	019	0.002	8 hr/day; Los Alamos
TA 2-49	020	0.005	8 hr/day; Los Alamos
TA 3-29	021	0.004	8 hr/day; Sandia
TA 3-127	022	0.004	1.5 hr/day; Sandia
TA 3-105, 156	023	0.002	1.5 hr/day; Sandia
TA 3-187	024	0.001	1 hr/day; Sandia
TA 3-208	025	0.002	1.5 hr/day; Pajarito
TA 3-208	026	0.001	1.5 hr/day; Sandia
TA 3-285	027	0.020	5 hr/day; Sandia
TA 15-202	028	0.001	3 hr/day; Water Canyon
TA 16-340	029	NA	NA
TA 21-2	030	0.0021	2 hr/day; Los Alamos
TA 21-143	031	0.002	2 hr/day; Los Alamos
TA 21-150	032	0.0004	5 hr/day; Los Alamos
TA 21-152	033	NA	NA
TA 21-166	034	0.01	1 hr/day; Los Alamos
TA 21-210	035	0.0002	1 hr/day; Los Alamos
TA 21-220	036	0.001	1 hr/day; Los Alamos
TA 21-314	037	0.0003	8 hr/day; Los Alamos
TA 33-114	038	0.0001	14 hr/day; Los Alamos
TA 35-33	039	NA	NA
TA 46-1	042	0.0005	8 hr/day; Canada del Buey
TA 46-31	043	0.0005	1 hr/day; Canada del Buey
TA 46-86	044	No flow	NA; Canada del Buey
TA 48-1	045	0.012	2 hr/day; Mortandad
TA 48-1	046	0.007	1 hr/day; Mortandad
TA 53-60	047	0.002	3 hr/day; Los Alamos
TA 53-62	048	0.006	3 hr/day; Los Alamos
TA 53-64	049	0.010	3 hr/day; Los Alamos
TA 16-430	060	0.003	24 hr/day; Water
TA 16-370	092	0.001	6.75 hr/day; Water
TA 53-1	098	0.002	7 hr/day; Twomile
TA 15-40	103	0.0007	7 hr/day; Pajarito
TA 53-293, 294	113	0.002	24 hr/day; Sandia
TA 53-2	114	0.012	24 hr/day; Sandia
TA 46-169	124	0.0001	7 hr/day; Canada del Buey
TA 53-28	125	0.0007	7 hr/day; Sandia

Source: NPDES Permit Application - #NM 0028355

NA - not available.

MGD - million gallons per day.

TABLE 3-19

CATEGORY 4A OUTFALL DATA, LANL
(Noncontact, once-through cooling water)

Technical Area-Building	NPDES Outfall Number	Average Flow (MGD)	Period of Flow/Day; Canyon Receiving Discharge
TA 3-102	009	0.018	4 hr/day; Pajarito
TA 3-105	010	NA	NA
TA 22-5	011	0.001	4 hr/day; Pajarito
TA 35-67	012	0.001	4 hr/day; Mortandad
TA 46-30	013	0.0005	4 hr/day; Canada del Buey
TA 46-88	014	0.0036	4 hr/day; Canada del Buey
TA 48-1	015	NA	NA
TA 48-1	016	0.014	4 hr/day; Mortandad
TA 46-24, 59, 76	018	0.007	4 hr/day; Canada del Buey
TA 3-105	023	0.002	1.5 hr/day; Sandia
TA 43-1	040	0.004	0.5 hr/day; Los Alamos
TA 16-220	070	0.001	0.5 hr/day; Los Alamos
TA 16-202	083	0.002	0.5 hr/day; Valle
TA 22-5	084	0.001	7 hr/day; Water
TA 22-6	085	NA	3 hr/day; Pajarito
TA 3-216	086	NA	NA
TA 35-46	087	0.021	NA; Sandia
TA 35-67	088	NA	NA
TA 35-84	089	NA	NA
TA 35-85	090	0.0007	8 hr/day; Mortandad
TA 16-450	091	0.0003	0.25 hr/day; Water
TA 15-194	093	0.002	6.5 hr/day; Water
TA 3-170	094	0.002	0.25 hr/day; Sandia
TA 15-40	102	0.0007	7.5 hr/day; Pajarito
TA 15-138	105	NA	NA
TA 3-73	109	0.001	3 hr/day; Sandia
TA 3-73	110	0.001	24 hr/day; Sandia
TA 52-1	111	NA	NA
TA 52-11	112	0.002	4 hr/day; Mortandad
TA 8-70	115	0.001	7.5 hr/day; Valle
TA 35-29	116	NA	NA
TA 46-41	117	0.002	24 hr/day; Canada del Buey
TA 15-263	121	0.001	7 hr/day; Pajarito
TA 15-R45	122	0.001	7 hr/day; Pajarito
TA 48-8	126	0.014	7 hr/day; Mortandad
TA 35-213	127	0.0036	7 hr/day; Mortandad

Source: NPDES Permit Application - #NM0028355

NA - not available

MGD - million gallons per day

3.3.2.3 Wastewater from HE Facilities

High explosives development, synthesis, and production are performed at TAs-16, 9, and 22. These outfalls are included in the NPDES Permit as Category 5A (see Table 3-20). The formulation, mixing, synthesis, and machining of HE result in the discharge of dissolved or particulate HE. For example, HE is machined on a cutting lathe that uses water to cool, lubricate, and clean the cutting surface. Chips, fragments, and HE dust are sluiced from the cutting surface with water jets. The water (monthly washdown water and cooling water) that is discharged from the buildings where HE is handled is directed to a sump. This sump is equipped with a basket and a series of baffles. Solid HE particles carried with the water are removed in the basket or settle as the flow passes through the baffled area. Any HE that accumulates in the baskets or in the baffled areas is removed by a vacuum truck and taken to a burn area for disposal. Wastewater from the sump is then discharged to a canyon via a permitted outfall (with the recent exception of wastewater from TA-16-478). Possible contaminants are solvents (methyl ethyl ketone, acetone, phthalates), small amounts of HE (TNT, HMX, RDX, PETN, TATB, and others) and, in the case of mock explosive, barium salts.

3.3.2.4 Photographic Laboratory Rinsewater

There are 14 photographic laboratories at the LANL (see Table 3-21). Discharges from these laboratories are rinsewater flows that are very low in volume (0.00001 to .002 mgd). Typically they include silver and cyanide, but concentrations are low, ranging from 0.5 to 1.0 mg/L of silver and less than 0.2 mg/L of cyanide. All the discharges are to canyons via NPDES outfalls.

3.3.2.5 Power-House Discharges

TA-3-22 is the power house for TA-3, the major technical area for the laboratory. The power house has three boilers, which are continuously blown down to control concentrations of dissolved solids. There is also a cooling-water system to provide the necessary condenser cooling water. The cooling towers also release blowdown to control the level of dissolved solids. These wastes plus the neutralized demineralizer regenerants are discharged to Sandia Canyon via NPDES Outfall 001.

TABLE 3-20

CATEGORY 5A OUTFALL DATA, LANL
(High-Explosive Wastewater Discharges)

Technical Area-Building	NPDES Outfall Number	Average Flow (MGD)	Period of Flow/Day; Canyon Receiving Discharge
TA-16-330	052	0.00009	7 hr/day; Water
TA-16-410	053	0.0001	7 hr/day; Water
TA-16-340	054	0.023	8 hr/day; Valle
TA-16-401, 406	055	0.014	0.5 hr/day; Valle
TA-16-260	056	0.004	7 hr/day; Valle
TA-16-265, 267	057	0.0001	2 hr/day; Valle
TA-16-300 Line	058	0.021	7 hr/day; Valle
TA-16-280	061	0.0004	8 hr/day; Valle
TA-16-342	062	0.00007	2 hr/day; Valle
TA-16-400	063	0.009	2 hr/day; Water
TA-22-34	064	0.0001	7 hr/day; Pajarito
TA-22-1	065	0.0002	7 hr/day; Pajarito
TA-9-A	066	0.006	8 hr/day; Valle
TA-9-B	067	0.008	8 hr/day; Valle
TA-9-48	068	0.014	8 hr/day; Valle
TA-11-50	069	0.00008	2 hr/day; Valle
TA-16-430	071	0.0007	5 hr/day; Water
TA-16-460	072	0.003	8 hr/day; Water
TA-11-51	096	0.0001	2 hr/day; Valle
TA-11-52	097	0.0001	1 hr/day; Valle

Source: NPDES Permit Application - #NM0028355

MGD - million gallons per day

TABLE 3-21

CATEGORY 6A OUTFALL DATA, LANL
(Photographic Laboratory Waste Discharges)

Technical Area-Building	NPDES Outfall Number	Average Flow (MGD)	Period of Flow/Day; Canyon Receiving Discharge
TA-16-222	073	0.001	7.5 hr/day; Valle
TA-8-22	074	0.003	8.5 hr/day; Valle
TA-8-21	075	0.001	8.5 hr/day; Valle
TA-22-34	078	0.002	7 hr/day; Pajarito
TA-40-4	079	0.001	7 hr/day; Pajarito
TA-40-5	080	0.0007	7 hr/day; Pajarito
TA-40-8	081	0.0003	7 hr/day; Pajarito
TA-40-12	082	0.0005	7 hr/day; Pajarito
TA-40-1	099	0.0007	4 hr/day; Pajarito
TA-40-15	100		NA
TA-40-9	101	0.00001	7 hr/day; Pajarito
TA-15-40	102	0.0007	7 hr/day; Pajarito
TA-36-1	106	0.002	7 hr/day; Pajarito
TA-15-R183	123	0.007	7 hr/day; Pajarito

Source: NPDES Permit Application #NM0028355

MGD - million gallons per day

NA - not available

This 90,000 gallon/day waste stream has a pH in the range of 6 to 9 units and total suspended solids (TSS) in the range of 30 to 100 mg/L. Additionally, chlorine is in the cooling water at times (due to disinfection practices) at approximately 0.2 mg/L (LANL, 1985).

3.3.2.6 Sanitary Wastewater Treatment Plants

Of 11 permitted sanitary wastewater treatment systems at the LANL (see Table 3-22), 2 have been combined with other sanitary outfalls, leaving 9 discharges of treated sanitary wastewater to the canyons. All the sanitary treatment facilities discharge directly to one of the canyons.

Six of the sanitary waste water systems are included in the Federal Facility Compliance Agreement (FFCA) signed in July 1986 between the DOE, Los Alamos Area Office, and the EPA, Region VI. The six facilities included in the FFCA are the sewage treatment plants in TA-3 (which discharge through Outfall 1S), TA-18 (which discharges through Outfall 4S), TA-21 (which discharges through Outfall 5S), TA-41 (which discharges through Outfall 6S), TA-35 (which discharges through Outfall 10S), and TA-9-211 (which discharges through Outfall 11S). The major impetus for the FFCA was the occasional violation of NPDES permit limits on TSS and chlorine from these outfalls. The construction/renovation being performed on these six systems is designed for greater consistency in meeting the requirements of the NPDES permit by improving the removal efficiency of organics and TSS, and by improving the feed of chlorine for disinfection of the discharges. The construction projects encompass sand filtration to reduce TSS and upgrading of existing chlorination facilities. At the time of the Survey, most of the construction at the LANL had been finished; and the estimated final completion date is May 1988.

The largest of the sanitary wastewater treatment facilities is located at TA-3. There are actually two plants at this facility, identical in construction. Flow enters the plant and is distributed evenly to the two trains of equipment. The flow is through Imhoff tanks followed by trickling filters (the two processes provide removal of organics). The wastewater then goes to secondary clarifiers, where suspended

TABLE 3-22

SANITARY WASTE TREATMENT PLANTS, LANL

Technical Area-Building	NPDES Outfall Number	Average Flow (MGD)	Canyon Receiving Discharge
TA-3	01S	0.2899	Sandia
TA-9	02S	0.003	Pajarito
TA-16	03S	0.0171	Water
TA-18	04S	0.0053	Pajarito
TA-21	05S	0.0215	Los Alamos
TA-41	06S	0.0217	Los Alamos
TA-46	07S	0.0068	Canada del Buey
TA-48-5	08S	0.002	Outfall 10S; Mortandad
TA-53	09S	0.0113	Sandia
TA-35	10S	0.014	Mortandad
TA-8	11S	0.0027	Combined with Outfall 02S; Pajarito

Source: NPDES Permit Application - #NM0028355
 MGD - million gallons per day

solids are removed. The water overflows the clarifiers, where it can either be sent back to the power house (for reuse as cooling tower makeup) or be discharged to Sandia Canyon after receiving chlorination. Solids that are washed from the clarifiers are directed to a sand filter for dewatering. After the water is drained from the solids, the solids are removed and taken to TA-54, Area G, for disposal because the sludge may contain low-level radioactivity.

The next largest flow of sanitary waste is treated in the treatment plant at TA-21. This consists of an aeration system (for removal of organics) followed by a secondary clarifier for removal of solids. Again, the solids are dewatered in a sand filter.

The sanitary wastewater lagoon system at TA-53 receives, in addition to the sanitary waste, some water containing low-level radioactive material. Under a normal mode of operation, these lagoons are designed to operate as evaporation ponds. However, due to increased employee population at TA-53, discharge does occur through Outfall 095. This has resulted in contamination of soils at the outfall with radionuclides. Potential exists for transport off-site during periods of heavy runoff.

Sixty-three active septic tank systems, scattered throughout the various TAs, are registered with Los Alamos County. These septic tanks are simply inground tanks that provide anaerobic treatment of organics. The treated water flows from the tanks and is directed to seepage beds or pits. Septic systems are used in areas which are more distant from the LANL main core area (i.e., TA-3 and vicinity) and in areas with few, isolated structures. For example, TA-39 is located in the southern portion of the LANL site. TA-39 sanitary wastes are disposed of through a septic and drain field system. The LANL is no longer installing septic systems. It is constructing holding tanks, the contents of which will be pumped to a tank truck, which can transport the sewage to one of the sewage treatment plants.

3.3.2.7 Liquid Radioactive Waste Treatment

There are three liquid radioactive waste treatment facilities at the LANL. Two are at TA-50 and the third is at TA-21, but there is only one discharge point. Wastes from TA-21 contain low-level radioactive waste and are presently collected at TA-21-257, a treatment facility. Until 1986, these treated wastes were discharged to the canyon via NPDES Outfall 050. Since 1986, however, the treatment facility has been used as

a pretreatment system, and treated wastes are now pumped to TA-50-1, where they are mixed with other low-level radioactive wastes that have been collected for treatment. Thus, NPDES Outfall 050 is now inactive even though it still remains on the permit.

The treatment plant at TA-50-1 is the principal industrial wastewater treatment system at the LANL. Waste is received from several other facilities, most of it transported by pipeline, but some by truck. The treatment plant receives low-level radioactive wastewater containing heavy metals from the following facilities:

1. Laboratory shops in TA-3
2. Chemistry and metallurgy research in TA-3
3. Weapons test support in TA-6
4. Materials technology in TA-8
5. Radiochemistry in TA-48
6. Target Fabrication Facility
7. Waste management in TA-50
8. Liquid waste treatment in TA-21
9. Occupational health-environmental surveillance in TA-59
10. Omega West Reactor in TA-2
11. Plutonium processing in TA-55
12. Plutonium metallurgy (by truck) in TA-55
13. Meson-Physics (by truck) in TA-53 and
14. Other small sources throughout the LANL site.

The treatment plant at TA-50-1 provides for precipitation, coagulation, and clarification of wastewaters that are sent there. The treated water is then discharged to Mortandad Canyon via Outfall 051 two or three times per week at the rate of 44,000 gpd over a 2-hour period. The NPDES discharge criteria for this outfall are displayed in Table 3-23. The treatment plant at TA-50-1 produces an effluent stream that is usually of better quality than required by the NPDES permit.

Sludges that settle out from the wastewater streams are dewatered. The dewatered sludge is placed in containers, cemented, and sent to TA-54, Area G, for disposal. The sludge has been tested by the Extraction Procedure (EP) Toxicity test

TABLE 3-23

NPDES DISCHARGE CRITERIA FOR TA-50

	Daily Average	Daily Maximum
pH, S.U.	6-9	6-9
	pounds/day	pounds/day
COD	94	156
TSS	18.8	62.6
Cd	0.06	0.3
Cr	0.19	0.38
Cu	0.63	0.63
Fe	1.0	2.0
Pb	0.06	0.15
Hg	0.003	0.09
Zn	0.62	1.83

Source: LANL, 1987a

to determine if it is a hazardous waste. The EP Toxicity test results did not detect metals or pesticides in sufficient quantities to constitute a hazardous waste.

3.3.2.8 Miscellaneous Discharge

NPDES Outfall 095 from TA-30-170 was from an operation that cleaned gas cylinders. This operation no longer exists; therefore the outfall is presently inactive. In the past, however, wastewater discharged from this operation may have contained caustic soda and possibly paint constituents.

3.3.3 **Environmental Monitoring Program**

The LANL's surface-water monitoring program includes sampling in support of the NPDES Permit monitoring requirements; analysis of samples from the potable water system and stormwater runoff; and radiological monitoring of various water streams. Fish and sediment in some of these streams are also monitored.

3.3.3.1 NPDES Monitoring Program

At present, the LANL has 20 discharge categories covered by NPDES Permit NM 0028355. This permit, which became effective on March 1, 1986, and is valid until March 1, 1991, established a monitoring schedule for these discharge categories that includes frequency of testing as well as the parameters to be tested. Table 3-24 is a listing of the monitoring requirements for the various categories listed in the permit.

Of the 20 NPDES categories included in the permit, 8 are considered industrial outfalls, and 11 are from the sanitary waste treatment facilities. The sanitary waste outfall numbers contain an "S". The remaining outfall is at Fenton Hill. However, several of the industrial categories include a number of sources, each source being a LANL numbered outfall. The LANL numbers are included in the permit, listed in the proper category.

TABLE 3-24

NPDES MONITORING REQUIREMENTS, LANL

Outfall Category Number	Frequency	Parameters
01A	1/month	Flow (estimate), TSS, free available chlorine, pH, As, Cd, F, Li,
03A (includes 31 sources)	1/week ^a	Flow (estimate), TSS, free available chlorine, total phosphorus, pH
04A (includes 30 sources)	1/week ^a	Flow (estimate), pH
050	1/week, 1/month; continuous	COD, TSS, Cd, Cr, Cu, Fe, Pb, Hg, Zn, ammonia flow, pH
051	1/week 1/month; continuous	COD, TSS, Cd, Cr, Cu, Fe, Pb, Hg, Zn, ammonia flow, pH
05A (includes 19 sources)	1/week ^a	Flow (estimate), COD, TSS, pH
06A (includes 13 sources)	1/week ^a	Flow (estimate), total cyanide, total silver, pH
095	1/month	Flow (estimate), TSS, total phosphorus, pH
01S	3/month (composite); continuous	BOD ₅ , TSS, pH, fecal coliform bacteria (grab) flow
02S	1/3 month (composite); continuous	BOD ₅ , TSS, pH flow
03S	2/month (composite); continuous	BOD ₅ , TSS, pH flow
04S	1/3 month (composite); continuous	BOD ₅ , TSS, pH flow
05S	1/3 month (composite); continuous	BOD ₅ , TSS, pH flow

^a One source in each category is sampled each week on a rotating basis.

TABLE 3-24

NPDES MONITORING REQUIREMENTS, LANL (Continued)

Outfall Number	Frequency	Parameters
06S	1/3 month (composite); continuous	BOD ₅ , TSS, pH; fecal coliform bacteria (grab) flow
07S	1/3 month (composite)	BOD ₅ , TSS, pH, flow
08S	1/3 month (composite);	Flow (estimate), BOD ₅ , TSS
09S	1/3 month (composite); continuous	BOD ₅ , TSS, pH flow
10S	1/3 month (composite); continuous	BOD ₅ , TSS, pH flow
11S	1/3 month (composite)	Flow (estimate), BOD ₅ , TSS, pH
Fenton Hill	Daily	pH, As, B, Cd, F, Li, flow

Source: NPDES Permit Application NM0028355

The sanitary discharges (Outfall categories 01S through 11S) are monitored per the NPDES Permit for pH, TSS, and BOD₅ (i.e., the 5-day biological oxygen demand test). Both BOD₅ and TSS are indicators of how well the systems are operating. BOD₅ analyses show the degree of removal of organics by the treatment process, and TSS content shows how well suspended matter is being settled and/or removed. Fecal coliform testing is also performed on the effluent at 01s and 06s sanitary outfalls, which serve TA-3 and TA-41, respectively. All these systems are chlorinated. The fecal coliform count gives an indication of how well the chlorination process is functioning with regard to disinfection.

NPDES Outfall 01A is a mixture of wastewaters discharged from the power house (TA 3-22). Suspended solids, pH, and free available chlorine residual are analyzed for this outfall. The pH is analyzed to make certain that acidic and alkaline waste streams are neutralized prior to discharge. Total suspended solids are tested to make certain that high levels of suspended material are not being discharged. The free available chlorine residual is analyzed to determine if the cooling-tower water is overchlorinated (chlorine is used to control slime and bacterial growths in the cooling water).

NPDES Outfall Category 3A is composed of some 31 different sources in the various TAs listed in Table 3-18. These outfalls include blowdown from cooling towers, evaporative coolers, condensers, and air washers. The streams are checked for pH, TSS, total phosphorus, and free available chlorine. The pH is analyzed to determine if the waste stream is too acidic or alkaline. Total suspended solids are analyzed to determine if content of suspended material is too high. Total phosphorus is analyzed since some of the deposition/corrosion control chemicals being used in the cooling systems contain phosphate. Again, free available chlorine residual is checked to ascertain that excessive chlorine is not being discharged.

NPDES Outfall Category 04A consists of 30 sources scattered throughout the various TAs listed in Table 3-19. These sources are noncontact, once-through cooling water. Since these streams do not contact any product, NPDES testing requirements are minimal (i.e., only pH).

NPDES Outfall 050 is the discharge from the treatment system at TA-21-257. This outfall has not been used for the last year (i.e., 1986). Any wastewater treated in

the system is now sent to TA-50-1 for final treatment. Nevertheless, testing is still performed on the treated water before it is sent to TA-50-1. In accordance with the NPDES Permit, chemical oxygen demand (COD), TSS, cadmium, chromium, copper, iron, lead, mercury, zinc, and ammonia are analyzed, and pH and flow are continuously monitored. The COD analysis is a check on the organic matter in the waste stream. The TSS concentrations are an indicator of how well the coagulation/clarification process is operating. Concentrations of heavy metals are monitored to make certain that the removal of these constituents by precipitation is satisfactory. Ammonia is tested to see if any contamination with ammonia-containing materials is occurring. Though monitoring radionuclides is not a condition of the NPDES Permit, the LANL checks radionuclides (gross alpha, gross beta, tritium, strontium-89 and 90, cesium-137, uranium-234, plutonium-238 and 239, and americium-241) on a daily composited sample.

NPDES Outfall 051 is the discharge from TA 50-1, the principal industrial waste treatment facility. Monitoring requirements for this outfall are the same as those for Outfall 050. Again, the LANL analyzes the radionuclides in this discharge.

NPDES Outfall Category 05A includes all 19 outfalls that come from HE operation areas (See Table 3-20). These outfalls are analyzed for COD, TSS, and pH. The COD analysis is performed as an indication of the organic content of the waste stream. Suspended solids are analyzed to determine the amount of suspended material being discharged.

NPDES Outfall Category 06A covers the discharges from the 13 photographic laboratories listed in Table 3-21. These outfalls are checked for total cyanide, total silver, and pH. Cyanide and silver are indicators of process contamination of the rinsewater, while pH is an indicator of acidity/alkalinity.

NPDES Outfall 095 was the discharge from a gas cylinder cleaning operation. This operation has been discontinued and removed. Thus, the outfall is inactive and a discharge point no longer exists.

These outfalls are sampled and analyzed according to the schedule outlined in the permit and listed in Table 3-24. The multiple-source categories are scheduled for sampling consecutively (i.e., one per week on a schedule developed by HSE-8 until

all have been sampled; then the list is repeated). Table 3-25 presents a summary of the 1986 monitoring results for the NPDES industrial outfall categories. Of the 95 outfalls, 15 had one or more exceedances of a parameter standard. Similarly, Table 3-26 presents a summary of the 1986 monitoring results of the NPDES sanitary sewage treatment outfalls. For the 11 discharge points, there were a total of 23 exceedances.

The LANL has also been issued an NPDES Permit for the Fenton Hill Geothermal Program (NPDES Permit NM 0028576). The discharge (if flowing) is monitored daily and is checked for pH, arsenic, boron, cadmium, fluoride, and lithium. Figure 3-16 indicates the location of sampling points at Fenton Hill.

The LANL monitors regional, perimeter, and on-site surface waters at several locations for radionuclide and chemical constituents (See Figure 3-17). Surface-water monitoring is conducted in areas where effluents are known to be discharged from LANL operations and in areas with no known effluent releases. The 1986 monitoring results for noneffluent release areas showed that the maximum concentrations of chloride, fluoride, nitrate, total dissolved solids (TDS), and pH were within drinking water standards (LANL, 1987a). Concentrations of cesium and plutonium were at or below drinking water standards. Los Alamos, Sandia, Mortandad, and Acid-Pueblo Canyons are considered within effluent release areas. Mortandad Canyon receives the largest flow of industrial effluent from LANL operations and recorded the highest pH, TDS, and nitrate concentrations. The concentrations were above drinking water standards (as is to be expected for industrial discharges) but below DOE discharge limits. In addition, surface flow in Mortandad Canyon is not known to reach beyond LANL site boundaries (LANL, 1987a). All canyons in the effluent areas showed measurable quantities of radionuclide in surface waters. Mortandad Canyon waters consistently displayed the maximum concentrations of cesium-137, plutonium, tritium, and total uranium. With the exception of tritium, however, all radionuclide levels were less than 1 percent of the applicable DOE concentration guide for liquid effluents. Tritium values were equivalent to 1 percent of the applicable DOE concentration guide.

TABLE 3-25

NPDES PERMIT EFFLUENT QUALITY MONITORING OF INDUSTRIAL OUTFALLS, 1986

Discharge Category	Number of Outfalls	Permit Parameter	Number of Deviations	Daily Maximum Standard	Range of Deviations	Number of Outfalls With Deviations
Power Plant, Outfall 01A	1	TSS ^a Free Cl pH	0 1 1	100 mg/L 0.5 mg/L 6-9 SU	--- 0.6 11.4	0 1 1
Treated Cooling Water, Outfall 03A	30	TSS Free Cl P	0 6 0	100 mg/L 0.5 mg/L 5.0 mg/L	--- 0.8 to 10.6 ---	0 6 0
Noncontact Cooling Water, Outfall 04A	29	pH	1	6-9 SU	9.5	1
Radioactive Waste Treatment Plant, Outfall 051	2	COD ^b TSS Cd Cr Cu Fe Pb Hg Zn pH	6 0 0 0 0 0 0 0 0 0 7	37.5 lb/d 62.6 lb/d 0.03 lb/d 0.48 lb/d 0.63 lb/d 2.0 lb/d 0.15 lb/d 0.09 lb/d 1.83 lb/d 6-9 SU	180.2 to 787.33 --- --- --- --- --- --- --- --- 9.4 to 12.8	1 0 0 0 0 0 0 0 0 0 1
High Explosives, Outfall 05A	20	COD TSS pH	0 2 0	25 mg/L 45 mg/L 6-9 SU	178.2 to 1067.0 49.0 to 1368.0 ---	2 1 0
Photo Wastes, Outfall 06A	13	Cu Ag pH	0 0 1	0.2 mg/L 1.0 mg/L 6-9 SU	--- --- 5.6	0 0 1

Source: LANL, 1987a

a Total Suspended Solids

b Chemical Oxygen Demand

TABLE 3-26

**NPDES PERMIT EFFLUENT QUALITY MONITORING OF SANITARY SEWAGE
TREATMENT OUTFALLS, 1986**

Discharge Location	Outfall Number	Permit Parameters	Number of Deviations	Range of Deviation
TA-3	01S	BOD ^a TSS ^b Fecal Coliform ^c pH ^d	4 0 7 0	48.9 to 63.3 --- 4060.0 to 353,000 ---
TA-8	11S	BOD TSS (90) pH	0 1 0	--- 155.4 ---
TA-9	02S	BOD TSS pH	0 0 0	--- --- ---
TA-16	03S	BOD TSS pH	0 2 0	--- 47.6 to 83.0 ---
TA-18	04S	BOD TSS (90) pH	0 1 2	--- 128.0 5.8 to 9.2
TA-21	05S	BOD TSS pH	0 0 0	--- --- ---
TA-35	10S	BOD TSS (90) pH	1 0 0	49.0 --- ---
TA-41	06S	BOD TSS Fecal Coliforms pH	1 0 0 0	59.2 --- --- ---
TA-46	07S	BOD TSS pH	0 0 1	--- --- 5.0
TA-48	08S	BOD TSS pH	0 0 0	--- --- ---
TA-53	09S	BOD TSS (90) pH	0 1 2	--- 313.0 9.1 to 10.0

Source: LANI, 1987a

^a Biochemical Oxygen Demand (BOD) permit limits are 30 mg/L (20-day average) and 45 mg/L (7-day average)

^b Total Suspended Solids (TSS) permit limits are 30 mg/L (20-day average) and 45 mg/L or 90 mg/L (7-day average).

^c Fecal coliform limits are 1000 organism/100 mL (20-day average) and 2000 organism/100 mL (7-day average).

^d Range of permit pH limits is >6.0 and <9.0 standard units.

SAMPLING STATIONS FOR SURFACE WATER NEAR
THE FENTON HILL SITE-LANL

FIGURE 3-16

SURFACE-WATER SAMPLING LOCATIONS ON AND
NEAR THE LANL SITE

FIGURE 3-17

3.3.3.2 Potable Water System

The wells, springs, and distribution system are sampled and analyzed yearly for radionuclides, heavy metals, and other generally accepted chemical parameters such as silica, calcium, magnesium, potassium, sodium, alkalinity, phosphate, hardness, and conductivity. Additionally, bacterial analyses are performed. The sampling locations are shown in Figure 3-17. These analyses are normally performed on the site. In 1986, heavy metals and organics were checked, also with the organics analyzed by a state-approved contractor laboratory. Starting in 1987, trihalomethanes will be monitored also.

Table 3-27 is a tabulation of radionuclide and chemical parameters analyzed in drinking water in 1985, the maximum measured value from all of the wells, and the EPA standard for drinking water. These results indicate that the drinking water was of satisfactory quality and met the drinking water quality criteria. One well has an arsenic concentration that is higher than allowed; therefore, it is not used. One other well has a higher fluoride concentration than allowed by the criteria, but because of blending with the other wells, the standard is not exceeded.

3.3.3.3 Surface Runoff

Surface runoff occurs in two modes. Spring snowmelt runoff occurs over a period of several days at a low discharge rate. Summer runoff from thunderstorms occurs over a few hours at a high discharge rate. The LANL has an ongoing sampling and analysis program for runoff. This program collects samples during snowmelt and heavy rainstorm runoff. Both these samplings are for radionuclide content. The water portion is analyzed for tritium; cesium-137; plutonium-238, 239, and 240; and total uranium, while the suspended sediments are analyzed for plutonium -238, 239, and 240. Figure 3-18 shows the location of four of the five locations at which samples are usually taken. The other is at the retention ponds in Mortandad Canyon. Traces of tritium, cesium, and uranium were detected in most of the 1986 solution samples. The measurements for plutonium were less than the background levels for water and sediment except for sediment measurements at Los Alamos

TABLE 3-27
MAXIMUM RADIOACTIVITY AND CHEMICAL CONCENTRATION,
POTABLE WATER DISTRIBUTION SYSTEM, 1985
(10⁻⁹ μ Ci/mL)

Radioactivity	Concentration Max.	USEPA Max. Contaminant Levels
Cesium - 137	98 $\pm$ 54	200
Plutonium - 238	0.019 $\pm$ 0.012	15
Plutonium - 239, 240	0.034 $\pm$ 0.014	15
Gross Alpha	21 $\pm$ 5.0	15
Gross Beta	7.4 $\pm$ 0.9	
Tritium*	-0.4 $\pm$ 0.3	20
Total Uranium**	6.8 $\pm$ 1.0	1800

* 10⁻⁶ μ g/mL

** μ g/L, Level recommended by International Commission on Radiological Protection

Chemical	Concentration (mg/L)	Max. Contaminant Levels
Primary Standards:		
Silver	<0.01	0.05
Arsenic	0.050	0.05
Barium	0.07	1.0
Cadmium	<0.0002	0.010
Chromium	0.025	0.05
Fluoride	3.0	2.0
Mercury	<0.0002	0.002
Nitrate Nitrogen	5.3	10
Lead	.020	0.05
Selenium	<0.003	0.01
Secondary Standards:		
Chloride	15	250
Copper	0.021	1.0
Iron	0.036	0.3
Manganese	<0.001	0.05
Sulfate	6	250
Zinc	0.05	5
Total Dissolved Solids	236	500
pH, SU	8.0 - 8.2	6.5 - 8.5

Source: LANL, 1987a

LOCATION OF SURFACE RUNOFF SAMPLING STATIONS AT STATE ROAD 4 **FIGURE 3-18**

Canyon at State Route 4 and at the Rio Grande, and in Mortandad Canyon. Table 3-28 summarizes the results of the runoff measurements for plutonium.

In the summer of 1986, the LANL also collected runoff samples from 17 locations to check content of approximately 30 inorganic pollutants and 145 organic pollutants. Inorganic pollutants were commonly detected in stormwater runoff. Most metals and anions analyzed for exceeded reporting criteria in one or more samples. For several elements, the analytical level of detection exceeded the reporting criteria. Aluminum and iron were the most abundant metals in runoff. The majority of organic pollutants occurred at levels below the minimum limits of detection by the analytical methods used. However, methylene chloride was detected in two samples from TA-35 and from TA-50, exceeding 8 $\mu\text{g/L}$ in one sample. Fluoranthene and phenol were also detected in one sample from TA-35. None of these detected pollutants exceeded EPA's criteria for reporting in the NPDES Permit application. Levels of chloroform exceeded these criteria in one sample from TA-35 and one from TA-59. General phenolic levels were at or above the EPA reporting criteria in all but one sample. Oil and grease were present in three samples from TA-3 at levels near the reporting criteria. These analyses were done in anticipation of fulfilling requirements for obtaining a stormwater discharge permit. At the time of the Survey, the LANL had filed a permit application for stormwater discharges that was being reviewed by EPA Region VI.

3.3.3.4 Surface-Water Monitoring

LANL monitors regional, perimeter, and on-site surface waters at several locations for radionuclides and chemical constituents (See Figure 3-17). Surface-water monitoring is conducted in areas where effluents are known to be discharged from LANL operations and in areas with no known effluent releases.

The LANL samples and analyzes for radionuclides twice a year. There are 6 regional locations (Figure 3-19), 31 perimeter locations within 4 kilometers of the LANL, and 38 on-site locations. The on-site sampling locations are divided into two groups: 12 locations are in noneffluent (i.e., no discharge) areas and 26 are in effluent release areas (Figure 3-17). The radionuclide parameters include cesium-137; plutonium-238, 239, and 240; tritium; and total uranium. Los Alamos, Sandia, Mortandad, and Acid-Pueblo Canyons are considered within the effluent release areas. All canyons

Table 3-28

AVERAGE PLUTONIUM CONCENTRATIONS IN SUMMER RUNOFF IN EFFLUENT RECEIVING CANYONS

	Number of Analyses	Solution		Suspended Sediments	
		²³⁸ Pu (10 ⁻³ pCi/mL)	^{239,240} Pu (10 ⁻³ pCi/mL)	²³⁸ Pu (pCi/g)	^{239,240} Pu (pCi/g)
Los Alamos Canyon at State Road 4	11	0.002 (0.011) ^a	0.005 (0.008)	0.239 (0.173)	1.57 (0.88)
Pueblo Canyon at State Road 4	1	0.004 (0.007)	0.004 (0.008)	-0.022 (0.016)	0.000 (0.21)
Los Alamos Canyon at Rio Grande	4	0.004 (0.011)	0.013 (0.011)	0.104 (0.055)	1.53 (1.34)
Pajarito Canyon at State Road 4	8	-0.002 (0.011)	0.009 (0.012)	-0.055 (0.081)	0.290 (0.451)
Mortandad Canyon at Retention Ponds Near MCO-7	2	--	--	6.88 (2.07)	20.2 (7.71)
Regional and Local Back-ground ^b	--	0.005	0.036	0.026	0.740
Limits of Detection	--	0.009	0.03	0.003	0.002

Source: LANL, 1987a

a Standard deviation is contained in parentheses.

b Solution surface water, Rio Grande, and Rio Chama, 1986 (12 analyses x + s).

Suspended Sediments Pajarito Canyon, 1986 (8 analyses x + s).

REGIONAL SURFACE-WATER SAMPLING LOCATIONS
AT THE LANL SITE

FIGURE 3-19

in the effluent areas showed measurable quantities of radionuclide in surface waters. Mortandad Canyon waters consistently displayed the maximum concentrations of cesium-137; plutonium-238, 239, and 240; tritium; and total uranium. However, all radionuclide levels were less than 1 percent of the applicable DOE concentration guide for liquid effluents with the exception of tritium. Tritium values were equivalent to 1 percent of the applicable DOE concentration guide. Table 3-29 presents a summary of the radioactivity in the surface waters and groundwater at the off-site and on-site monitoring locations.

3.3.3.5 Fish Monitoring

The LANL monitors nearby fish annually for radioactivity. Fish are taken from reservoirs upstream and downstream of the LANL. Figure 3-19 shows the location of the Abicuiu and Cochiti Reservoirs where fish samples are collected. Radionuclides (strontium-90, cesium-137, uranium, and plutonium-238 and 239) are checked on the edible tissue from two classes of fish: bottom-feeding catfish, and intermediate or surface-feeding fish. Results for 1986 show no statistically significant differences between the upstream and downstream samples.

3.3.3.6 Sediments

The LANL samples sediments at regional, perimeter, and on-site stream locations. These samples are checked for the radionuclides cesium-137; strontium-90; plutonium-238, 239, and 240; total uranium; and gross gamma. Figure 3-20 shows these locations. LANL monitors on-site surface-water sediment for radionuclide contamination in Los Alamos, Acid-Pueblo, and Mortandad Canyons. These canyons receive treated, low-level radioactive effluents. The concentrations of radionuclides in these canyons exceed regional background levels. Table 3-30 presents a summary of the radioactivity measurements in the sediments from the regional, perimeter, and on-site sampling locations. In general, the concentrations decrease downgradient in the sediments as the radionuclides are dispersed and mixed with uncontaminated sediments. The radionuclides in these canyons are due to the low-level radioactive effluents released from the treatment plants (LANL, 1987a). Mortandad Canyon displayed the highest concentration of radionuclides in

TABLE 3-29

**MAXIMUM CONCENTRATIONS OF RADIOACTIVITY IN SURFACE AND GROUNDWATERS
FROM OFF-SITE AND ON-SITE STATIONS**

	Number of Stations ^a	¹³⁷ Cs (10 ⁻⁹ μ Ci/mL)	²³⁸ Pu (10 ⁻⁹ μ Ci/mL)	^{239,240} Pu (10 ⁻⁹ μ Ci/mL)	³ H (10 ⁻⁶ μ Ci/mL)	Total U (μ g/L)
Off-site Stations (Uncontrolled Areas)						
Derived Concentration Guide (DCG) for Uncontrolled Areas						
Regional	6	3000	400	300	2000	800
Perimeter						
Adjacent	7	38 (34) ^b	0.028 (0.015)	0.028 (0.013)	1.3 (0.4)	5.0 (1.0)
White Rock	24	58 (38) ^b 110 (57)	0.019 (0.015) 0.018 (0.012)	0.036 (0.027) 0.037 (0.015)	3.5 (0.6) 104 (0.4)	13 (1.0) 16 (1.0)
Off-site Station Group Summary:						
Maximum Concentration		110	0.028	0.028	3.5	16
Maximum Concentration as % DCG for Uncontrolled Areas		4		<1	<1	2
On-site Stations (Controlled Areas)						
Concentration Guide (CG) for Controlled Areas						
Noneffluent Areas						
Groundwater (Main Aquifer)	6	400,000	100,000	100,000	100,000	60,000
		73 (30)	0.016 (0.015)	0.016 (0.012)	1.4 (0.4)	3.0 (1.0)

TABLE 3-29

**MAXIMUM CONCENTRATIONS OF RADIOACTIVITY IN SURFACE AND GROUNDWATERS
FROM OFF-SITE AND ON-SITE STATIONS (Continued)**

	Number of Stations ^a	¹³⁷ Cs (10 ⁻⁹ μ Ci/mL)	²³⁸ Pu (10 ⁻⁹ μ Ci/mL)	^{239,240} Pu (10 ⁻⁹ μ Ci/mL)	³ H (10 ⁻⁶ μ Ci/mL)	Total U (μ g/L)
Surface Water	3	52 (33)	0.012 (0.011)	0.013 (0.010)	1.7 (0.4)	4.0 (1.0)
Pajarito Canyon	3	-10 (64)	0.016 (0.026)	0.021 (0.020)	1.2 (0.8)	3.7 (0.8)
Effluent Areas						
Acid-Pueblo Canyon	8	53 (36)	0.031 (0.017)	0.220 (0.005)	5.2 (0.7)	4.0 (1.0)
DP-Los Alamos Canyon	8	59 (35)	0.067 (0.019)	0.180 (0.029)	7.2 (0.9)	3.0 (1.0)
Sandia Canyon	3	18 (33)	0.012 (0.018)	0.015 (0.009)	2.9 (0.5)	12.0 (1.0)
Mortandad Canyon	7	72 (34)	0.961 (0.066)	3.82 (0.165)	1300 (100)	12.0 (1.0)
On-site Group Summary:						
Maximum Concentration		72	0.961	3.82	1300	12
Maximum Concentration as %		<1	<1		<1	<1

Source: LANL, 1987a

^aOne or two analyses from each station.^bCounting uncertainty in parentheses.

SEDIMENT SAMPLING LOCATIONS IN AND
NEAR THE LANL SITE

FIGURE 3-20

TABLE 3-30

**MAXIMUM CONCENTRATIONS OF RADIOACTIVITY IN SEDIMENTS
FROM REGIONAL, PERIMETER, AND ON-SITE STATIONS, 1986**

	Number of Stations	⁹⁰ Sr (pCi/g)	¹³⁷ Cs (pCi/g)	Total U (μg/g)	²³⁸ Pu (pCi/g)	^{239,240} Pu (pCi/g)	Gross Gamma (cpm/g)
<u>Sediments</u>							
Background (1978-1985) ^a		1.15	0.52	4.8	0.002	0.011	8.1
Regional Stations	9		0.28 (0) ^b	4.4 (0)	0.002 (0)	0.013 (1)	5.2 (0)
Perimeter Stations	18		0.21 (0)	3.6 (0)	0.002 (0)	0.006 (0)	4.8 (0)
On-site Station, Effluent							
Release Areas							
Acid-Pueblo Canyon	6	0.54 (0)	0.83 (0)	3.4 (0)	0.063 (1)	10.1 (4)	6.3 (0)
DP-Los Alamos Canyon	11	1.6 (2)	1.1 (6)	3.2 (0)	0.299 (8)	0.507 (9)	10.2 (2)
Mortandad Canyon	7	4.8 (3)	64 (5)	5.9 (5)	11.1 (6)	50.6 (7)	8.3 (3)

Source: LANL, 1987a

^ax + 2s of a number of background analyses for soils and bed sediments (Pattymun, 1986).^bNumber in parentheses indicates number of stations exceeding background concentrations

samples of suspended sediment. The most contaminated sample was collected at one of three basins constructed to trap and restrict the flow of sediment.

3.3.4 Findings and Observations

3.3.4.1 Category I

None

3.3.4.2 Category II

1. Potential organic and inorganic contamination in the soils at permitted NPDES outfalls. Several NPDES-permitted outfalls are discharging organic (e.g., methyl ethyl ketone, acetone) and inorganic (e.g., barium) constituents that are not monitored and result in potential contamination of soils and sediments.

These substances were not included on the permit application that was sent to EPA for the NPDES Permit and are not included as permit monitoring conditions. In the 1985 permit application, a representative sample was taken from one discharge point for each outfall category and analyzed for permit requirements. However, since all operations are not identical, each discharge point has its own composition of discharged wastewater. Specific examples include the following:

* NPDES Outfall 058

This outfall serves Buildings 300, 302, 304, 306, and 307 in TA-16. Building 300 formulates "mock" explosives, a major ingredient being barium salts. Additionally, solvents (methyl ethyl ketone, acetone, ethyl and butyl acetates) are being used in Buildings 300 and 302. Since barium nitrate is soluble in water and solvents to some degree are also soluble, they would all be in the water discharged from the sumps. In turn, the HE formulations have some solubility (particularly in warm water). Thus, all these materials could be contaminating soils in the vicinity of the outfall. Outfall 058 is monitored for COD, pH, flow, and TSS, pursuant to NPDES Permit requirements. During the

Sampling and Analysis phase of the Survey, the sediments downstream of this outfall will be sampled to determine if organics, barium, heavy metals, and mercury can be detected.

* NPDES Outfall 062

This outfall discharges water from Building 342 in TA-16. This is a dry formulation building. However, there is a wet scrubber used to scrub any chemical dust from the mixer loading. This water, plus any water from the mixers, is discharged to Outfall 062. Since barium salts are used, barium could be contaminating the soils at the outfall. HE outfalls in TA-16 are monitored for COD, pH, flow, and TSS. During the Sampling and Analysis phase of the Survey, the discharge from Outfall 062 as well as the soils in the vicinity of the outfall will be sampled to determine if organics, barium, heavy metals, and HE are present.

* NPDES Outfall 035

This outfall is the discharge from the sanitary waste treatment facility at TA-16. The wastewater from the laundry at TA-16 is discharged to the sanitary facility. All work clothes from TA-16 and clothing from the LANL sites where personnel handle beryllium are washed at this laundry. Thus, there is the potential for barium, beryllium, HE, and solvent materials to be in these wastewaters. They might not be removed in the treatment facility and could thus contaminate soils at the outfall. The sanitary waste treatment facilities at the LANL are monitored for pH, BOD, flow, and TSS. During the Sampling and Analysis phase of the Survey, the water, soils at the discharge, and the waste sludge from the sand drying beds will be sampled to determine if organics, barium, heavy metals, and radionuclides are present.

3.3.4.3 Category III

1. Radionuclide contamination in several canyons. Site activities have resulted in the release of radionuclides into several of the canyons. Sampling results reported in the Annual Environmental Surveillance Reports indicate that plutonium in the sediments from Los Alamos Canyon has been transported to

the Rio Grande at levels above background. In 1984, sediment samples at Otowi contained .096 pCi/g plutonium-239 and 240, as compared to a regional background of .005 pCi/g. Los Alamos Canyon receives flow from Acid, Pueblo, and DP Canyons, all of which received industrial discharges in the past. The plutonium is bound up with the sediments that are moved down during runoff events.

Water Canyon can potentially receive plutonium in surface runoff from TA-49. This contamination can then move downstream toward the Rio Grande. (See related finding in Section 3.2.4.3.)

The treated wastewaters from the TA-50-1 treatment plant discharge to Mortandad Canyon. This treatment plant is the principal industrial waste treatment facility at the LANL. As such, it handles various wastewater streams that contain heavy metals, organics, and radionuclides. This outfall is monitored monthly for radionuclides, COD, TDS, and several metals including cadmium, chromium, copper, nickel, lead, mercury, and zinc. While the facility provides a good degree of removal, some contaminants are still present in the discharge. Over a period of time, there has been an accumulation of radionuclide contaminants in the sediment; thus, the sediment has the potential to be contaminated by other metals as well. LANL monitoring of the sediment has shown a mean plutonium-239 and 240 concentration of 14 pCi/g from the seven monitoring stations in Mortandad Canyon for 1986 (LANL, 1987a). A series of sediment traps have been installed in the canyon between sample stations MCO-7 and MCO-9 to prevent movement of contaminated sediment down the canyon. These appear to have functioned properly; however, extreme flood events could result in the movement of contaminated sediments down the canyon.

During the Sampling and Analysis phase of the Survey, the sediments at and downstream of the TA-50-1 Outfall will be sampled to determine the extent of any heavy metals and radionuclides present in the sediment.

2. Potential for HE and solvent contamination of soils at NPDES Outfall 054. Organics (e.g., methyl ethyl ketone, acetone, butyl and ethyl acetate) are

present in this discharge, resulting in the potential contamination of the soils beneath the discharge water flume and at the discharge point.

Explosives synthesis is performed at TA-16-340. Wastewaters from this building are discharged to a baffled sump behind Building TA-16-340. From this sump, the wastewater is discharged to Outfall 054. The COD concentration has been as high as 1,200 to 1,300 mg/L as a result of the volatile organics that are present. A weir box and a fiberglass trough (water flume) have been installed to convey the wastewater to the canyon bottom and to provide aeration of organic constituents. However, the weir box and trough were not properly sized at the time of installation, resulting in overflow of discharge water. This overflow may have resulted in contamination of the soils beneath and downgradient of the weir box and trough with organics and HE. During the Sampling and Analysis phase of the Survey, the water at the weir box and at the discharge of the water flume and the soils beneath the flume will be sampled to determine if organics, heavy metals, and HE are present.

3. Potential contamination by organic solvents, tritium, and other radionuclides of soils at TA-33, Building 86. Tritium and organics may be discharged from TA-33-56 and may be contaminating the marshy area east of the security fence. Any wildlife or workers walking in this area may be exposed to water containing tritium, as there is no security fence around the marsh.

It is estimated that the marsh is approximately 200 feet by 100 feet. A tritium laboratory is located in a portion of Building TA-33-86. The drains from this building discharge to a sump east of the building. The water from Building TA-33-86 (particularly washwater) can contain tritium from contamination of the equipment and walls. In addition, solvents such as TCE, acetone, and ethanol are used in a nearby building. This water seeps from the sump to a marshy area, since the flow into the sump simply percolates out to the soils. Thus, tritium and solvent contamination of the soils may have occurred from recent operations. Past practices are thought to have used polonium, and there is potential for past use of uranium and thorium. During the Sampling and Analysis phase of the Survey, the water from the sump and the soils in the marsh will be sampled to determine if organics and radionuclides are present.

4. Potential contamination of soils with radionuclides and other substances due to the TA-53 lagoon outfall (NPDES Outfall 09S). Radionuclides, oil and grease, and possibly heavy metals may be contaminating the soils in Los Alamos Canyon below Outfall 09S.

The lagoon system is a sanitary treatment system that also receives wastewater containing radionuclides. Radionuclides (tritium; beryllium-7; sodium-22; manganese-54; cobalt-57 and 60; and cesium-134) are contained in Outfall 09S and may be contaminating the soils at the outfall (LANL, 1987a). Under normal operation, these lagoons are designed to operate as evaporation ponds. Owing to increased employee population at TA-53, however, discharge does occur through NPDES Outfall 09S. (Discharge occurred from July through December 1986.) This has resulted in contamination of soils at the outfall with radionuclides. Potential exists for transport off-site during periods of heavy runoff. During the Sampling and Analysis phase of the Survey, water and soils at this discharge will be sampled to determine if oil and grease, heavy metals, and radionuclides are present.

5. Potential soil contamination with HE and solvents from the outfall at TA-16-478. This outfall may have discharged water containing HE and organics in the past, thus contaminating soils in the vicinity of the outfall. As in all the buildings where HE is processed, wastewater is discharged to a sump behind the building; the water then passes through a series of baffles where the velocity is decreased so as to allow other suspended solids to settle. The sump outlet to the drain pipe has been filled with concrete to prevent additional discharge. However, soil sampling (Baytos, 1986a) performed in 1985 by the LANL found soil concentrations of HE near 5 percent at this outfall. During the Sampling and Analysis phase of the Survey, soils in the vicinity of the TA-16-478 discharge will be analyzed for presence of possible HE, volatile, semivolatile, and metal contaminants which may have been discharged.

3.3.4.4 Category IV

1. Improper fixation of samples. During the Survey, samples collected for cyanide analysis were not being fixed immediately after collection, but instead were being held until being delivered to the laboratory. Since the cyanide concentrations are low, the cyanide may dissipate if not fixed in the field. These samples should be fixed as soon as they are collected with sodium hydroxide to a pH of 12.0.

This procedure was corrected while the Survey team was at the LANL and the samples are now fixed in the field.

2. Improper pH meter calibration. At the time of the Survey, the pH meter was being calibrated against pH standards of 7.0 and 10.0 and then checked against a quality assurance (QA) standard of 7.0 pH. Laboratory procedures generally call for calibrating at pH values of 4.0 and 10.0 when checking against a QA standard of 7.0. The proper procedure was initiated while the Survey team was still at the LANL.
3. Noncontact once-through cooling-water discharge from TA-53-19. Building 19, TA-53, has a noncontact, once-through cooling-water stream not included in the present NPDES Permit. It is discharged onto a roadway, eventually flowing to a storm catch basin that discharges to Mortandad Canyon.

3.4 Hydrogeology

3.4.1 Background Environmental Information

3.4.1.1 Regional Geology

The Los Alamos National Laboratory (LANL) is located on the Pajarito Plateau, on the western side of the Rio Grande Rift. The rocks of the Los Alamos area are related to the Rio Grande Rift, and their history is in large part a history of this structural depression and its associated volcanism. Although tectonic activity apparently occurred along the axis of the rift from Paleozoic time, the current features of the Rio Grande Rift began to form in the Middle Tertiary, approximately 20 million years ago (Cordell, 1978). The western boundary of the graben-like structure of the rift is formed by the Pajarito Fault, a normal fault which is downthrown to the east. It is apparent from microseismic data collected at Los Alamos that this or associated faults is still active (TERA Corporation, 1984). A geologic cross-section, Figure 3-21, illustrates the subsurface configurations.

As the rift opened and widened, erosional material from the adjoining highlands was deposited in the valley, forming the lowermost unit of the Santa Fe Group. This unit, described by Griggs (1964) as "the undifferentiated unit" of the Santa Fe Group, was deposited as coalescing alluvial fans and alluvial plain deposits in Miocene and Pliocene times. More current reports describe this unit as the Tesuque Formation, which consists of siltstones and sandstones with lenses of clay. This unit occurs directly over the Precambrian basement rocks with no intervening layers representing the Mesozoic or Paleozoic eras. Although the total thickness of the Tesuque Formation is not known, wells in Guaje Canyon penetrate more than 2,000 feet without reaching the bottom of the formation. The Tesuque Formation also contains several basalt flows. In the western part of the Pajarito Plateau, the Tesuque interfingers with the Tschicoma Formation, which includes the volcanic rocks that form the interior of the Jemez Mountains. These volcanic rocks extend under the Pajarito Plateau but thin rapidly to the east.

Overlying the Tesuque and also interfingering with the Tschicoma is the Puye Conglomerate. This formation consists of a lower unit, the Totavi Lentil, which is

FIGURE 3-21
GENERALIZED CROSS-SECTION OF STRATIGRAPHIC RELATIONS OF THE
BANDELIER TUFF TO OLDER ROCKS IN THE LOS ALAMOS AREA

composed of gravel, cobbles, and boulders of quartz, granite, and volcanic debris; and an upper unit, the conglomerate member, which is composed of erosional debris from the Tschicoma Formation. The Puye Conglomerate is present only on the east side of the Jemez Mountains and occurs in a strip approximately 10 miles wide. South of Los Alamos Canyon the deposition of the Puye Conglomerate was restricted to the east because of the contemporaneous outpouring of lava flows of the lower unit of the basaltic rocks of Chino Mesa. The basalt flows originated to the southeast in the Cerros del Rio and form the steep walls of White Rock Canyon. They are exposed in deep canyons cut in the Pajarito Plateau as far north as Los Alamos Canyon.

The uppermost formation beneath the Los Alamos site is the Bandelier Tuff. All facilities at the LANL are built on this formation. The Bandelier Tuff was formed during explosive eruptions in the Jemez Mountains. The eruptions also produced the Valle Grande, the large caldera west of Los Alamos. The Bandelier Tuff is composed chiefly of ashfall and ashflow tuff, with some thin, water-lain sediments. The formation has been divided into three members: Guaje, Otowi, and Tshirege, from oldest to youngest.

The Guaje member of the Bandelier Tuff is an ashfall pumice and water-laid pumiceous tuff that rests unconformably on older rocks. The base of the unit contains gray, lump-pumice fragments up to 16 feet in length. The Otowi Member of the Bandelier Tuff is a light gray, nonwelded, pumiceous rhyolite tuff that weathers to a gentle slope. The Otowi consists of a massive ashflow, with several beds of silt and water-laid pumice near the top. The Tshirege member of the Bandelier Tuff is composed of a series of ashflows of rhyolite tuff. The Tshirege unconformably overlies the Otowi and forms the caprock of the narrow mesas of the Pajarito Plateau. The rhyolite tuff is composed of quartz-sanidine crystals and crystal fragments, rock fragments of rhyolite, dacite, and pumice in an ash matrix that ranges from nonwelded to welded.

Alluvial material, eroded from the Jemez Mountains and the Pajarito Plateau, has been deposited in the canyons that dissect the plateau. Near the heads of the canyons, bedrock is commonly exposed, but further down the canyons, the alluvium may be 250 feet wide and as much as 90 feet thick.

3.4.1.2 Hydrogeology

Groundwater occurs in three modes in the Los Alamos area. These include the main aquifer, which provides the water supply for the laboratory and surrounding communities, perched water in isolated zones in basalts, and water in the alluvial material in some canyons.

The main aquifer is located in the Tesuque Formation beneath the Pajarito Plateau and the Rio Grande Valley. The lower part of the Puye Conglomerate is also within the saturated zone in the central and western parts of the plateau. Depths to the main aquifer range from 1,200 feet in the western part of the plateau to about 600 feet along the eastern rim. The total thickness of the main aquifer is not known, but some wells have penetrated over 2,000 feet of saturated thickness, and total thickness is estimated to be at least 3,900 feet.

The hydraulic gradient in the main aquifer varies through different depositional horizons. The average hydraulic gradient in the saturated portion of the Puye Conglomerate is 60 feet per mile. The gradient increases to about 100 feet per mile along the eastern edge of the plateau. Based on the results of several pumping tests in the Los Alamos Canyon well field (Theis and Conover, 1962), the estimated average rate of movement in the aquifer is approximately 1 foot per day. This estimate is based on an average hydraulic conductivity of 1.5×10^{-3} cm/sec. Tests in other well fields indicated hydraulic conductivities ranging from 1.1×10^{-3} cm/sec to 2.2×10^{-1} cm/sec. Recharge to the main aquifer is derived from precipitation in the Valle Grande to the west of Los Alamos. The precipitation infiltrates through the volcanic rocks of the Tschicoma Formation and enters the Tesuque Formation, where it interfingers with the Tschicoma. Movement through the aquifer is generally eastward toward the Rio Grande, as shown in Figure 3-21 by the contours. Discharge from the aquifer occurs in springs along the Rio Grande. It is estimated that between 1.4 and 1.8 billion gallons of water are discharged from the aquifer into the Rio Grande in White Rock Canyon annually (LASL, 1980).

A perched water zone exists in localized areas within the basaltic rocks of Chino Mesa. This zone is recharged by surface infiltration through the volcanic debris in lower Pueblo Canyon and the midreach of Los Alamos Canyon. Discharge occurs at

Basalt Spring in Los Alamos Canyon. Movement through this aquifer is believed to be fairly rapid, approximately 12.5 feet/day (DOE, 1979).

Groundwater also occurs in the alluvium that covers some canyon floors. Intermittent streams have deposited alluvial material in the canyons that traverse the Pajarito Plateau. In some places, the alluvial layer may be as much as 100 feet thick. Intermittent runoff in the canyons infiltrates the alluvium until its downward movement is impeded by the less permeable tuff and volcanic sediments. This results in a shallow alluvial groundwater body that migrates downgradient in the alluvium. As it moves down the canyon, the water is depleted by evapotranspiration and infiltration into underlying volcanics (Purtymun, Buchholz, and Hakonson, 1977). Canyons that are likely to have groundwater in the alluvium include those with large drainage areas, such as Water, Pajarito, and Los Alamos Canyons, and those that receive discharges from the site, such as Sandia, Mortandad, and Pueblo Canyons. The alluvium in canyons that do not receive discharge and have relatively small drainage areas either have been tested and found to be dry or have not been tested. In tests performed in the alluvium in Mortandad Canyon (Purtymun, 1974), a field coefficient of permeability was derived for several horizons in the alluvial deposits. These values ranged from 8.8×10^{-3} cm/sec to 1.6×10^{-1} cm/sec. The velocity of transport in the alluvium ranged from 5.7 feet/day to 67 feet/day.

Any discussion of the hydrogeology of Los Alamos must address the vadose, or unsaturated, zone. In many parts of the country, where groundwater occurs at fairly shallow depths, the vadose zone is often ignored because it has a very minor influence on the rate of movement of contaminants. At Los Alamos, the vadose zone is very thick, ranging from 600 to 1,200 feet. As a result, this zone acts as a major impediment to vertical flow and infiltration of surface water or precipitation. In addition, the moisture content of the Bandelier Tuff is very low, further impeding flow in this formation. Studies conducted at TA-54 (International Technology Corporation, 1987) indicate that moisture content in the upper 20 feet of the tuff varies in response to precipitation, but below that depth the moisture content of the tuff is fairly constant and in the range of 2 to 4 percent (volumetric).

Unsaturated hydraulic conductivities were calculated based on higher moisture contents than those encountered in the field. Since unsaturated hydraulic

conductivity is proportional to moisture content, the calculated values are conservative and represent values greater than those likely to exist under field conditions. The calculated values are still very low, ranging from 1.63×10^{-7} cm/sec to 3.01×10^{-9} cm/sec. Actual unsaturated hydraulic conductivity in the field may be several orders of magnitude lower.

3.4.2 General Description of Pollution Sources and Controls

Potential sources of groundwater pollution at the LANL consist of various releases of contaminants over time to other media. Specific potential sources of groundwater contamination are discussed more completely under subsections of the air, soil, surface water, waste management, toxic materials, direct radiation, and inactive waste sites sections of this report.

In general, potential sources of groundwater contamination can be identified as follows:

- 1) Liquid discharges, either current or historical, may impact the shallow alluvial groundwater found in some canyons. Specific discharges are discussed in Section 3.3.2 of this report. Effects of discharges have been noted in some canyons and are discussed more fully in Section 3.4.3.
- 2) Historic and current disposal by shallow burial has the potential to impact the alluvial groundwater. (See Section 4.5.2 for a more detailed discussion of these sources.) This is particularly true in cases where ephemeral streams could encounter waste material and mobilize it. Disposal by burial on the mesa tops is unlikely to affect groundwater, owing to the thick unsaturated zone and the lack of available surface water to mobilize the waste.
- 3) Disposal of hazardous wastes in pits and shafts in TA-54, Area L, has an apparent potential to impact groundwater. (See Section 4.1.2 for a more detailed discussion of this source.) Studies conducted by the LANL have indicated vapor phase transport of organic contaminants to a depth of at least 100 feet. These studies are discussed in Section 3.4.3.

3.4.3 Environmental Monitoring Program

Groundwater quality at the LANL is monitored by collection and analyses of samples from 70 locations. The sample locations include both wells and springs within the laboratory boundaries and in the surrounding areas. Samples from the main aquifer are collected from 7 test wells, 18 water supply wells, and 25 springs. Samples of perched groundwater are collected from two wells and one spring. The alluvial groundwater is sampled from 16 wells and one spring. The location of all sample points are shown in Figure 3-22. Location numbers in the figure are further identified in Table 3-31. Most locations are sampled on an annual basis and the results are reported in the annual environmental monitoring report. Results for 1986, as reported in the annual report (LANL, 1987a), are summarized in Table 3-31. Not all locations were sampled in 1986 for various reasons, including out-of-service pumps, dry wells, and high water in the Rio Grande which covered some springs.

All samples are analyzed for radionuclides, including tritium, plutonium, uranium, cesium, and gross gamma. More than half the samples are also analyzed for drinking water standard constituents. As indicated in Table 3-31, samples from the main aquifer show no observable effects directly attributable to laboratory operations. A review of data from earlier years (1977-1985) confirms this conclusion. The few samples that exceed primary or secondary drinking water standards for nonradiological constituents are shown in Table 3-32. These include exceedances for fluoride, nitrate, iron, manganese, and total dissolved solids. Samples are also collected from water supply wells in the three well fields: Los Alamos, Pajarito, and Guaje. With two exceptions, samples from those wells also meet EPA primary and secondary drinking water standards. Well LA-6, which was not sampled in 1986, exceeds the standard for arsenic. The arsenic is believed to occur naturally and may be derived from igneous rocks in the vicinity. As a result of the elevated levels of arsenic, well LA-6 is not used for water supply but is maintained on a standby basis for extreme emergencies. Well LA-1B exceeds the EPA Secondary Drinking Water Standard for fluoride (2 mg/L), but it is within the limit of the Primary Drinking Water Standard (4 mg/L). The primary standard is health based, whereas the secondary standard is based on aesthetic criteria for public acceptance. In any case, the water derived from LA-1B is mixed with water

GROUNDWATER SAMPLING LOCATIONS ON AND
NEAR THE LANL SITE

FIGURE 3-22

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986

Station	Map #	Radionuclides					
		3H (nCi/L) ^a	137Cs (pCi/L) ^b	Total U (ppb) ^c	238Pu (pCi/L) ^d	239,240Pu (pCi/L) ^e	Gross Gamma (cpm/L)
La Mesita Spring	10	0.3 0.4	37 -50	13 10	-0.008 -0.005	-0.004 0.010	-5 -75
Sacred Spring	11	0.4 3.5	45 10	3.5 2.0	0.019 0.014	0.010 0.019	-- -75
Indian Spring	12	1.4 0.1	50 -46	2.5 5.0	-0.005 -0.012	0.010 0.036	-20 -200
Sandia Spring	13	0.6	-48	4	-0.008	0.004	200
Spring 3	14	0.4	27	4	0.011	0.000	450
Spring 3A	15	0.0	8	4	0.000	0.000	450
Spring 3AA	16	0.4	110	5	-0.004	0.004	-150
Spring 4	17	0.4	-46	4	0.004	0.037	300
Spring 4A	18	-0.1	25	4	0.009	0.004	200
Spring 5	19	0.6	-34	3	0.004	0.004	200
Spring 5AA	20	0.6	6	2	0.003	-0.004	150
Ancho Spring	21	1.3	15	2	-0.013	0.004	75
Spring 5A	22	0.5	85	4	0.008	0.010	750
Spring 6	23	0.3	-12	3	0.000	0.004	-75
Spring 6A	24	0.0	-43	3	0.000	0.000	800
Spring 7	25	0.5	1	2	0.000	0.007	800
Spring 8	26	-0.1	61	1	-0.015	0.005	-75
Spring 8A	27	0.6	7	1	0.004	0.000	75
Spring 9	28	0.6	7	1	0.004	0.000	75
Spring 9A	29	-0.1	-33	1	0.018	0.004	150
Doe Spring	30	0.3	53	1	0.008	0.019	-75
Spring 10	31	--	--	--	--	--	--
Spring 1	32	0.8	34	3	0.008	0.004	75
Spring 2	33	0.5	31	4	-0.008	0.016	150
Spring 3B	34	0.4	25	16	-0.008	0.017	-75
Test Well 1	39	1.0 0.9	-92 -38	1 3	-0.008 -0.012	-0.004 0.016	15 -150
Test Well 2	40	0.4 1.4	73 -16	0.0 3.0	-0.005 0.000	0.009 -0.004	-150 -200
Test Well 3	41	0.0 1.4	5 -17	0.0 3.0	-0.004 -0.012	0.008 0.008	-150 -300
Test Well DT-5A	42	-0.1	-45	0.1 2.0	0.000 --	0.012 --	-120 --
Test Well 8	43	1.0 0.7	-38 -39	0.1 1.0	0.016 0.008	0.000 0.004	-120 -75
Test Well DT-9	44	--	--	--	--	--	--
Test Well DT-10	45	-0.2 1.7	-78 22	0.0 1.0	0.004 0.004	0.013 0.008	-160 -200
PCO-1	102	-1.4 0.8	-17 -28	0.0 1.0	0.016 -0.010	0.021 0.005	-30 -90
PCO-2	103	-- 0.8	-- -38	-- 2.5	-- 0.006	-- -0.011	-- -140
PCO-3	104	1.2 0.9	-44 -10	0.5 3.7	0.012 -0.027	0.015 -0.005	-40 -120
Hamilton Bend Spring	53	-- 1.0	-- -69	-- 1.0	-- 0.020	-- 0.020	-- 150

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Station	Map #	Radionuclides					
		3H (nCi/L) ^a	137Cs (pCi/L) ^b	Total U (ppb) ^c	238Pu (pCi/L) ^d	239,240Pu (pCi/L) ^e	Gross Gamma (cpm/L)
Test Well 1A	54	0.3 0.5	19 17	0.1 3.0	-0.004 0.024	0.004 0.019	-75 -75
Test Well 2A	55	5.2 1.0	-40 32	0.1 3.0	0.005 -0.010	-0.005 0.000	-75 -150
Basalt Spring	56	0.9 2.3	50 53	1.1 1.0	-0.010 0.009	0.000 0.017	-- -75
LAOC	59	0.8 1.2	28 -6	0.0 2.0	0.000 0.005	0.005 0.000	-5 0
LAO-1	60	5.2 0.7	5 -10	1.1 1.0	0.008 0.008	0.016 0.004	-20 -150
LAO-2	61	7.2 3.1	-12 26	0.2 2.0	0.008 0.004	0.008 0.004	15 0
LAO-3	62	5.9 3.2	-85 -45	3.8 2.0	0.000 -0.008	-0.014 0.024	-5 -150
LAO-4	63	3.5 3.6	-13 --	0.5 3.0	-0.014 0.000	-0.014 0.000	-60 -75
LAO-4.5	64	3.1 2.9	36 -6	0.4 3.0	-0.008 0.011	0.017 0.028	15 75
MCO-3	69	21 14	32 58	0.2 4.0	-0.961 --	3.82 --	-110 320
MCO-4	70	560 810	-6 23	9.7 6.0	0.198 0.309	0.651 1.55	140 150
MCO-5	71	1300 660	-25 68	8.7 2.0	0.397 0.231	1.01 0.910	310 300
MCO-6	72	720 620	-31 4	5.2 12.0	0.226 0.134	0.869 0.359	170 150
MCO-7	73	500 760	72 -30	4.7 3.0	0.038 0.043	0.105 0.032	0 -75
MCO-7.5	74	530 760	41 -30	5.6 5.0	0.040 0.045	0.081 0.051	-80 -150
MCO-8							
Well LA-1B	76	-1.0	-76	5.1	0.016	-0.012	150
Well LA-2	77	-0.9	22	8.1	0.009	-0.004	360
Well LA-3	78	-0.1	-5	0.5	-0.012	-0.008	360
Well LA-4	79	-0.8	-62	0.2	-0.008	-0.004	200
Well LA-5	80	-1.0	16	1.0	0.021	0.000	75
Well LA-6	81	--	--	--	--	--	--
Well G-1	82	-0.6	-43	0.2	-0.004	-0.004	150
Well G-1A	83	-0.4	41	0.2	-0.009	0.000	60
Well G-2	84	-0.8	2	0.2	-0.004	0.000	190
Well G-3	85	-0.5	34	0.3	-0.008	0.000	190
Well G-4	86	0.1	40	0.3	-0.006	0.006	325
Well G-5	87	--	--	--	--	--	--
Well G-6	88	-0.6	54	0.2	-0.004	0.004	150
Well PM-1	9	-0.2	13	0.8	-0.012	0.012	110
Well PM-2	90	-1.1	8	0.1	-0.005	0.005	350
Well PM-3	91	-0.6	29	0.2	0.008	0.004	160
Well PM-4	92	--	--	--	--	--	--
Well PM-5	93	-0.6	-25	0.4	0.005	0.005	175

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Station	Map #	Primary Drinking Water Constituents (mg/L)								
		Ag	As	Ba	Cd	Cr	F	N	Pb	Se
La Mesita Spring	10									
Sacred Spring	11									
Indian Spring	12									
Sandia Spring	13	<0.05	<0.05	<0.05	<0.01	<0.05	0.7	0.3	<0.05	<0.01
Spring 3	14	<0.05	<0.05	<0.05	<0.01	0.05	0.6	0.7	<0.05	0.01
Spring 3A	15	<0.05	<0.05	<0.05	<0.01	0.05	0.6	0.6	<0.05	<0.01
Spring 3AA	16	<0.05	<0.05	<0.05	<0.01	<0.05	0.7	0.7	<0.05	<0.01
Spring 4	17	<0.05	<0.05	<0.05	<0.01	0.05	0.7	1.4	<0.05	<0.01
Spring 4A	18	<0.05	<0.05	<0.05	<0.01	0.06	0.7	1.1	<0.05	<0.01
Spring 5	19	<0.05	<0.05	<0.05	<0.01	0.06	0.6	0.5	<0.05	<0.01
Spring 5AA	20	<0.05	<0.05	<0.05	<0.01	0.06	0.6	0.7	<0.05	<0.01
Ancho Spring	21	<0.05	<0.05	<0.05	<0.01	0.06	0.5	0.3	<0.05	0.01
Spring 5A	22	<0.05	<0.05	<0.05	<0.01	0.06	0.5	0.4	<0.05	<0.01
Spring 6	23	<0.05	<0.05	<0.05	<0.01	0.06	0.5	0.4	<0.05	0.03
Spring 6A	24	<0.05	<0.05	<0.05	<0.01	0.06	0.4	0.4	<0.05	0.01
Spring 7	25	--	--	--	--	--	--	--	--	--
Spring 8	26	--	--	--	--	--	--	--	--	--
Spring 8A	27	<0.05	<0.05	<0.05	<0.01	<0.05	0.5	0.9	<0.05	<0.01
Spring 9	28	<0.05	<0.05	<0.05	<0.01	<0.05	0.6	0.2	<0.05	<0.01
Spring 9A	29	<0.05	<0.05	<0.05	<0.01	<0.05	0.5	<0.1	<0.05	0.02
Doe Spring	30	<0.05	<0.05	<0.05	<0.01	<0.05	0.7	<0.1	<0.05	<0.01
Spring 10	31	--	--	--	--	--	--	--	--	--
Spring 1	32	<0.05	<0.05	0.05	<0.01	<0.05	1.0	0.1	<0.05	<0.01
Spring 2	33	<0.05	<0.05	<0.05	<0.01	<0.05	1.4	0.8	<0.05	<0.01
Spring 3B	34	<0.05	<0.05	0.06	<0.01	<0.05	0.7	1.6	<0.05	<0.01
Test Well 1	39									
Test Well 2	40									
Test Well 3	41									
Test Well DT-5A	42									
Test Well 8	43									
Test Well DT-9	44									
Test Well DT-10	45									
PCO-1	102									
PCO-2	103									
PCO-3	104									
Hamilton Bend Spring	53									

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Station	Map #	Primary Drinking Water Constituents (mg/L)								
		Ag	As	Ba	Cd	Cr	F	N	Pb	Se
Test Well 1A	54									
Test Well 2A	55									
Basalt Spring	56	--	<0.002	0.06	<0.001	0.006	0.6	2.3	<0.001	0.003
LAOC	59									
LAO-1	60	--	0.007	0.07	<0.001	0.005	2.4	2.5	0.009	0.004
LAO-2	61									
LAO-3	62	--	<0.002	0.15	<0.001	0.005	2.4	2.8	<0.001	0.004
LAO-4	63									
LAO-4.5	64	--	<0.002	0.08	<0.001	0.004	0.9	<0.1	<0.001	<0.002
MCO-3	69									
MCO-4	70	--	<0.002	0.08	<0.001	<0.005	4.0	90	0.004	0.008
MCO-5	71									
MCO-6	72									
MCO-7	73	--	<0.002	0.12	<0.001	<0.005	2.0	74	0.001	0.005
MCO-7.5	74									
MCO-8										
Well LA-1B	76	<0.001	0.039	0.067	<0.0002	0.024	3.3	0.6	0.003	<0.003
Well LA-2	77	<0.001	0.012	0.104	<0.0002	<0.005	1.0	0.7	<0.002	<0.003
Well LA-3	78	<0.001	0.004	0.066	<0.0002	0.008	0.6	0.6	<0.002	<0.003
Well LA-4	79	<0.001	0.003	0.030	<0.0002	<0.005	0.4	0.6	<0.002	<0.003
Well LA-5	80	<0.001	0.004	0.091	<0.0002	<0.005	0.4	0.6	<0.002	<0.003
Well LA-6	81	--	--	--	--	--	--	--	--	--
Well G-1	82	<0.001	0.005	0.060	<0.0002	<0.005	0.4	0.6	<0.002	<0.003
Well G-1A	83	<0.001	0.012	0.047	<0.0002	0.005	0.5	0.7	0.009	<0.003
Well G-2	84	<0.001	0.013	0.074	<0.0002	0.006	6.7	0.6	0.002	<0.003
Well G-3	85	<0.001	0.005	0.017	<0.0002	<0.005	0.4	0.7	<0.002	<0.003
Well G-4	86	<0.001	<0.002	0.028	<0.0002	<0.005	0.3	0.8	<0.002	<0.003
Well G-5	87	--	--	--	--	--	--	--	--	--
Well G-6	88	<0.001	<0.002	0.012	0.0003	<0.005	0.4	1.7	<0.002	<0.003
Well PM-1	89	<0.001	<0.002	0.069	<0.0002	<0.005	0.3	1.5	<0.002	<0.003
Well PM-2	90	<0.001	<0.002	0.026	<0.0002	0.006	0.2	0.2	0.003	<0.003
Well PM-3	91	<0.001	<0.002	0.049	0.0004	<0.005	0.3	0.6	<0.002	<0.003
Well PM-4	92	--	--	--	--	--	--	--	--	--
Well PM-5	93	<0.001	<0.002	0.028	<0.0002	0.007	0.3	0.4	0.003	<0.003

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Station	Map #	Secondary Drinking Water Constituents (mg/L)							
		Cl	Cu	Fe	Mn	SO ₄	Zn	TDS	pH
La Mesita Spring	10								
Sacred Spring	11								
Indian Spring	12								
Sandia Spring	13	6	<0.05	0.2	<0.05	7	<0.05	179	8.1
Spring 3	14	4	<0.05	0.2	<0.05	6	<0.05	150	8.2
Spring 3A	15	4	<0.05	0.2	<0.05	6	<0.05	148	8.2
Spring 3AA	16	3	<0.05	0.2	<0.05	4	<0.05	135	7.4
Spring 4	17	8	<0.05	0.2	<0.05	9	<0.05	161	7.7
Spring 4A	18	7	<0.05	0.2	<0.05	8	<0.05	178	8.0
Spring 5	19	6	<0.05	0.2	<0.05	6	<0.05	154	7.7
Spring 5AA	20	6	<0.05	0.3	0.08	5	<0.05	182	7.4
Ancho Spring	21	4	<0.05	0.2	<0.05	7	0.08	130	7.5
Spring 5A	22	7	<0.05	0.2	<0.05	15	<0.05	187	7.7
Spring 6	23	3	<0.05	0.3	<0.05	5	<0.05	146	7.8
Spring 6A	24	2	<0.05	0.3	<0.05	2	<0.05	131	7.6
Spring 7	25	--	--	--	--	--	--	--	--
Spring 8	26	--	--	--	--	--	--	--	--
Spring 8A	27	4	<0.05	<0.05	<0.05	4	<0.05	137	8.2
Spring 9	28	2	<0.05	<0.05	<0.05	2	<0.05	139	8.1
Spring 9A	29	2	<0.05	<0.05	0.05	3	<0.05	126	7.8
Doe Spring	30	4	<0.05	0.2	<0.05	5	<0.05	137	7.8
Spring 10	31	--	--	--	--	--	--	--	--
Spring 1	32	5	<0.05	0.2	<0.05	9	<0.05	162	8.0
Spring 2	33	5	<0.05	0.2	<0.05	12	<0.05	198	8.4
Spring 3B	34	6	<0.05	0.2	<0.05	10	<0.05	395	7.9
Test Well 1	39								
Test Well 2	40								
Test Well 3	41								
Test Well DT-5A	42								
Test Well 8	43								
Test Well DT-9	44								
Test Well DT-10	45								
PCO-1	102								
PCO-2	103								
PCO-3	104								
Hamilton Bend Spring	53								

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Station	Map #	Secondary Drinking Water Constituents (mg/L)							
		Cl	Cu	Fe	Mn	SO ₄	Zn	TDS	pH
Testwell 1A	54								7.9
Testwell 2A	55								8.1
Basalt Spring	56	13	<0.001	0.020	0.016	18	0.01	178	8.0
LAOC	59								7.4
LAO-1	60	50	0.003	0.055	<0.005	26	0.02	283	7.6
LAO-2	61								7.2
LAO-3	62	49	0.010	0.014	0.008	28	0.04	295	7.4
LAO-4	63								7.4
LAO-4.5	64	32	0.030	0.023	0.011	12	0.02	196	7.5
MCO-3	69								8.6
MCO-4	70	29	0.093	0.428	0.008	44	0.05	344	7.7
MCO-5	71								7.7
MCO-6	72								7.8
MCO-7	73	32	0.063	0.020	0.022	41	0.08	854	7.4
MCO-7.5	74								7.4
MCO-8									
Well LA-1B	76	17	0.007	0.005	<0.001	40	<0.01	456	8.2
Well LA-2	77	4	<0.005	0.004	<0.001	9	<0.01	144	8.5
Well LA-3	78	3	<0.005	0.004	<0.001	7	<0.01	135	8.3
Well LA-4	79	2	0.019	0.004	<0.001	4	<0.01	115	8.3
Well LA-5	80	2	<0.005	0.006	<0.001	4	0.02	251	8.3
Well LA-6	81	--	--	--	--	--	--	--	--
Well G-1	82	3	<0.005	0.004	<0.001	4	<0.01	166	8.3
Well G-1A	83	2	<0.005	0.004	<0.001	4	<0.01	170	8.3
Well G-2	84	3	<0.005	0.004	<0.001	4	<0.01	174	8.3
Well G-3	85	3	0.015	0.005	<0.001	4	<0.01	135	8.3
Well G-4	86	3	0.008	0.006	<0.001	4	<0.01	147	8.2
Well G-5	87	--	--	--	--	--	--	--	--
Well G-6	88	3	<0.005	0.005	<0.001	4	<0.01	159	8.0
Well PM-1	89	3	<0.005	0.004	<0.001	3	<0.01	213	8.2
Well PM-2	90	2	<0.005	<0.001	<0.001	2	0.02	139	8.1
Well PM-3	91	7	<0.005	0.004	<0.001	6	<0.01	227	8.2
Well PM-4	92	--	--	--	--	--	--	--	--
Well PM-5	93	2	0.007	0.005	<0.001	2	0.03	156	8.0

TABLE 3-31 LANL GROUNDWATER DATA SUMMARY, 1986 (Continued)

Source: LANL, 1987a

- a. DCG = 1×10^8 pCi/L, MCL = 20,000 pCi/l
- b. DCG = 4×10^5 pCi/L, MCL = 200 pCi/l
- c. DCG = 1×10^8 pCi/L, MCL = NA
- d. DCG = 1×10^5 pCi/L, MCL = 15 pCi/L
- e. DCG = 2×10^5 pCi/L, MCL = 15 pCi/L

PRELIMINARY

TABLE 3-32

**SAMPLES EXCEEDING PRIMARY OR
SECONDARY DRINKING WATER STANDARDS, 1986 FOR
NONRADIOLOGICAL CONSTITUENTS**

Station	Parameter	Concentration (mg/L)	Standard
Primary Standard			
DPS-4	F	5.5	2
LAO-1	F	2.4	2
LAO-4	F	2.4	2
SCS-1	F	12	2
MCO-4	F	4	2
Pueblo-1	N	10	10
TW-1A	N	12	10
MCO-4	N	90	10
MCO-7	N	70	10
Secondary Standard			
SCS-3	Fe	0.43	0.3
MCO-4	Fe	0.43	0.3
Pueblo-3	Mn	0.15	0.05
MCGS-1	Mn	0.05	0.05
SCS-3	TDS	583	500
MCO-4	TDS	944	500
MCO-7	TDS	854	500

Source: LANL, 1987a

from other wells in the distribution system and is in full compliance at the point of delivery.

Groundwater samples collected from the alluvial aquifers in the canyons can be divided into two groups: samples from canyons that do not receive effluent discharges from the site, and samples that are from effluent release areas. Samples from canyons that do not receive effluent releases show no observable effects from laboratory operations. Samples from canyons that do receive effluents from the site show some impact. Site effluents, as discussed in Section 3.3, include treated sanitary effluents, noncontact cooling water, boiler blowdown, and treated industrial effluents. As shown in Table 3-31, the clearest example of impacted groundwater is in the samples from Mortandad Canyon (MCO-3 to MCO-7.5). This canyon receives treated industrial effluent from TA-50. While the radionuclide levels that are detected in the samples are within DOE on-site guidelines, they do exceed EPA's maximum contaminant levels (MCL). The DOE on-site Derived Concentration Guidelines (DCGs) for Controlled Areas and the EPA's MCL for tritium, cesium-137, uranium, and plutonium are listed in the footnotes of Table 3-31.

It is appropriate to note, however, that the alluvial aquifers are not used for water supplies and would not be adequate for that purpose. Although surface-water flows in Mortandad Canyon do not reach off-site areas, flow in the alluvial aquifer may be transporting radionuclides to off-site areas. Additional sample points farther down the canyon would be useful in clarifying this point. Site personnel have recognized that additional data would be appropriate and have on several occasions requested access to the private property. However, since the land is considered sacred to the landowners, permission has not been granted.

In addition to the annual monitoring program, the LANL has undertaken a number of special studies which have investigated groundwater and subsurface transport. The majority of these studies addressed specific Technical Areas and were often in support of decontamination and decommissioning activities. A recent study of particular note was conducted at TA-54 to characterize the hydrogeologic conditions around Areas G and L, the radioactive waste disposal area and the former hazardous waste disposal area. Materials disposed of at these areas are discussed in Section 4.1. In 1985, the laboratory applied for a waiver from the

groundwater monitoring requirements of the Resource Conservation and Recovery Act (RCRA). In order to evaluate the applicability of the waiver, the New Mexico Environmental Improvement Division (EID) required the laboratory to conduct certain studies and assessments at Areas G and L. The New Mexico EID requirements were specified in a Compliance Order/Schedule dated May 7, 1985, and this order formed the basis for the subsequent studies. The major conclusions of the assessment in the report (International Technology Corporation, 1987) are provided below:

"Several specific conclusions, based on the hydrogeologic investigations performed at Mesita del Buey in 1985 and 1986 and on previous work, can be reached relative to the characteristics of Areas G and L and the potential for migration of contaminants from waste disposal units in these areas:

- "1. The Bandelier Tuff stratigraphy at Areas G and L is similar to that of the tuff throughout the western Pajarito Plateau.
- "2. Vertical and near-vertical fractures (formed during cooling of the volcanically deposited material) are common in the Bandelier Tuff on Mesita del Buey (and elsewhere), though the degree of openness or pervasiveness of individual fractures is not well characterized.
- "3. No major fault zones that could serve as conduits from the shallow subsurface to the regional water table are known to exist at or near Areas G and L.
- "4. The combination of very low moisture content in the tuff, empirical determination that moisture from precipitation does not infiltrate below a depth of 10 to 22 feet, and very low calculated flux rates all suggest that aqueous transport of contaminants through Bandelier Tuff is not a viable mechanism for contaminant migration at Areas G and L.
- "5. Volatile organic waste constituents have migrated (probably in the vapor phase) from land disposal units at Areas G and L, based on the results of core and pore gas analyses conducted in 1985 and 1986.

- "6. Metals contamination from the land disposal units at Areas G and L was detected in only two samples from shallow depths (20 feet or less) at Area L.
- "7. Chemical data from the core and pore gas analyses (and information obtained from vadose zone characterization) support vapor phase migration from Areas G and L as the dominant transport mechanism, based on the presence of volatile organic vapors at depths of up to 100 feet.
- "8. No perched bodies of water which could be hydraulically connected to the main aquifer have been detected beneath Areas G and L.
- "9. Perched water in Pajarito Canyon is confined to alluvium within the canyon and does not extend vertically or horizontally into the Bandelier Tuff which forms Mesita del Buey. No perched water was detected in Canada del Buey.
- "10. There is no evidence of migration of hazardous waste constituents from Areas G and L into the perched water contained in the alluvium of Pajarito Canyon."

While this study has provided convincing evidence that fluid phase flow does not occur below very shallow depths, it has also demonstrated that vapor phase flow apparently does occur. The organic vapors detected in pore gas samples from depths of 100 feet suggest that volatile components of the wastes have migrated by vapor diffusion. Site personnel plan to investigate the extent of migration of vapors in Area L (Barr, 1987). Their initial effort will be to develop reliable sampling procedures and to determine distribution gradients in test holes.

In 1986, samples from nine stations were analyzed for volatile and semivolatile organic compounds. The results of these analyses are provided in Table 3-33. In general, levels detected were very low and did not exceed EPA toxicity standards for aquatic life. The compounds detected include some that are ubiquitous in the

TABLE 3-33
ORGANIC ANALYSES, LANL, 1986

Station	Compounds Detected	Concentration ($\mu\text{g/L}$)	Toxicity Standard for Aquatic Life
Rio Grande at Otowi	bis (2-ethylhexyl) phthalate	5	940
	di-N-butylphthalate	2	940
	pyrene	3.5	940
Los Alamos Reservoir	bis (2-ethylhexyl) phthalate	14	940
	di-N-butylphthalate	4	940
	hexachlorobutadiene	1100	90
Frijoles Canyon	bis (2-ethylhexyl) phthalate	29	940
Test Well TW-1	bis (2-ethylhexyl) phthalate	7	940
	di-N-butylphthalate	2	940
	4-chlorophenylphenyl ether	4	360
Test Well DT-5A	bis (2-ethylhexyl) phthalate	32	940
Test Well TW-1A	bis (2-ethylhexyl) phthalate	4	940
Basalt Spring	bis (2-ethylhexyl) phthalate	4	940
SCS-1	bis (2-ethylhexyl) phthalate	18	940
	di-N-butylphthalate	6	940
	diethylphthalate	9	940
	naphthalene	12	2300
	Fluoranthene	4	4000
	2,6-dinitrotoluene	20	330
SCS-2	bis (2-ethylhexyl) phthalate	4	940
	2,4-dinitrotoluene	250	330
SCS-3	methylene chloride	11	10

environment, such as bis (2-ethylhexyl) phthalate and di-N-butylphthalate, and common laboratory artifacts, such as methylene chloride. The single contaminant measure that exceeds the standards, hexachlorobutadiene, occurs at a location upgradient from the Laboratory.

3.4.4 Findings and Observations

3.4.4.1 Category I

None

3.4.4.2 Category II

None

3.4.4.3 Category III

1. Potential groundwater contamination with organic constituents. Area L, the hazardous waste disposal site, and to a lesser extent Area G, the radioactive waste disposal site, represent a potential source of contamination to the groundwater through vapor phase flow.

Studies conducted by site personnel clearly indicate that liquid phase flow (in either saturated or unsaturated modes) is not a viable transport mechanism for organic contaminants in this environment. However, studies have indicated that vapor phase flow by diffusion has occurred, and organic vapors are detected at a depth of 100 feet. The full vertical and horizontal extent of the vapor plume is presently unknown. At Area L, pore gas samples at the depth of 100 feet contain organic vapors in the parts-per-million range. Organic vapors in the parts-per-billion range are detectable at the 100-foot depth in Area G as well. Further study of the extent of movement of vapors at Area L is planned by LANL personnel. During the Sampling and Analysis phase of the Survey, soil-gas samples will be taken to gain additional information pertaining to the extent of organic contamination under Area L.

3.4.4.4 Category IV

1. Inadequate security for monitoring wells. Some of the monitor wells are not adequately secured to prevent well contamination or destruction. Site personnel have fabricated protective casings and expect to install them shortly after the completion of the Survey.
2. Potential for well cross-contamination. There is a potential for cross-contamination of monitor wells that are sampled with a bailer, in that a single brass bailer secured with a hemp rope is used for all bailed wells. Although the bailer is rinsed with distilled water between samples, the rope cannot be adequately decontaminated. Site personnel have indicated that they intend to use dedicated sampling equipment in the future.

PRELIMINARY

4.0 NON-MEDIA-SPECIFIC FINDINGS AND OBSERVATIONS

This section discusses findings and observations pertaining to waste management, toxic and chemical materials, direct radiation, quality assurance, and inactive waste sites and releases. These discussions do not include a background environmental information section because the areas addressed are not necessarily tied to one medium as was the case with the discussions in Section 3.0. The discussions include an environmental monitoring program section where appropriate and where information was available.

4.1 Waste Management

Waste management activities at the Los Alamos National Laboratory (LANL) include the generation, handling, and disposal of hazardous, mixed (i.e., containing both hazardous and radioactive components), radioactive, and nonhazardous/non-radioactive waste. The findings and observations pertaining to the four different categories of waste are combined and presented in Section 4.1.5.

4.1.1 General Description of Pollution Sources and Controls-Hazardous Waste

4.1.1.1 Hazardous Waste Generation

The latest biennial Hazardous Waste Report (Valencia, 1986) states that the LANL generates the following five classes of hazardous waste:

- Ignitable wastes
- Corrosive wastes
- Reactive wastes
- Extraction Procedure (EP) toxic wastes
- Listed hazardous wastes

Table 4-1 depicts the estimated annual quantity of waste generated. The major quantity of hazardous waste is composed of corrosive nitric and sulfuric acids from the isotope separation area of Technical Area 46 (TA-46); 62,687 kilograms of this waste are generated per year (Valencia, 1986). The 6 to 7 Molar nitric acid waste

TABLE 4-1

ANNUAL HAZARDOUS WASTE GENERATION AT THE LANL

Waste Category	Estimated Annual Quantity (kg)
Nitric and Sulfuric Acids from Isotope Separation (Corrosive Waste)	62,687
Wastewater Treatment Sludges from Manufacturing & Processing Explosives (Listed Waste)	17,176
Waste Alcohols, Brand-Name Resins & Epoxies (Ignitable Waste)	9,778
Barium-Nitrate-Contaminated Sand Used at Firing Sites (EP-Toxic Waste)	7,621
Trichloroethylene (Listed Waste)	1,520
Acetone (Listed Waste)	1,452
Spent Halogenated Solvents (Listed Waste)	956
Reactive Wastes (Sodium, Cesium, Lithium Hydride, Ethyl Ether, Peroxides)	764
Methylchloroform (Listed Waste)	726
Spent Non-Halogenated Solvents (Listed Waste)	545
Arsenic Salts (Labpacked, EP-Toxic Waste)	516
Spent Halogenated Solvents Used in Degreasing (Listed Waste)	363
Benzene (Listed Waste)	318
Pesticides (Labpacked Endrin & 2,4-D, EP-Toxic Waste)	257
Corrosive Solids (Labpacked)	255
Chromic Acids & Chrome Salts (EP-Toxic Waste)	218
Lead Batteries (EP-Toxic Waste)	182
Mercury Metal (Listed Waste)	103
Mercury-Contaminated Material from Spills (EP-Toxic Waste)	89
Methanol (Listed Waste)	46

Source: Adapted from Valencia, 1986

is accumulated in a 5,000-gallon tank. The 11 to 12 Molar sulfuric acid waste is accumulated in portable tanks that are taken to the TA-54, Area L storage area by truck for storage prior to disposal.

Wastewater treatment sludges from the manufacturing and processing of explosives (a listed hazardous waste) comprise the second highest quantity of hazardous waste generated at the LANL, amounting to 17,176 kilograms per year. The sludges are generated as a result of the machining of high-explosive (HE) components. Chips and residue of HE are removed from machining operations effluent by screens and baffles, causing particles of HE to settle out of the waste streams. The waste is generated primarily in machining buildings in TA-16. It is disposed of at the TA-16 burn area.

Waste alcohols, brand-name resins, and epoxies as a class compose the third largest hazardous waste stream (an ignitable hazardous waste) at the LANL, with 9,778 kilograms generated per year (Valencia, 1986). This waste type is generated throughout the LANL as a result of the broad research and development (R&D) activities conducted for weapons components and technologies.

Barium nitrate-contaminated sand generated at HE test-firing sites in TAs-14, 15, 16, 36, and 39 is the fourth largest hazardous (EP-toxic) waste stream. The firing sites generate approximately 7,621 kilograms of this waste per year (Valencia, 1986).

Discarded quantities of the organic solvent trichloroethylene compose the fifth largest waste stream with 1,520 kilograms generated per year. Trichloroethylene is used largely as a degreaser in maintenance of equipment at vehicle and machine shops in TA-3. Waste acetone is the sixth largest hazardous waste stream (1,452 kilograms per year) (Valencia, 1986). Acetone is used in the formulation and synthesis of HEs, including HMX, TATB, and PETN. Buildings in TA-16 (e.g., TA-16-340) and TA-9 (e.g., TA-9-21) generate an acetone waste stream.

Other hazardous wastes generated at the LANL in quantities of less than 1,000 kilograms per year are depicted in Table 4-1.

Hazardous wastes are generated in six types of LANL facilities as follows:

- Chemistry R&D activities
- Electrochemistry activities
- Isotope separation activities
- Shops Department activities
- Explosives-related activities
- Waste oil-related activities

Chemistry R&D activities that produce hazardous waste are primarily conducted in the Chemistry and Metallurgy Research (CMR) Building (TA-3-29), Radiochemistry Laboratory (TA-48), Sigma Building (TA-3-66), and Health Research Laboratory (TA-43). Wastes from these buildings are diverse waste chemicals, solvents, and oils, some produced in extremely small quantities, that comprise the majority of the nearly 400 hazardous wastes identified in the LANL Part A application (LANL, ND).

The CMR Building engages in R&D studies with uranium, plutonium, thorium, and other metals. Weapons-grade material and scrap are subjected to physiochemical testing, dissolution, and analysis.

The Sigma Building (TA-3-66) operates a large foundry for casting uranium, copper, lead, and other metals. The casting operation results in the generation of uranium, lead, copper, and other metal solid wastes. Precious-metals foundry work is performed on a much smaller scale for gold, silver, and platinum in this building. Waste solvents are generated in small quantities in the Sigma Building. Trichloroethylene and chloroform are used to clean precious-metals foundry molds. The TA-3-66 Plastics Shop uses acetone and toluene as mold cleaners. In addition, waste vacuum pump oil is generated from equipment used in the Sigma Building.

The Radiochemistry Laboratory performs research with americium, plutonium, and other radioactive elements. Hydrofluoric, nitric, and hydrochloric acids are used in dissolution studies. The Health Research Laboratory engages in radiobiology, physiology, and health physics-related research. As with TA-3-29, TA-48, and TA-3-66, TA-43 generates waste test samples, laboratory reagents, solvents, scintillation fluids, and other laboratory wastes.

Electrochemical wastes are composed of waste plating solutions containing chromates and cyanides. These wastes are generated at TA-3-66, the Sigma Building. The TA-3-66 Plating Shop has gold, silver, nickel, chrome, and copper plating baths. Cyanide, nitric acid, hydrochloric acid, and sodium hydroxide baths as well as a trichloroethylene vapor degreaser are associated with the plating operations. The plating-bath wastes are discharged to two unlined cement tanks, one for acid and one for cyanide, in the basement of the Sigma Building. Each tank measures 18 feet by 10 feet by 4 feet. There is no leak detection system for these tanks other than visual observation. The acid tank has leaked in the past (personal communication with Sigma Building personnel). The Printed Circuit Board Shop at TA-3-40 also generates electrochemical waste. TA-3-40 generates corrosive waste contaminated with copper.

Isotope separation activities at TA-46-88 generate nitric and sulfuric acid wastes. The acid wastes are accumulated in a stationary 5,000-gallon tank and two portable 400-gallon plastic tanks located directly outside TA-46-88. There are no overflow preventers on these tanks. The 5,000-gallon nitric acid tank overflowed in March 1987.

The Shops Department is centered at TA-3-102 but has remote facilities such as those in TA-9-28 that perform metals machining and equipment maintenance functions. The Shops Department facilities machine classified parts and other components from a variety of hazardous metals including lead, beryllium, magnesium, and lithium hydride. The operations generate solid hazardous metal wastes, waste cutting oils, and waste solvents.

Explosive wastes are generated in the process of explosives machining, processing, and testing. Explosive waste consists of HE fragments, chips and cuttings from lathing operations, and HE-contaminated kimwipes, equipment, and solvents. These wastes are disposed of at facilities in TAs-14, 15, 16, 36, and 39.

4.1.1.2 Hazardous Waste Facilities

The Resource Conservation and Recovery Act (RCRA) Part A Permit notification (LANL, ND) identified 10 container storage facilities, 1 tank storage facility, 1 tank treatment facility, 1 batch treatment area (not yet operational at the time of the

Survey), 6 thermal treatment facilities, and 1 controlled air incinerator as active facilities. These areas are discussed in the following paragraphs. In addition, landfills that are open or only recently closed that were formerly used to dispose of hazardous wastes are discussed in this section.

Container Storage

The container storage facilities are located in TA-54, Area L, TA-50-1, TA-3-102, TA-3-40, TA-9-39, TA-22-24, TA-22-96, TA-40-2, TA-40 scrap detonation pit, and TA-16.

The largest container storage facility is located at TA-54, Area L. The roofed concrete storage pad measures 120 feet long by 24 feet wide. Wastes are segregated into categories (e.g., corrosives, organics, metals) and the categories of waste are separated onto different parts of the storage pad. The waste is stored in 55-gallon drums, portable plastic tanks, or plastic carboys. A total of 304 55-gallon drums can be stored at this facility if drums are double-stacked. The LANL plans to use this site as the embarkation point for waste to be shipped to off-site hazardous waste management contractors.

The majority of the other storage areas are small drum-storage locations such as TA-50-1, which has storage space sufficient for only four 55-gallon drums, or former HE storage bunkers used to store waste HE.

Storage of hazardous waste in tanks occurs at TA-46, at TA-54, Area L, and at TA-50. The storage area of sulfuric and nitric acids at TA-46 is the only tank storage area not associated with a treatment facility and has been discussed previously. Tank facilities at TA-54, Area L and at TA-50 are associated with treatment operations and will be discussed in conjunction with the discussion of the treatment facilities.

In addition, a large number of drums (in excess of 1,000) containing waste were stored outdoors on bare ground at the time of the Survey. The storage of these drums is discussed in more detail in Section 4.2.

Treatment Facilities

Batch Treatment

The LANL hazardous waste batch treatment system is located at TA-50-1. The system is a totally enclosed, vented, 500-gallon pressure vessel and filtering system. It is designed with washdown capabilities to treat incompatible wastes. When it becomes operational, TA-50-1 will treat cyanide, chromate plating solutions, acids, bases, and heavy-metal wastes. The three major waste streams to this system will be the acid/base copper-containing waste, the chromate plating-bath waste and the cyanide plating-bath waste.

Thermal Treatment

The LANL thermal treatment facilities are located at TAs 14, 15, 16, 36, 39, and 50.

The TA-16 thermal treatment facility contains three sand pads surrounded by protective berms where HE or HE-contaminated articles are burned. TA-16 also contains a group of five shallow sand-filled metal pans into which waste HE fluids are discharged; periodically they are ignited. The five small sand-filled pans each sit inside a larger sand-filled pan. Approximately 55 gallons of waste are burned each month (LANL, 1987a) in this manner. TA-16 contains burn cones into which waste HE-sludge is placed, dried with forced hot air, and ignited. The cones have an effluent drain at the bottom and are regulated by a National Pollutant Discharge Elimination System (NPDES) Permit (NM 0028355). There are two such facilities at TA-16. Each facility burns approximately .75 lb/week of explosive sludge.

Thermal treatment facilities at TAs-14, 15, 36, and 39 consist of burn pads that detonate scrap HE, classified explosive shapes, and reactive chemicals. For example, the burn pads at TA-39 are located in small canyons surrounded on three sides by walls. The activities in these areas deal primarily with HE research and testing, but may occasionally involve firing waste HE.

The LANL has a Toxic Substances Control Act (TSCA) permitted Controlled Air Incinerator at TA-50-37. It is described in Section 4.2 and is discussed further in the radioactive waste section.

Tank Treatment

LANL has a tank treatment facility at TA-54, Area L, composed of four 1,665-gallon, 10-gauge carbon steel tanks lined with plastic. The tanks are used to evaporate, neutralize, and oxidize wastes. Lithium hydroxide is the most commonly oxidized waste. Ammonium bifluoride (not a RCRA waste) is the most commonly evaporated waste.

Landfills

Area L is the largest area currently operated that LANL has designated for hazardous waste management. Area L contains treatment and storage facilities described earlier, but also contains shafts, a pit, and a surface impoundment formerly used for disposing of hazardous and chemical wastes. Thirty-four shafts are located in Area L (see Figure 4-1); all are capped and no longer used. They are 3 to 8 feet in diameter and approximately 60 feet deep. They are capped with a 3-foot concrete plug and the bottom of the shaft is lined with 3 feet of crushed tuff. The shafts were in use from June 1975 until May 1985. The classes of waste disposed of in each shaft are shown in Table 4-2. Shaft 1 is likely to have received noncontainerized bulk liquids. Prior to 1982, wastes were disposed of in drums without the use of absorbents. Trichloroethylene, methyl ethyl ketone (MEK), methylene chloride, and other solvents were disposed of in drums with absorbent after 1982.

Chemical wastes were disposed of in a pit measuring approximately 25 feet wide, 15 feet deep, and 60 feet long from 1964 when Area L was first opened until May 1975 when shaft construction began. The composition of waste material disposed of in this pit is unknown but is believed to be a wide variety of organic, inorganic, waste oil, and reactive chemical wastes (i.e., any nonradioactive chemical waste that LANL produced from 1964 to 1975). Typically the contents of the pit were burned periodically to reduce volume (personal communication with LANL Waste Management personnel). A thin layer of soil was occasionally added to cover the waste. In addition, Area L was the site of a surface impoundment, approximately 10

TABLE 4-2
CONTENTS OF SHAFTS IN AREA L

Shaft No.	Shaft Diameter (feet)	Date Drilled	Date Capped	Contents
1	3	4/80	9/83	Organics ⁽²⁾
2	3	2/75	7/79	Acids & Bases
3	3	2/75	11/78	Inorganic
4	5	2/75	5/80	Organic
5	3	2/75	6/77	Waste Oil
6	4	6/75	6/79	Reactive
7	3	6/75	6/79	Reactive
8	3	6/75	6/79	Reactive
9	3	6/75	6/79	Gas Cylinders
10	3	6/77	6/79	Waste Oil
11	8	1/78	7/79	Waste Oil/Solvent
12	4	1/78	7/79	Waste Oil/Solvent
13	3	6/79	5/82	Inorganic
14	3	6/79	5/82	Reactive
15	3	6/79	5/82	Reactive
16	3	6/79	5/82	Gas Cylinders
17	3	6/79	5/82	Organic
18	8	6/79	6/80	Waste Oil
19	8	4/80	5/82	Waste Oil
20	3	4/80	9/83	Inorganic
21	3	4/80	Open	Gas Cylinders
22	3	4/80	9/83	Organic
23(3)	8	4/82	3/84	Waste Oil
24(4)	8	4/82	4/84	Organic & Waste Oil
25	6	9/82	5/85	Inorganic
26	6	9/82	3/84	Organic
27	4	1/83	2/85	Special ⁽⁵⁾
28	4	1/82	5/85	Special
29	6	12/83	8/84	Organic
30	6	12/83	8/84	Organic
31	6	12/83	9/84	Organic
32	4	9/84	9/84	Organic
33	6	9/84	2/85	Organic
34	6	2/85	5/85	Organic

Source: LANL, 1987a

- (1) All shafts are approximately 60 feet deep.
- (2) Shaft 1 contains wastes not in drums.
- (3) Prior to Shaft 23, liquids were disposed of in drums without adding absorbents.
- (4) Middle section of this shaft not used.
- (5) Used for miscellaneous waste requiring greater isolation.

feet wide, 40 feet long, and 5 feet deep, used from 1977 to 1984 to dispose of ammonium bifluoride and treated plating-bath solutions (personal communication with LANL Waste Management personnel). This pit was used sporadically over its 7-year operational life.

The LANL has performed subsurface sampling of soil gas in the vicinity of the Area L shafts. The sampling, conducted in late 1985, detected vapor phase contamination of the subsurface environment by organic constituents. The vapor phase contamination was in the parts-per-million range at the 100-foot level (see Section 3.4 for further information regarding subsurface sampling). In addition, 7 holes were drilled in Area L to 200 feet. The holes had not been sampled by the time the Survey team left the site.

Area H is located in TA-54 and encompasses 9 shafts measuring 6 feet in diameter by 60 feet in depth. Eight of the shafts were closed with concrete caps prior to November 1980. However, Shaft 9 was operated beyond that date. It received 10.5 tons of primarily metallic nonhazardous waste and 15 pounds of lithium hydride (a hazardous waste). Use of Shaft 9 was terminated in March 1986 and a temporary cover was placed over it. The LANL has submitted a RCRA closure plan to regulatory authorities for hazardous waste management activities that occurred in Area H.

Area P is situated in TA-16 and has been the disposal site for wastes from HE-related operations of TA-16 since the 1950s. The landfill is located on the edge of a mesa. Typical landfill procedure was to dump waste over the mesa edge onto the canyon walls. The average depth of the landfill is 12 to 14 feet and the estimated volume is 351,000 cubic feet (LANL, 1987a). The LANL has found that sand from firing sites and ash from burning HE in TA-16 were deposited in Area P. The sand has an associated barium residue and is considered a hazardous waste. Pieces of rubble and other debris are visible on the surface of the Area P landfill slope. Surface runoff, which runs down the face of the landfill, flows to the bottom of the adjacent valley. No runoff control measures other than revegetation of the landfill surface have been taken.

Area P has not been used since 1986. It is included in the LANL Part A RCRA notification and LANL plans to close the site under RCRA interim status requirements.

A disposal pit measuring approximately 80 feet long, 30 feet wide, and 15 feet deep is located in TA-39. The pit contains waste that has accumulated in TA-39 and contains wood, paper, plastics, metal equipment, and other material. TA-39 personnel stated that the pit has also received sand from firing sites within the TA. The pit has been in operation since approximately 1977 and is adjacent to a pit of similar dimensions (closed in 1977) that received approximately the same kind of waste material. Two pits located near TA-39-69 were used to dispose of solid wastes from TA-39 during the 1960s.

In addition to the facilities discussed above, the LANL operates a number of facilities that may have received hazardous waste. Two surface impoundments, one at TA-35-125 and one at TA-35-85, may have received hazardous waste from activities occurring near the impoundments. Two lagoons at TA-53 used for wastewater retention may have received hazardous wastes from a machine shop in that TA.

4.1.2 General Description of Pollution Sources and Controls - Mixed Waste

The LANL has identified (LANL, 1987a) three major mixed waste streams -- scintillation vials, miscellaneous chemicals, and lithium hydride (see Table 4-3 for the quantities of each mixed waste type generated). In addition, the LANL generates two previously unidentified mixed waste streams at the Sigma Building foundry. The foundry air pollution control system generates a solid-waste stream that contains lead and uranium dust resulting from foundry operations. Approximately 500 cubic feet of this waste are generated per year and are disposed of in Area G. The Sigma Building foundry breakout system generates uranium and lead solids, which are collected in the same dumpster, transported to Area G, and disposed of. Approximately 100 cubic feet of this waste are generated per year.

Scintillation vial, miscellaneous chemical, and lithium hydride waste are stored in Area L. At the time of the Survey, approximately 100 drums of primarily scintillation

TABLE 4-3
LOW-LEVEL MIXED WASTE STORED AT LOS ALAMOS
THROUGH FY 1986

Description	Chemical Composition Including Radioactive Constituents	Volume (m ³)
Scintillation Vials	Alkylbenzene, Pseudocumene, Xylene; Pu, ³ H, ¹⁴ C, ³² P	10.0
Miscellaneous Chemicals	Variable Chemical Composition and Radioactive Contamination	0.3
Lithium Hydride	Uranium Contamination.	2.3

Source: LANL, 1987a

PRELIMINARY

vial waste were stored on bare ground at the eastern end of Area L. The area containing the drums was completely bermed and there was no evidence of leakage from drums to the soil beneath. In March 1987 the LANL Controlled Air Incinerator was used to dispose of scintillation vial waste. The Controlled Air Incinerator has obtained interim status approval to operate under the RCRA.

4.1.3 General Description of Pollution Sources and Controls - Radioactive Waste

4.1.3.1 Radioactive Waste Generation

The LANL generates both solid and liquid radioactive wastes. Ten percent of the radioactive waste is transuranic (TRU) waste, 89 percent is low-level waste, and the remaining 1 percent is radioactive waste mixed with hazardous waste (discussed in the previous section). The LANL generates no high-level radioactive waste.

Radioactive waste is generated from a diverse group of facilities and operations in TAs-3, 9, 15, 18, 21, 33, 35, 41, 43, 46, 48, 50, 53, and 55. Figure 4-2 depicts the source location, the specific radionuclide or class of radionuclide generated as waste, the waste packaging method, and the ultimate disposal point. The figure shows that TA-3 contains more radioactive waste generators than any other TA and generates primarily plutonium and uranium waste. Americium, tritium, thorium, mixed activation products, and mixed fission products are generated in the other TAs. All radioactive wastes are stored or disposed of in TA-54, Area G.

Table 4-4 delineates the quantity of solid radioactive wastes generated and disposed of by the LANL in fiscal year (FY) 1986. Laboratory trash (i.e., paper, plastic, rubber, glassware, and small tools) made up the majority of the alpha-contaminated, low-activity waste, which was the highest volume waste category. Tritium-bearing waste showed the highest radioactivity of any waste category.

Liquid radioactive waste is generated in a variety of laboratories, shops, and processing facilities spread throughout the LANL site. TA-50-1 and TA-22-257 are the major liquid radioactive waste treatment facilities for the LANL; these facilities are described in detail in Section 3.3.

Source: LANL, 1987

FLOW SHEET FOR LOS ALAMOS RADIOACTIVELY CONTAMINATED SOLID WASTE

FIGURE 4-2

FIGURE 4-2 (CONTINUED)

FLOW SHEET FOR LOS ALAMOS RADIOACTIVELY CONTAMINATED SOLID WASTE

FIGURE 4-2 (CONTINUED)

FLOW SHEET FOR LOS ALAMOS RADIOACTIVELY CONTAMINATED SOLID WASTE

FIGURE 4-2 (CONTINUED)

FLOW SHEET FOR LOS ALAMOS RADIOACTIVELY CONTAMINATED SOLID WASTE

TABLE 4-4

**SOLID RADIOACTIVE WASTE BURIED AND/OR STORED, AS REPORTED FOR
FISCAL YEAR 1986, LANL**

Waste Category	Buried (B) Stored (S)	Volume (m ³)	Radioactivity (Ci) ^a	Radionuclide Content (g)		
				Pu	Am	U/Th
1 - CH-TRU	S	377.4	49049.4	84624.9	16.5	34790.5
2 - U/Th	B	736.5	2.9			4191491.0
3 - MFP	B	1211.2	2589.8			
4 - MAP	B	307.2	847.2			
5 - H-3	B	191.3	196004.6			
6 - RH-TRU	S	0.2	46.4	11.6		66.6
7 - Alpha	B	<u>2668.3</u>	<u>7.5</u>	<u>38.3</u>	<u>0.8</u>	<u>636.3</u>
TOTALS		5492.1	248547.4	84674.8	17.3	4226984.4

Source: LANL, 1987a

^a Total activity of all contaminants.

Solid TRU waste is generated in TAs-3, 50, and 55. The radiochemistry laboratory at the CMR Building in TA-3 generates small amounts of solidified material containing plutonium-239 and trace amounts of plutonium-238 and americium. In addition, some solidified residues from examination of irradiated fuels are generated in the same location. TA-55 generates three types of TRU waste. The first waste is combustible and noncombustible solids from work in glove-box lines, and is primarily contaminated by plutonium-239 and americium. The second TRU waste is cemented process residues resulting from plutonium operations. The third waste type is similar to the first except that plutonium-238 is the major contaminant. TA-50 generates solid TRU waste in two locations. A cemented sludge that is a certified TRU waste is generated in TA-50-1. This waste is certified as appropriate for disposal at the U.S. Department of Energy (DOE) TRU disposal site in southern New Mexico when that facility becomes operational. The Size Reduction Facility (SRF) in TA-50 generates TRU waste in large steel boxes. The boxes contain ductwork and glove boxes that have been cut and packaged in the SRF. The SRF was designed to dismantle large pieces of equipment that are highly contaminated with radioactivity.

4.1.3.2 Radioactive Waste Storage and Treatment Facilities

The LANL stores radioactive waste using pads, shafts, casks, and piping. Four asphalt storage pads located in TA-54, Area G store LANL TRU waste. The pads measure 40 feet by 405 feet. Waste drums and containers are stacked on the pad to a height of 16 feet, covered with plastic sheeting, and then covered with a layer of crushed tuff. Highly radioactive TRU waste from hot cells and other sources has been stored in steel-lined concrete storage shafts in Area G. Plutonium wastes of high activity are stored in 30-gallon drums in concrete casks buried in Area G. In addition, the LANL stores 158 TRU-containing corrugated metal pipes measuring 2.5 feet in diameter by 60 feet in length at Area G. This waste form is no longer generated.

The LANL treats radioactive waste using liquid waste treatment facilities, a solid waste compactor, the SRF (described above), and a Controlled Air Incinerator.

The LANL radioactive waste compactor is located in Area G. The compactor crushes cardboard boxes containing paper, plastic, cloth, and glassware that are or may be contaminated with low levels of radioactivity. A volume reduction of nearly 5:1 is achieved. The compacted waste is buried in Area G pits.

The Controlled Air Incinerator at TA-50-37 is used to treat radioactively contaminated liquids, ion exchange resins, and PCBs. The Controlled Air Incinerator is operated on a campaign basis; during FY 1986, it incinerated 160 cubic feet of TRU waste.

Treatment of liquid radioactive wastes at the LANL is accomplished at two physical/chemical treatment plants, one located at TA-21 and one at TA-50. The plant at TA-21 serves as a pretreatment facility for wastes generated in that area. The plant treats approximately 3×10^6 L/yr. The plant at TA-50-1 treats all other wastes as well as the pretreated effluent from TA-21. The flow to this plant is approximately 3×10^7 L/yr. The final effluent from TA-50-1 is discharged to Mortandad Canyon. The main components of the radioactive waste treatment system consist of a network of underground pipes used to convey wastes from the point of generation to the treatment plants, and a number of aboveground and underground tanks used for waste storage and treatment. These components are described below.

Waste Transfer Lines

The radioactive liquid waste collection system at the LANL consists of the following three main components: the lines serving TA-21, the cross-country line from TA-21 to TA-50-1, and the main trunk lines serving the rest of the LANL, which lead to TA-50-1. The lines in TA-21 consist of buried 4-inch-diameter cast iron pipe installed approximately 20 years ago. There are two sections to this line, one serving the eastern part of TA-21 (DPE), which includes Tritium Systems Test Assembly (TSTA), and the other serving the western part of TA-21 (DPW). These lines are not double-contained, and there is no method of inventory control to determine if these lines are leaking.

The cross-country waste line from TA-21 to TA-50-1 is approximately 5 miles long and consists of steel pipe without double containment. In addition to conveying pretreated wastes from TA-21, this line also conveys raw wastes from TA-2 to the TA-50 Treatment Plant. Leak detection is accomplished by inventory control, whereby the volume of wastes discharged into the line is compared to the volume of wastes received at TA-50.

The main waste line to TA-50-1 consists of approximately 4.5 miles of double-contained polyethylene line, installed approximately 4 years ago. The outer containment line is connected to manholes and forces any leakage from the inner pipe to flow to detection sumps in manholes. There are leak detection sumps at each of the 62 manholes along the line. These sumps have probes connected to alarms in the TA-50-1 plant control room. In addition to the leak detection alarms, flow volumes entering the lines from each facility are monitored and compared to volumes reaching the treatment plant.

TA-2 Storage Tanks

Storage tanks are used at TA-2 for storing wastes before they are discharged to the waste collection line. Features of these tanks are given in Table 4-5. Radioactive liquid wastes generated at TA-2 are stored in three 1,200-gallon stainless steel underground storage tanks (USTs). These tanks are all 23 years old. They have not been tested for tightness, and there is no inventory control. There is also an above-ground emergency waste storage tank for use should the USTs be full.

TA-3 Storage Tanks

Storage tanks have been and are being used at Building TA-3-29 (CMR) for temporary storage of radioactive wastes before the wastes are discharged to the waste treatment line. Features of these tanks are presented in Table 4-6. The only tanks presently active are the fiberglass storage tanks located in the basements of Wings 4 and 5. These tanks are used because wastes from these wings cannot flow by gravity into the waste line and must be collected and pumped. The tanks are

TABLE 4-5

SUMMARY DATA FOR RADIOACTIVE WASTE TANKS AT TA-2

TA	Structure	Type ^a	Age (yrs)	Capacity (gal)	Construction Material	Substance Stored	Comments
2	TA-2-54	U	23	1,200	Stainless steel	Radioactive waste	
2	TA-2-55	U	23	1,200	Stainless steel	Radioactive waste	
2	TA-2-56	U	23	1,200	Stainless steel	Radioactive waste	
2	TA-2 Waste #1	A	Unknown	Unknown	Stainless steel	Radioactive waste	Never used - Emergency only, no containment

Source: RCRA UST Notification Submitted to EPA, Site Inspection by Survey team

^a U = Underground; A = Aboveground^b Age relative to 1987

TABLE 4-6

SUMMARY DATA FOR RADIOACTIVE WASTE TANKS AT TA-3

TA	Technical Area and Structure	Type	Age (yrs)	Capacity (gal)	Construction Material	Substance Stored	Comments
3	TA-3-29-W2A	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W2B	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W3A	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W3B	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W4A	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W4B	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W4C	A	5	800	Fiberglass	Radioactive waste	Located in CMR basement
3	TA-3-29-W4D	A	5	800	Fiberglass	Radioactive waste	Located in CMR basement, backup tank not in use
3	TA-3-29-W5A	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W5B	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W5C	A	5	800	Fiberglass	Radioactive waste	Located in CMR basement
3	TA-3-29-W5D	A	5	800	Fiberglass	Radioactive waste	Located in CMR basement, backup tank not in use
3	TA-3-29-W5D	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-29-W7B	U	27	5,000	Concrete	Radioactive waste	Located in CMR basement, not currently in use
3	TA-3-154-HL1	U	27	1,000	Stainless steel	Radioactive waste	Not currently in use
3	TA-3-154-HL2	U	27	1,000	Stainless steel	Radioactive waste	Not currently in use
3	TA-3-154-LL1	U	27	5,000	Concrete	Radioactive waste	Not currently in use
3	TA-3-154-LL2	U	27	5,000	Concrete	Radioactive waste	Not currently in use

Source: RCRA UST Notification Submitted to EPA; Site Inspection by Survey team

aU = Underground; A = Aboveground

above the ground (i.e., on the floor of the basement) and their levels are continuously monitored at the TA-50-1 plant control room. In addition, leak detectors in floor sumps near the tanks are monitored in the control room. The 14 USTs at CMR are associated with the old waste collection system and are all empty and no longer in use. There are no plans to use any of these tanks in the future; they are kept available only for emergency waste storage.

TA-21 Treatment Plant

The TA-21 Treatment Plant is a batch process plant consisting of a number of aboveground and underground storage and treatment tanks. (Additional discussion of the TA-21 treatment system is provided in Section 3.3.) Features of the TA-21 tanks are presented in Table 4-7. Waste influent from DPW flows to one of two 28,000-gallon underground concrete raw waste storage tanks (TA-21-257-RW-1 and 2), and influent from DPE flows to one of two 16,000-gallon aboveground steel tanks (TA-21-110 and 111). Treatment is conducted in a series of underground concrete and steel tanks located in the treatment plant building. These tanks consist of a flash mixer (TA-21-257-FM-1), a flocculator (TA-21-257-FL-1), a settling tank (TA-21-257-ST-1), a sludge storage tank (TA-21-257-SS-1), and a filter sump (TA-21-257-FS-1). Treated effluent is stored in two steel 16,000-gallon aboveground tanks (TA-21-112 and 113) before being pumped to TA-50. Leak detection for all these tanks consists of continuous monitoring of tank levels at the TA-50 plant control room. The four aboveground storage tanks are located outside the facility and have only minimal spill containment with curbs approximately 6 inches high. If these tanks begin to leak, tank contents can be diverted to the large underground raw waste storage tanks.

There are also three inactive USTs located in the TA-21 Treatment Plant (TA-21-257-B5-1, 2, and 3). During the Survey, staff at the TA-21 Treatment Plant reported that one of the 412-gallon stainless steel tanks developed a leak in the early 1980s and was taken out of service. The leak was apparently noticed because of a drop in tank content. Staff at the LANL indicated that material stored in the tank at the time of the leak was a uranium recovery raffinate consisting of 2 Molar nitric acid which contained high concentrations of fluoride and aluminum. The extent of the contamination resulting from this leak has not been determined.

TABLE 4-7

SUMMARY DATA FOR RADIOACTIVE WASTE TANKS AT TA-21

TA	Technical Area and Structure	Type	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
21	TA-21-110	A		16,000	Steel	Radioactive waste	Waste influent DP-East, small curb containment
21	TA-21-111	A		16,000	Steel	Radioactive waste	Waste influent DP-East, small curb containment
21	TA-21-112	A		16,000	Steel	Radioactive waste	Waste effluent, small curb containment
21	TA-21-113	A		16,000	Steel	Radioactive waste	Waste effluent, small curb containment
21	TA-21-257-SS-1	U	20	412	Steel	Radioactive waste	Bldg. 257 batch storage tank, may have leaked
21	TA-21-257-BS-2	U	20	412	Steel	Radioactive waste	Bldg. 257 batch storage tank, may have leaked
21	TA-21-257-BS-3	U	20	1,740	Concrete	Radioactive waste	Bldg. 257 batch storage tank
21	TA-21-257-FL-1	U	20	3,980	Concrete	Radioactive waste	Bldg. 257 flocculator
21	TA-21-257-FM-1	U	20	123	Concrete	Radioactive waste	Bldg. 257 flash mixer
21	TA-21-257-FS-1	U	20	5,900	Concrete	Radioactive waste	Bldg. 257 filter sump
21	TA-21-257-RW-1	U	20	28,000	Concrete	Radioactive waste	Bldg. 257 raw waste storage tank
21	TA-21-257-RW-2	U	20	28,000	Concrete	Radioactive waste	Bldg. 257 raw waste storage tank
21	TA-21-257-SS-1	U	20	4,200	Concrete	Radioactive waste	Bldg. 257 sludge storage tank
21	TA-21-257-ST-1	U	20	1,800	Concrete	Radioactive waste	Bldg. 257 settling tank
21	TA-21-288	U	20	NA	Steel	Radioactive waste	No containment, can drain to raw waste storage

Source: RCRA UST Notification Submitted to EPA; Site inspection by Survey team

aU = Underground, A = Aboveground

TA-41 Storage Tanks

An underground industrial waste storage tank at TA-41 was identified in the Comprehensive Environmental Assessment and Response Program (CEARP) Report (DOE-AO, 1986). The status of this tank is unknown because no wastes currently go from TA-41 to the radioactive waste collection line. The capacity of the tank was estimated from a recent engineering drawing to be approximately 4,000 gallons. Staff at TA-41 contacted during the Environmental Survey were unaware of the history or current status of this tank.

TA-50-1 Treatment Plant

The TA-50-1 Treatment Plant is a batch treatment plant similar to the TA-21 Treatment Plant. Operations at the plant consist of physical/chemical treatment (i.e., flocculation and settling) to remove radionuclides. Separate pretreatment is provided for wastes from TA-55 because of their higher concentrations of TRU waste. Influent to the plant averages approximately 10^{-2} to 10^{-3} Ci/L TRU for wastes from TA-55, and 10^{-5} Ci/L TRU for wastes from other sources. Plant effluent averages approximately 10^{-8} Ci/L TRU. (Additional discussion of the operation of the TA-50-1 Treatment Plant is provided in Section 3.3.)

Features of the storage and treatment tanks at this plant are given in Table 4-8. Most of the influent storage and treatment tanks are 25-year-old, underground concrete tanks, ranging in capacity from 1,000 to 75,000 gallons. Staff at the LANL reported that these tanks have not been tested for tightness. Leak detection is accomplished through constant monitoring of tank levels. There are also two aboveground radioactive waste tanks in an underground vault outside the treatment plant. Regulatory standards categorize tanks in an underground vault as aboveground tanks. The underground vault provides containment for these tanks. There is also a 100,000-gallon aboveground tank outside the treatment plant that is used for emergency storage of influent or effluent. This tank is contained by the overall containment for TA-50-1.

TABLE 4-8

SUMMARY DATA FOR RADIOACTIVE WASTE TANKS AT TA-50

TA	Technical Area and Structure	Type ^a	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
50	TA-50-1-1	U	25	2,000	Concrete	Radioactive waste	
50	TA-50-1-2	U	25	5,000	Concrete	Radioactive waste	
50	TA-50-1-3	U	25	5,000	Concrete	Radioactive waste	
50	TA-50-2-1	U	25	25,000	Concrete	Radioactive waste	
50	TA-50-2-2	U	25	25,000	Concrete	Radioactive waste	
50	TA-50-2-3	U	25	25,000	Concrete	Radioactive waste	
50	TA-50-2-4	U	25	25,000	Concrete	Radioactive waste	
50	TA-50-2-5	U	25	25,000	Concrete	Radioactive waste	
50	TA-50-3-1	U	25	5,000	Concrete	Radioactive waste	Temporarily out of service
50	TA-50-3-2	U	25	2,000	Concrete	Radioactive waste	Temporarily out of service
50	TA-50-3-3	U	25	1,000	Concrete	Radioactive waste	Temporarily out of service
50	TA-50-66-1	A	25	Unknown	Unknown	Radioactive waste	Caustic waste tank in underground vault Bldg. 66
50	TA-50-66-2	A	25	Unknown	Unknown	Radioactive waste	Acid waste tank in underground vault Bldg. 66
50	TA-50-90	A	25	100,000	Steel	Radioactive waste	Emergency storage tank, entire area contained

Source: RCRA UST Notification Submitted to EPA; Site Inspection by Survey team

^aA = Aboveground; U = Underground

TA-53 Storage Tanks

There are seven USTs at the Los Alamos Meson-Physics Facility (LAMPF) (TA-53) used for storage of radioactive wastes. Features of these tanks are given in Table 4-9. Laboratory wastes from Building TA-53-1 are stored in a 16-year-old concrete tank having a capacity of 3,000 gallons. Similar wastes from Building TA-53-3 are stored in a 13-year-old stainless steel tank that has a capacity of 2,200 gallons. Wastes stored in both tanks consist of neutralized chemicals and water from laboratory sinks. These wastes are periodically pumped from the tanks and trucked to TA-50-1 for treatment. The LAMPF has two 2,500-gallon stainless steel radioactive waste tanks (TA-53-68 and 69) that are 16 years old and used for storing cooling water containing activation products. Water is stored in these tanks to allow for decay of short-lived activation products. Water is discharged from the tanks to the sanitary sewage lagoons at TA-53. There are two similar tanks (TA-53-144 and 145) at the Los Alamos Neutron Scattering (LANS) Facility. These tanks are constructed of concrete, are 16 years old, and have capacities of 4,000 gallons each. Like the tanks at the LAMPF, these tanks are used to store activated cooling water before it is discharged to the sanitary lagoons. Leak detection for all these tanks is accomplished through monitoring of liquid levels. Finally, Tank TA-53-59 is a 2,000-gallon steel tank used for disposal of ion exchange resins contaminated with activation products.

TA-54 Storage Tanks

There is one UST in TA-54 in Area G. This tank is a 600-gallon, 10-year-old steel tank used for storage of radioactive liquids.

Abandoned and Removed Radioactive Waste Lines

Underground radioactive waste lines have been used at the LANL over the years to convey liquid radioactive wastes from points of generation to points of treatment and/or discharge. Some of these lines have been replaced, with the old lines being abandoned in place or removed. Over 6 miles of these lines have been removed and over 1 mile are currently left in place. In general, lines have been left in place only if they are impractical to remove (e.g., lines are under buildings).

TABLE 4-9

SUMMARY DATA FOR RADIOACTIVE UNDERGROUND WASTE TANKS AT TA-53

TA	Technical Area and Structure	Age (yr) ^a	Capacity (gal)	Construction Material	Substance Stored	Comments
53	TA-53-1	16	3,000	Concrete	Radioactive waste	Located at Lab Office Building
53	TA-53-3	13	2,200	Stainless steel	Radioactive waste	
53	TA-53-59	?	2,000	Steel	Radioactive waste	Receives waste ion exchange resin
53	TA-53-60	16	2,500	Stainless steel	Radioactive waste	
53	TA-53-69	16	2,500	Stainless steel	Radioactive waste	
53	TA-53-144	16	4,000	Concrete	Radioactive waste	
53	TA-53-145	16	4,000	Concrete	Radioactive waste	

Source: RCRA UST Notification Submitted to EPA; Site inspection by Survey team

^a Relative to 1987

PRELIMINARY

There are no regulatory requirements that are strictly applicable to these waste lines. Past releases from these lines may be reportable under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), though no such releases have been reported. Waste lines, related structures, and contaminated soil have been removed primarily to reduce the risk of intrusion from future construction and maintenance activities. These waste lines, structures, and contaminated soil have been disposed of on the site as radioactive waste. All removal activities have been conducted under the principle of maintaining radiation doses as low as reasonably achievable (ALARA).

Radioactive waste lines at the LANL were originally constructed to transport radioactive liquid wastes from TA-1 to their point of discharge at Pueblo Canyon. These lines were replaced in 1952 when a radioactive waste treatment plant was constructed at TA-45. Additional lines were constructed in 1953 to serve TA-3 and TA-43 and in 1958 to serve TA-48. These lines were all used until 1963 and 1964 when a new treatment plant was constructed at TA-50. In addition, waste lines were constructed in TA-35 to transport wastes to the TA-35 Treatment Plant. These lines ranged in diameter from 3 to 8 inches and were constructed of vitrified clay, polyvinyl chloride (PVC), cast iron, black iron, black steel, Duriron, galvanized steel, and stainless steel.

Several efforts have been undertaken to remove inactive lines. Initial efforts were undertaken in 1965 through 1967 to decommission lines in TA-1. From 1967 to 1976, line removals were primarily related to construction activities. The major line removal effort was conducted in 1981 and from 1984 through 1986. This effort is described by Elder et al. (1986). During that time, 34,829 feet of waste line were removed and 6,139 were abandoned in place.

Waste line removal generally involved excavating to the depth of the line and then either removing the line or abandoning it in place. Lines and other structures that were removed (e.g., manholes, holding tanks) were transported to TA-54 for disposal as radioactive waste. Lines were left in place only if removal was not practical (e.g., interference of excavation with existing structures or utility lines). All

lines that were left were decontaminated as much as possible, and then both ends of the line were sealed with concrete. Lines were abandoned only after a determination that abandonment was consistent with ALARA guidelines. All lines left in place, as well as the supporting ALARA decisions, are described by Elder et al. (1986).

During line removal, contaminated soil was removed until contamination was at background or de minimis levels. De minimis levels of soil contamination used are given in Table 4-10. If these levels could not be reasonably achieved, guidelines were used based on a maximum organ dose of 500 mrem/yr. These guidelines are shown in Table 4-11. Contaminated soil was transported to TA-54 for disposal as radioactive waste. ALARA decisions where soil above guideline levels was left in place are included in Elder et al. (1986).

4.1.3.3 Radioactive Waste Disposal Facilities

TA-54, Area G is the active solid radioactive waste disposal and storage area for the LANL. Area G encompasses 63 acres and has been in continuous use since 1957. Figure 4-3 depicts the arrangement of pits, trenches, and pads in Area G. Most of the waste disposed of in Area G has been placed in pits that are 400 to 600 feet in length, 26 to 100 feet wide, and 26 to 46 feet deep. A layer of crushed tuff (0.5 foot to 1 foot in depth) is placed in the bottom of the pit before any waste is disposed of. Wastes are placed in the pit in layers separated by 0.5 foot of crushed tuff. When the pit is filled to within 3 feet of the surface, it is covered with crushed tuff and topsoil. Area G contained a total of 31 pits at the time of the Survey. Twenty-eight pits had been filled and three were open. Two trenches that contain the concrete radioactive waste casks previously described have been cored in Area G. In addition, approximately 100 disposal shafts were drilled in Area G for the disposal of radioactive waste. Most shafts are unlined, but Shafts 14 through 23 are lined with concrete and steel. The lined shafts were used for storing tritium-contaminated waste.

Area G has received a wide variety of waste since it was opened. It is known to have received asbestos, beryllium residues, empty pesticide containers, PCB-contaminated solids, and mixed waste in addition to low-level radioactive waste. In

TABLE 4-10

**SOIL CONCENTRATION GUIDELINES (ABOVE BACKGROUND)
CONFORMING TO DE MINIMIS LEVELS**

	Surface Soil ^a	Subsurface Soil ^b
Gross alpha	Nondetectable ^c	75 pCi/g
Gross beta	25 pCi/g	75 pCi/g
External gamma ^d	5 uR/hr	20 uR/hr
Tritium	100 pCi/mL	250 pCi/mL

Source: Elder et al., 1986

a Surface soil is defined as soil located within 5 ft (1.5 m) of the surface.

b Subsurface soil is located at any depth greater than 5 ft (1.5 m).

c Detector background plus 3 sigma counting error.

d If cesium-137 is present.

PRELIMINARY

TABLE 4-11

**SOIL CONCENTRATION GUIDELINES (ABOVE BACKGROUND)
BASED ON 500 MREM/YR ORGAN LIMIT**

Radionuclide	Surface Soil ^a	Subsurface Soil ^b
Americium-241	50	600
Plutonium-241 ^c	1,670	20,400
Plutonium 239-240	200	1,900
Plutonium-238	350	3,200
Uranium-238	80	960
Uranium-235	80	960
Uranium-234	80	960
Cesium-137	80	960
Strontium-90	100	1,200
Tritium ^d	8,870	120,000

Source: Elder et al., 1986

a Surface soil is defined as soil located within 5 ft (1.5 m) of the surface.

b Subsurface soil is located at any depth greater than 5 ft (1.5 m).

c Plutonium-241 limit derived from americium-241 concentration.

d In pCi/mL of soil moisture.

FIGURE 4-3

TA-54, AREA G AT LANL

1980, the LANL received U.S. Environmental Protection Agency (EPA) approval to dispose of PCB solid waste in dedicated facilities in Area G. The LANL has performed vapor phase sampling of the soils beneath Area G and has detected organic contamination of subsurface soils in the parts-per-billion range (see related discussion in Section 3.4.3).

4.1.4 General Description of Pollution Sources and Controls - Nonhazardous Nonradioactive Waste

Nonhazardous wastes generated at the LANL generally consist of sanitary refuse, office and cafeteria wastes, and other wastes generated throughout the LANL complex. Most of these wastes are disposed of by burial at the Los Alamos County Landfill, located outside TA-3. This landfill is located on land owned by the DOE and is operated by Los Alamos County. Solid wastes generated within the HE area of TA-16 are disposed of separately by incineration at the TA-16 burn cage. Solid wastes generated within TA-39 are disposed of separately at a disposal pit located at that area. Relevant solid waste management regulations in New Mexico relate primarily to operation of landfills. New Mexico does not have a landfill permitting program but does require registration of landfills. The Los Alamos County Landfill has been registered with the state.

Solid Waste Collection

Solid wastes are generated in virtually all the facilities at the LANL. Collection of these wastes is performed by Pan Am World Services. Most solid wastes are placed by the generators into dumpsters, which are then picked up by Pan Am trucks. Large construction wastes and other bulk wastes that do not fit into dumpsters are collected separately, as are salvageable wastes. Collection of salvageable wastes is coordinated through the LANL Property Office.

Segregation of wastes at the LANL is primarily the responsibility of the waste generator. Segregation is accomplished by providing separate containers for solid, radioactive, and hazardous wastes. Standard dumpsters are provided for solid wastes, and each generator is responsible for ensuring that these receive only solid wastes. Pan Am crews do not check for unauthorized wastes when picking up these dumpsters. The only wastes that are specifically checked by Pan Am personnel are

salvageable wastes, which are checked for radioactivity and hazardous materials. In addition, all wastes leaving TA-53 are monitored for radioactivity.

Los Alamos County Landfill

The Los Alamos County Landfill has been operated for approximately 10 years. The site receives about 280 tons/week of solid wastes from the LANL, and also receives residential and commercial wastes from the surrounding area. The landfill has three active areas. These are a refuse disposal area used for disposal of most solid wastes, a rubble pit used for disposal of construction wastes and other bulk wastes, and an animal pit used for disposal of animal carcasses. Operational requirements include placement of at least 6 inches of cover soil at the end of each operating day, prevention of runoff into active fill areas, placement of a final cover consisting of at least 2 feet of compacted soil and graded to promote runoff without puddling or erosion, and maintenance of at least 20 feet of separation from the bottom of the fill to the top of the groundwater.

Because of the shallow depth of soil at the site, it did not appear that there was an adequate supply of cover soil. The active refuse area did not appear to have been receiving the required daily cover. Wastes placed in the refuse pit are compacted daily with heavy equipment, with water added occasionally to aid with compaction.

The active rubble pit is located on top of a closed refuse pit. One of the closed rubble pits appeared to have some problem with maintenance of final cover. Some gully erosion was noted at the site, with runoff going into Sandia Canyon. The animal pit is used only occasionally. The site was observed during the Environmental Survey site visit and appeared to have adequate cover.

Some waste segregation is practiced at the landfill. All trucks entering the landfill area are monitored for radioactivity. The operators at the site are supposed to monitor wastes received and check for hazardous materials or other unauthorized wastes. The site supervisor also indicated that the site did not accept transformers or capacitors unless certified free of polychlorinated biphenyls (PCBs). However, during the Environmental Survey site visit, only one operator was at the site, and it did not appear that all trucks were being inspected while unloading.

Waste Motor Oil

Waste motor oil at the LANL is generated primarily at the main Motor Pool in TA-3 and stored in two underground steel tanks. These tanks each have a capacity of 500 gallons and are 9 years old. According to Pan Am staff, the tanks have not been tested for tightness, and there is no inventory control. Waste oil is transferred from the shop areas and poured into the tanks. When the tanks are full, the oil is pumped out for recycling. Some evidence of oil staining and spillage was noted around the tanks.

Area J

Area J is located in TA-54 and is used for the burial of equipment that may be contaminated with HE. The area has three pits and two deep shafts. The material disposed of in Area J is nonradioactive, nonhazardous solid waste. In the past, drums of liquid absorbed onto vermiculite were disposed of at Area J as well as non-PCB oil spill cleanup material. Beryllium waste is disposed of in the two deep shafts (6 feet in diameter and 60 feet deep). The waste results from beryllium machining operations conducted at TA-3-102. The pits receive equipment that has been flashed to remove HE contamination and have also received bagged asbestos waste. The area is currently operating and there are plans for its continued use for the disposal of nonhazardous, nonradioactive waste.

4.1.5 Findings and Observations

4.1.5.1 Category I

None

4.1.5.2 Category II

1. Lack of effective characterization and segregation of waste. The LANL does not effectively characterize and segregate radioactive, mixed, hazardous, and solid waste.

The lack of accurate waste characterization and segregation results in hazardous waste entering radioactive waste disposal areas and sanitary landfill areas. Disposal of hazardous wastes in radioactive and sanitary disposal areas is an environmental and regulatory problem. Hazardous waste disposal can contribute to subsurface soil contamination and vapor phase releases. In addition, disposal of hazardous waste in other than permitted and properly constructed disposal facilities is an environmental compliance problem.

Improper characterization and segregation of waste is a problem that occurs at many locations throughout the LANL. The following have resulted from the lack of effective characterization and segregation of waste:

- The TA-54, Area G, Radioactive Waste Landfill is receiving mixed waste for disposal.

The Area G Radioactive Waste Landfill is receiving mixed and hazardous waste from several sources, primarily the TA-3-66 Sigma Building foundry, the TA-3-102 machine shop, and to a lesser extent various other buildings using radioactive material. In addition, hazardous substances may be entering Area G from TA-50-1. The Area G Landfill is not constructed with the liners and leachate collection system required for hazardous waste disposal under the RCRA and is not authorized for disposal of hazardous waste. Area G has been administratively closed to hazardous waste since May 1985. However, it was receiving mixed waste at the time of the Survey. The TA-3-66 waste consists of dust collected in the air cleaning system and solids from the breakout station that accumulate from lead and uranium operations in the Sigma Building. The breakout station solids are estimated by LANL Sigma Building personnel to total approximately 100 ft³/yr. The air pollution control system dust totals approximately 500 ft³/yr of waste. In addition, the TA-3-102 Machine Shop disposes of waste from lead machining in radioactive waste containers that are disposed of at Area G in pits. The amount of lead material disposed of could not be determined due to the variability in production.

The Area G Landfill has also received organic solvents that are contained on kimwipes and rags from buildings using radioactive materials. For example, solvents such as trichloroethylene, chloroform, methylene chloride, and Freon are used to clean components, parts, molds, and equipment throughout the LANL site. Such solvent-contaminated rags suspected of containing low-level radioactive waste are disposed of in the Area G pits.

Finally, the TA-50-1 dewatered sludge disposed of at Area G may be contaminated with organic solvents due to the use of the radioactive waste sewer for the disposal of laboratory analytical wastes. These wastes may include organic solvents such as methylene chloride, xylene, MEK, and others. The dewatered sludge will be tested in the Sampling and Analysis phase of the Survey to determine if organic contaminants are present.

Area G has been sampled by soil gas analysis and has shown vapor phase release of organics at parts-per-billion levels at 100-foot depth. The continued disposal of materials containing solvents at the Area G Landfill may contribute to the source of subsurface vapor phase releases.

- The Los Alamos County Sanitary Landfill is receiving hazardous wastes from LANL for disposal.

The Los Alamos County Sanitary Landfill is receiving scrap lead and waste cleaning solvents from numerous LANL operations. The widespread use and machining of lead has resulted in lead being disposed of in the sanitary waste stream. For example, the machine shops at TA-3-102 and TA-9 dispose of waste lead to the sanitary landfill with regular trash. In addition, the cleaning of machine parts and components with solvents such as acetone and toluene results in the disposal of small quantities of these solvents to the sanitary landfill. For example, the TA-3 Plastics Shop and TA-3 Paint Shop dispose of small quantities of organic solvent materials to the sanitary trash.

2. Chemical contamination of subsurface soil at TA-54, Area L. The current hazardous waste treatment and storage area, TA-54, Area L, is releasing hazardous chemicals as a result of past chemical waste disposal.

Subsurface sampling conducted by the LANL has detected vapor phase releases from the chemical disposal shafts and pit in parts-per-million concentrations at 100 feet below the Area L surface. The release results in an environmental problem (see Section 3.4) and a compliance problem. The vapor phase contamination may be considered a release from a waste management unit that requires corrective action. Section 3016 of the RCRA contains provisions for corrective action pertaining to solid waste management units if there has been a release of hazardous waste or hazardous constituents to the environment. The LANL has detected and reported the vapor phase releases described above to regulatory authorities. The LANL is aware of the potential compliance problem and was reviewing corrective action options for Area L at the time of the Survey.

The extent to which the vapor phase contamination has extended below the 100-foot level is unclear. The Sampling and Analysis phase of the Environmental Survey will sample Area L to determine if vapor phase contamination has extended below 100 feet.

4.1.5.3 Category III

1. Potential hazardous waste contamination of the TA-53 lagoons. The TA-53 lagoons have potentially received hazardous waste from operations at TA-53. Soils beneath the lagoon may be contaminated with hazardous wastes.

The LANL has analyzed the sludge in the lagoons by the Extraction Procedure (EP) toxicity test to determine if the sludge is a hazardous waste. However, the EP toxicity test does not detect organic contamination as does the Toxicity Concentration Leaching Procedure (TCLP). The lagoons have occasionally received oily wastes (personal communication, TA-53 personnel), which appear as a surface sheen. In addition, wastes released to drains in the TA-53 Machine Shop may contain paint or solvent material, which may be piped to the lagoons.

The two upper lagoons contain 1 to 4 inches of sludge, and are gunite-lined at the sides for stability, but are unlined at the bottom. During the Sampling and Analysis phase of the Survey, sludge in the upper lagoons will be analyzed to determine the extent of contamination.

2. Potential hazardous waste contamination of waste-oil surface impoundments in TA-35. Two surface impoundments in TA-35 may have received hazardous waste from operations in TA-35-125 and TA-35-85. The sludges in the ponds have been tested for PCBs, but have not been fully characterized and have not been tested by the EP toxicity test to determine if they are hazardous wastes.

The pond at TA-35-125 is located near the Antares Building, which contains large PCB transformers. The pond is situated approximately 20 feet lower than the building at a saddle on the side of a mesa. It measures approximately 20 feet square, is of unknown depth, and is cement-lined. The cement lining is constructed with an overflow spout that leads to soils on the mesa side. The cement lining, the spout, and the soils both up and down the elevation gradient from the pond are stained with a black substance. The liquid in the pond is covered by a floating yellow substance of unknown composition. In addition, the mesa top above the pond was the storage location for deteriorating waste drums, some of which had discharged their contents to the asphalt area nearby. The size and appearance of the pond at TA-35-85 is similar to that of the pond near TA-35-125.

During the Sampling and Analysis phase of the Survey, the sludge in the ponds will be tested to determine if the ponds contain a hazardous waste.

3. Potential hazardous waste release to soils at the TA-46-88 acid waste tanks. The two acid waste tanks at TA-46-88 are unbermed; one has released hazardous waste to nearby soils during a spill in March 1987, and there is a potential to result in future releases.

One 5,000-gallon nitric acid tank has no automatic overflow preventer and requires frequent manual inventory reduction to avoid a release. At least 5 gallons of 6 to 7 Molar nitric acid were released to nearby soils due to an

overflow that occurred during the early morning of March 19, 1987. In addition, at the time of the Survey, the 750-gallon tanks receiving sulfuric acid were marked as containing nitric acid. The tank marking has the potential to result in improper handling of this hazardous waste.

Personnel at the LANL stated that the area is to be bermed in the future but that the schedule for such construction is unclear.

4. Hazardous waste contamination of TA-16, Area P. Area P may be contributing to contamination of surface water with HE, barium, and heavy-metal discharges resulting from stormwater runoff draining from the exposed waste on the face of the landfill.

Area P of TA-16 has been the site of disposal of hazardous waste from HE research and development and waste-HE burning operations at TA-16. Area P has also received chemical bottles, trash, and incinerator ash (DOE-AO, 1986). The site encompasses 6.7 acres at the edge of Canyon de Valle. Some of the landfill has been covered with soil, but metal debris is visible protruding from the face of the landfill. The site has been sampled, is known to be contaminated with barium, and is expected to contain HE contamination as well. The concentration of barium in Area P was found to be above regulated concentration limits (i.e., exceeded EP toxicity test level) by LANL sampling conducted in 1985 (DOE-AO, 1986). The site will close under the RCRA and a closure plan has been submitted to the state. The LANL is currently assessing proper closure alternatives and may revise its existing closure plan to completely cover Area P and provide runoff and runoff control that was not in place at the time of the Survey. During the Sampling and Analysis phase of the Survey, runoff channels that receive precipitation that has washed over the face of the landfill will be sampled to determine if barium and other pollutants have contaminated sediments.

5. Potential releases of radioactive substances from partially contained or uncontained aboveground tanks. A number of aboveground storage tanks at the LANL used for the storage of radioactive liquids have insufficient secondary containment capacity for major spills or leaks.

Four tanks at TA-21-257 are only partially contained. Spills of significant quantities at tanks TA-21-257-110, 111, 112, and 113 would not be totally contained, resulting in contamination of soils surrounding them. These tanks each contain 16,000 gallons of low-level radioactive waste. One tank at Omega West (TA-2-46) was totally uncontained. Any leak at this tank could result in the release of small quantities of radionuclides (e.g., activation products) to nearby soils and possibly to a stream in Los Alamos Canyon, which is approximately 50 feet from the tank.

6. Potential lead contamination of surface soils. Lead shots, lead shavings, lead sheeting, and lead bricks are stored directly on the ground, in unprotected, unbermed locations, which may result in lead contamination of soils.

Of particular concern is the TA-53 bone yard, which contains 25 barrels of lead bricks, shot, and other lead material stored in drums which are deteriorating, uncovered, or have released lead materials to the soil. The improper storage of lead is a pervasive problem throughout the LANL. The Environmental Survey team found individual lead bricks or groups of lead bricks in a range of locations, where they appeared to be abandoned (i.e., partially buried with soil) or stored in a manner constituting disposal. The specific lead brick locations with potential for soil contamination are presented in Table 4-12.

7. Potential contamination at active burn areas. Three active burn areas at the LANL may be contaminated by hazardous waste and other substances that have the potential to contaminate the soils in the vicinity of the TA-14 incinerator, TA-14 trash pile, and TA-36 debris pit. The TA-14 incinerator is a 55-gallon drum with holes punched into the bottom to provide a draft for burning laboratory trash from TA-16 (personal communication with TA-14 personnel). The area in a 5-foot radius from the drum was covered to a depth of approximately 2 inches with ash, bottles, and other debris from the drum incinerator. The TA-14 trash area contained a small trash pile approximately 5 feet in diameter and 2 feet high, which contained unburned wood and other trash from TA-14 maintenance operations. In addition, the pile contained approximately 10 five-gallon plastic pails labeled as having contained HE. The trash area is located between electrical boxes 27 and 28. The TA-36 Lower

TABLE 4-12

LEAD STORAGE LOCATIONS AT LANL

Location	Approximate Amount
TA-53 (near lagoons)	Lead bricks, sheeting, shot in small piles throughout the area
TA-53 (in bone yard)	25 deteriorated drums, lead shot, and bricks on the ground
TA-2	4 pallets
TA-36 (MINIE)	2-3 sheets
TA-21 (East of WWTP)	8 bricks on soil
TA-48 (drainage into canyon)	2 pallets, 1 open box lead shot

PRELIMINARY

Slobbovia debris pit is located southwest of the Lower Slobbovia firing site and measures 80 feet long by 20 feet wide by 15 feet deep. The pit contains debris such as wood, ash, and other substances from firing site operations within TA-36.

During the Sampling and Analysis phase of the Survey, the TA-14 incinerator ash, TA-14 trash pile, and TA-36 debris pit material will be tested to determine if the waste is hazardous and if the soil nearby has been contaminated.

8. Potential for hazardous and mixed waste disposal into a landfill at TA-39.

The Survey team was told that sand from the TA-39 firing sites has been disposed of in the TA-39 disposal pit by TA-39 personnel in the past. If so, the sand may have contained barium, lead, uranium, and other contaminants resulting from HE research, development, and testing activities in TA-39. The sand currently at the TA-39 firing sites was recently sampled by LANL and found to contain barium at levels which are well below hazardous waste limits. No other constituents were analyzed and the landfill itself was not tested. The landfill receives lead waste from the TA-39 Machine Shop; perchloroethylene-soaked rags from gun-cleaning operation in TA-39-69; and paint cans, epoxy activators, and potentially HE-contaminated materials. The landfill has a potential for subsurface soil contamination due to the lack of a lining and may be considered to have received hazardous waste. The landfill has been in continuous operation for approximately 10 years. In addition, there is a closed pit (which was operated for approximately 10 years prior to the construction of the current pit) adjacent to the pit described above, and two similar closed pits near TA-39-69. It is likely that all the pits, when they were operational, received materials only from TA-39. During the Sampling and Analysis phase of the Survey, the wastes in the open landfill will be tested to determine if hazardous wastes are present.

4.1.5.4 Category IV

1. Potential release of radioactive wastes directly to Los Alamos Canyon. An unused emergency stainless steel radioactive waste holding tank at TA-2 has no secondary containment and is located on asphalt paving directly above a

structure that diverts surface runoff water to the creek in Los Alamos Canyon. A spill or leak from this tank would result in the release of radioactive material to the creek. Although the tank has never been used, its location represents a potential for environmental contamination should it be used in an emergency.

2. Storage of hazardous waste in excess of 90 days. Hazardous waste is stored in excess of 90 days throughout the LANL site without the required RCRA approvals. In addition to drums stored in deteriorating containers that present the possibility of soil contamination (see related finding in Section 4.2), certain buildings are used to store known hazardous waste without notification being given to regulatory authorities. For example, seven drums of reactive ammonium nitrate have been declared a waste and have been stored in TA-46-75 since 1977. Two drums of HE-contaminated carbon bed material are stored in TA-9-38. One drum is dated August 25, 1986, and the other September 4, 1979. These drums were in good condition and were not in danger of releasing waste, but had exceeded the allowable 90-day storage period.
3. Lithium hydride contamination of Area J. One of nine disposal shafts in TA-54, Area J is contaminated with 15 pounds of lithium hydride, a hazardous waste. The lithium hydride is contained in an enclosed shaft. The other waste in the shaft is nonhazardous solid waste. This presents a compliance problem because the waste was emplaced in a landfill not approved for hazardous waste disposal after the RCRA became effective. The shaft must be closed under the RCRA requirements for closure. LANL has developed a closure plan for this shaft, and has submitted it to the State of New Mexico.
4. Potential release from acid and cyanide tanks in the Sigma Building. There is a potential for a release of hazardous waste from the acid tank or the cyanide tank in the basement of the Sigma Building as a result of their ages. The tanks are approximately 30 years old and have leaked in the past. The past leak occurred in the acid tank and was contained within the building.
5. Storage of scrap magnesium chips. A 30-gallon container of magnesium metal chips was stored with an unsecured cover. Magnesium chips can react violently with water in a rapid exothermic reaction. An unsecure cover can be removed

by the wind and cause the metal to come in contact with precipitation. The container was located with three others in TA-39 behind TA-39-101. TA-39 personnel were made aware of the container.

PRELIMINARY

4.2 Toxic and Chemical Materials

The toxic and chemical materials portion of the Environmental Survey included a review of the TSCA-regulated materials (primarily PCBs and asbestos) pesticides, herbicides, and the handling of other chemicals used in processes conducted at LANL.

4.2.1 General Description of Pollution Sources and Controls

4.2.1.1 Polychlorinated Biphenyls

The LANL makes extensive use of PCBs in its electrical system. PCBs are present in both transformers and capacitors used at the site. All known oil-filled equipment (both active and inactive) was sampled and chemically analyzed for PCB content in an initial assessment conducted by LANL in 1985. Records indicate that there were 41 PCB transformers and 3,626 PCB capacitors. PCB levels in these units are greater than 500 parts per million (Delta H Engineering, 1986a). Additionally, 144 PCB-contaminated transformers with levels in the range of 50-500 parts per million were identified in that report. No hydraulic equipment contained PCBs. A more extensive inventory, dated March 24, 1987, listed a total of 133 PCB transformers in operation, 110 PCB-contaminated transformers in use and 2,796 PCB capacitors on-line. Seventy-six PCB transformers are located indoors and 57 outdoors. Table 4-13 shows the Technical Areas (TAs) where these PCB transformers are located and the amount of PCB fluids they contain.

Table 4-13 shows that the greatest number of PCB transformers are located in TAs-3, 21, and 53, with TA-3 having the greatest number. Almost 58 percent of the PCB transformers are indoors usually in basements; the remaining 42 percent are outdoors adjacent to the building using the electrical power delivered by these units. Most outdoor PCB transformers are mounted on concrete pads. An exception exists for 11 PCB transformers in TA-53 that are mounted on open grating that creates the mezzanine for Building M. In all cases, electrical equipment is located as near as possible to the using facility to avoid power loss through extended delivery lines. Most capacitors are located indoors for the same reason. Table 4-14 lists the PCB capacitors at the LANL by TA; all capacitors are sealed units.

TABLE 4-13
PCB TRANSFORMERS

Technical Area	Indoors		Outdoors		Total	
	Units	Volume PCBs (gal)	Units	Volume PCBs (gal)	Units	Volume PCBs (gal)
0	--	--	1	210	1	210
2	--	--	2	390	2	390
3	43	15,969	12	4,180	55	20,077
9	1	126	--	--	1	126
15	4	1,260	1	325	5	1,585
16	3	853	2	415	5	1,268
21	11	2,372	2	610	13	2,982
33	1	220	1	392	2	612
35	2	470	4	1,050	6	1,520
39	--	--	2	134	2	134
48	2	342	--	--	2	342
50	--	--	1	265	1	265
52	--	--	2	500	2	500
53	2	477	27	6,927	29	7,404
55	6	1,382	--	--	6	1,382
59	1	212	--	--	1	212
Totals	76	23,683	57	15,326	133	39,009

Source: LANL, 1987e

TABLE 4-14
LANL PCB CAPACITORS

Technical Area	Units	Volume PCBs (gal)
0	88	509.19
3	1,567	7,924.95
15	583	4,634.87
16	6	16.50
21	37	80.10
35	3	8.10
39	161	848.47
46	3	8.10
53	1,115	5,515.64
Total	3,626	18,147.11

Source: Delta H Engineering, 1986a

PRELIMINARY

In addition to the PCB transformers listed in Table 4-13 and the PCB capacitors in Table 4-14, the LANL has 110 PCB-contaminated transformers in operation, as shown in Table 4-15. The PCB concentration ranges from 50 to 500 parts per million in these transformers. The largest numbers are in TAs-0(18), 3(12), 16(15) and 53(14). The numbers are less than 10 for each remaining TA. Most of these units are located indoors.

Except for TA-2 and TA-39, most TAs with PCB transformers or capacitors are located on top of the mesas. All outdoor PCB transformers mounted on concrete pads have no curbing or berm to collect spills that might occur.

Ages of the PCB transformers at the LANL were tabulated and are presented in Table 4-16 as of 1985. As shown in that table, 49 percent of the PCB transformers are 20 years old or more. Units are often situated in work areas without security (such as a locked wire cage) or containment facilities (such as concrete curbing) in place. In some areas, the transformers are located adjacent to a floor drain.

Survey activities concentrated on the 133 PCB transformers at the LANL. Plant documentation of annual inventories, laboratory reports, disposal manifests, and inspection logs was reviewed. All PCB transformers in TAs-0, 2, 3, and 53 were inspected to determine their operating status. Spot-checks of transformers in TA-6 and TA-39 were made as well.

PCB-contaminated transformers were spot-checked in TAs-3 and 53. PCB capacitors in TAs-0, 3, and 53 were spot-checked for only proper labeling (i.e., location and condition) due to time limitations.

Annual inventory records for the PCB transformers were reviewed. A computer inventory of all PCB transformers, PCB-contaminated transformers, and PCB capacitors is operational at the LANL. Each month an electrician from Pan Am completes an inspection of all PCB transformers. The inspection log lists each unit, its location, manufacturer, serial number, LANL identification number, PCB volume, time and date of inspection, observation comments, corrective action, and a space marked "Any leak(s) found last month?"

TABLE 4-15
PCB-CONTAMINATED TRANSFORMERS

Technical Area	Indoors		Outdoors		Total	
	Units	Volume (gal)	Units	Volume (gal)	Units	Volume (gal)
0	17	1,768	1	183	18	1,951
2	1	5.5	--	--	1	5.5
3	12	2,930	--	--	12	2,930
6	2	28		--	2	28
8	1	10		--	1	10
11	4	443			4	443
15	5	126	4	295	9	421
16	15	1,348.5			15	1,348.5
18	4	401		228	5	629
21	4	532		80	5	612
22	4	105		--	4	105
33	6	201	1	38	7	239
35	1	375		--	1	375
36		43		--	1	43
39	4	272	--	--	4	272
40	5	114		--	5	114
46	2	122			2	122
49	1	11			1	11
52	--	--	1	250	1	250
53	5	1,393	9	2,937	14	4,330
	94	10,228	18	4,011	112	14,239

Source: LANL, 1987e

TABLE 4-16
PCB TRANSFORMER AGES AS OF 1985

Age (yrs)	Number of Units
10-15	40
16-20	31
21-25	9
26-30	6
31-35	36
36-40	16
Total	138

Source: LANL, 1987e

PRELIMINARY

Small leaks around fittings are covered with a plastic "baggie" to prevent leaking PCBs from accumulating on the transformer pad. In some cases a catch pan is placed inside the plastic bag. In the event that a pinhole leak develops in the radiator cooling fins, epoxy is applied to the metal to seal the leaking surface. Any such corrective action is noted on the inspection forms. Re-inspections are not part of the corrective process. Small leaks are checked during the next regular monthly inspection.

Hydraulic Systems

The LANL inspected all hydraulic oils on the site during 1986 to determine if any oils were PCB-contaminated (i.e., PCB concentrations greater than 50 parts per million). Any equipment with levels greater than 50 parts per million was drained, flushed, refilled with non-PCB oil, and retested. All equipment that had negative results was labeled and the PCB level was recorded on the tag attached to each piece of equipment. Table 4-17 shows the summary of that inspection. Waste oil that had been drained from these machines was treated as PCB waste and disposed of by the site PCB contractor (CECOS, Inc.).

Controls

The LANL has an incinerator that was used for radioactively contaminated PCBs. The incinerator was given a research pilot project permit by EPA for incineration of radioactively contaminated oils from the Rocky Flats Plant. A pilot-scale operation was initiated and monitored by DOE and EPA personnel. A total of 400 gallons of oil was incinerated by this process. LANL plans to continue to use the facility to incinerate PCBs. The facility is fully permitted for PCBs incineration under the TSCA.

The LANL TA-54 Area G landfill is permitted to dispose of PCB-contaminated waste oil. The manner of disposal depends on the concentration of PCBs in the oil. Oil that is free of PCBs (less than 5 parts per million) is stored for off-site disposal. Oil with a concentration of PCBs between 5 and 50 parts per million is contracted for off-site incineration. Oil with a PCB concentration between 50 and 500 parts per million is contracted for off-site disposal or is absorbed on vermiculite for disposal in

TABLE 4-17
PCBs IN MACHINES MEC DIVISION 3/87

TA	Bldg.	Shop	Equipment	ID#	PCBs(ppm)	Status
3	39	4	Lathe	479424	62	Flushed in March; needs to be resampled
3	39	6	American	479098	62	Flushed in March; needs to be resampled
3	66	20	Sunnen	480406	138	Flushed in March; needs to be resampled
3	287	48	Racine	480224	50	Flushed in March; needs to be resampled
3	39	4	EDM	479428	<1	Completed
3	102	13	EDM	479927	<1	Completed
3	102	13	Elox	479929	<1	Completed
35	2	33	Lathe	125563	6	Reflushed in March; needs to be resampled
3	102	13	Storage barrel	N/A	88	awaiting disposal

Source: Carpenter, 1987

Area G. All soil, equipment, and other solid materials contaminated with PCB oil are disposed of at Area G.

Equipment, such as transformers and capacitors containing liquids, is taken to TA-21-61 for sampling and analysis. When the analysis is complete, the oils are drained and placed in the appropriate holding tank. An 8,000-gallon tank on an asphalt-diked pad is designated for storage of PCB fluids with a concentration greater than 500 parts per million. A second tank of 5,000-gallon capacity is available for storage of PCB fluids with a concentration less than 500 parts per million. At the time of the Environmental Survey, the 8,000-gallon tank was properly marked and diked to contain sufficient volume in the event of failure of the tank.

Figure 4-4 shows the location of the PCB-approved landfill in TA-54.

4.2.1.2 Pesticides/Herbicides

A comprehensive policy is in place at the LANL to control both pests and vegetation. The policy was written by the Pest Control Oversight Committee (PCOC), whose members are representatives from the Industrial Hygiene HSE-5, Environmental Surveillance HSE-8, and the Maintenance and Operations ENG-4 Divisions. This committee reports to the Laboratory Environmental Review Committee. A formal policy of this committee was published in June 1984 (Vegetation, Insect, Rodent and Small Animal Control Policy, Procedures and Implementation Plan for Los Alamos DOE Facilities), and is automatically reviewed and updated every 3 years. The policy defines situations and locations where pesticides and herbicides will be applied, safety precautions and limitations observed in usage, and records and training that are required to use these chemicals.

Application of pesticides and herbicides is supervised by a commercial applicator licensed by New Mexico. Applications are preceded by a meeting between applications personnel and their supervisors, who review the plan for areas to be treated, proper mixing and preparation of chemicals, and safe application procedures. Records as to the amounts applied, personnel involved, and dates applied are maintained for each application of these chemicals.

FIGURE 4-4

PCB DISPOSAL AREA AT TA-54, AREA G

Training of applicator crews is conducted by manufacturer's representatives. Written tests on the use of these materials are prepared by the supervisor with input from the instructors. Respirators and personal protective equipment must be worn when these chemicals are handled, mixed, or applied. All chemicals are mixed in accordance with manufacturer's directions. Wind and weather conditions are considered in applications. Records of all applications, the amounts used, and the personnel applying them are maintained.

Pesticides and herbicides are stored in locked buildings at TA-3-SM1494 with limited access and warning signs posted. No flammable chemicals are stored in the same building with pesticides or herbicides. Storage sheds are heated to prevent freezing of the chemicals. Excess or outdated pesticides or herbicides are disposed of at the TA-54 Landfill at the LANL. Table 4-18 provides a listing of the chemicals used in this program.

4.2.1.3 Asbestos

Building construction at the LANL dates from that period when asbestos was commonly used in building materials. Asbestos was present in construction materials and products developed at the LANL and was used for insulation materials in heating and cooling systems, ceiling tiles, paneling, and roofing materials.

In 1986, the LANL began a program to inventory all locations in facilities where asbestos is present. The Health, Safety, and Environment Division is directing this program. Pan Am staff members collect samples at each suspected location in each building, recording the type, labeling the areas where asbestos exists, and identifying problem areas. These records are being reviewed and areas prioritized for repair and replacement of the asbestos. Kaiser Engineers is subcontracting the prioritization of the areas where asbestos has been found.

The asbestos program was in progress when the DOE Environmental Survey was conducted in April 1987. At that time, approximately 60 percent of the buildings had been evaluated. The asbestos inspection is conducted by a two-man team, who collect samples, appraise the site, and examine fiber samples microscopically. Samples are frequently submitted for examination using EPA-approved methods for

TABLE 4-18
PESTICIDES AND HERBICIDES USED AT THE LANL

Pesticides	Herbicides
Ficam W (Bendiocarb)	Needer 64 (2,4-D)
Diazinon	Roundup (Glyphosate)
Pyrethrins	Dowpon (Dalapon)
Max Force	Velpar (Hexazinone)
Bazgon	Balan (Benefin-WSA)
Resmethrin	Dacthal (DCPA)
	Princep 80W (Simazine)
	Gencor
	Oust

Source: LANL, 1987d

PRELIMINARY

analysis and identification of friable asbestos particles using phase contrast microscopy, electron microscopy, and X-ray fluorescence.

Removal or repair of asbestos from LANL facilities is coordinated and supervised by the Health, Safety, and Environment Division. Actual removal and repair of asbestos is carried out by specially trained crews from the Pan Am maintenance division. Written instructions that dictate removal procedures are on file at Pan Am and HSE-5. Work areas are sealed with plastic curtains, signs are posted to alert personnel in the area that entry is prohibited for asbestos removal, and removal crews wear appropriate protective clothing and respirators. Negative pressures are maintained in the work area, and air flow is monitored outside the work area to ensure that the asbestos fibers are contained. Waste materials are bagged and labeled as required by TSCA regulations.

In addition, Environmental Survey personnel visited buildings on the inventory list of asbestos-containing buildings. The locations visited include two buildings that had been recently surveyed (TA-3-SM-28 and TA-16-370), three older, inactive buildings (TA-16-315, 316, and 317), and two buildings that have public access and are either currently used by DOE or were used by the LANL in the past (Bradley Science Museum and the Old Community Center).

It is important to recognize that the asbestos program focuses primarily on worker health and safety concerns and therefore places a lower priority on areas which may contribute to an environmental concern. For example, inactive portions of TA-16 include a number of buildings that contain considerable amounts of asbestos. In some locations, loose asbestos was observed on the floors and near open doorways of abandoned buildings. While these buildings will be inventoried by the asbestos program, the priority for both inventorying and abatement is lower than inactive areas since no workers are exposed.

Another area of potential environmental concern on which the asbestos inspection places a lower priority is asbestos insulation on exterior steam lines. Steam lines in the more active areas of the LANL appeared to be well maintained and to pose no environmental problem. In inactive areas, some loose insulation was observed on some steam lines. Again, because few workers enter these areas, the possibility of exposures is limited.

4.2.1.4 Chemical Storage

There are two principal chemical distribution centers that account for most chemicals used and distributed at the LANL. The first is the chemical warehouse, managed and operated by Van Waters and Rogers, a subcontractor to the University of California, in TAs-3-30 and 31. Pan Am operates the second warehouse storage facility at TA-3-381. The warehouses store and disburse the major quantities of chemicals used on the site. Small quantities of specialty chemicals may be ordered directly from suppliers by user divisions at the LANL.

Table 4-19 presents the quantities of volatile chemicals and compressed gases used at the LANL. Usage over the 5-year period from 1981 to 1985 shows a general decrease in amounts of these chemicals. All chemical orders are approved by the Industrial Hygiene Section HSE-5 to ensure that Material Safety Data Sheet (MSDS) information is supplied with the purchase request for the material. Chemicals are delivered from stock in the warehouses or delivered directly from the supplier to the user divisions in accordance with U.S. Department of Transportation (DOT) regulations. Warehousing operations ensure that chemicals are properly labeled and that MSDSs are on file. If a new chemical is ordered, procedures are in place to ensure that the MSDS is on file and that DOT regulations are satisfied, but no other policy to review and maintain chemical labels (e.g., National Fire Prevention Association, NFPA, Hazardous Warning Labels) is consistently applied throughout the LANL.

Chemicals at TA-3-31 are stored off the floor on pallets or racks in case-lot quantities. A computer inventory system identifies where chemicals are stored. Materials are shipped in case-lot quantities so that the chemicals are received from Van Waters and Rogers warehouses and distributed to site requestors without subdividing case-lot quantities.

Flammable and toxic chemical store areas are separated, with adequate lighting and ventilation. Spill cleanup kits are placed around the warehouse in sufficient quantity to control accidental spillage of any materials. Warehouse staff were trained in safe handling and emergency response procedures. HSE-7 is notified in

TABLE 4-19

**QUANTITIES OF VOLATILE CHEMICALS AND COMPRESSED
GASES USED AT THE LANL (kg)^{a,b}**

	1981	1982	1983	1984	1985
Acids					
Acetic Acid	230	170	--	99	65
Hydrochloric Acid	6,500	6,000	1,400	1,655	758
Hydrofluoric Acid	420	270	640	191	278 ^c
Nitric Acid	99,500	70,500	52,100	55,976	54,212 ^c
Perchloric Acid	230	180	60	321	88
Phosphoric Acid	480	490	30	111	59
Sulfuric Acid	2,200	2,200	2,600	692	830 ^c
Gases					
Ammonia	2,900	1,800	2,400	2,177	2,404 ^c
Carbon Monoxide	6,200	9,600	--	2,965	0
Chlorine	1,200	610	140	1,238	3,006 ^c
Freon	3,300	1,600	2,600	4,137	4,368
Hydrogen Fluoride	1,000	1,600	1,600	1,134	2,812 ^c
Nitrogen Oxides	440	330	410	354	435 ^c
Sulfur Dioxide	370	210	30	0	0
Sulfur Hexafluoride	10,600	8,800	14,200	9,507	14,560 ^c
Inorganic Chemicals					
Ammonium Hydroxide	1,900	1,200	2,100	797	331
Mercury	200	210	60	24	1 ^c
Sodium Hydroxide	--	--	39,500	73,539	44,821 ^c
Organic Chemicals					
Acetone	10,200	10,700	10,900	10,118	6,735 ^c
Benzene	--	--	70	12	78
Carbon Tetrachloride	180	190	60	103	238
Chloroform	250	320	500	177	208
Ethanol	11,800	12,800	13,500	7,024	9,420
Freons	12,500	32,200	28,400	22,006	27,097
Kerosene	5,300	5,500	2,800	1,315	614
Methanol	3,400	3,100	730	3,298	1,607
Methylene Chloride	230	430	100	1,876	2,028 ^c
Methyl Ethyl Ketone	21,000	400	6,200	5,805	4,238
Perchloroethylene	9,100	340	--	2	32
Tetrahydrofuran	--	--	--	30	79
Toluene	60	60	190	337	83
Trichlorethane	39,300	25,600	31,100	27,674	29,665 ^c
Trichlorethylene	3,200	390	4,200	2,204	3,041 ^c
Xylene	--	--	70	59	135

Source: LANL, 1986a

^a This table does not include chemicals received under special orders.^b 1 kg = 2.2 lb.^c Greater than or equal to EPA Reportable Quantity (40 CFR 302).

the event of any spills or chemical cleanups. MSDSs are reviewed by personnel. Packing and labeling procedures are in place. Chemicals in the cool room included cases of nitric acid and photographic chemicals that were adjacent to a floor drain near an air conditioning unit. The drain would transport condensate mixture to the sewer system.

The compressed gas storage facility at TA-3-SM 140 contains liquid nitrogen, helium, argon, compressed air, acetylene, hydrogen, oxygen, chlorine, Freon, ammonia, hydrogen fluoride, and sulfur hexafluoride. Separate facilities are available for flammable and nonflammable gases.

At the Pan Am warehouse, TA-3-381, a computer tracking system maintains inventory and storage data. Chemicals are stored off the floor in shelving in designated areas. Aisles are wide for towmotor maneuvering, and shelving is adequate to hold chemicals. A separate storehouse had the flammables acetone, trichloroethane, and trichloroethylene adjacent to Building 381.

The storage and use of the toxic chemicals of interest at individual operating divisions was identified by means of a computer inventory that was developed by HSE-5, the Industrial Hygiene Section. An inventory of all chemicals used at the LANL had been conducted in 1986. The information included the chemical, CAS Number, location by TA, building, and room number, the amount in stock, and an estimate of the amount used annually. Although the LANL survey was completed for all operating divisions at the LANL, four divisions had not supplied the data in machine-readable format. These include the Isotope and Nuclear Chemistry Division, Life Sciences Division, Center for Non-Linear Sciences, and the Physics Division.

The computer chemical files were checked during the Environmental Survey for the RCRA Appendix VIII compounds. Quantities of these chemicals in excess of 1 gallon for liquids and 1 pound for solids were checked at a random number of areas that included Electronics (E), Materials Science and Technology (MST), Controlled Thermonuclear Research (CTR), and Earth & Space Sciences (ESS). Areas of particular interest were those in which the quantity of chemicals on hand was in excess of annual usage estimates. The individual divisions were responsible for proper

storage, use, and disposal of chemicals. Table 4-20 lists the compounds and locations that were reviewed for this portion of the Environmental Survey.

Operations within TA-39 were observed for proper labeling, storage, and disposal of toxic chemicals. Exceptions to acceptable practices are described in the Findings that follow.

4.2.1.5 Underground Storage Tanks

Underground storage tanks (USTs) are used extensively for storage of petroleum products and raw materials, and for storage and treatment of radioactive and hazardous wastes. Tanks used for waste treatment and storage are discussed separately in Section 4.1. This section describes the use of USTs for material storage.

There are 49 active USTs for storage of raw material and petroleum products at the LANL. These tanks are listed in Table 4-21 and were identified from RCRA underground tank notification forms, engineering drawings, and site visits. Underground tanks are used to store petroleum products (gasoline, diesel fuel, and fuel oil), dielectric oil, and process/treatment chemicals. Petroleum products constitute the largest volume of material stored, followed by dielectric oil.

There are also a number of USTs which were inactive and had been either abandoned in place or removed. These tanks are discussed separately in Section 4.5. In addition to active and inactive USTs, there are nine tanks of unknown operational status. These tanks were identified from the Comprehensive Environmental Assessment and Response Program (CEARP) Report (DOE-AO, 1986). These tanks are listed in Table 4-22 and were used mainly for storage of petroleum products.

At the time of the Survey, regulatory compliance for USTs was limited to submission of notification forms. These forms have been submitted for all but one of the active storage tanks shown in Table 4-21. Proposed UST regulations were issued by the EPA in 1987 (FR, 1987) and include requirements for one of the following methods of release detection: a combination of tightness testing and inventory reconciliation; several monitoring options; or automatic in-tank level monitoring and inventory reconciliation. Release detection programs have started

TABLE 4-20

CHEMICAL STORAGE FACILITIES REVIEWED AT OPERATING DIVISIONS

Div.	TA	Bldg.	Room	Chemical	Amount
E-1	3	30	7701	1,1,1-trichloroethane	30 gal.
MST-7	3	66	Cold	Methyl methacrylate	10 gal.
MST-7	3	66	Dark	O-xylene	2 L
MST-7	3	66	J-105	Acetone	5 gal.
MST-7	3	66	J-1	Perchloroethylene	55 gal.
MST-7	3	66		Trichloroethylene	55
MST-7	3	66		Acetone	55
MST-7	3	66		Methyl ethyl ketone	10
MST-7	3	66		Toluene	12
MST-7	3	66	J-2	Methyl isobutyl ketone	10
MST-7	3	66		Trichloroethylene	10
MST-7	3	66		Chloroethene	55
MST-7	3	66	Pr	Mercury	
MST-7	3	66		Acetone	20
MST-7	3	66		Chromic sulfuric	310 lb.
CTR-2	3	100	105	Chloroethene	
MST-7	3	169	1	Copper sulfate solution	3 drums
CTR-9	3	218	0	TCE	6 gal.
CTR-DQ		287	21A	TCE	41 gal.
ESS-1		494	103	Acetone	12 L

Source: Environmental Survey team, 1987

TABLE 4-21

SUMMARY DATA FOR ACTIVE UNDERGROUND PRODUCT STORAGE TANKS

TA	Technical Area and Structure	RCRA	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
0	TA-0-195-1	Y	22	2,000	Black iron	Gasoline	Located at Los Alamos Airport
0	TA-0-195-2	Y	22	6,000	Black iron	Gasoline	Located at Los Alamos Airport
0	TA-0-195-3	Y	14	4,000	Black iron	Gasoline	Located at Los Alamos Airport
0	TA-0-195-4	Y	14	5,000	Black iron	Gasoline	Located at Los Alamos Airport
0	TA-0-195-5	Y	15	300	Steel	Gasoline	Located at Los Alamos Airport
0	TA-0-1051-1	Y	37	14,496	Steel	Fuel oil	Western Steam Plant, Tested - Passed
0	TA-0-1051-2	Y	37	14,496	Steel	Fuel oil	Western Steam Plant, Tested - Passed
0	TA-0-1051-3	Y	37	2,938	Steel	Fuel oil	Western Steam Plant, Tested - Failed
3	TA-2-1	Y	1	560	Steel	Diesel fuel	Located at Main Building
3	Motor Pool 1	Y	9	10,000	Steel	Gasoline	Motor Pool near TA-3-382, Tested - Passed
3	Motor Pool 2	Y	9	10,000	Steel	Diesel fuel	Motor Pool near TA-3-382, Tested - Failed
3	Tank Farm #1	Y	4	8,000	Steel	Kerosene	Tank farm NW of TA-3-382
3	Tank Farm #2	Y	4	25,000	Steel	Fuel oil	Tank farm NW of TA-3-382
3	Tank Farm #3	Y	4	15,000	Steel	Gasoline	Tank farm NW of TA-3-382
3	Tank Farm #4	Y	4	25,000	Steel	Gasoline	Tank farm NW of TA-3-382
3	Tank Farm #5	Y	4	25,000	Steel	Gasoline	Tank farm NW of TA-3-382
3	TA-3-36-1	Y	8	6,000	Steel	Gasoline	Located at Service Station, Tested - Passed
3	TA-3-36-2	Y	8	5,000	Steel	Gasoline	Located at Service Station, Tested - Passed
3	TA-3-36-3	Y	8	3,000	Steel	Diesel fuel	Located at Service Station, Tested - Passed

TABLE 4-21

SUMMARY DATA FOR ACTIVE UNDERGROUND PRODUCT STORAGE TANKS (Continued)

TA	Technical Area and Structure	RCRA	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
3	TA-3-75	Y	35	20,000	Steel	Asphalt	Located at Batch Plant
3	TA-3-76	Y	35	20,000	Steel	Asphalt	Located at Batch Plant
3	TA-3-178	Y	35	8,000	Steel	Asphalt	Formerly TA-49-66
3	TA-3-191	Y	22	100	Steel	Gasoline	
3	TA-3-335	Y	35	13,500	Steel	Asphalt	
3	TA-3-1255	Y	6	800	Steel	Deisel fuel	Tested - Failed
15	TA-15-274	Y	24	218	Steel	Gasoline	
15	TA-287	Y	7	15,000	Stainless steel	Dielectric oil	
15	TA-15-291	N		1,200	Fiberglass	Ethylene glycol	Not currently in use
16	TA-16-197	Y	35	4,000	Steel	Gasoline	Tested - Passed
16	TA-16-205	Y	2	560	Steel	Diesel	Tested - Failed
16	TA-16-543	Y	36	30,000	Steel	Fuel oil	Tested - Passed
16	TA-16-544	Y	36	30,000	Steel	Fuel oil	Tested - Passed
16	TA-16-545	Y	36	30,000	Steel	Fuel oil	Could not test because of viscosity
16	TA-16-546	Y	36	30,000	Steel	Fuel oil	Tested - Passed
18	TA-18-PL-30	Y	1	560	Steel	Diesel fuel	Located at Laboratory and Office Building
21	TA-21-155	Y	7	1,000	Steel	Diesel fuel	Tested - Passed

TABLE 4-21

SUMMARY DATA FOR ACTIVE UNDERGROUND PRODUCT STORAGE TANKS (Continued)

TA	Technical Area and Structure	ICRA	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
21	TA-21-325	Y	15	5,200	Stainless steel	Nitric acid	Half-buried tank for nitric acid; concrete berm
35	TA-35-159	Y	10	800	Steel	Dielectric oil	
35	TA-35-188-1	Y	17	6,000	Steel	Dielectric fluid	Located at High-Voltage Development Lab.
35	TA-35-188-2	Y	17	6,000	Steel	Dielectric fluid	Located at High-Voltage Development Lab.
35	TA-35-197-1	Y	8	8,000	Steel	Dielectric oil	
35	TA-35-197-2	Y	8	8,000	Steel	Dielectric oil	
35	TA-35-197-3	Y	8	8,000	Steel	Dielectric oil	
41	TA-41-W-2	Y	1	560	Steel	Diesel fuel	Located at Guardhouse
50	TA-50-37	Y	7	1,000	Steel	Diesel fuel	Tested - Passed
55	TA-55-15	Y	11	550	Steel	Diesel fuel	Tested - Passed
55	TA-55-16	Y	11	550	Steel	Diesel fuel	Tested - Failed
55	TA-55-17	Y	11	3,000	Steel	Diesel fuel	Tested - Passed
55	TA-55-M4	Y	1	1,034	Steel	Diesel fuel	New tank not currently in use
55	TA-55-PF-47	Y	2	110	Fiberglass	Diesel fuel	Tested - Passed
59	TA-59-6	Y	20		Steel	Diesel fuel	Tested - Passed

Source: LANL, 1987c

TABLE A-22

SUMMARY DATA FOR UNDERGROUND STORAGE TANKS OF UNKNOWN OPERATIONAL STATUS

TA	Structure	RCRA	Capacity (gal)	Construction Material	Substance Stored	Comments
1	Gas Storage Tank	N		Unknown	Gasoline	Shown on section of 1943 COE Map
1	TA-1-442	N		Unknown	Fuel	Shown on section of 1943 COE Map
1	TA-1-443	N		Unknown	Fuel	Shown on section of 1943 COE Map
1	TA-1-444	N		Unknown	Fuel	Shown on section of 1943 COE Map
2	OWR Core Spray	N		Unknown	Unknown	Storage tank for OWR Emergency Core Spray
6	TA-6-2	N	100	Unknown	Gasoline	Located behind Generator Building
41	TA-41-10	N		Unknown	Unknown	Sump pit
41	TA-41-46	N	1,200	Unknown	Fuel	Shown on engineering drawings
52	TA-52-12	N	300	Unknown	Diesel fuel	Underground diesel tank for generator

Source: Environmental Survey team, 1987 from communication with LANL personnel

for some of the tanks at the LANL. For example, a tank-tightness testing program has started with tanks prioritized for testing on the basis of operational status (i.e., only active tanks were tested), capacity (tanks with volumes of less than 500 gallons were not tested), substance stored, installation specifications, and age. To date, most of the petroleum product tanks have been tested, and results of these tests are included in Table 4-21. In cases where a tank did not pass the test, the cause of failure was investigated. In all but one case, failure was related to leakage from piping leading to the tank rather than to leakage from the tank itself. For the remaining tank, the cause of failure was not determined because it would have involved excavation through reinforced concrete. Testing of dielectric oil tanks was not performed because the testing method was not compatible with the high viscosity of the oil.

The USTs identified in Tables 4-21 and 4-22 are described below for each TA.

TA-0 - USTs in TA-0 consist of fuel tanks at the Los Alamos Airport and fuel oil tanks at the Western Steam Plant. There are five underground gasoline tanks at the airport, ranging in size from 300 to 6,000 gallons and in age from 14 to 22 years old. Four of the tanks are constructed of black iron and one of steel. These tanks have not been tested for tightness, and the inventory control practices used could not be ascertained by the Environmental Survey. Tanks at the Western Steam Plant contain fuel oil for emergency use at the plant. There are two tanks having capacities of approximately 15,000 gallons and one with a capacity of approximately 3,000 gallons. All three tanks are constructed of steel and are 37 years old. Staff at the LANL reported that the three tanks were tested for tightness and the 3,000-gallon tank failed. The cause of failure was determined to be leakage from the fill line when the line was under pressure. Soil was excavated from around the fill lines and staff members indicated that no evidence of leakage was noted. Fuel from the tanks is used very rarely and then only to test the backup system. Staff at the Western Steam Plant reported that tank levels are checked infrequently and there is no formal inventory control system.

TA-1 - There are four USTs of unknown status identified for TA-1. These tanks are gasoline and fuel tanks identified on 1943 U.S. Army Corps of Engineers maps. The tanks are assumed to be inactive, but it is not known how they were closed. The

CEARP Report (DOE-AO, 1986) found that there was no indication of environmental contamination of concern associated with these tanks.

TA-2 - There is one active UST at TA-2. This tank is a 560-gallon diesel fuel tank used with an emergency generator and is only 1 year old. This steel tank has not been tested, and LANL staff indicated that there is no formal inventory control program. One tank of unknown status at TA-2 is a tank used as storage for emergency core spraying at the Omega West Reactor (OWR). This tank was identified in the CEARP report, though there was no indication of its size, location, or construction. Personnel at OWR during the Environmental Survey visit did not have any information concerning this tank.

TA-3 - USTs at TA-3 consist of a number of fuel tanks including those at the motor pool, main tank farm, service station, Van de Graaff Generator, and Central Alarm Station. USTs are also used to store tar at the asphalt batch plant. All the underground tanks at TA-3 are constructed of steel. Fuel tanks at the motor pool are a 10,000-gallon gasoline tank and a 10,000-gallon diesel fuel tank, both 9 years old. The tanks were tested for tightness and the diesel tank failed (DOE-AO, 1986). The cause of failure was not investigated because the tank is located beneath reinforced concrete. Tank inventories are determined twice daily by the stick method, and inventory differences are compared to pump meter readings. Daily inventory discrepancies greater than 1 percent must be reported to supervisors and to HSE-8. Staff at the LANL indicated that there have not been any discrepancies greater than this limit.

The main Los Alamos fuel tank farm is located near the motor pool and consists of 5 tanks that are 4 years old and that range in size from 8,000 to 25,000 gallons. These tanks are installed on a hillside, and approximately one-third of each tank is above grade. The tanks have not been tested for tightness. Large leaks would likely seep to the ground surface downhill of the tanks. Inventory control is accomplished by stick measurement of the tanks weekly and before and after delivery.

The TA-3 Service Station has two underground gasoline tanks with capacities of 5,000 and 6,000 gallons and one underground tank for storing diesel fuel with a capacity of 3,000 gallons. All three tanks are 8 years old. All three tanks were tested

for tightness and passed. Inventory control is accomplished as with the motor pool fuel tanks (i.e., twice daily sticking and comparison to meter readings).

The Van de Graaff generator has one underground gasoline tank (TA-3-191). This 100-gallon tank is 22 years old and has not been tested. There is no formal inventory control procedure.

The Central Alarm Station has one 800-gallon underground diesel fuel storage tank. This 6-year-old tank was tested for tightness. Staff at the LANL indicated that the tank failed due to leakage from the fill line. There is no formal inventory control program for this tank.

The asphalt plant has four USTs used for storage of tar. These tanks are classified as underground only on the basis of regulatory definitions (i.e., greater than 10 percent volume below grade); the four tanks are almost all above grade. Two of the tanks (TA-3-75 and TA-3-76) were observed to be leaking tar to the surface. Earthen berms have been constructed around the tanks to contain the leakage, and the leaked tar solidifies upon cooling. These 35-year-old tanks are scheduled to be replaced. There is no formal inventory control program for any of the tar tanks.

TA-6 - One UST of unknown status was identified for TA-6. This tank is described in the CEARP Report (DOE-AO, 1986) as a 100-gallon underground gasoline tank located behind the TA-6 Generator Building. The tank was apparently identified during an employee interview, and it is not known if it is still in place.

TA-15 - Three USTs are located in TA-15, all at the PHERMEX facility. These tanks consist of a 218-gallon steel gasoline tank (TA-15-274), a 15,000-gallon stainless steel dielectric oil tank (TA-15-287), and a 1,200-gallon fiberglass tank (TA-15-291) formerly used to store ethylene glycol. The gasoline tank is 24 years old and has not been used for some time. Facility personnel indicated that the tank was empty when last checked, and that it is not likely to be used again in the future. The dielectric oil tank is 7 years old. There is no inventory control program for these tanks, and LANL staff reported that slight spillage of oil occurs during oil transfer operations. The ethylene glycol tank was taken out of service because of leakage in the supply line running from the tank to the building.

TA-16 - USTs at TA-16 consist of one gasoline tank at the TA-16 Service Station, one diesel fuel tank at the new Tritium Facility, and four fuel oil tanks at the TA-16 Steam Plant. These tanks are all constructed of steel. The tank at the service station has a capacity of 4,000 gallons and is 35 years old. This tank was tested for tightness and passed. Inventory is measured daily as with the other service stations. The tank at the new tritium facility has a capacity of 560 gallons and is 2 years old. The tank was tested for tightness and failed due to leaks in the inlet line. The four tanks at the steam plant all have capacities of 30,000 gallons and are all 35 years old. Three of the tanks were tested for tightness and passed. The fourth tank could not be tested because of the high viscosity of the oil stored in it. Oil from the tanks is used only rarely (i.e., every 4 or 5 months) and only to check the backup fuel system. Tank inventories are measured monthly.

TA-18 - One UST is located in TA-18 and consists of a 1-year-old diesel fuel tank having a capacity of 560 gallons. This steel tank has not been tested for tightness, and there is no inventory control for it.

TA-21 - Two USTs in TA-21 are used to store diesel fuel and nitric acid. The diesel fuel tank is located at Building TA-21-155 and has a capacity of 1,000 gallons. This 7-year-old tank is constructed of steel, and it has been tested for tightness and passed. The stainless steel nitric acid tank is located adjacent to Building TA-21-2, has a capacity of 5,200 gallons, and is 15 years old. Approximately half of the tank is above grade, and there is a concrete wall around the tank to contain spills.

TA-35 - Six USTs are used in TA-35 to store dielectric oil. These steel tanks range in capacity from 800 to 8,000 gallons and in age from 8 to 17 years. None of these tanks has been tested for tightness, and there is no inventory control program for them.

TA-41 - TA-41 has one active UST, located at the TA-41 Guardhouse, which is used for storage of diesel fuel. This steel tank is 1 year old and has a capacity of 560 gallons. It has not been tested, and there is no inventory control. There are two USTs of unknown status identified for TA-41. The first, TA-41-10, was identified in the CEARP Report (DOE-AO, 1986) as a sump pit. A pit that may have been this facility was identified during the Environmental Survey site visit. According to site personnel, this pit received drainage from storage tunnels. The other tank, TA-41-

46, was identified in the CEARP Report (DOE-AO, 1986) as a fuel tank. Its volume was estimated from an engineering drawing to be approximately 1,200 gallons. Site personnel could not identify the location of this tank during the Survey site visit.

TA-50 - There is an underground diesel fuel tank located at the incinerator facility in TA-50 (TA-50-37). This 1,000-gallon tank is constructed of steel and is 7 years old. It was tested for tightness and passed. There is no inventory control system for this tank.

TA-52 - There is one UST of unknown status at TA-52. It is identified in the CEARP Report (DOE-AO, 1986) as a 300-gallon tank installed for a diesel generator when the UHTREX Reactor was constructed. This facility is now inactive.

TA-55 - Four active USTs are used in TA-55 for storage of diesel fuel. Another underground diesel tank has been constructed but has not yet been used. These tanks range in capacity from 110 to 3,000 gallons and in age from 1 to 11 years. All are constructed of steel except the 110-gallon tank, which is constructed of fiberglass. The four active tanks were tested for tightness and three passed. There is no inventory control for any of the tanks.

TA-59 - One underground diesel fuel tank is located at TA-59. This 3,000-gallon steel tank is 20 years old. It was tested for tightness and passed. There is no inventory control program for it.

4.2.1.6 Aboveground Product Storage Tanks

Aboveground storage tanks are used extensively for storage of raw materials and products, storage and treatment of radioactive wastes, and storage and treatment of hazardous wastes. Tanks used for waste treatment and storage are discussed separately in Section 4.1.1.3. This section describes the use of aboveground tanks for raw material and product storage.

There are 37 active aboveground raw material and product storage tanks at the LANL. These tanks are listed in Table 4-23 and were identified from engineering drawings and site visits. Aboveground tanks are used to store dielectric oil, petroleum products, and process/treatment chemicals, with dielectric oil constituting the largest volume of material stored. Most of the tanks identified have some type of secondary containment for spill control, although at many sites this containment was adequate only for minor spills.

The only regulatory compliance requirement associated with these tanks is preparation and maintenance of a Spill Prevention, Control, and Countermeasures (SPCC) Plan. The SPCC Plan was prepared in 1986 (Delta H Engineering, 1986b), and a number of spill control upgrades were identified. A conceptual design report was prepared describing these upgrades (Salgado, 1987), which typically consist of improvements to secondary containment. This plan lists all the potential areas on the site where spillage and/or leakage could either cause contamination of the soils in the immediate area of the tanks or enter a water course and get into the canyons. The LANL has identified 20 tanks that need some attention to prevent any leakage from leaving the area of the tank. Implementation of this plan will result in construction and/or renovation to hold the contents of the tank until action can be taken to clean up the spill and decontaminate the site of the spill. Implementation of the SPCC upgrade program has begun.

Descriptions of the tanks identified in Table 4-23, their contents, and spill control features and upgrades are given below for each TA.

TA-3 - A variety of aboveground storage tanks are located in TA-3. Tanks located at the asphalt plant include two small petroleum product tanks used for refueling maintenance equipment, a 5,000-gallon tank of kerosene, and a 7,400-gallon tank of oil used for road surfacing. These four tanks are all constructed of steel and are located within a curbed area. The curbed area drains into an unlined depression that provides adequate capacity to contain major spills. There are plans to replace this unlined containment basin with a concrete basin (Salgado, 1987). Other tanks at the asphalt plant are small kerosene tanks and diesel oil tanks that have no spill containment. Present plans call for construction of asphalt dikes around these tanks (Salgado, 1987).

TABLE 4-23

SUMMARY DATA FOR ACTIVE ABOVEGROUND PRODUCT STORAGE TANKS

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Comments
3	Asphalt Plant #1	500	Steel	Gasoline	Within bermed area
3	Asphalt Plant #2	7,400	Steel	Thick oil ("Reclaimite")	Within bermed area
3	Asphalt Plant #3	5,000	Steel	Kerosene	Within bermed area
3	Asphalt Plant #4	250	Steel	Diesel fuel	Within bermed area
3	TA-3-22	4,000	Stainless steel	Sulfuric acid	No containment
3	TA-3-26	150,000	Steel	Diesel fuel	Earth berm containment
3	TA-3-27	150,000	Steel	Diesel fuel	Earth berm containment
3	TA-3-550-1	31,000	Steel	Dielectric oil	24,000-gal. containment pit below oil tanks
3	TA-3-550-2	31,000	Steel	Dielectric oil	24,000-gal. containment pit below oil tanks
15	TA-15-261	12,000	Steel	Dielectric oil	Asphalt containment dike
15	TA-15-276-1	19,000	Steel	Dielectric oil	Within concreted sandbag containment
15	TA-15-276-2	19,000	Steel	Dielectric oil	Within concreted sandbag containment
21	TA-21-3-1		Stainless steel	Aluminum nitrate	40% full, possibly abandoned, no containment
21	TA-21-3-2		Stainless steel	Aluminum nitrate	15% full, possibly abandoned, no containment
21	TA-21-57	50,000	Steel	Fuel	Earth berm containment

TABLE 4-23

SUMMARY DATA FOR ACTIVE ABOVEGROUND PRODUCT STORAGE TANKS (Continued)

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Comments
21	TA-21-268		Steel	Fuel	Fuel tank
21	TA-21-289		Steel	50% NaOH	No containment
21	TA-21-357-2		Plastic	Sulfuric acid	Within confined area
21	TA-21-357-3		Steel	Diesel fuel	No containment
35	TA-35-29-1	35,000	Steel	Dielectric oil	No containment
35	TA-35-29-2	35,000	Steel	Dielectric oil	No containment
35	TA-35-34	2,000	Steel	Dielectric oil	No containment, near edge of canyon
35	TA-35-85	13,000	Steel	Dielectric oil	6-inch curb containment, spills drain to lagoon
35	TA-35-125	3,000	Steel	Dielectric oil	Within bermed area, spills drain to lagoon
35	TA-35-149	35,000	Steel	Dielectric oil	Within confined area west of TA-35-86
35	TA-35-150	35,000	Steel	Dielectric oil	Within confined area west of TA-35-86
35	TA-35-151	35,000	Steel	Dielectric oil	Within confined area west of TA-35-86
35	TA-35-152	35,000	Steel	Dielectric oil	Within confined area west of TA-35-86
35	TA-35-153	35,000	Steel	Dielectric oil	Within confined area west of TA-35-86

TABLE 4-23

SUMMARY DATA FOR ACTIVE ABOVEGROUND PRODUCT STORAGE TANKS (Continued)

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Comments
35	TA-35-154	5,000	Steel	Dielectric oil	Within confined area west of TA-35-86
50	TA-50-5	5,000	Stainless steel	Nitric acid	No containment
50	TA-50-85	20,000	Unknown	Heat transfer oil	Dike containment, has not been used
53	TA-53-14	7,500	Steel	Dielectric oil	Small curb containment
57	TA-57 #1	10,000	Steel	Diesel fuel	4-inch metal lip containment
57	TA-57 #4	500	Steel	Diesel fuel	No containment
57	TA-57 #5	500	Steel	Gasoline	No containment

Source: Environmental Survey team, 1987

Tanks at the main power plant consist of two 150,000-gallon tanks of fuel oil used for backup operation of boilers and a 4,000-gallon tank of sulfuric acid used for ion exchange regeneration. The fuel oil tanks are constructed of steel and have earth berms for spill containment. The sulfuric acid tank is constructed of stainless steel and has no containment. This tank is scheduled to be moved from its present location to a new location having secondary containment (Salgado, 1987). No spill containment upgrades are planned for these locations, which are directly above the main gas line to the power plant.

There are two 31,000-gallon dielectric oil tanks located near Building TA-3-550. These tanks are constructed of steel and are located above a 21,000-gallon spill containment sump close to the edge of Twomile Canyon. Spill containment upgrades planned for this site include construction of a new bentonite-lined containment basin. In addition, earthen dikes will be constructed to divert runoff away from the tanks (Salgado, 1987).

TA-15 - Tanks in TA-15 are used to store dielectric oil and consist of a single 12,000-gallon tank (TA-15-261) near TA-15-194 and TA-15-203 and two 19,000-gallon tanks near TA-15-276. Tank TA-15-261 is located at the edge of Water Canyon and is within an asphalt containment basin. Plans call for this basin to be reconstructed to provide better spill containment (Salgado, 1987). The tanks near TA-15-276 are located within a basin with dikes approximately 10 feet high constructed of cemented sandbags. The containment basin is scheduled to be improved by sealing with bentonite (Salgado, 1987). In addition, spill containment will be provided for Building TA-15-276, where the oil is transferred and used.

TA-21 - A variety of tanks were identified in TA-21. Two vertical stainless steel tanks were located behind Building TA-21-3. The tanks were apparently abandoned by the former building occupants and the present building occupants did not have any information concerning the tanks or their contents. Staff members formerly associated with activities at the facility identified the contents of the tanks as an aluminum nitrate solution. The tanks appeared to be approximately 5,000 gallons in capacity. One tank was approximately 15 percent full and the other approximately 40 percent full. There is no containment around these tanks and future plans for the tanks are unknown.

There were four tanks located at the TA-21-357 Steam Plant. The largest of these tanks (TA-21-57) is a 50,000-gallon fuel oil tank. This tank is constructed of steel and contains fuel oil that is used as backup fuel for the plant. The tank is over 40 years old and is located within an area contained by earthen dikes. A smaller tank (TA-21-368) is also located within this confinement basin. This tank apparently contained fuel oil that was used to prime the oil pumps for the larger tank. The containment for these two tanks is scheduled to be improved by sealing with bentonite (Salgado, 1987). There are two other small tanks located behind the power plant. These tanks are a diesel fuel tank used for an emergency generator and a plastic tank containing sulfuric acid used for water treatment. The diesel fuel tank has no containment. The acid tank is located within a bermed area with a collection sump.

There is also a caustic storage tank located at the TA-21-257 Waste Treatment Plant. No spill containment is associated with this tank.

TA-35 - There are a number of tanks within TA-35 used for storage of dielectric oil. Located at Building TA-35-29 are two 35,000-gallon steel tanks. These plywood-covered steel tanks have no spill containment and are presently located on crushed stone. Present plans call for removal of one of the tanks and construction of a concrete containment basin for the other (Salgado, 1987).

There is a 3,000-gallon steel dielectric oil tank next to Building TA-35-34. This tank is located near the edge of Mortandad Canyon and has no containment. Present plans call for construction of a concrete containment basin for this tank (Salgado, 1987).

A 13,000-gallon steel dielectric oil tank is located next to Building TA-35-85 at the edge of Mortandad Canyon. Containment for this tank consists of a 6-inch high curb and a sump that drains to a gunite-lined lagoon. Present plans call for construction of an additional concrete tank within the lagoon to contain spilled oil (Delta H Engineering, 1986b).

A system similar to the above exists at Building TA-35-125, where a 3,000-gallon dielectric oil tank is located within a curbed area draining to another gunite-lined lagoon at the edge of Mortandad Canyon. Plans call for improving spill

containment at this site by increasing the height of the curb and plugging the drain leading to the impoundment (Salgado, 1987).

There are six dielectric oil storage tanks at Building TA-35-86. These tanks consist of five 35,000-gallon rectangular siege and Marx tanks and one 5,000-gallon vertical cylindrical tank. These tanks are located on a concrete pad within a contained area adjacent to the building.

TA-50 - Tanks at TA-50 consist of a 5,000-gallon stainless steel nitric acid tank and a 20,000-gallon tank constructed for storage of heat transfer oil for a solar collector system. The acid tank had no containment at the time of the Environmental Survey, but construction of a concrete dike around the tank was planned (Delta H Engineering, 1986b). The oil storage tank is contained by dikes but has never been used. There are plans to increase the capacity of the containment if the tank is ever used (Salgado, 1987).

TA-53 - There is one dielectric oil storage tank located in TA-53. This tank has a capacity of 7,500 gallons and is located at Building TA-53-14. Containment consists of a small curb. Present plans call for construction of a concrete containment basin for this tank (Salgado, 1987).

TA-55 - There is one tank in TA-55 used to store nitric acid. This 6,100-gallon tank is stainless steel and is located at Building TA-55-4. It is contained by a curb that provides a total containment volume of 1,120 gallons. There are plans for constructing a new concrete containment basin having a larger capacity (Salgado, 1987).

TA-57 - Three product storage tanks are located at the Fenton Hill site (TA-57). There is a 10,000-gallon diesel fuel tank that has spill containment consisting of a 4-inch-high metal lip. The tank belongs to the drilling contractor at the site and will be removed when drilling activities are completed. The two other tanks are 500-gallon tanks containing gasoline and diesel fuel. There is presently no containment for these tanks, though plans call for construction of containment curbs around them (Salgado, 1987).

4.2.1.7 Outdoor Drum Storage

Drums are used extensively at the LANL for storage of chemical products. The LANL presently receives approximately 4,000 drums each year of chemical products. Materials received in drums include petroleum products, dielectric oil, hydraulic oil, solvents, and various chemicals and reagents. (See Table 4-19 for a listing of chemical products used at the LANL). Many of these products are stored outside the facilities in which they are used. The Environmental Survey identified a number of drums stored outside that appeared to be stored in such a way as to be of potential concern with respect to releases to the environment. To better assess drum management at the LANL, the Environmental Survey conducted a detailed inspection of 10 TAs: TA-3, TA-9, TA-15, TA-16, TA-18, TA-21, TA-33, TA-35, TA-46, and TA-53. These areas had been identified earlier in the Survey as areas that potentially had large numbers of drums in outdoor storage. The inspection focused on outdoor storage of drums and sought to obtain an inventory of drums and drum management practices. This portion of the Survey did not focus on hazardous waste storage areas (i.e., designated staging and satellite areas). Many of the drums observed, however, appear to be discarded chemical products, and as such, may be considered hazardous waste.

The outdoor drum storage inspection identified 803 drums at the 10 TAs surveyed. Table 4-24 summarizes storage conditions for these drums by TA. The types of materials stored and associated drum management practices are discussed below for each of the 10 TAs.

TA-3 - The areas surveyed in TA-3 were the Sigma Building (TA-3-66), the Motor Pool, and the Asphalt Plant. A total of 160 drums were observed in these areas. Many of the drums stored outside the Sigma Building appeared to be drums containing suspect radioactive material. There was no marking on these drums indicating their contents. Other waste drums were observed that contain waste oil. Product materials stored in this area included solvents, acetone, oil, and trichloroethylene (TCE). Most drums in this area were placed directly on the ground surface or directly on soil. There was some evidence of past spillage indicated by stained soil. Drums at the Motor Pool contained a variety of materials including kerosene, solvent, antifreeze, automatic transmission fluid, and diesel oil. Many of

TABLE 4-24

**NUMBER OF DRUMS OBSERVED FOR VARIOUS DRUM
STORAGE PRACTICES AT DIFFERENT TECHNICAL AREAS**

Technical Area	Total Number Observed	Drum Storage Practice				
		Storage Directly on Ground Surface	Storage Without Spill/Leakage Containment	Storage of Unmarked/ Unlabeled Drums	Storage in Uncovered Locations	Storage Adjacent to Drainage Ditches
3	160	26	128	19	151	0
9	40	7	31	2	37	0
15	18	7	12	2	7	0
16	116	51	116	20	75	0
18	24	17	24	13	18	2
21	46	8	46	7	37	7
33	27	25	27	2	27	1
35	70	15	70	0	70	33
46	104	38	104	5	85	37
53	198	152	198	89	198	0
TOTAL	803	446	756	159	705	80

Source: Environmental Survey team, 1987

the product drums were stored on horizontal racks with drip pans. Others were stored directly on the ground with no secondary containment. There was some indication of past spillage, particularly where waste oil was handled. Drums at the TA-3 Asphalt Plant contained waste oil, kerosene, and solvents. Several unmarked drums were also noted.

TA-9 - A number of shops and storage buildings were surveyed in TA-9 with a total of 40 drums being observed. In general, these drums stored raw materials and were placed on horizontal storage racks. Drip pans were noted under several of these storage racks. Evidence of spills and leaks was limited to several areas of minor soil or pavement staining. Materials stored in drums in this area include TCE, 1,1,1-trichloroethane (TCA), oil, acetone, methanol, dibutyl carbitol, diphenyl oxide, methyl sulfoxide, kerosene, toluol, isobutyl acetate, used oil, ethylene glycol, n-methyl-2-pyrrolidene, ethanol, and fuel oil.

TA-15 - Areas surveyed in TA-15 were the shop area around Building TA-15-50 and the PHERMEX and ECTOR facilities. A total of 18 drums were observed in these areas. Most product drums were stored on horizontal racks inside sheds. These drums contained thinner, acetone, dielectric oil, and kerosene. Several drums of TCE and TCA, as well as two unlabeled drums, were stored outside. Evidence of spills and leaks was limited to areas of minor soil staining.

TA-16 - Observations in TA-16 were limited to the storage area at Buildings TA-16-516, 517, 518, 519, and 520. A total of 116 drums containing a variety of materials were observed for this area. Most of the product drums contained hydraulic oil, and were stored under cover on pallets. Drums stored outside directly on concrete contained used solvent, hydraulic oil, methanol, and kerosene; there were also several unmarked drums. There was no secondary containment around these drums. Also stored outside directly on the soil were over 50 empty (drained) drums containing residuals of hydraulic oil contaminated by HE material. The soil at this area was stained, indicating leakage of residuals from these drums.

TA-18 - At TA-18 the drum inspection was limited to the shops and storage areas near the entrance to the TA. A total of 24 drums was observed. Product materials stored in drums were ethanol, gasoline, TCA, and motor oil. Some of these drums were stored under cover. Some minor evidence of spillage and leakage was

observed. Two rusted drums, one containing TCA and the other ethanol, were stored outside next to a drainage ditch. A number of unlabeled drums were also observed.

TA-21 - The assessment of TA-21 included the whole TA except for the area around the TSTA facility. A total of 46 drums was observed. These drums contained a variety of materials: used oil, hydrofluoric acid, Freon, sulfuric acid, ethanol, and dielectric oil. Most drums in TA-21 were stored in uncovered locations, and all storage areas lacked secondary containment. Some product drums appeared to have been stored outside for long periods and the material inside is probably now waste material, although the drums are not marked as such. Evidence of spillage and leakage included soil staining next to old Freon drums that were located in a drainage ditch that discharges to Los Alamos Canyon.

TA-33 - The assessment at TA-33 was limited to storage areas near TA-33-22 and TA-33-23. Most drums at these areas contained waste oil. Other materials stored at these areas included kerosene, diesel, and solvent. Two unmarked drums were also noted. All the drums in this TA were stored in uncovered locations with most of them being stored directly on the soil. Drum leakage has resulted in heavy staining of the soil. One leaking drum was observed to be stored in a drainage ditch.

TA-35 - At TA-35, the entire area was surveyed except the area around Building TA-35-68. Seventy drums were identified, all of which contained dielectric oil or waste dielectric oil. All these drums were stored uncovered, and none had secondary containment. Oil staining of the soil and pavement was observed in several areas, indicating leakage from drums. In several instances, leaking drums were stored next to drainage ditches and adjacent to the canyon wall.

TA-46 - The entire area of TA-46 was inspected and 104 drums were observed. These drums contained a wide variety of materials including isopentene, hydraulic fluid, Freon, dielectric oil, kerosene, TCA, acetone, 2-propanol, ethanol, motor oil, and acids. Several unlabeled drums were also noted. Most drums at this TA were stored in uncovered areas, and all were stored without any secondary containment. There were several instances of leaking drums stored in, or adjacent to, drainage ditches. Other areas of leakage were indicated by soil staining.

TA-53 - All of TA-53 was inspected and 198 drums were observed. Materials stored in these drums included waste oil, ethylene, acetone and waste acetone, ethanol and waste ethanol, waste solvent, Cimcool machine coolant, Stoddard solvent, motor oil, TCE, and TCA. A number of unmarked drums were observed, most of which apparently contained a concrete-based radioactive shielding. All the drums in this TA were stored in uncovered locations, and all were stored without secondary containment. Most of the drums were stored directly on the soil surface. Some ground staining indicating leakage was noted at several areas where waste oils and waste solvents were stored.

4.2.2 Findings and Observations

4.2.2.1 Category I

None

4.2.2.2 Category II

1. Potential release of PCB-containing fluids. Widespread use of PCB fluids in electrical transformers and capacitors represents a potential for the release and transport of PCBs into the environment and, in some instances, the potential for direct contact.

During the Survey, there were 133 PCB transformers in use that had PCB concentrations greater than 500 parts per million in their dielectric fluids. In addition, there were 110 PCB-contaminated transformers in use with concentrations of PCBs in the range of 50 to 500 parts per million. A 1986 inventory of capacitors in use at the LANL reports that 2,796 PCB-containing units are in service. The total amount of PCB fluids in these units is significant: 565,000 kilograms in PCB transformers; 99,800 kilograms in PCB-contaminated transformers; and 117,000 kilograms in capacitors. The potential for serious environmental damage in using these materials is enhanced by several factors:

- Absence of spill containment facilities
- Location of PCB transformers near drains

- Operating condition and age of the PCB transformers in use
- Location of PCB transformers and capacitors indoors within high traffic areas for LANL personnel

A brief discussion of each of these factors follows.

A. Absence of Spill Containment at Outdoor Transformers

In total, 57 of the 133 PCB transformers are outdoors. No dikes are in place to contain a possible leak of PCB fluid from these units, and any significant leak would flow directly to the surrounding soil. Minor leaks that were contained using plastic bags were reported for three PCB transformers in this group during the January monthly inspection conducted by Pan Am linemen. Units at TA-53-67, TA-35-32, and TA-3-56 had small leaks.

Of particular concern are two PCB transformers in TA-2 outside the Omega West Reactor in Building 51 adjacent to the stream flowing through Los Alamos Canyon. These transformers are of particular concern because of the possibility of rockfalls from the canyon wall above the transformer location. At the time of the Environmental Survey, a large boulder was secured by cables directly above the transformer pad. The pad supporting the transformers has no dike to retain the transformer fluid should a leak develop in the units. A drain in the pad empties directly to the canyon stream. Should a leak occur, the PCB fluid would discharge directly to the canyon stream. Rockfall from the canyon wall near these units would almost certainly hit the transformers and initiate a leak of PCB fluids.

B. Location of PCB Transformers Near Drains

There are eight PCB transformers located indoors near drains. Three units located in TA-3-22, the Powerhouse, are of particular concern. These transformers contain a total of 2,013 gallons of PCBs, are 36 to 40 years old, and have had pinhole leaks that were contained with plastic bags and epoxy cement. The three transformers had a total of five plastic bags and three epoxy plugs. A sewer opening is adjacent to one of these units. Because no

containment dike is in place, any leak in these units would flow to the drain system.

C. Operating condition and age of the PCB transformers.

Pan Am electricians inspect the 133 PCB transformers on a regular monthly basis. Review of the linemen's inspection report to the LANL indicates that leaks were observed at 31 of these units. In some cases more than one leak was observed. Table 4-25 shows the location of these leaking units, their identification numbers, whether they are indoors or outdoors and their approximate ages. It is evident that the leaks are common to the older operating units. The average age of units in this category is in the range of 31 to 35 years. It is logical to expect increasing failure rate with increasing age.

D. Location of PCB transformers indoors within high traffic areas.

The majority of leaking transformers listed in Table 4-25 are located indoors. There is particular concern that the 17 transformers in TA-3, Building 29, are close to LANL personnel performing routine assignments in their work areas. There is potential for direct contact by these staff members with PCB fluids should major leaks develop. The possibilities increase with the increasing age of the transformers.

2. Potential release of oil and hazardous materials. There is a significant potential for releases of oil and hazardous materials to the environment due to inadequate drum management practices.

Because of the large number of drums observed at the LANL by the Environmental Survey team, a detailed inspection of drum management practices was performed in 10 TAs where a large number of drums had been observed. More than 800 drums of products and wastes were observed during this inspection. Materials contained in drums included dielectric oil, motor oil,

TABLE 4-25
LEAKING PCB TRANSFORMERS

Technical Area	Bldg.	Room	Identification No.	Indoors/Out	Age (yrs)
53	67	0	5036	O	16-20
59	1	0	5550	I	21-25
48	1	26	5548	I	31-35
48	1	26	5549	I	26-30
35	32	0	5024	O	21-25
(2)35	2	A-10	5618	I	31-35
18	142	0			31-35
3	16	70	5002	I	36-40
3	16	70	5001	I	36-40
0	0	0			
16	586	0	5608	I	31-35
16	260	110	5020	I	31-35
16	540	0		I	31-35
15	185	B-3	5611	I	21-25
3	39	0		I	31-35
3	40	N8	5554	I	31-35
3	40	E6	5555	I	31-35
3	40	S18	5553	I	31-35
(2) 3	22	0		I	36-40
3	22	0		I	36-40
3	56	0		O	31-35
3	29	1090		I	31-35
3	29	4000	5575	I	31-35
3	29	4000	5574	I	31-35
3	29	4095	5573	I	31-35
3	29	4095	5572	I	31-35
3	29	3095	5568	I	31-35
3	29	3095	5569	I	31-35
3	29	3009	5567	I	31-35
3	29	3009		I	31-35
3	29	9014	5578	I	31-35

Source: Environmental Survey team, 1987

(2) Multiple Leaks Reported.

hydraulic fluid, alcohols, chlorinated solvents, various laboratory and process wastes, and discarded materials. The following inadequate drum management practices were observed:

- Storage of drums directly on the ground surface (soil)
- Storage of drums without secondary containment berms, dikes, or drip pans
- Storage of unmarked and unlabeled drums
- Storage of drums in uncovered locations
- Storage of drums adjacent to drainage ditches.

The total number of drums observed for each practice by TA is summarized in Table 4-24. Each management practice is discussed below.

- Storage of drums directly on the ground surface. Storage of drums directly on the ground surface is of concern because it increases the potential for corrosion of drums and soil contamination following spills or leakage from drums. That is, there is no secondary barrier (e.g., asphalt or concrete) to prevent soil contamination following release from drums. Several factors are of importance when determining the environmental significance of storage of drums directly on the soil surface. These factors include the toxicity of the material stored in the drum (i.e., the potential hazard associated with release), the condition of the drum (i.e., the likelihood for a release), and the location of the drum (i.e., the potential to impact receptors). Instances of particular concern with respect to the material stored in the drums were the storage of drained HE-contaminated oil drums on the soil near Building TA-16-517 and the storage of drums containing waste dielectric oil (which had not been analyzed for PCBs) and chlorinated solvent on the ground south of

Building TA-46-76. In both cases, leakage from drums would result in contamination of the soil with hazardous materials.

- Storage of drums without secondary containment berms, dikes, or drip pans. Storage of drums without secondary containment berms, dikes, or drip pans is of concern because it increases the potential for environmental contamination resulting from drum leaks. Nevertheless, this practice was widespread throughout the areas surveyed. No dikes or bermed storage areas were observed, and it is estimated that less than half of the product drums stored on horizontal racks had drip pans. As with storage on the ground, the factors related to significance of potential environmental problems are those related to the likelihood and consequences of leakage (i.e., contents, condition, and location). One instance of particular concern was the storage of waste transformer oil in an unbermed location north of Building TA-53-2. This oil is potentially contaminated with PCBs, and uncontained leakage could result in contamination of a large area with this material. Also, 16 waste oil drums were stored on pavement at the north edge of Mortandad Canyon south of Building TA-35-67. There was no containment structure between the drums and the canyon to prevent leaks from reaching the canyon.
- Storage of unmarked and unlabeled drums. Storage of unmarked and unlabeled drums is of concern because it increases the opportunity for mishandling the stored material. Of particular concern are unmarked product drums which may be misused or improperly disposed of by laboratory personnel. As an example, an unlabeled product drum was located on a storage rack next to Building TA-21-210. Personnel in the area did not know what the stored material was. Also of particular concern are unlabeled drums stored together. This practice increases the opportunity for improper storage of incompatible or reactive materials. Approximately 20 unlabeled drums were stored together next to Building TA-16-516. These drums could potentially contain incompatible materials.

- Storage of drums in uncovered locations. Storage of drums in uncovered locations is of concern because it exposes drums to the weather and increases the opportunity for rusting and corrosion. The vast majority of drums observed at the LANL by the Environmental Survey were stored in uncovered locations. A factor complicating this practice is that outdoor storage generally presents a greater opportunity for contaminant migration should spillage occur (e.g., outdoor storage allows for direct contact with surface runoff). Of particular concern were two drums of solvents near Building TA-18-110 and one unmarked drum near Building TA-18-126. These drums were all stored outside, were rusted or corroded, and were located very near drainage sumps. Similarly, a rusted unlabeled drum was stored outside next to a drainage ditch near TA-21-155. Another problem associated with outdoor storage of drums is that precipitation causes drum labels to fade or wash off. Drums where labels had been destroyed by the weather were observed near Buildings TA-8-43 and TA-9-35. Another concern with the storage of drums in uncovered locations is that heat expansion can lead to pressurization of drums (particularly those containing volatile substances), which increases the opportunity for leakage. Because of the mild temperatures during the Survey, such cases were not observed. A number of instances of outdoor storage of volatile materials were observed, however, which may be of concern during warmer weather.
- Storage of drums in or adjacent to drainage ditches. Storage of drums in or adjacent to drainage ditches is of concern because it greatly increases the opportunity for migration of contaminants should leakage occur. Factors of importance with respect to this practice are the condition of drums and the toxicity of the stored material. Of particular concern was an open drum of unknown material located in a drainage ditch southwest of Building TA-21-3. In addition, 15 drums of waste dielectric oil were observed next to a drainage ditch between Buildings TA-46-1 and TA-46-42. These drums were apparently in poor condition, as evidenced by signs of leakage. With respect to storage of toxic materials, 20 drums of a variety of material were stored next to a drainage ditch by Building TA-46-76. These drums contained chlorinated solvents and dielectric oil potentially contaminated with PCBs.

4.2.2.3 Category III

1. Potential soil contamination from leaking drums. Releases of oil and hazardous materials from drums were observed during the Environmental Survey. Evidence of drum spillage and leakage was observed in all 10 TAs that were the subject of a detailed outdoor inspection conducted by the Environmental Survey team. Specific instances of spillage observed were as follows:

- Soil staining, indicative of leakage, was observed where 43 drums were stacked near Building TA-16-517. These drums were empty but contained residuals of HE-contaminated hydraulic oil.
- Ground staining, indicative of leakage or spillage, was observed where seven drums were stored east of Building TA-53-4. These drums contained oils and solvents. Five of the drums were certified free of PCBs.
- Oil sludge, resulting from leakage of dielectric oil from drums, was observed on the concrete roadway southwest of Building TA-35-125. The drums were removed by the LANL during the Environmental Survey.
- Soil staining indicative of drum leakage was observed at the edge of Mortandao Canyon south of Building TA-35-67. This staining appeared to be the result of 4 leaking oil drums, which were noted among 16 oil drums stored on asphalt at the edge of the canyon.
- Some oil staining from minor spillage was noted at the drum storage area near Building TA-15-203. These drums, which include several containing chlorinated solvents, are stored near the edge of Water Canyon.
- Soil staining was noted in a drainage ditch located near Building TA-33-23. This staining was the result of a leaking drum of kerosene stored in the ditch.

- Soil heavily stained from drum leakage was observed at a drum storage area northwest of Building TA-33-22. This staining appeared to come from several leaking drums that were noted among 24 waste oil drums stored at the area.
- Ground staining indicative of minor spillage was observed at a drum storage area located at TA-9-38. Drums at this area are stored outside on racks and contain a variety of organic solvents.
- Soil contamination indicative of leakage was observed at four partly full waste Freon drums located in a drainage ditch south of Building TA-21-3. This ditch discharges to Los Alamos Canyon.
- Soil staining from drum leakage was noted at 20 drums stored south of Building TA-46-76. These drums, located next to a drainage ditch, contain waste oil, hydraulic fluid, and chlorinated solvents.
- Heavy soil staining and pooling of oil on the asphalt surface was observed at a drum storage area located north of the parking lot between Buildings TA-46-1 and TA-46-42. The area of soil staining extends from the edge of the asphalt storage pad into an adjacent drainage ditch. This area is used to store 15 old drums of waste dielectric oil.
- Some soil staining indicative of minor spillage was noted at four product drums stored north of Building TA-18-141. These drums contain alcohols, oil, and an unknown product. There were no drip pans under the drums.
- Soil and asphalt staining from drum leakage was observed at two drum storage areas east and north of Building TA-3-66. These two sites have over 60 drums containing a variety of materials including oil, solvents, and suspect radioactively contaminated material.
- Much evidence of oil spillage was noted in the area behind the main Motor Pool Shop. One spilled oil drum was located next to the fence behind the shop.

During the Sampling and Analysis phase of the Survey, samples of drum spill residuals at TA-16-517, TA-35-125, TA-35-67, TA-33-22, TA-21-3, TA-46-1, and TA-3-66 will be analyzed. The objectives of this sampling are to determine if spills and leakage from drums at various locations within the LANL have resulted in contamination of soils with hazardous constituents, and to determine the potential for migration of hazardous materials in surface runoff at locations where drum spills have occurred in or near drainage ditches.

2. Potential releases of hazardous liquids. A large number of the USTs at the LANL have the potential for undetected releases of hazardous and radioactive liquids to surface and subsurface soils. Tanks with the potential for undetected releases fall into one of two classes: untested tanks (or those tanks with inadequate inventory control) and unknown or unidentified tanks.

Tanks identified by the Environmental Survey team in these two categories are shown in Tables 4-22 and 4-26. Potential environmental problems associated with these two classes are discussed below.

- Untested tanks or those tanks with inadequate inventory control. Storage of hazardous materials in these tanks is of concern because there is no means to accurately determine if the tanks are leaking. Leaks from these tanks may go undetected and, therefore, uncorrected. Those tanks of particular concern are high-volume tanks that have not been tested for tightness and that have no active inventory control program. Tanks in this category are the dielectric oil tanks at Buildings TA-15-287, TA-35-188, and TA-35-197. It is not known whether the dielectric oil in these tanks contains PCBs.
- Tanks of unknown history and location. There are several USTs of unknown history and location. These tanks are of concern because they may have leaked, or have the potential to leak, without detection. The concern over these tanks is related to the toxicity of the tank contents,

TABLE 4-26

UNDERGROUND TANKS NOT TESTED AND WITHOUT INVENTORY CONTROL

TA	Structure	Age (yr)	Capacity (gal)	Construction Material	Substance Stored	Comments
2	TA-2-1	1	560	Steel	Diesel fuel	Untested, no inventory control
3	Tank Farm #1	4	8,000	Steel	Kerosene	Untested, weekly sticking for inventory control
3	Tank Farm #2	4	25,000	Steel	Fuel oil	Untested, weekly sticking for inventory control
3	Tank Farm #3	4	15,000	Steel	Gasoline	Untested, weekly sticking for inventory control
3	Tank Farm #4	4	25,000	Steel	Gasoline	Untested, weekly sticking for inventory control
3	Tank Farm #5	4	25,000	Steel	Gasoline	Untested, weekly sticking for inventory control
3	Motor Pool 3		500	Steel	Waste oil	Untested, no inventory control
3	Motor Pool 4		500	Steel	Waste oil	Untested, no inventory control
15	TA-15-287	7	15,000	Stainless steel	Dielectric oil	Untested, no inventory control
16	TA-16-545	36	30,000	Steel	Fuel oil	Could not test because of viscosity
18	TA-18 PL-30	1	560	Steel	Diesel fuel	Untested, no inventory control
35	TA-35-159	10	8,000	Steel	Dielectric oil	Untested, No inventory control
35	TA-35-188-1	17	6,000	Steel	Dielectric fluid	Untested, no inventory control
35	TA-35-188-2	17	6,000	Steel	Dielectric fluid	Untested, no inventory control
35	TA-35-197-1	8	8,000	Steel	Dielectric oil	Untested, no inventory control
35	TA-35-197-2	8	8,000	Steel	Dielectric oil	Untested, no inventory control
35	TA-35-197-3	8	8,000	Steel	Dielectric oil	Untested, no inventory control
41	TA-41 W-2	1	560	Steel	Diesel fuel	Untested, no inventory control

Note: LANL, 1987c

the location of the tanks, and the amount of information existing for these tanks. Of particular concern are those tanks about which very little is known. Tank TA-41-46 was identified as a fuel tank in engineering drawings, yet the Survey team could not locate anyone who knew anything of the existence of this tank. According to these drawings, the tank is located within several hundred feet of the creek in Los Alamos Canyon. Tanks TA-1-442, TA-1-443, and TA-1-444 are abandoned tanks located in the Los Alamos townsite. Both location and history of these tanks are unknown.

3. Potential releases of oil and hazardous materials from uncontained aboveground storage tanks. A number of aboveground storage tanks at the LANL used for storage of oil and hazardous materials lack any secondary containment. Thirteen of these tanks observed by the Environmental Survey team are identified in Table 4-27. Eleven contained raw materials and products, and two contained waste oil.

Because of the lack of containment, any spill or leak from these tanks can be released to the environment. The potential hazard associated with these tanks depends on the toxicity of the material stored, the location of the tanks with respect to receptors, and the condition of the tanks. Several tanks were noted to be of particular concern. The 3,000-gallon dielectric oil tank south of Building TA-35-34 is located next to Mortandad Canyon. A leak from this tank would likely reach the canyon. It is unknown if this oil contains PCBs. Dielectric oil is stored in two 35,000-gallon siege tanks located west of Building TA-35-29. There is much evidence of spills and leakage around these tanks. The plywood-covered metal tanks appear to be old and their condition is unknown.

4. Potential releases of oil and hazardous materials from partially contained tanks. A number of aboveground storage tanks at the LANL used for oil and hazardous materials storage have insufficient secondary containment capacity for major spills or leaks. Twelve tanks observed by the Environmental Survey team are identified in Table 4-28. The 12 tanks contained raw materials and products.

TABLE 4-27

TANKS LACKING SECONDARY CONTAINMENT

TA	Structure	Capacity (gal)	Construction Material	Substance Stored
3	TA-3-22	4,000	Stainless steel	Sulfuric acid
21	TA-21-3-1		Stainless steel	Aluminum nitrate
21	TA-21-3-2		Stainless steel	Aluminum nitrate
21	TA-21-289		Steel	50% NaOH
21	TA-21-357-3		Steel	Diesel fuel
35	TA-35-29-1	35,000	Steel	Dielectric oil
35	TA-35-29-2	35,000	Steel	Dielectric oil*
35	TA-35-34	2,000	Steel	Dielectric oil*
50	TA-50-5	5,000	Stainless steel	Nitric acid*
57	TA-57 #2	500	Steel	Waste oil*
57	TA-57 #3	500	Steel	Waste oil*
57	TA-57 #4	500	Steel	Diesel fuel*
57	TA-57 #5	500	Steel	Gasoline*

* Spill containment upgrades planned (Delta H Engineering, 1986b; DOE-AO, 1986)

TABLE 4-28

TANKS WITH MINOR SECONDARY CONTAINMENT

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Containment
3	TA-3-550-1	31,000	Steel	Dielectric oil	24,000-gal. containment pit*
3	TA-3-550-2	31,000	Steel	Dielectric oil	24,000-gal. containment pit*
21	TA-21-57	50,000	Steel	Fuel	Earth berm containment*
35	TA-35-149	35,000	Steel	Dielectric oil	Curb approx. 12 inches high*
35	TA-35-150	35,000	Steel	Dielectric oil	Curb approx. 12 inches high*
35	TA-35-151	35,000	Steel	Dielectric oil	Curb approx. 12 inches high*
35	TA-35-152	35,000	Steel	Dielectric oil	Curb approx. 12 inches high*
35	TA-35-153	35,000	Steel	Dielectric oil	Curb approx. 12 inches high*
35	TA-35-154	5,000	Steel	Dielectric oil	Curb approx. 12 inches high*
53	TA-53-14	7,500	Steel	Dielectric oil	Curb approx. 12 inches high*
55	TA-55-4	6,100	Stainless steel	Nitric acid	1,120-gal capacity curbing*
57	TA-57 #1	10,000	Steel	Diesel fuel	4-inch metal lip containment*

* Spill containment upgrades planned (Delta H Engineering, 1986b; DOE-AO, 1986)

Because the tanks are only partially contained, major spills or leaks (e.g., most of the tank contents) could result in releases to the environment. The potential hazard associated with these tanks depends on the toxicity of the material stored, the location of the tanks with respect to receptors, the condition of the tanks, and the capacity of the tanks compared to the containment capacity. Two 31,000-gallon dielectric oil tanks at Building TA-3-550 are located above a 21,000-gallon collection sump. The Environmental Survey noted that this sump was filled mostly with oily water, presumably rainwater. The sump was observed to have only about 12 inches of freeboard, significantly less than its empty capacity. These tanks are located next to Twomile Canyon, and a major release would likely overflow the sump and flow into the canyon. Spill containment upgrades planned for these tanks include construction of a new bentonite-lined containment basin. In addition, earthen dikes will be constructed to divert runoff away from the tanks (Salgado, 1987).

5. Potential soil contamination from spills and leakage of dielectric oil at TA-35. Activities at the LANL involving high-voltage equipment require the use of large quantities of dielectric oil. Operations involving the storage and transfer of this oil have resulted in spillage and leakage at TA-35.

Transfer of dielectric oil from storage tanks to the Marx Generator in Building TA-15-276 has resulted in overflow and spillage into Mortandad Canyon. Similarly, transfer of oil from the Marx tanks in Building TA-35-125 to underground storage tanks has resulted in spillage, as indicated by the area above the underground tanks being heavily stained. Oil spilled during transfer operations flows to a gunite-lined surface impoundment, where accumulation of precipitation runoff causes the oil to overflow to Mortandad Canyon (see related finding in 4.1.5.3). Dielectric oil at Buildings TA-35-29 and TA-35-86 is stored in several 35,000-gallon Marx and siege tanks. These plywood-covered metal tanks show signs of leakage. In addition, the area around Tank TA-35-154 is heavily stained from oil spilled during transfer operations. The surface runoff control culverts in this area are stained with oil, indicating that oil spilled in this area has been carried by runoff to Mortandad Canyon.

During the Sampling and Analysis phase of the Survey, samples will be collected and analyzed for spill residuals at TA-35-86 and TA-35-125. The objective of this sampling is to determine if the leakage of dielectric oil has resulted in contamination of soils or surface runoff with PCBs or other hazardous materials.

6. Potential for releases of asbestos to the environment. Of the asbestos on-site, that used as insulation on exterior steam lines is of particular concern since the steam lines are exposed to the elements and friable asbestos could easily be dispersed.

Steam lines of this type were observed in poor condition at TA-16-515 (an unused site) and were observed in good condition in TA-21 (an active area). Exterior steam lines are being inventoried by the site asbestos inspection, although the emphasis of that assessment is on worker health and safety concerns.

Abandoned buildings with loose asbestos and open doorways are of secondary concern as a source of asbestos to the environment. This situation was observed at TA-16-517.

Although the probability of such an event is low, catastrophic destruction (by fire or explosion) of a building containing asbestos could produce a substantial release of asbestos to the environment.

4.2.2.4 Category IV

1. Potential for a chemical fire from failure to use grounding straps. Solvent drums used to dispense flammable chemicals were in place without electrical ground straps being connected. Drums at TA-39-69 containing ethyl alcohol and drums at TA-39-100 containing acetone were in place on horizontal support racks without ground straps. These flammable solvents present a potential for fire when smaller containers are filled and may result in environmental contamination from release of these chemicals (e.g., in the process of containing a fire in this area).

2. Potential contamination of soil beneath storage sheds for pesticides and herbicides. The steel storage sheds for storage of pesticides and herbicides have plywood floors with a seam at the center of the building. If a spill occurs on the shed's floor, it would pass through the wooden floor to the soil below.

The sheds are placed on a mound above TA-3-38. It is unlikely that the contaminated soil would leach these chemicals to surface water runoff since the surface flow is impeded by the foundation for the shed.

3. Lack of identifying labels on drums. The use of chemicals in drums is extensive at the LANL. Four thousand drums are used each year. Most drums are stored outside and many have weathered to the extent that there is no indication of their contents. As one example, a 55-gallon drum in TA-39 near Firing Point 8 was marked "Flammable," but there was no indication of the contents of the drum. The drum was stored on the ground, and the label identifying the contents had deteriorated beyond recognition.
4. No consistent policy for labeling asbestos. The inconsistency in labeling could result in improper handling and, as a result, unnecessary exposures. In some locations, yellow tape with "Asbestos" printed on it was used to denote asbestos within buildings, but at other locations, plain brown tape was used with no markings.
5. Inspection and response to PCB leaks. TSCA regulations require cleanup and repair of PCB spills within 48 hours. Using polyethylene bags to contain the leaks prevents release of PCBs to the environment, but TSCA regulations stipulate that leaking units be re-inspected on a daily basis. This requirement has not been met, and no record of such inspections exists. A citation for failure to meet this requirement is possible. Due to the age of the transformers, a potential exists for other leaks to develop and be significant without being discovered until the next monthly inspection.

The LANL transformer inspection form completed by the Pan Am electrician is designed to record and summarize a history of problems with each unit. A space marked "Any leak(s) found last month?" had no entries.

6. Combustible materials stored near PBC transformers. Eight PCB transformers had combustible material stored nearby. Table 4-29 summarizes the material found near the specific unit. The Fire Rule published July 17, 1985, for 40 CFR 61.30 restricts location of flammable materials to within 5 meters of a PCB transformer.

PRELIMINARY

TABLE 4-29
COMBUSTIBLE MATERIALS NEAR PCB TRANSFORMERS

Transformer ID	Material
5036	Wood
5616	Tarpaulin, plywood panels
5008	Rag
5588	Paper, rags
S-66 B-5	Plastic cover, paper
5590	Paper, cardboard, plastic
5587	Storeroom, plywood sheets
5527	Plywood sheet, 2x4 section

Source: Environmental Survey team, 1987

PRELIMINARY

4.3 Radiation

4.3.1 Background Environmental Information

Background radiation in the vicinity of the Los Alamos National Laboratory (LANL) is from both natural and man-made sources. Some specific examples include cosmic radiation, natural radioactive materials in the soil, and fallout from past detonations of atmospheric weapons. The average annual effective dose equivalent* to humans from natural background radiation in the United States is 189 mrem/year (FR, 1986). The components of this dose are detailed in Table 4-30. The data in this table were derived by using the approach recommended by the International Commission on Radiological Protection (ICRP) in ICRP Reports 26 and 30, the latest internationally accepted guidance for radiation protection. About half the annual effective dose equivalent is attributable to the inhalation of radon-222 and its decay products. Previously accepted estimates of background doses did not include the radon contribution and were about 100 mrem/year.

The EPA reports gamma radiation dose rates for locations throughout the United States on a quarterly basis. For example, during the period January-March 1986, the EPA reported measured gamma dose rates equivalent to annual doses of between 62 ± 56 mrem for Harrisburg, Pennsylvania, and 164 ± 47 mrem for Denver, Colorado (EPA, 1986c). The average measured gamma dose rates equivalent to annual doses at the 21 locations monitored was 99 ± 27 mrem.

The DOE establishes radiation protection guidelines for DOE facilities. Radiation standards for the protection of the public in the vicinity of the LANL are given in DOE Order 5480.1A ("Environmental Protection, Safety and Health Protection Program for DOE Operations"). These standards are based on the recommendations of the ICRP and the National Council on Radiation Protection and Measurements (NCRP).

*The effective dose equivalent is the sum of products of the dose delivered to individual organs and specific "weighting factors." These "weighting factors" are expressed as the fraction of total risk for the entire body attributable to that organ.

TABLE 4-30

**AVERAGE ANNUAL EFFECTIVE DOSE EQUIVALENT TO HUMANS
FROM NATURAL BACKGROUND RADIATION**

Organ	Annual Effective Dose Equivalent (mrem)
Gonads	24
Breast	14
Lung (total)	100
Red Bone Marrow	13
Bone Surfaces	6
Thyroid	3
Other	29
Total	189

Source: FR, 1987

In 1985, DOE Order 5480.1A was amended to incorporate recommendations and internal dose models contained in ICRP Reports 26 and 30. Also included in the revised Order are annual limits set by the EPA in 40 CFR 61 Subpart H for atmospheric pathway radiation doses. The limits to the public for atmospheric releases associated with normal DOE operations, as stipulated in DOE Order 5480.1A, are an effective dose equivalent of 100 mrem/year for all pathways, excluding natural background and medical exposures, a dose equivalent of 25 mrem/year for the whole body, and 75 mrem/year for any individual organ.

Concurrent with its amended Order, DOE replaced its Concentration Guides (CGs) with Derived Concentration Guides (DCGs). The DCGs are based on limiting the off-site annual effective dose equivalent to 100 mrem, as against 500 mrem in the CGs. These DCGs account only for drinking water or inhalation of air and represent the concentration of a specific radionuclide in either air or water that would result in an effective dose equivalent of 100 mrem/year to an individual.

4.3.2 General Description of Pollution Sources and Controls

This section deals with the dose model and compares the reported dose assessment of the LANL radiological effluent releases with applicable standards. The radioactive sources and controls are discussed in the sections for air (3.1.2), soil (3.2.2), surface water (3.3.2), and groundwater (3.4.2). The evaluation of dose assessments was performed for atmospheric and liquid releases that stem from the operations at the LANL.

4.3.2.1 Dose Assessment for Releases to the Atmosphere

Section 3.1 discusses radioactive releases to the atmosphere. Members of the public can be exposed to these releases through inhalation of the contents of the plume and through exposure to external radiation from standing in or near the plume. In addition, radioactively contaminated particulates may be deposited onto the soil surrounding the facility. The radioactive constituents of the particulates deposited onto the soil emit direct radiation, can be inhaled or ingested by humans, and are available for uptake by plants. The radioactive constituents in the plants may be consumed by humans either directly or indirectly through animals that eat the vegetation.

For the purpose of complying with the requirements of DOE Order 5480.1A, the LANL used the AIRDOS-EPA computer code to calculate the dose to the maximum individual from inhalation and exposure to the external radiation of the radioactive materials released to the atmosphere during 1986. The dose equivalents were 10.4 mrem/year to the whole body and 11 mrem/year to the lung (LANL, 1987a). These doses represent 41 percent of the EPA 25 mrem/year whole-body limit and 15 percent of the 75-mrem/year-limit for any organ.

In addition, the LANL evaluated doses to individuals from inhalation and ingestion of foodstuffs, either by using monitoring data for those radioisotopes detected in the monitoring program or, for those radioisotopes not detected in that program, by using measured releases to determine concentrations and resultant doses. The concentrations were converted to doses through conversion factors recommended by Vaughan (1985).

Inhalation doses were estimated for measured concentrations to be a maximum of 0.4 percent (0.29 mrem/year to bone) of the EPA limit of 75 mrem/year for any organ (LANL, 1987a). For radioisotopes not detected by the monitoring program, the dose equivalent was calculated to be less than 0.29 mrem/year. From ingestion of foodstuffs contaminated with atmospheric release, the dose was evaluated at 0.1 mrem/year dose equivalent to the bone and 0.03 mrem/year effective dose equivalent (LANL, 1987a).

4.3.2.2 Dose Assessment for Releases to Liquids

Although treated liquid effluents do not flow beyond the LANL boundary, small quantities of radioactive contaminants that have been deposited in streambeds on-site can be transported to the Rio Grande during heavy runoff (see related discussion on runoff in Section 3.3.3). Eating the meat of a steer that had drunk water and grazed in lower Los Alamos Canyon would result in a calculated dose equivalent of 0.0013 mrem/year to the bone of the consumer (LANL, 1987a). In addition, if fish caught in the Cochiti Reservoir were eaten, the estimated dose would be 0.14 mrem/year bone surface dose equivalent and 0.03 mrem/year effective dose equivalent (LANL, 1987a). This estimate is based on the measured radioisotopic concentrations in fish caught in the reservoir.

4.3.2.3 Dose Assessment for Exposure to Direct Radiation

Direct radiation is defined as exposure to gamma photons, X-rays, and beta particles from radioactive material outside the body. Direct radiation is monitored at 147 locations in and around LANL by thermoluminescent dosimeter (TLD). The only TLD measurements showing any effect from LANL current operations were those taken north of LAMPF. No direct radiation from LANL operations was detected by TLD monitoring in off-site areas (LANL, 1987a). However, a member of the public could receive about 4 mrem/year of direct gamma/neutron radiation from the TA-18 operations (LANL, 1987a). The dose is estimated by assuming that a person traveling on the road passed TA-18 at 12 mph while a test was being conducted. The road past TA-18 is DOE-owned but open for public use. There was less than 1 hour during all of 1986 when this exposure could have occurred at TA-18.

4.3.2.4 Summary of Exposures

As discussed above, in addition to the EPA 40 CFR 61 dose limit for radiation exposure to the public, the DOE imposes a 100 mrem/year effective dose equivalent from all pathways due to normal operations of DOE facilities (Vaughan, 1985). The LANL has evaluated the exposures to radiation from its operations for releases to the atmosphere, releases to liquids, and direct radiation. To determine compliance with the 100 mrem/year effective dose equivalent, all exposure pathways must be summed for an individual who would receive the highest doses. Based on the 1986 Environmental Surveillance Report, the highest reported off-site dose was 10.4 mrem whole-body dose equivalent from the emissions from the LAMPF. If it were assumed that the individual receiving this dose also received the other reported exposures from ingestion of foodstuffs (0.1 mrem/year bone or 0.03 mrem/year effective dose equivalent), inhalation of atmospheric releases (0.29 mrem/year bone or 0.09 mrem/year effective dose equivalent), ingestion from liquid releases (0.00113 mrem/year bone or 0.00039 mrem/year effective dose equivalent from beef and 0.03 mrem/year bone or 0.009 mrem/year effective dose equivalent from fish), and direct radiation from operations at TA-18, then the dose would be less than 15 mrem/year effective dose equivalent. This would be only about 15 percent of the 100 mrem/year effective dose equivalent from all pathways.

4.3.3 Findings and Observations

4.3.3.1 Category I

None

4.3.3.2 Category II

None

4.3.3.3 Category III

None

4.3.3.4 Category IV

1. Improper comparison of doses. The LANL did not compare the total exposure from the combination of atmospheric and liquid effluents and direct radiation with the DOE limit of 100 mrem/year. From the radiological dose information presented in the Environmental Surveillance Report, the total dose can be conservatively estimated, and this maximum dose does not exceed the 100 mrem limit. The LANL did, however, properly calculate and compare doses from atmospheric releases to the EPA limits mandated by 40 CFR 61 Subpart H.

4.4 Quality Assurance

4.4.1 General Description of Laboratory Analyses

LANL analyzes air, water, and soil samples to determine the presence of environmental contaminants at the site. Analytical chemical laboratories are organized within the Health, Safety and Environment (HSE) Division as the Health and Environmental Chemistry Groups, HSE-9. The five units within the Group are organized as shown in Figure 4-5, these include three laboratories at TA 59 which provide organic, inorganic, and radiochemical analyses. The Waste Treatment Laboratory at TA-50 analyses process materials and wastes for organic, inorganic, and radiochemical parameters. An additional laboratory is operated by Pan Am World Services for determinations of inorganic contaminants in water and wastewater. Rocky Mountain Analytical Laboratories and Assagai, Inc. are off-site contract laboratories used for the analysis of PCBs and other environmental pollutants. Quality Assurance (QA) of all on-site environmental measurements is coordinated through the HSE-9 QA unit personnel.

A formal Quality Assurance program is in operation at LANL for all environmental measurements. A complete description of this program is published in the LANL publication Quality Assurance for Health and Environmental Chemistry: 1985, LA-10813-MS. Two distinct concepts constitute the Quality Assurance program: quality assurance (QA), which is the system for verifying and maintaining a desired level of quality in a product; and quality control (QC), which is the detailed mechanism for ensuring the quality of the analytical data. Quality assurance consists of three basic elements: 1) good laboratory practices, 2) the availability of approved standard analytical procedures, and 3) the development and implementation of quality assurance procedures. These elements include the use of qualified personnel, of reliable and well-maintained instruments, and of appropriate calibrations and standards, and consistent supervision and review of all operations. Quality control contains all the elements that are used to determine whether the analytical process is within statistical acceptance criteria. These measures include updating and maintaining analytical control charts, analysis of reference materials to confirm instrument calibration, and the analysis of duplicate samples to confirm analytical

HEALTH AND ENVIRONMENTAL
CHEMISTRY GROUP

FIGURE 4-5

precision. All environmental analytical data produced at LANL are traceable to instrumentation calibrated with standard reference materials supplied by national and international agencies, such as the National Bureau of Standards (NBS), the EPA, the Canadian Geological Survey (CGS), and the International Atomic Energy Agency (IAEA). Each batch of samples analyzed includes a calibration verification sample of comparable matrix. The quality of the analytical data for each sample batch is directly related to the value measured for the calibration verification sample contained in that batch. If the value determined for the verification standard is not within the published acceptance limits for that standard, the sample values are flagged and reanalyzed.

4.4.1.1 Air Monitoring Data

The LANL Inorganic Laboratory (TA-59) analyzes air monitoring and emission samples for the radioactive particulate and metal constituents: gross alpha, gross beta, gross gamma, isotopic plutonium, americium, uranium, cesium, tritium, and strontium. A procedure manual was prepared for all air-media environmental methods. These procedures are DOE-approved methods as published in HASL 300/500. Table 4-31 summarizes the techniques and their applicable determinations.

All procedures are entered into lab operating computers, and are available to the analysts on terminals in the laboratory. Data from the analytical instrumentation is entered into the computer by the analyst. Analytical results are calculated, formatted and prepared for QA review.

Calibration verification standards are included with each batch of samples analyzed. The standards are supplied from a variety of sources, including the EPA, NBS, National Institute for Occupational Safety and Health (NIOSH), and the DOE's Environmental Measurements Laboratory (EML). A minimum of 10 percent of all analyses are matrix-based calibration verification samples. Additional quality control measures are included with each sample batch. These include the analysis of sample blanks and duplicates. Data from the sample blanks provide the LANL with

TABLE 4-31

ANALYTICAL METHODS FOR
VARIOUS STABLE CONSTITUENTS

Technique	Stable Constituents Measured
Standard Chemical Methods	Total Alkalinity, Hardness, SO_3^{2-} , SO_4^{2-} , TDS, Conductivity, COD
Color Spectrophotometry	NO_3^- , PO_4^{3-} , Si, Pb, Ti, B
Neutron Activation Instrumental Thermal	Al, Sb, As, Ba, Br, Ca, Ce, Cs, Cl, Cr, Co, Dy, Eu, Au, Hf, In, I, Fe, La, Lu, Mg, Mn, K, Rb, Sm, Sc, Se, Na, Sr, S, Ta, Tb, Th, Ti, W, V, Yb, Zn
Instrumental Epithermal	Al, Sb, As, Ba, Br, Cs, Cr, F, Ga, Au, In, I, La, Mg, Mn, Mo, Ni, K, Sm, Se, Si, Na, Sr, Th, Ti, W, U, Zn, Zr
Thermal Neutron Capture Gamma Ray	Al, B, Ca, Cd, C, Gd, H, Fe, Mg, N, P, K, Si, Na, S, Ti
Radiochemical	Sb, As, Cu, Au, H, Hg, Mo, Os, Pd, Pt, Ru, Se, Ag, Te, Th, W, U, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb, Lu, $^{235}\text{U}/^{238}\text{U}$, ^{238}Pu , ^{239}Pu , Be, K, Cr, Co, Zn, Rb, Ru, Ce, Cs, Ba, Eu, Ra, Am, H^3
Delayed Neutron Assay	U
Atomic Absorption	Sb, As, Ba, Be, Bi, Cd, Ca, Cr, Co, Cu, Ga, In, Fe, Pb, Li, Mg, Mn, Hg, Mo, Ni, K, Se, Si, Ag, Na, Sr, Te, Ti, Sn, Ti, V, Zn, Al
Ion Chromatography	F ⁻ , Cl ⁻ , Br ⁻ , NO_2^- , NO_3^- , SO_4^{2-} , PO_4^{3-}
Potentiometric	F ⁻ , NH_4^+ , pH, Br ⁻ , Cl_2 (total) Cl_2 (free)
Combustion	C, N, H, S, Total Organic Carbon
Corrosivity	-
Ignitability	-
Automated Colorimetry	CN^- , NH_4^+ , PO_4^{3-} , NO_3^- , NO_2^- , Cl ⁻ , COD, TKN
Gas Chromatography	-Pesticides/Herbicides
Gas Chromatography/Mass Spectrometry	-EPA Toxic Compound List Organic Chemicals

Source: LANL, 1987a

information on preparation techniques and the quality of reagents employed in the labs. Data from the duplicates provide information on the analytical precision of the method and the analyst.

The Quality Coordinator from the QA unit takes an active part in approving all laboratory analyses. The calibration verification standard is assigned at random to each sample batch. The analyst is not aware of the correct analytic concentration in the verification standard. When the set of analyses is completed in the laboratory, the data are reviewed and evaluated by the Quality Coordinator. The verification standard values must be within the acceptance range for the sample data to be approved and sent to the sample requester.

4.4.1.2 Water Analyses

Water and wastewater analyses are conducted in LANL HSE-9 Inorganic, Organic (TA-59), and Waste Treatment (TA-50) Laboratories.

The Inorganic Laboratory determines the radiochemical and inorganic chemical quality of surface and groundwater samples. Radiochemical parameters include cesium, plutonium, tritium, total uranium, and gross gamma. The methods for these analyses were discussed in the Air section above. Inorganic chemical analyses include silica, calcium, magnesium, potassium, sodium, carbonate, bicarbonate, phosphorus, sulfate, chloride, fluoride, nitrate, nitrite, and ammonia nitrogens, total dissolved solids, pH, and specific conductance. The metals silver, arsenic, barium, cadmium, chromium, mercury, palladium, selenium, copper, iron, manganese, and zinc are analyzed at the Inorganic Laboratory as well. Methods published in EPA's "Methods for Chemical Analysis of Water and Wastes" (1979) are used for these determinations. Instrumentation available to the analysts include atomic absorption spectrophotometers, UV-Vis spectrophotometers, ion chromatographs, potentiometric meters, and auto analyzers.

The QA for these analyses conforms to the procedures noted in the Air Section above. Performance with respect to the QA control measures has been monitored and published annually since 1984. Complete records of all samples and analytical data are maintained in the respective laboratories.

The Organic Laboratory in TA-59 uses EPA-approved methods for analysis of organics in water and wastewater samples. Pesticides and herbicides are analyzed by gas chromatography. Organic chemicals on EPA's Toxic Compound List (TCL), including volatiles and base-neutrals/acid/extractables, are analyzed by gas chromatography/mass spectrometry (GC/MS). TA-59 has three mass source detectors (MSD) and one GC/MS. A review of calibration data for the mass spectrometers showed that decafluorotriphenylphosphine (DFTPP) was not being employed during instrument tuning. DFTPP has specific fragmentation ratio patterns and determining the relative abundance of the fragments provides information on the tuning of the unit.

The Quality Coordinator has incorporated the elements required in the EPA GC/MS procedures 624 "purgeables" and 625 "base-neutral/acid" with the elements of the LANL Quality Assurance Plan. This includes the analyses of blanks, matrix spikes, duplicates and surrogate spikes specified for these procedures.

The LANL Wastewater Laboratory (TA-50) analyzes radiochemical and inorganic parameters on wastewater samples. Analytical procedures are approved through the QA Coordinator. Method and documentation is consistent with EPA-approved procedures. The Organic Laboratory periodically analyzes performance evaluation samples from DOE-Environmental Monitoring Laboratory (EML), NIOSH, and EPA.

Pan Am World Services operates a wastewater laboratory and performs the chemical analyses for the NPDES outfalls. Analyses include pH, total suspended solids, biochemical oxygen demand, chemical oxygen demand, and fecal coliform for chlorinated effluents. EPA-approved methods (EPA, 1979) are used in these analyses. Quality control measures are incorporated into analyses and include duplicates and blanks.

4.4.1.3 Soils and Sediment Analyses

The Inorganic Laboratory at the LANL (TA-59) determines cesium, plutonium, strontium, total uranium, tritium, and gross gamma in soils and sediments. The analytical procedures are approved and referenced in the air section above. Inorganic parameters are analyzed by methods described in EPA procedures found

in SW-846. Radiochemical methods for cerium, plutonium, strontium, and tritium are found in HASL 300/500.

4.4.2 Findings and Observations

4.4.2.1 Category I

None

4.4.2.2 Category II

None

4.4.2.3 Category III

None

4.4.2.4 Category IV

1. Lack of chain-of-custody forms. Sample collectors complete laboratory request forms and submit the forms to the laboratory with samples. No sign-off of receipt by lab personnel is included with records. The sign-off documentation is needed to ensure that the sample has been secure and is properly handled. Lack of the documentation may result in difficulty in defending laboratory data.
2. Obviation of analyzing performance samples. The QA program at LANL for HSE-9 has been developed for all chemical and radiological analyses performed. Sample batches submitted to the laboratory for analysis are organized by matrix type and specific analysis required. The QA section will include a known performance sample with each batch. The samples are analyzed, and the results are reviewed by the QA unit. The data are compared to the acceptance value for the known standard. If the results are within the tolerance, the data are accepted and the data package is completed and sent to the original submitter. The reservation with this system is that the performance samples are readily identified by the analysts. The numerical

identification codes are completely different from those used for routine samples. The objectives for analyzing a performance sample are obviated by specially identifying these samples.

3. Lack of a measure of analytical accuracy. Matrix spike samples are not analyzed routinely with each batch of inorganic samples. This element of QC was dropped because of problems with incomplete recoveries of matrix spikes. EPA requires this element for an effective QA program. If recoveries of matrix spikes are incomplete, the laboratory must confirm that the problem is due to a sample matrix effect by completing additional analyses of that sample, using a procedure identified as "method of standard additions." A series of matrix spikes at different concentrations must be added to the sample. Analytical values for the sample must provide a linear relationship for all spike concentrations. HSE-9 has opted to replace matrix spikes by including a performance sample of known value with each batch of samples analyzed. This change represents a modification of the EPA's QA procedure.

4.5 Inactive Waste Sites and Releases

4.5.1 General Description of Pollution Sources and Controls

The Los Alamos National Laboratory (LANL) began operations in 1942. Since that time, spills or unplanned releases of radioactively and/or chemically contaminated substances have occurred at the site. In addition, hazardous substances have been placed in now-inactive waste disposal sites. This section provides an inventory of such sites that have been identified to date and a site-specific discussion of those that are of particular concern.

In early 1984, the Albuquerque Operations Office (AO) initiated the Comprehensive Environmental Assessment and Response Program (CEARP) at the LANL under the authority of U.S. Department of Energy (DOE) Order 5480.14 and other DOE and AO orders. One of the primary objectives of the CEARP is to identify and assess past waste disposal practices in relation to their potential to affect the surrounding population and the environment. At the time of the Environmental Survey, a working draft dated December 1986 of the CEARP Phase I: Installation Assessment, Los Alamos National Laboratory Report (DOE AO, 1986) was available to the Survey team for review. This report represented the most current and comprehensive information available on inactive waste sites and releases at the LANL and as such, served as a major reference for the Survey team. The CEARP is a long-term evaluation process that is continuing for the LANL; thus, many sites discussed in this section have been designated as requiring further assessment, which will be performed during the subsequent phases of the CEARP.

In addition to reviewing the Phase I Report, the Survey team reviewed environmental monitoring reports, specific documents involving special projects, supporting internal memoranda available in the CEARP files, aerial photographs for 1947, 1964, 1974, and 1986; and interviewed LANL personnel. During the Survey, over 200 sites were visited to visually assess their current condition.

The LANL can be geographically subdivided by Technical Areas (TAs) as shown in Figure 4-6. Over the years, there have been 61 TAs designated, 4 of which were

LOCATION OF ACTIVE AND INACTIVE TECHNICAL AREAS
AT LANL

FIGURE 4-6

never built (TAs-17, 34, 38, and 58) and 3 of which are not located within the LANL property boundaries (TA-44 in Los Angeles, California; TA-47 in Sante Fe, New Mexico; and TA-57 in Fenton Hill, New Mexico). Also, a number of TAs have been closed. As part of the inactive waste sites portion of the Survey, 43 TAs were visited to evaluate their known or potential inactive waste sites and their releases. Included in the 43 TAs are TA-0, which consists of areas without specific TA designations, and TA-1, which is property in the town of Los Alamos that is no longer owned by DOE. The designation TA-OOL stands for "out of laboratory" and represents sites that DOE did not create but that are located on LANL property. The TAs not visited for this portion of the Survey effort included the four that were never built, two outside LANL property (TAs-44 and 47), four that had no inactive waste disposal sites identified (TAs-9, 51, 52, and 54), and eight that collectively have very few inactive waste disposal sites (TAs-23, 28, 30, 43, 48, 50, 55, and 56).

The types of inactive waste sites located in the LANL TAs can be grouped into categories as follows:

1. Former liquid waste disposal sites
2. Spills and unplanned releases
3. Abandoned or removed tanks
4. Open dumps and boneyards
5. Landfills
6. Inactive firing sites
7. Contaminated structures
8. Miscellaneous

Generally, these categories reflect the nature of the waste disposed of (liquids versus solids), the method of disposal (land disposal versus detonation), and the potential pathway of contaminant release (subsurface migration versus surface-water runoff). The contaminated structures category includes those structures still standing and those that have been removed, both of which present unique concerns. The miscellaneous category was developed mainly to accommodate single-occurrence items.

4.5.1.1 Former Liquid Waste Disposal Sites

Formerly used liquid waste disposal sites at the LANL include sumps, septic tanks, drainfields, French drains, dry wells, unlined pits and ponds, lined lagoons, subsurface absorption beds, and direct discharges to land, down canyon sides, into stormwater ditches, or to ephemeral streams. Table D-1 in Appendix D lists the formerly used liquid waste disposal sites and potential sites at the LANL identified to date based on information reviewed during the Environmental Survey. The table is organized to present the TAs sequentially, noting that those TAs with no identified inactive liquid waste disposal sites have been omitted. For each site, information on period of use, waste characteristics, previous sampling, and current status is provided.

Conservatively, there are 175 liquid waste disposal sites at the LANL that have definitely or potentially received contaminated liquids in the past. This number is conservative because where appropriate, sites such as septic tanks were grouped together for a given TA. Also, in other TAs such as TA-16, the number of waste lines and sumps used in the past is not known and consequently not listed individually.

The duration of use of these sites generally is not well-documented but, as shown in Table D-1, in some cases disposal has occurred for up to 40 years. Based on information available, little or no treatment of these waste streams occurred prior to disposal. The volume of waste disposed of at each location is unknown for most of the sites.

Chemicals such as high explosives (HEs), solvents, photoprocessing solutions, metal plating solutions, and general laboratory wastes were disposed of at 38 percent (67) of the sites. Thirty-three percent (59) of the sites reportedly received only radioactively contaminated liquids. Mixed radioactively and chemically contaminated liquids were disposed of in 15 percent (26) and liquids with unknown contaminants were disposed of in 14 percent (23) of the sites.

At 80 of the sites, no cleanup action has been undertaken and at 9, the available information is inadequate to ascertain whether any remediation has been performed. Cleanup has been completed at 53 sites, with supporting documentation available for 31 of the 53 sites. Nine sites remain active but no

longer receive contaminated liquids (DOE-AO, 1986). The current status of 25 sites is unknown.

These inactive liquid waste sites were evaluated based on type of waste received, quantity of waste, duration of use, location relative to public access, and potential for contaminant migration. Based on this review, the 11 sites listed below were noted to be of particular concern:

- MDA-T in TA-21
- Liquid waste disposal in TA-10
- Stormwater collection basins in TA-35
- Pond east of Buildings 89 to 93 in TA-16
- Plating shop outfall from Building 92 in TA-16
- Backfilled ponds adjacent to former Buildings 30 to 34 in TA-16
- Plating shop outfall from Building 52 in TA-22
- Sumps 69 and 70 in TA-46
- Septic tank 59 in TA-8
- Overflow from a cooling tower (TA-21-143) in TA-21
- HE processing outfall from Building 34 in TA-22

The following paragraphs provide specific information on each of these sites.

Material Disposal Area (MDA) - T in TA-21

Past disposal of 18 million gallons of raw and treated process effluent at MDA-T has resulted in radioactive contamination to a depth of at least 100 feet and in surface-soil contamination in an area accessible to the public that is outside the disposal site.

In TA-21, there is an inactive liquid waste disposal site known as MDA-T on the northern side between Buildings 286 and 257, as shown on Figure 4-7. This disposal area was first used in 1945 and consisted of four subsurface absorption beds, each 120 feet long, 20 feet wide, and 4 feet deep. As shown in Figure 4-8, the beds were backfilled with stone, gravel, and sand, and finally covered with native soil. The design of the absorption beds was intended to allow liquids to percolate into the unsaturated zone.

FIGURE 4-7

LOCATION AND LAYOUT OF MDA-T IN TA-21

CROSS-SECTION OF MDA-T ABSORPTION BEDS

FIGURE 4-8

Between 1945 and 1952, MDA-T received 14 million gallons of untreated waste from the plutonium processing conducted at DP West in TA-21. The concentration of plutonium in this waste was estimated at 60 counts per minute and the average fluoride concentration was 160 parts per million. For a 1-year period, June 1951-June 1952, approximately 10,450 gallons of waste highly concentrated with ammonium citrate was disposed of in MDA-T. This waste had an average plutonium concentration of 7,000 counts per minute and a fluoride concentration of 200 parts per million (Rogers, M.A., 1977).

In 1952, a waste treatment plant (TA-21-35) was constructed, which resulted in a change in the use of MDA-T. The absorption beds were then used periodically from 1952 to 1967 and received an estimated 2.3 million gallons of treated waste from the TA-21-35 plant. From 1965 through 1967, 2 million gallons of low-level radioactive wastes from DP East were also disposed of in Absorption Beds 1 and 2. At least one of the absorption beds was still functional in 1976. The actual date these beds were taken out of service was not reported. The radionuclide inventory (decayed through 12-31-72) for the MDA-T absorption beds as of January 1973 was reportedly 4 curies of tritium and 10 curies of plutonium-239 (Rogers, M.A., 1977).

In mid-1968, the technique of disposing of liquid effluents in vertical shafts was introduced in MDA-T. Effluent from a new treatment plant (TA-21-257) was mixed with cement and pumped down shafts located between the north and south absorption beds. The wastes placed in these shafts reportedly included neutralized americium "strip," alkaline fluoride, and plant sludges. Approximately 100 shafts were used, their depths ranging from 20 to 65 feet and their diameters from 4 to 8 feet. Up to 21 experimental bathyspheres containing a total of 1,221 grams of plutonium-239 were also placed in the shafts. The shafts contained the following radionuclide inventory (decayed through 12-31-75) based on available records through July 1976 (1968 to 1971 plutonium-238 and plutonium-239 quantities could not be determined) (Rogers, M.A., 1977).

<u>Radionuclide</u>	<u>Number of Curies</u>
Uranium-233	7
Plutonium-238	47
Plutonium-239	191
Americium-241	3,761
Mixed fission products (primarily strontium and cesium)	3

The date the last of the disposal shafts was filled and closed was not available in the LANL background information.

At the end of 1975, treated effluent from the TA-21-257 plant that contained more than 10 nCi/g of plutonium-239 and americium-241 [i.e., transuranic (TRU) wastes] was mixed with cement and placed in 20-foot by 30-inch corrugated metal pipes located in a pit (120 feet long, 24 feet wide, 19 feet deep) between Absorption Beds 1 and 3 (Rogers, M. A., 1977). In 1986, 158 corrugated metal pipes containing TRU wastes were removed from this pit and placed at Area G in TA-54 (DOE, 1986).

MDA-T has been the subject of numerous studies, the first major one conducted in 1953 by the LANL and the U.S. Geological Survey (USGS). One focus of the studies has been on the vertical and horizontal movement of radioactive contaminants associated with the absorption beds. The 1953 USGS work reported that the ion exchange capacity of the soils ranged from 32 me/kg at 5 feet to 7 me/kg at 19 feet (Rogers, M. A., 1977). The most recent subsurface investigation was completed in 1978 and found that americium-241 had migrated to a depth of 100 feet next to the absorption beds and that plutonium-239 moved to 99.5 feet. The total depth of the investigation was 100 feet (Nyhan et al., 1985). Samples collected from the drilled holes were not analyzed for chemical constituents, although the raw waste disposed of at MDA-T was estimated to have an organic content of 3 percent and the treated waste had an organic content of 13 percent (DOE-AO, 1986).

Other, more recent studies have focused on surface-soil contamination both in MDA-T and outside the fenced area. Elevated levels of tritium, plutonium-239 and 238, cesium-137, and strontium-90 were detected in 1986 in surface soils downgradient and outside the MDA-T fenced disposal area. Cesium-137 and strontium-90 were found at levels in excess of 7,000 times background. Plutonium-239 was found at levels 100 times background and tritium was found as high as 240,000 pCi/L (background is 3.5 pCi/L) (Wenzel and Romero, 1986). These contaminants were located north of the paved perimeter roads, along the edge of the mesa surface. At the time of the Environmental Survey, the highest radiation measurement in this area was 1,500 μ R/hr using an open-window Geiger-Mueller tube instrument.

Further activities at MDA-T to investigate the full extent of contamination are in the planning stages under Phase II of the CEARP. The Phase II effort is being designed to address all of TA-21. Consequently, MDA-T will not be addressed during the Survey Sampling and Analysis phase.

Liquid Waste Disposal in TA-10

TA-10, located in a portion of Bayo Canyon, was used from the mid-1940s to 1961 for experiments involving studies on HE in conjunction with nuclear weapons development. This site contained radiochemistry laboratory buildings with ancillary structures that handled liquid radioactive and chemical wastes. These wastes were routed into holding tanks, sanitary sewer-pits, a leach field, and an unlined open-pit dump. This liquid waste system was called the "tank farm" and the area it occupied is shown in Figure 4-9. The holding tanks were periodically pressurized to purge the liquid wastes into the ephemeral stream bed.

Operations at this site ceased sometime between 1961 and 1963, at which time cleanup efforts commenced. This was a large-scale decommissioning and decontamination project that involved excavation of underground structures and removal of surface structures and buildings. These operations and subsequent periodic surveys were monitored for radioactivity and low-order HE only. These surveys and investigations (LASL, 1979b; LANL, 1982b) suggested the continued presence of contaminants, primarily strontium-90, at depth.

Surface soils in Bayo Canyon and this TA were free of radioactive and HE contamination and the property was transferred to Los Alamos County in 1967. The area known as the tank farm was horizontally surveyed for location and the limits of the area demarcated with monuments. These permanent marker monuments indicate that no excavation into the soils should be undertaken until the year 2142. This timeframe is based on the half-life of strontium-90, known to be present in the underlying soils.

Stormwater Collection Basins at TA-35

Two elongated stormwater collection basins are located south of Buildings TA-35-236, 34, and 110 as shown in Figure 4-10. Based on the review of aerial

LOCATION AND SKETCH OF
FORMER LIQUID DISPOSAL AREA ("TANK FARM")
IN TA-10

FIGURE 4-9

LOCATION OF STORMWATER COLLECTION BASINS IN TA-35

photographs, these basins have existed in TA-35 for at least 20 years. The western basin is approximately 60 feet long, 10 feet wide, and 8 feet deep. A breakthrough has occurred in the easternmost basin, which allows stormwater to flow down the side of the canyon.

Pond East of Buildings 89 to 93 in TA-16

Process wastes containing HEs, solvents, and possibly metals from drains in Buildings 89, 90, 91, 92, and 93 were disposed of in a pond east of the buildings. At the time of the Survey, the pond contained water. However, according to LANL personnel, the pond dries out seasonally. The pond is approximately 150 feet in diameter and the drains from these buildings reportedly discharged to a natural depression east of this group of buildings, as shown on Figure 4-11.

Plating Shop Outfall from Building 92 in TA-16

Building 92 was used in the 1950s for plating operations and, according to a LANL utility line map available during the Survey, an outfall from the building is located on the opposite side of the road. This area is north of Building 92, as shown in Figure 4-11, and is suspected of receiving untreated plating shop wastes.

Backfilled Ponds Adjacent to Former Buildings 30 to 34 in TA-16

Wastewater from HE machining work conducted in Buildings 30-34 in TA-16 during the 1950s was disposed of in four ponds adjacent to the buildings, as shown in Figure 4-11 (DOE-AO 1986). The four ponds have been backfilled and Buildings 30 to 34 have been removed.

Plating Shop Outfall from Building 52 in TA-22

Wastewater from the plating shop in Building TA-22-52 was discharged from 1953 to 1984 to the soils on the southern side of Twomile Mesa. These discharges flowed along a channel, as depicted in Figure 4-12, which continued over the mesa ridge, down the canyon, and into the stream at the bottom of Pajarito Canyon. These discharges contained a variety of organics and inorganics including sodium hydroxide; hydrogen peroxide; sodium thiosulfate; ferric chloride; thallium;

LOCATION OF THREE INACTIVE LIQUID WASTE DISPOSAL SITES IN TA-16

FIGURE 4-11

LOCATION OF PLATING SHOP OUTFALL FROM BUILDING 52
IN TA-22

FIGURE 4-12

sodium carbonate; perchloroethylene; inorganic constituents, such as beryllium, gold, lead, cyanide, nickel, copper, zinc, and cadmium; and acids, such as sulfuric, hydrochloric, chromic, hydrofluoric, and phosphoric (DOE-AO, 1986).

The LANL sampled the surface soils at the outfall in 1986. Samples were collected on a grid pattern throughout this drainage area and down the canyon side to the point where the gully coincides with the stream. Laboratory analysis of these samples for the presence of specific inorganic constituents and total organic halogens has been performed. However, at the time of the Survey, data analysis was not completed.

Sumps 69 and 70 in TA-46

Prior to 1973, waste from either Building 58 or Building 16 appeared to have flowed into two sumps numbers 69 and 70. The two sumps are connected, with the overflow from sump 70 entering sump 69. The sumps are approximately 3 feet in diameter and 8 feet deep (Lugar, 1987). The location of the sumps is shown in Figure 4-13. Activities at the time in Building 58 included a laboratory and shops. Building 16 was a test building used in the design of a nuclear rocket reactor known as the Rover Program. These sumps were abandoned in 1973 and limited radioactivity cleanup work was conducted at the TA (DOE-AO, 1986).

Septic Tank 59 in TA-8

An inactive tank in TA-8 potentially received HE-contaminated waste and other contaminants from laboratories involved in explosives development as well as contaminants from a gun-firing site (DOE-AO, 1986). The tank, numbered TA-8-59, is located north of Building 3 as shown on Figure 4-14. Tank 59 is situated such that surface water runoff can accumulate and periodically flood. The tank contained an estimated 3 to 4 feet of liquid in June 1987, according to observations made by the Survey sampling and analysis team (Lugar, 1987).

Overflow from a Cooling Tower (TA-21-143) in TA-21

LANL records from 1952 and 1953 document that the cooling water in Tower 143 was contaminated with plutonium from the plutonium processing conducted in

LOCATION OF SUMPS 69 AND 70 IN TA-46

FIGURE 4-13

LOCATION OF SEPTIC TANK 59 IN TA-8

FIGURE 4-14

Buildings 2, 4, and 5. The cooling tower continued to be active until some time in the 1970s. Overflow from the tower was reported to be 30,000 to 40,000 gal/week, with a high of 150,000 gal/week in the summer (DOE-AO, 1986). Presumably, this water was released over the edge of the mesa into Los Alamos Canyon.

HE Processing Outfall from Building 34 in TA-22

Two inactive outfalls discharged liquid wastes from Building 34 in TA-22. These outfalls, fabricated from clay drain tile, directed the flow of waste chemicals and HE contaminated solutions northward into a marsh area, as shown on Figure 4-15. Operations in Building 34, consisted of a chemistry laboratory and a photo laboratory that were both reportedly used for many years after the buildings construction in the early 1950s. Also, HE wastes were discharged through these drain systems. Acetone was used to solute solid HE into a slurry for shaping and research purposes. HE is believed to have been PETN and possibly RDX and/or HMX type explosives (DOE-AO, 1986).

4.5.1.2 Spills and Unplanned Releases

At the LANL, spills and releases identified to date have occurred in 19 TAs. Table D-2 in Appendix D provides a list of the past spills and the potential areas contaminated by historic leaks and releases identified from the background information and the Survey visit. The table provides information on the date of occurrence, contaminant characteristics (i.e., type and quantity), previous sampling conducted by the LANL, and current status or condition. This table excludes known or potential leaks from tanks, which are discussed in the next section. Also, contaminant dispersal resulting from tests conducted at the inactive firing sites has been excluded and instead is presented separately in Section 4.5.1.6.

As can be seen from review of the table, the specific number of spills is difficult to quantify because the background information is sometimes vague and refers to past spills over a general period that a building or TA was in operation. The types of contaminants that have been released include radionuclides, solvents, petroleum products, various inorganics, polychlorinated biphenyls (PCBs), numerous organic chemicals, chromates, and HEs. In some spill incidents, multiple types of contaminants were released. Ten TAs have had incidents resulting in a release of

FIGURE 4-15

LOCATION AND SKETCH OF HE PROCESSING OUTFALL
FROM BUILDING 34 OF TA-22

radioactive contaminants. Solvent spills have occurred in eight TAs and petroleum products and various inorganics, such as mercury and lead, have leaked or been released in seven TAs. Spills of PCBs have occurred in TAs-3, 15, 18, 33, and 35. Based on field observations during the Survey, TA-35 had the largest number of areas with stained soil potentially contaminated with PCBs. Chromate releases have occurred as a result of cooling tower operation in TAs-3 and 16. Spills or releases of HEs have been reported in TAs-6 and 16. The locations and number of incidents in TA-16, the TA where the majority of the explosives work is performed, have not been specifically identified in the available documentation.

The spills were evaluated based on the date of occurrence, the type of substance involved, the potential for migration, and visual evidence of residual soil contamination or stressed vegetation noted during the Environmental Survey. As a result of this review, the four areas listed below were found to be of particular concern:

- Stained soil south of Building 207 in TA-35
- Stained soils north of Building 31 in TA-46
- Spills around Shed 197 in TA-46
- Spill at former TA-32 moving onto DOE property

Each of these areas is described in more detail in the following paragraphs.

Stained Soil South of Building 207 in TA-35

Numerous areas of dark, stained soil exist throughout the area south of Building TA-35-207, as illustrated in Figure 4-16. The area is near a number of dielectric oil storage tanks, which are believed to be the source of much of the staining (see Section 4.1 for a related discussion). The stains continue down the wall of Mortandad Canyon.

Stained Soil North of Building 31 in TA-46

Past leaks and spills of unknown substances have discolored soils on the north side of Building 31, as shown in Figure 4-17. The CEARP Phase I Report (DOE-AO, 1986) indicates that activities conducted in Building 31 generated radioactive wastes,

FIGURE 4-16

LOCATION OF AREAS OF DARK, STAINED SOIL SOUTH
OF BUILDING 207 IN TA-35

LOCATION OF SPILLS AROUND BUILDING 31 IN TA-46 FIGURE 4-17

which may have been released behind the building in the past. Also, apparently in the 1960s, a concrete tank on the north side of the building was used to clean metal containers and components, during which spills may have occurred (as the containers were dipped in the tank). A drum storage area currently exists on the north side of Building 31 and dark, oil-like stains from past equipment storage were observed on the surface soils.

Spills Around Shed 197 in TA-46

Stained soil areas were observed around a storage shed in TA-46 as shown on Figure 4-18. This shed is near a storm drain and evidence of staining was also observed at the discharge point. In addition, equipment in the shed was observed leaking at the time of the Survey.

Spill at Former TA-32 Moving onto DOE Property

A spill or unplanned release of an oily, dark, tar-like substance was observed in the old TA-32 area, adjacent to an aboveground tank and fuel pump. The property is now owned by Los Alamos County and used by the County Road Department. The area affected by the spill continued past a chain-link fence, as shown in Figure 4-19, onto DOE-owned property, and down into Los Alamos Canyon. The soils were stained and blackened by the substance. The length of the affected area was approximately 50 feet and it was 10 to 15 feet wide at its broadest point. Vegetation, which included scrub oak, had browned and showed signs of stress.

4.5.1.3 Abandoned and Removed Tanks

Underground Tanks

Thirty-three abandoned underground storage tanks (USTs) were identified from Resource Conservation and Recovery Act (RCRA) UST notification forms, the CEARP Report (DOE-AO, 1986), and various LANL engineering drawings. Thirty-one of these tanks used for storage of petroleum products, and 2 used for storage of radioactive wastes are listed in Table 4-32. Twelve USTs and 1 tank farm that have

LOCATION AND SKETCH OF SPILL AT
FORMER TA-32 MOVING ONTO DOE PROPERTY

FIGURE 4-19

TABLE 4-32

SUMMARY DATA FOR ABANDONED UNDERGROUND TANKS

TA	STRUCTURE	RCRA*	AGE (yrs)	CAPACITY (gal)	CONSTRUCTION MATERIAL	SUBSTANCE STORED	COMMENTS
0	TA-0-195-6	Y	30	4,000	Steel	Fuel oil	Located at Los Alamos Airport, abandoned 1975
3	TA-3-107	Y			Unknown	Oil	Filled w/ sand and abandoned in place 1978
3	TA-3-108	N			Unknown	Oil	Filled w/ sand and abandoned in place 1978
3	TA-3-109	N			Unknown	Oil	Filled w/ sand and abandoned in place 1978
3	TA-3-318	Y	40	4,000	Steel	Diesel fuel	Abandoned 1980
6	TA-6-47	N			Unknown	Fuel	Abandoned in place 1960, contaminated w/ HE, some contents
8	TA-8-60	N		2,000	Unknown	Diesel fuel	Abandoned in place pre-1974
8	TA-8-61	N		2,000	Unknown	Fuel oil	Abandoned in place pre-1974
15	TA-15-48	N			Unknown	Fuel	Abandoned in place 1958
15	TA-15-52	N			Unknown	Fuel	Abandoned in place 1970
16	TA-16-196	N	35	4,000	Unknown	Fuel	Abandoned in place, emptied, isolated
18	TA-18-104	N			Unknown	Fuel	Fuel tank, abandoned 6/66
21	Tank Farm #1	Y	40	21,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #10	Y	40	25,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #11	Y	40	38,000	Steel	Diesel fuel	Abandoned 2/85
21	Tank Farm #12	Y	40	38,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #13	Y	40	36,000	Steel	Gasoline	Abandoned 2/85
21	Tank Farm #14	Y	40	26,500	Steel	Fuel oil	Abandoned 2/85

* Included in RCRA UST notification submitted to EPA.

TABLE 4-32

SUMMARY DATA FOR ABANDONED UNDERGROUND TANKS (Continued)

TA	STRUCTURE	RCRA	AGE (yrs)	CAPACITY (gal)	CONSTRUCTION MATERIAL	SUBSTANCE STORED	COMMENTS
21	Tank Farm #17	Y	40	49,000	Steel	Diesel fuel	Abandoned 2/85
21	Tank Farm #2	Y	40	21,500	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #3	Y	40	26,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #4	Y	40	22,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #5	Y	40	5,500	Steel	Kerosene	Abandoned 2/85
21	Tank Farm #6	Y	40	3,000	Steel	Kerosene	Abandoned 2/85
21	Tank Farm #7	Y	40	2,500	Steel	Kerosene	Abandoned 2/85
21	Tank Farm #8	Y	40	25,000	Steel	Fuel oil	Abandoned 2/85
21	Tank Farm #9	Y	40	25,000	Steel	Fuel oil	Abandoned 2/85
21	TA-21-3	Y	20	800	Steel	Diesel fuel	Abandoned 10/85
21	TA-21-107	N	42	Unknown	Stainless steel	Rad waste	May contain plutonium
21	TA-21-108	N	42	Unknown	Stainless steel	Rad waste	May contain plutonium
35	TA-35-18	N			Unknown	Diesel fuel	Abandoned in place 1973
35	TA-35-19	N			Unknown	Fuel oil	Abandoned in place 1973
35	TA-35-20	N			Unknown	Fuel oil	Abandoned in place 1973

* Included in RCRA UST notification submitted to EPA.

been removed were also identified from the above sources. Approximately half of these were used for storage of petroleum products and half for storage of radioactive waste. These tanks are listed in Table 4-33.

At present, RCRA regulatory requirements for abandoned USTs are limited to submission of notification forms for all tanks abandoned after January 1, 1974. The notification status of abandoned tanks is included in Table 4-32. Reporting under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is required for all abandoned tanks that have released reportable quantities (RQs) of regulated materials. Proposed UST regulations published by the U.S. Environmental Protection Agency (EPA, 1987) require all USTs taken out of service to be monitored for releases, emptied, and either removed from the ground or filled with an inert solid material.

USTs at the LANL that have been abandoned or removed are described below by TA.

TA-0 - There is one abandoned UST in TA-0 at the Los Alamos Municipal Airport. This tank is a 4,000-gallon steel tank used for storage of fuel oil. The tank is 30 years old and was abandoned in 1975. Details of the abandonment, including removal of the tank's inventory, are unknown.

TA-1 - There is one UST in TA-1 that has been removed. This tank is indicated on an old engineering drawing as a fuel tank. Another drawing indicates that this tank was removed in 1955. Details of the construction material of this tank, its capacity, and its removal, including the presence or absence of leakage, are unknown.

TA-2 - Four USTs at TA-2 were identified in the CEARP Report (DOE-AO, 1986) as having been removed. Two of these were used to store radioactive effluents and two to store petroleum products. One of the radioactive tanks, TA-2-19, was a sump with a shielded tank used to store radioactive stack gas condensate. The other radioactive tank, TA-2-62, was a surge tank used to store radioactive effluents. Both of these tanks were removed as part of recent Phase I Water Boiler Reactor Decommissioning efforts (Elder and Knoll, 1986). No soil contamination was found beneath TA-2-19. Some contaminated soil was discovered beneath TA-2-62 and was removed until a level of 25 pCi/g was achieved. Both petroleum product tanks,

TABLE 4-33

SUMMARY DATA FOR UNDERGROUND STORAGE TANKS THAT HAVE BEEN REMOVED

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Comments
1	TA-1-240		Unknown	Fuel	Fuel tank (ENG-R83); removed 1955 (ENG-R112)
2	TA-2-19		Unknown	Radioactive stack gas condensate	Structure recently removed, contained shielded tank
2	TA-2-29	1,000	Unknown	Fuel	Removed 1950
2	TA-2-62		Unknown	Radioactive effluent	Effluent holding tank, recently removed
2	TA-2-67		Unknown	Fuel	Removed 1950
10	Tank farm		Unknown	Radioactive waste	Excavated 1963
15	TA-15-266		Unknown	Fuel	Removed 1979
16	TA-16-1341	5,000	Unknown	Gasoline	Removed 1980
16	TA-16-1342	5,000	Unknown	Gasoline	Removed 1980
16	Ta-16-512		Unknown	Oil	Oil tank, removed 1968
18	Ta-18-38		Stainless steel	Radioactive waste	Tanks removed 1977, lines from Bldg. 30 capped
22	TA-22-45	6,000	Unknown	Oil	Removed 1984
35	TA-35-158		Unknown	Radioactive waste	Removed 1985

TA-2-29 and TA-2-67, were reportedly removed during 1950. TA-2-29 was a 1,000-gallon tank and TA-2-67 is of unknown size and construction. Details of the removal, including the presence or absence of contamination, are unknown.

TA-3 - TA-3 has three abandoned oil tanks and one abandoned diesel fuel tank. The oil tanks (TA-3-107, 108, and 109) are located at the Magnetic Fusion Building (TA-3-105) and are of unknown age, size, and construction. These tanks were abandoned in 1978 and filled with sand (DOE-AO, 1986). It is not known if any of these tanks ever leaked. The diesel fuel tank (TA-3-318) is located at an old communications bunker on Sigma Mesa. The RCRA UST notification for the LANL identifies the tank as being 4,000 gallons in capacity, constructed of steel, and 40 years old. Details of the abandonment are unknown and it is not known if the tank ever leaked.

TA-6 - There is one abandoned UST (TA-6-47) in TA-6. This tank is of unknown age, capacity, and construction. The tank is identified on a 1955 drawing as a fuel tank, and the CEARP Report (DOE-AO, 1986) notes that in 1959 the tank was found to be contaminated with HE. It was abandoned in 1960. The tank was still in place and contained liquid during the Survey.

TA-8 - An abandoned diesel fuel tank (TA-8-60) and fuel oil tank (TA-8-61) are located near the TA-8-1 Laboratory and Shop Building. The tanks are reported to be 2,000 gallons in capacity and are of unknown age and construction. Details of abandonment, including the exact date and disposition of inventory, are unknown. The CEARP Report (DOE-AO, 1986) references a 1971 memo stating that the tanks were free of toxic or chemical contaminants.

TA-10 - TA-10 is an inactive area formerly used to conduct test shots. According to the CEARP Report (DOE-AO, 1986), the site included stainless steel holding tanks and concrete disposal pits used for radioactive liquid wastes. The area was decommissioned in 1963 and the tanks removed. Radioactivity was found in the soil where the tanks had been and in associated leachfields. Some of this contaminated soil was removed although residual contamination remains (DOE-AO, 1986). No sampling has been done to identify chemical contamination associated with the tanks.

TA-15 - Two abandoned fuel tanks in TA-15 as well as one dielectric oil tank, which has been removed, are identified for TA-15. The two fuel tanks (TA-15-48 and 52) are of unknown age, capacity, and construction. Tank TA-15-48 is located near the old Shop Building and was abandoned in place in 1958. Tank TA-15-52 is located near the Branch Shop and Laboratory Building and was abandoned in place in 1970. Details of the abandonment of these tanks, including disposition of their inventories, are unknown. Tank TA-15-266 was a fuel tank located at the PHERMEX facility. According to the CEARP Report (DOE-AO, 1986), the tank was removed in 1979. Details of the removal, including the presence or absence of contamination, are unknown.

TA-16 - One abandoned fuel tank (TA-16-196), and two gasoline tanks and one oil tank that have been removed, are identified in TA-16. TA-16-196 is a gasoline tank located at the TA-16 Service Station. It has a capacity of 4,000 gallons and is 35 years old. According to LANL staff, abandonment included removal of the tank's contents and isolation of the tank's piping. Also at the TA-16 Service Station were two 5,000-gallon gasoline tanks (TA-16-1341 and TA-16-1342). According to LANL staff, these tanks were both removed in 1980. No soil contamination or evidence of leakage was noted during removal. TA-16-512 was an underground oil tank that was removed in 1968 as part of decommissioning activities in TA-16. Details of the removal are unknown.

TA-18 - One abandoned fuel tank and two radioactive waste tanks that have been removed have been identified in TA-18. Tank TA-18-104 is a fuel tank of unknown age, capacity, and construction. According to engineering drawings, the tank was abandoned in 1966. Details of the abandonment, including disposition of tank content, are unknown. Tank TA-18-38 was a subsurface concrete pit containing two portable stainless steel radioactive waste tanks. The tanks were removed in 1977, the waste line isolated, and the pit demolished and backfilled. The CEARP Report (DOE-AO, 1986) notes that there was no evidence of leakage during the removal.

TA-21 - The DP Road Tank Farm, located outside TA-21, consists of one gasoline tank, two diesel tanks, four kerosene tanks, and eight fuel oil tanks. These tanks are all 40 years old, constructed of steel, and range in capacity from 2,500 gallons to 49,000 gallons. The tank farm was abandoned in 1985. Pan Am staff reported that during abandonment, the contents of the tanks were removed. However, several of

the tanks were checked during the Environmental Survey and found to contain liquid residuals. Also during the Survey, some evidence of minor leakage and spillage around valves and piping was noted. The future disposition of these tanks is unknown.

Also in TA-21 are one abandoned diesel fuel tank and two abandoned radioactive waste tanks. The diesel tank is an 800-gallon steel tank which is 20 years old. This tank is located at Building TA-21-3 and was abandoned in 1985. Details of the abandonment, including disposition of the tank inventory, are unknown. Tanks TA-21-107 and 108 are abandoned stainless steel radioactive waste tanks of unknown capacity. The tanks were originally used to store waste from plutonium recovery. According to LANL staff, these tanks contain some residual sludge contaminated with plutonium.

TA-22 - There is one UST identified for TA-22 that was removed in 1984. This 6,000-gallon tank (TA-22-45) was used for storage of oil at the TA-22 boiler. It is of unknown age. Details of the tank removal, including the presence of contamination, are unknown.

TA-35 - Three abandoned fuel oil tanks and one radioactive waste tank that was recently removed have been identified for TA-35. Tanks TA-35-18, 19, and 20 are located near Building TA-35-2. These tanks were all abandoned in place in 1973. The tanks are of unknown construction, capacity, and age. Details of the abandonment, including the disposition of tank inventories, are unknown. Tank TA-35-158 is identified as an underground radioactive waste tank that was reportedly removed during 1985. The tank is shown as having been located adjacent to Building TA-35-85, and the CEARP Report (DOE-AO, 1986) indicates that it probably received spill drainage from that building. The age, size, and construction of the tank are unknown, as are details of the removal, including the presence or absence of contamination.

Aboveground Tanks

Seventeen removed or abandoned aboveground storage tanks (ASTs) were identified from the CEARP Report (DOE-AO, 1986) and from various LANL engineering drawings. Eight of these tanks were used for storage of petroleum

products, seven for storage of radioactive wastes, and two contained unknown materials. Available information for these tanks is presented in Table 4-34.

At present, there are no regulatory requirements specifically for abandoned or removed ASTs. Reporting under CERCLA is required for all abandoned or removed tanks that have released Reportable Quantities (RQs) of regulated materials. No such reporting has been done at the LANL. No known releases of regulated materials above RQ limits from these tanks were identified during the Environmental Survey. The 17 ASTs at the LANL that have been abandoned or removed are described below by TA.

TA-3 - Three ASTs that have been removed were identified for TA-3. Tanks TA-3-63 and 64 were of unknown size, age, and construction. According to engineering drawings, they were removed in 1967. Their contents were not specified, although the CEARP Report (DOE-AO, 1986) indicated that an oil sump was observed where these tanks used to be located. The report noted that residual oil remained in the sump. Tank TA-3-93 was a fuel oil tank that, according to engineering drawings, was removed in 1966. No information was available concerning the size, age, or construction of this tank or of any residual contamination at its former site.

TA-16 - At TA-16, four ASTs that have been removed and one that has been abandoned have been identified. The four tanks that were removed were identified in the CEARP Report (DOE-AO, 1986) as facilities removed during decommissioning activities in this area. TA-16-29 and TA-16-1140 were both removed in 1956. Removal dates for TA-16-1138 and 1139 are unknown. Tank TA-16-391 was identified on an engineering drawing as a fuel tank abandoned in 1970. No information was available for any of these tanks concerning size, construction, age, or residual contamination.

TA-21 - Two ASTs have been removed from TA-21. Tanks TA-21-119 and TA-21-256 were identified on engineering drawings as a fuel tank and radioactive waste tank, respectively. Although identified on these drawings as currently active, the tanks could not be located during the Environmental Survey and were apparently recently removed. No evidence of contamination was noted at the former locations of these tanks.

TABLE 4-34

SUMMARY DATA FOR REMOVED AND ABANDONED ABOVEGROUND STORAGE TANKS, LANL

TA	Structure	Capacity (gal)	Construction Material	Substance Stored	Comments
3	TA-3-63		Unknown	Unknown	Removed 1967
3	TA-3-64		Unknown	Unknown	Removed 1967
3	TA-3-93		Unknown	Fuel oil	Removed 1966
16	TA-16-1138		Unknown	Fuel	Fuel tank, removed
16	TA-16-1139		Unknown	Fuel	Fuel tank, removed
16	TA-16-1140		Unknown	Fuel	Fuel tank, removed 1956
16	TA-16-29		Unknown	Fuel oil	Fuel oil tank, removed 1956
16	TA-16-391		Unknown	Fuel	Fuel tank, abandoned 1970
21	TA-21-119		Unknown	Fuel	Fuel tank, removed
21	TA-21-256		Unknown	Radioactive waste	Removed
35	TA-35-10 #1	50,000	Concrete	Radioactive waste	Recently removed, soil contamination noted
35	TA-35-10 #2	50,000	Concrete	Radioactive waste	Recently removed, soil contamination noted
35	TA-35-10 #3	50,000	Concrete	Radioactive waste	Recently removed, soil contamination noted
35	TA-35-10 #4	50,000	Concrete	Radioactive waste	Recently removed, soil contamination noted
42	TA-42-2	37,000	Unknown	Incinerator ash	Radioactive ash storage tank, decommissioned
42	TA-42-3	37,000	Unknown	Incinerator ash	Radioactive ash storage tank, decommissioned
49	TA-49-65		Unknown	Fuel	Removed

TA-35 - There were four radioactive waste tanks at TA-35, located at the TA-35 Treatment Plant, that have been removed. These tanks were all 50,000-gallon concrete tanks located in Building TA-35-10. These tanks were recently removed, and radioactively contaminated soil beneath Building TA-35-10 was excavated to a depth of 18 to 20 feet below grade. Soil contaminated up to 356 pCi/g gross beta was left in place at this depth and the excavation backfilled to grade (Elder et al., 1986).

TA-42 - TA-42 formerly had two 37,000-gallon tanks that were used to store radioactive ash from an incinerator. According to the CEARP Report (DOE-AO, 1986), these tanks were removed when TA-42 was decommissioned. The tanks contained plutonium-contaminated sludge, which was removed and taken to TA-54 to be stored. No other information was available concerning removal of the tanks or contamination of the soils beneath them.

TA-49 - There was one tank in TA-49 that has been removed. Engineering drawings identified TA-49-65 as a fuel tank. LANL staff reported that this tank has been removed. No information was available concerning the size, age, or construction of this tank or any residual contamination at its location.

Tanks with Unknown Ground-Level Position

Some abandoned or removed tanks at the LANL lack information as to whether they were located aboveground or underground. Twenty-six such tanks were identified in the CEARP Report (DOE-AO, 1986) or on various LANL engineering drawings. Summary information for these tanks is presented in Table 4-35.

Regulatory requirements for abandoned tanks are limited to USTs abandoned after January 1, 1974, and tanks that have released RQs of CERCLA-regulated materials. The former is a requirement under the RCRA regulations and the latter under the CERCLA. No reporting has been done for any of the tanks listed in Table 4-35. No known releases of regulated materials above RQ limits from these tanks were identified during the Survey. These abandoned and removed tanks are described below by TA.

TABLE 4-35

SUMMARY DATA FOR ABANDONED AND REMOVED TANKS WITH UNKNOWN GROUND-LEVEL POSITION, LANL

TA	Structure	Age (yrs)	Capacity (gal)	Construction Material	Substance Stored	Comments
10	TA-10-1			Stainless steel	Radioactive waste	Holding tanks, Radiochemistry Bldg., removed 1963
16	TA-16-541			Unknown	Unknown	Tank, abandoned
21	TA-21-120	35	4,000	Unknown	Radioactive waste	Records indicated built 1952
21	TA-21-123			Unknown	Radioactive waste	Abandoned 1966
21	TA-21-145			Unknown	Unknown	Removed 1968
21	TA-21-147			Unknown	Unknown	Tank, removed 1968
21	TA-21-185			Unknown	Radioactive waste	Removed 1968
21	TA-21-187			Unknown	Radioactive waste	Removed 1966
21	TA-21-255			Unknown	Unknown	Removed 1968
21	TA-21-47			Unknown	Fuel	Removed 1960
21	TA-21-58			Unknown	Fuel	Removed 1957
21	TA-21-60			Unknown	Fuel	Removed 1957
21	TA-21-64			Unknown	Fuel	Removed 1963
35	TA-35-22			Unknown	Radioactive waste	Sludge tank, removed early 1980s
35	TA-35-28			Unknown	Radioactive waste	Pump pit, removed 1965
35	TA-35-31			Unknown	Radioactive waste	Retention tank, removed early 1980s
35	TA-35-36		25,000	Unknown	Radioactive waste	Storage tank, removed 1980
35	TA-35-37			Unknown	Radioactive waste	Fluctuator tank, removed 1980
35	TA-35-38			Unknown	Radioactive waste	Regenerant tank, removed 1980
35	TA-35-39			Unknown	Radioactive waste	Ion exchange tank, removed 1980
35	TA-35-40			Unknown	Radioactive waste	Ion exchange tank, removed 1980
35	TA-35-78			Unknown	Radioactive waste	Surge tank, removed 1976
35	TA-35-96			Unknown	Radioactive waste	Storage tank, removed 1976
35	TA-35-97			Unknown	Radioactive waste	Storage tank, removed 1976
48	TA-48-1			Unknown	Radioactive waste	3 neutralization tanks, abandoned 1982
57	TA-57-12			Unknown	Unknown	Storage tank, removed 1979

TA-10 - Radioactive waste holding tanks in Building TA-10-1 were identified in the CEARP Report (DOE-AO, 1986). These tanks were described as stainless steel tanks that received radioactive wastes from that building. It was not indicated whether these tanks were aboveground or underground. These tanks, as well as other radioactive waste management facilities, were removed in 1963. Radioactively contaminated soil was discovered beneath some of these tanks. Some of this soil was removed although there is apparently residual contamination (DOE-AO, 1986). The presence of chemical contamination was not determined.

TA-16 - Tank TA-16-541 was identified on engineering drawings as an abandoned tank located at the TA-16 Power Plant. No other information concerning this tank was available. The tank could not be located during the Environmental Survey site visit, and personnel at the site were unaware of it.

TA-21 - Eleven abandoned and removed tanks were identified for TA-21. Tank TA-21-120 was identified on engineering drawings as a 4,000-gallon radioactive waste tank constructed during the early 1950s. No other information was available. The tank could not be located during the Environmental Survey site visit, and LANL personnel had no information concerning it. The tank is definitely not active, but it is not known whether it has been abandoned or removed. Tank TA-21-123 is identified on engineering drawings as a radioactive waste tank that was abandoned in 1966. No other information was available concerning this tank. Tanks TA-21-145, 147, 185, and 255 were identified in the CEARP Report (DOE-AO, 1986) as tanks that were part of a decommissioned radioactive waste treatment plant in TA-21. These tanks were removed in 1968 as part of the facility decommissioning (DOE-AO, 1986). Material removed during the decommissioning was reportedly taken to the radioactive waste disposal site in Mesita del Buey. Tank TA-21-187 was identified on engineering drawings as a radioactive waste tank that was removed in 1966. Tanks TA-21-47, 58, 60, and 64 were identified on engineering drawings as fuel tanks removed in 1960, 1957, 1957, and 1963, respectively. No other information was available concerning these tanks, including size, age, construction, disposition of contents, or residual contamination.

TA-35 - There were 11 tanks removed as part of the decommissioning of the Radioactive Waste Treatment Plant at TA-35 (DOE-AO, 1986). TA-35-28 was a pump pit removed in 1965. Structures removed in 1976 included a surge tank (TA-35-78)

and two storage tanks (TA-35-96 and 97). Structures removed in the early 1980s included a concrete sludge tank (TA-35-22), a concrete holding tank (TA-35-31), a 25,000-gallon liquid waste collection tank (TA-35-36), a flocculator tank (TA-35-37), a regenerant tank (TA-35-38), and two ion exchange tanks (TA-35-39 and 40). Residual soil contamination was found beneath the former site of TA-35-22, and contaminated soil was excavated and removed to a depth of 10 feet. At this depth there was residual contamination in the underlying tuff at levels ranging from 180 to 5,000 pCi/g gross beta. This contamination was left in place and the excavation backfilled (Elder et al., 1986). Contamination of soil beneath the other structures was not described. Material removed from the site was reportedly taken to the radioactive waste disposal site at TA-54 (Elder et al., 1986).

TA-48 - The CEARP Report (DOE-AO, 1986) identified three waste tanks of unknown age, capacity, and construction associated with Building TA-48-1. These tanks were described as tanks used to neutralize perchloric acid and other laboratory wastes. The tanks and associated wet wells were reportedly abandoned in place in 1982. Details of the abandonment were not given, nor was there any indication of residual contamination.

TA-57 - Structure TA-57-12 was identified on engineering drawings as a storage tank removed in 1979. No other information was given.

4.5.1.4 Open Dumps and Boneyards

The open dumps and boneyards category includes sites where wastes, debris, and/or potentially contaminated equipment have been placed on the ground surface. Also included are locations on the land surface that were used to burn wastes. The group of sites in this category represents known or potential sources of surface-soil contamination with possible contaminant transport via runoff and resuspension.

Open dumps and/or boneyards have been identified in 17 TAs and at 2 locations on property not owned by DOE (TA-OOL). A total of 30 sites exist and are presented in Table D-3 in Appendix D, along with information on the waste characteristics and current condition. One-third of the sites contain building rubble, such as concrete, reinforcing rods, and wire. Eight areas are disposal locations for firing site debris that may be contaminated with HEs, and with uranium, beryllium, or other metals.

Four burn areas have been identified, two in TA-15 used to burn oil-soaked uranium turnings and two in TA-16, one used to burn HEs and the other to dispose of an unknown type of waste.

Boneyards or open areas used for equipment storage exist in TAs-3, 11, 14, 36, and 46. In addition to storage of equipment and parts, drums or containers are located in each of these boneyards except the one in TA-11. Also, during the Environmental Survey, some of the equipment stored at TA-36 was found to be radioactively contaminated. Four of the open dumps contain metal scrap and fragments. One located in TA-53 contained only lead bricks. One in TA-8 contained rusting fragments of metal. The dumping area in TA-33 contained approximately 100 capacitors with PCB-contaminated oil and radioactively contaminated wastes in addition to metal scrap. The disposal area located near the Los Alamos County Municipal Airport contained both metal scrap and ash from an incinerator once used to burn wastes from the LANL.

Of the 30 open dumps and boneyards, cleanup activities have been conducted at 3 sites. An open dump of building rubble with asbestos, located at the head of Sandia Canyon in TA-3, has been partially removed. Removal operations have been completed at a firing site debris disposal area located in TA-4. Also, wastes contaminated with PCBs, and with uranium, beryllium, and other metals have been removed from a dump at TA-33. Following these removal activities, radiation assessments were performed and the results showed that no areas of elevated radioactive contamination remained (DOE-AO, 1986).

Seven of the 30 open dumps and boneyards identified at LANL were of particular concern as sources of pollution based on the type of wastes or contaminated equipment found to be exposed on the land surface.

These seven sites are:

- Open dump MDA-M in TA-0
- Open dump MDA-Z in TA-15
- Open dump in TA-14
- Boneyard in TA-14
- Boneyard in TA-36

- Incinerator Ash Dump in TA-00L
- Suspected dump at G Point in TA-15

The following paragraphs provide detailed information on each of these sites.

Open dump MDA-M in TA-0

In 1947 the dump known as MDA-M, located north of TA-9 and south of the road leading to TA-3, was opened (DOE-AO, 1986). MDA-M is in a clearing, surrounded by trees, and accessible by an unpaved road. There is a smaller dump on the side of the road leading to MDA-M. There is no inventory of the wastes placed in the surface dump; however, some general types of wastes were noted during the Environmental Survey. A material that appears to be asbestos is uncovered and located near the entrance road, as shown in Figure 4-20. Numerous unlabeled glass bottles are in MDA-M, some intact with lids, and containing 1 to 2 inches of liquid. Paint, solvent, and trash cans have been disposed of at MDA-M. A large portion of the dump was used for disposal of construction and building rubble along with various metal debris. According to LANL personnel, radioactively contaminated wastes were placed in the smaller dump on the side of the road leading to MDA-M.

Open Dump MDA-Z in TA-15

First use of MDA-Z is believed to have occurred in 1965 and reportedly, wastes have not been dumped there since 1981. The site consists of wastes associated with TA-15 firing sites, most of which were generated at PHERMEX (DOE-AO, 1986). Approximately 15 old, woven cables known as blast mats are scattered over the area. These blast mats are contaminated with uranium and possibly other radioisotopes. Sandbags and other debris potentially contaminated with uranium, beryllium, lead, and possibly mercury have been disposed of over the side of a bank, as shown in Figure 4-21.

Open Dump in TA-14

Sandbags and blast mats that were collected from the firing sites in TA-14 have been disposed of south of Buildings Q-34 and Q-40. Wastes associated with firing sites are often contaminated with HEs, radioisotopes, and various metals; therefore,

LOCATION AND SKETCH OF INACTIVE OPEN DUMP
MDA-M

FIGURE 4-20

LOCATION AND SKETCH OF OPEN DUMP
MDA-Z IN TA-15

FIGURE 4-21

these sandbags and blast mats may be contaminated. The wastes have been placed along the edge of the pavement and across a small gully that leads into Canyon de Valle. Several 5-gallon containers and one 55-gallon drum were located down the hillside below the sandbags and blast mat dumping area, as depicted in Figure 4-22.

Boneyard in TA-14

A small boneyard consisting of an old Navy cannon and gun parts, metal ingots, and 14 used, 55-gallon drums is located north of Buildings Q-34 and Q-40, as shown in Figure 4-22. The drums were reportedly used in a Navy experiment that involved sodium. The previous use of the other equipment stored at this boneyard is unknown as is the length of time that this area has been used for open storage.

Boneyard in TA-36

The boneyard in TA-36 is located east of the road leading to Minie Firing Site and south of Potrillo Drive. A complete inventory of the items in the boneyard does not exist and its initial date of use is unknown. Located near the entrance to the boneyard, as shown in Figure 4-23, are several piles of metal objects known as witness plates, some of which have been used in past experiments and therefore may be contaminated. Radiation measurements next to a piece of metal equipment (a collimeter) were as high as 14,000 counts per minute. Other items at the boneyard included gun barrels and two small test chambers. Numerous canisters of Freon and approximately 10 full 5-gallon cans labeled "Isopentane" were stored on the ground in one area. In another area were 20 to 25 empty containers of sealant.

Incinerator Ash Dump in TA-00L

An incinerator once operated at a location near the present-day airport, as shown in Figure 4-24, and was used for disposal of wastes generated by the LANL. The incinerator is inactive; yet, records are unclear on the dates of its operation. Reportedly, combustibles and miscellaneous metal scrap from the LANL were burned in the incinerator. The ash from this operation was pushed off a ramp-like structure over the top of the mesa (DOE-AO, 1986) and gradually accumulated on the edge of Pueblo Canyon.

LOCATION AND SKETCH OF OPEN DUMP AND BONEYARD NEAR BUILDINGS Q-34 AND -40 IN TA-14 FIGURE 4-22

FIGURE 4-23

LOCATION AND SKETCH OF BONEYARD IN TA-36

LOCATION AND SKETCH OF INCINERATOR ASH DUMP IN TA-OO
LOS ALAMOS, NEW MEXICO

FIGURE 4-24

Suspected Dump at G Point in TA-15

At Firing Point G, a small rectangular depression was observed during the Environmental Survey around which the soil was found to have elevated radiation measurements. Because of its proximity to Firing Point G, it is reasonable to assume that this area was used for disposal of contaminated soil from the firing site. Elevated radiation readings were noted along the bank beside the road, as shown on Figure 4-25. The soils in the depression were also radioactively contaminated as were both sides of the bank of pushed-up soil at the end (southern side) of the depression. In addition, a shed used for solvent storage was located upgradient and west of the small depression.

4.5.1.5 Inactive Landfills

At the LANL, 49 inactive landfills or disposal pits in 22 TAs have been identified to date. Three of the 49 sites are on property no longer owned by the DOE. Table D-4 in Appendix D provides a list of these landfills by TA along with information regarding the type of waste disposed of, the period of use, previous sampling conducted by the LANL, and the current condition. All the sites included in this group are subsurface disposal areas. For example, a buried reactor vessel is included in this group, along with excavations or pits that were used to burn wastes and that are currently backfilled.

Landfills have been used for waste disposal since the LANL was established in the 1940s. Most of the inactive landfills listed in Table D-4 in Appendix D were used between 1945 and the mid-1960s. In the late 1950s and mid-1960s, MDAs-G, J, and L were opened in TA-54. This TA continues to be active and is the principal waste disposal area for the LANL (see Section 4.1).

For most of the sites, the quantity of wastes disposed of is not documented. The types of waste disposed of have been reported for 43 of the sites; the waste in the remaining 6 is unknown. Many of the disposal sites received more than one type of waste; therefore, as a summary, the waste types can be listed by their presence in a TA. The following lists the waste type in descending order according to the number of TAs in which it was present:

LOCATION OF SUSPECTED DUMP AT G POINT
IN TA-15

FIGURE 4-25

<u>Waste Type</u>	<u># of TAs</u>
Radioactively contaminated solids	9
High-explosive-contaminated wastes	9
Chemical wastes	4
Guns and other firing-related hardware	4
Potentially radioactively contaminated ash	3
Building and construction debris	3
Reactor	2
Reactor coolant	1
Ash from burning nonradioactive combustibles	1
Nonradioactive firing site debris	1

The three inactive landfills on non-DOE-owned property include the Los Alamos County Municipal Airport landfill, disposal pits off DP Road, and a gun parts burial area on the North Mesa. The types of LANL waste potentially in the airport landfill include building and construction debris, 100 pounds of uranium, oils, and HE-contaminated wastes. The pits near DP Road potentially received chemical wastes from D Building, which presumably was Building TA-1-6, used for chemistry and metallurgy that included processing both uranium and plutonium.

The LANL has performed varying degrees of remediation at eight landfill sites. Wastes have been excavated and removed from the landfills in TA-10 and TA-16. Wastes were possibly removed from the Area 1 disposal pit in TA-20, but this has not been fully substantiated. MDA-W, in TA-35, which contains sodium coolant from a reactor, was marked by a concrete monument at the time it was closed and is considered stabilized. Surface-stabilization measures have recently been completed at MDA-A and MDA-B, both in TA-21, and at MDA-C in TA-0 (DOE-AO, 1986). Other landfills were covered at the time of closure, but the depth of cover material was not reported and in most cases the location was not fenced or marked with signs.

The closed landfills, burial areas, and formerly used burn pits at the LANL were evaluated during the Survey. Factors such as the types of waste (known or suspected), volume of waste or reported size of the area, location relative to potential migration pathways (i.e., mesa top, edge of mesa top, floor of canyon), and history of use were reviewed. From this evaluation, 12 sites were found to be of particular concern. These sites are as follows:

1. MDA-B in TA-21

2. MDA-C in TA-0
3. Airport landfill in TA-00L
4. Two waste disposal pits in TA-39
5. Area 1 in TA-20
6. Suspected landfill in TA-33
7. Suspected landfill in TA-46
8. MDA-F in TA-6
9. MDA-N in TA-15
10. Suspected landfill, known as the "Cold Dump," in TA-21
11. Suspected burn pit in TA-10
12. Three suspected disposal pits in TA-6

The following paragraphs describe each of these areas in detail.

MDA-B in TA-21

MDA-B is a 6-acre landfill that was opened in 1945 as the first solid waste disposal area of LANL and closed in 1950 (Reynolds, 1987). Radioactive wastes in the landfill likely include plutonium, polonium, uranium, americium, curium, radioactive lanthanum, actinium, and mixed fission products from the reactor known as the Water Boiler. Wastes were reportedly packaged in cardboard boxes or wrapped with paper (Rogers, M. A., 1977). An inventory of the waste volume and curie content is not available. Waste chemicals deemed hazardous by LANL personnel were also placed in MDA-B and include: organics, perchlorates, ethers, solvents, other spent chemicals, and corrosive gases (DOE-AO, 1986). Records indicate that spontaneous fires occurred at this landfill (Rogers, M. A., 1977).

Varied opinions exist on the number of pits in MDA-B, with some references indicating that it was one large pit and others stating that it was a series of pits. Records of the dimensions of two pits are available. One pit created in 1945 is 300 feet long, 15 feet wide and 12 feet deep. On the eastern end of MDA-B is a pit 40 feet long, 2 feet wide, and 3 feet deep that was designated the hazardous chemical disposal area. Apparently the progression of waste burial in MDA-B was intended to be from west to east, with one estimate given that the series of pits includes at least six. The west end of the MDA-B is L-shaped and may reflect a north-south pit

orientation whereas the majority of the enclosed fence area is oriented east-west (Rogers, M. A., 1977).

A study by the USGS in 1966 indicated some lateral movement of liquid associated with MDA-B. Test holes placed around the perimeter did not detect radioactive contamination. At this time, the western two-thirds of the landfill was paved and leased to Los Alamos County and has been used by the public for trailer storage. In 1973, there was a subsidence problem in the paved section of the landfill that LANL repaired. In the late 1970s, problems with animal intrusion and root penetration were noted on the unpaved, eastern portion. Surface stabilization measures were conducted in 1983 and currently the eastern end is used for an experiment with cover material to prevent biointrusion. MDA-B is currently monitored by the LANL for radioactivity.

MDA-C in TA-0

MDA-C is an approximately 12-acre, fenced landfill that operated from 1948 to 1974 for disposal of radioactive and chemical wastes. The site consists of 7 pits and 107 shafts as depicted in Figure 4-26. The period of operation and the dimensions of the unlined pits are listed below:

<u>Pit Designation</u>	<u>Period of Operation</u>	<u>Dimensions (feet)</u>		
		<u>Length</u>	<u>Width</u>	<u>Depth</u>
1	1948-1949	610	40	NR*
2	1950-1953	610	40	NR
3	1950-1953	610	40	NR
4	1950-1955	610	40	NR
5	1953-1964	705	110	18
6	1956-1959	505	100	23
Chemical Pit	1960-1964	18	25	12

*NR = Not Reported

Source: (Rogers, M. A., 1977)

LOCATION AND SKETCH OF THE INACTIVE LANDFILL
MDA-C IN TA-0, SOUTH OF TA-50

FIGURE 4-26

The shafts are vertical holes drilled into the ground around the perimeter of the pits. Their dimensions varied slightly as listed below:

<u>Shaft Designation</u>	<u>Total # of Shafts</u>	<u>Diameter (ft)</u>	<u>Depth (ft)</u>
1-55	55	2	15
56-67	12	2	10
68-107	40	1-2	20-25

One shaft was not numbered and is designated the Sr-90 disposal shaft. Ten of the shafts (98-107) were lined with concrete; the others apparently were not lined. The number designation given to the shafts does not correlate sequentially with the date the shaft was used. The first shafts were used in 1958 and the last shaft was formally closed in 1974. Based on available records, MDA-C was apparently not regularly used for waste disposal between 1968 and 1974 (Rogers, M. A., 1977).

MDA-C received hazardous chemicals, radioactive wastes, classified materials, treatment plant sludge, and demolition debris. Radioactively contaminated wastes were packaged in cardboard boxes until the mid-1950s when the laboratory began using plastic trash bags. The waste placed in the pit was not covered daily and sometimes not weekly, leaving the wastes exposed for indefinite periods of time. Waste chemicals were apparently placed in the chemical pit and burned. Spontaneous fires also occurred occasionally in the pits designated for radioactively contaminated waste and are indicative of mixed radioactive and chemical wastes being disposed of in pits 1 through 6 (Rogers, M. A., 1977).

An inventory of radionuclides in the pits and shafts was estimated in a LANL report (Rogers, M. A., 1977) and is presented below. The values given are decayed through January 1, 1973.

<u>Isotope</u>	<u>Inventory In Curies</u>	
	<u>Pits</u>	<u>Shafts</u>
U-234, 235, 236, 238	25	<0.1
U-233	--	5
Pu-239	26	--
Am-241	149	--
H-3	--	49,136
Na-22	--	40
Co-60	--	20
Sr-90/Y-90	--	31
Fission Products	--	50
Induced Activity	--	200

The Rogers report provides the quantity of some of the radionuclides which are listed below, based on a 1974 quarterly progress report.

<u>Isotope</u>	<u>Quantity</u>
D-38	34,455 lbs
U-238	13,853 g
Pu-239	2,063 g
U-233	1,467 g
H-3*	10 g

*Reported as of 1974 for MDA-C and MDA-G assuming 1 g H-3 = 9,600 C:

An internal memorandum dated 1964 is cited in the Rogers report (Rogers, M. A., 1977), that describes the types of wastes placed in the chemical pit and reads as follows:

"A brief review of the use of this pit shows that a variety of chemicals, pyrophoric metals, hydrides and powders, sealed vessels containing sodium-potassium alloy or compressed gases, and equipment not suitable for salvage,

public dump or the contaminated dump have been placed in the pit. No high explosives have ever been disposed of in this pit. Normal uranium powders and hydrides have been disposed of in this pit. Inadvertently, some plutonium-contaminated objects were placed in the pit but have long since been covered. Because of the uranium disposed it should be assumed that the pit is mildly alpha contaminated.

The total volume of waste placed in the pit is not given in the available documentation.

The waste disposed of in the 107 shafts included beta and gamma emitters; specific records for each shaft may exist but were not included in the background information. The wastes were usually packaged in a steel containers, primarily to reduce exposure to personnel handling the wastes. The containers used prior to 1959 were designed to hold up to 40 curies. In 1959 the procedures changed and up to 400 curies could be handled. The shafts were covered with soil and/or concrete, and permanently marked (Rogers, M.A., 1977).

Infiltration studies performed in the vicinity of MDA-C between 1959 and 1961 found that moisture did not penetrate the transition zone between soil and tuff. In 1973, the vegetation on MDA-C was found to be a source of tritium contamination that was affecting honeybees. In 1978, a phoswich survey identified 26 locations with elevated gamma readings on surface soils in MDA-C (Rogers, M.A., 1977). Also, animal intrusion has reportedly been a problem at MDA-C. In 1984, LANL completed surface stabilization of MDA-C that involved adding soil cover material and recontouring the surface (DOE-AO, 1986).

Airport Landfill in TA-00L

An inactive landfill, which received some radioactive and possibly hazardous wastes from the LANL, exists on property that is now owned by Los Alamos County. This site is situated at the eastern end and northeastern side of the present Los Alamos County Municipal Airport landing strip, as shown in Figure 4-27. It was owned and operated by the LANL until 1966, and received primarily municipal and "noncontaminated" wastes from the surrounding town residences and the LANL.

FIGURE 4-27

LOCATION AND SKETCH OF INACTIVE LANDFILL AT EASTERN END
OF COUNTY MUNICIPAL AIRPORT

However, reports indicate that some uranium and possibly HEs have been disposed of at the site. The reported uranium was believed to be as much as 125 pounds which was accidentally picked up by the refuse crew and disposed of at the landfill. In 1953, 25 pounds of this uranium was recovered. The remaining radioactivity was covered with soil and left in the landfill. Construction debris, flammable liquids, animal carcasses, and spent oils from the motor pool were also disposed of at this landfill site. Wastes were burned at the landfill at the time of disposal, prior to 1966 (DOE-AO, 1986).

Los Alamos County took over ownership and operations in 1966 (DOE-AO, 1986). At present the site is covered with relatively permeable soils. Some construction-type debris protrudes from the bank that parallels Pueblo Canyon. As recently as the summer of 1985 the site received "noncontaminated" debris from TA-5 during the decontamination and decommissioning activities at that TA. This debris was reportedly only the concrete structures removed from the firing site.

In the past, leachate has been observed flowing out of the landfill bank onto the mesa top and subsequently into the canyon side. This area has limited access due to its being the safe area beyond the landing strip.

Two Waste Disposal Pits in TA-39

Two waste disposal pits may exist north and northwest of Building 69 in TA-39, as shown in Figure 4-28. There are no reports that provide a record of the types and quantity of wastes placed in these pits. The activities in TA-39 result in the generation of firing site debris and general laboratory, shops, and office wastes (DOE-AO, 1986). The area that the pits are believed to occupy is beneath a paved driveway and a volleyball/basketball court. Some of the area is not paved. A steambed is located immediately north of the two suspected pits.

Area 1 in TA-20

Area 1 was located at the eastern end of TA-20 in Sandia Canyon. This burial pit was apparently used only once in 1945, for the disposal of radioactively contaminated

LOCATION OF TWO WASTE DISPOSAL PITS IN TA-39

FIGURE 4-28

metal scrap and other debris possibly contaminated with beryllium, HEs, and/or uranium.

The exact location of Area 1 is not known; however, it is believed to be located in an area across from the existing LANL guard's firing range, a parking area, and an underground water supply tank, as shown in Figure 4-29. It is not clear whether the wastes were removed from Area 1 during previous actions (DOE-AO, 1986).

Sampling programs were performed under the Los Alamos Site Characterization Program (LASCP) and the CEARP program. Surface soils and a phosphorus survey were performed on a grid pattern that reportedly covered the presumed burial location. Soils, collected in 1985 under LASCP, were analyzed for depleted uranium, beryllium, and HEs. The results of this effort were unavailable at the time of the Survey, pending LANL review. A magnetometer study was performed, under the CEARP program, in the general vicinity of the pit. Preliminary review by the CEARP contractor indicates that no anomalous conditions were encountered; however, all of the open area that could have been a disposal pit was not included in the geophysical study. Figure 4-29 shows the approximate limit of the magnetometer study.

Suspected Landfill in TA-33

On the southernmost mesa top in TA-33 (Tower Area), near Building TA-33-26 as shown in Figure 4-30, metal fragments and debris were observed along the rim of the mesa that may represent an inactive landfill. A distinctive surface-water drainage pathway is located at the base of the suspected fill area. This portion of TA-33 was used as a firing site, including tests on mechanisms required for the assembly of weapons.

Suspected Landfill in TA-46

Based on historical aerial photographs dating back to 1964, the CEARP Phase I report (DOE-AO, 1986), and observations made during the Survey, a landfill is suspected to exist in TA-46. The location of this area is shown in Figure 4-31 and is along the edge of the mesa that drains into Canyon del Buey. No waste disposal

LOCATION AND SKETCH OF SUSPECT BURIAL AREA 1 IN TA-20

FIGURE 4-29

LOCATION AND SKETCH OF SUSPECTED LANDFILL IN TA-33

FIGURE 4-30

LOCATION OF SUSPECTED LANDFILL IN TA-46

FIGURE 4-31

records exist for this landfill. Concrete rubble, asphalt, and general construction debris were noted to be exposed down the side of the fill area.

MDA-F in TA-6

MDA-F is located in TA-6 and consists of at least two pits inside a fenced area and possibly an unknown number of additional pits outside the fenced area. Preliminary results of a geophysical study have identified anomalies outside the fence, which may be indicative of these additional disposal pits. The location of MDA-F and the area included in the geophysical study is shown in Figure 4-32.

MDA-F was first used in 1947. Wastes buried here include tuballoy, HE, and metal parts and equipment, some of which was associated with development of plutonium implosion weapons (DOE-AO, 1986). Further information on waste types and quantities is not available.

MDA-N in TA-15

MDA-N existed as of 1965 and was used for disposal of materials or objects that were possibly contaminated with HEs or chemicals (DOE-AO, 1986). The source of this waste was not reported, nor was other specific information on the type and quantity of waste. The location of this approximately 0.1-acre landfill is shown on Figure 4-33. LANL performed a geophysical study in 1985 or 1986 to better identify the extent of the landfill. The results were pending at the time of the Survey.

Suspected Landfill, Known as the "Cold Dump," in TA-21

A landfill known as the "Cold Dump" is suspected to exist on the northern side of the access road to TA-21 as shown in Figure 4-34; however, the exact location and lateral extent is not known. Aerial photographs from the 1940s indicate that the landfill may have been a series of unlined trenches grouped together north of MDA-B.

FIGURE 4-33

LOCATION OF THE INACTIVE LANDFILL MDA-N IN TA-15

FIGURE 4-34
LOCATION OF SUSPECTED LANDFILL, KNOWN AS THE
"COLD DUMP," IN TA-21

Records of the waste disposal practices, volumes of material, or specific chemicals disposed of in the landfill are not available. General memos are available in CEARP files that suggest use of this area for disposal of nonradioactive chemicals.

Suspected Burn Pit in TA-10

According to the CEARP Phase I report (DOE-AO, 1986), a burn pit may have been used for waste disposal in TA-10 during its operation as a combined radiochemistry and firing site facility. A 1956 work order authorized excavation of a pit for disposal and subsequent burning of combustibles. It further states that residual ash and noncombustibles should be removed and disposed of at a radioactive disposal site. Although the location of the burn pit was not specified, a shallow depression was observed during the Survey in between the firing areas as shown in Figure 4-35.

TA-10 was active from 1944 to the early 1960s, at which time it was decontaminated and decommissioned with follow-up cleanup conducted in 1976. Ownership of this area has been transferred to Los Alamos County and it is open to the public.

Three Suspected Disposal Pits in TA-6

CEARP files indicate that three small disposal pits in TA-6 received weapons components contaminated with cesium-137 in the early 1950s. Other wastes may also have been disposed of at these areas (DOE-AO, 1986). During the Survey, three shallow depressions were observed within approximately 70 feet of Twomile Mesa Road as shown in Figure 4-36. These depressions had evidence of settlement of up to 3 feet. The areas were approximately 10 to 20 feet in diameter. All three were in-line, paralleling the road, and were west of the concrete saucer firing site.

4.5.1.6 Inactive Firing Sites

A total of 66 inactive firing sites and/or gun test sites have been identified in 21 TAs at the LANL. (Active firing sites are discussed in Section 3.2.) The category of firing sites includes areas used for a wide variety of experiments required for weapon development, such as testing detonators and initiators, implosion tests, HE

LOCATION OF SUSPECTED BURN PIT IN TA-10

FIGURE 4-35

LOCATION OF THREE SUSPECTED PITS IN TA-6

FIGURE 4-36

sensitivity tests, and high-velocity projectile tests. The firing sites are listed on Table D-5 in Appendix D along with information on the dates of use, the possible contaminants resulting from the experiments, previous environmental sampling work performed by the LANL, and the current condition of each area. The total number of sites can vary based on how the firing structures are grouped. The total of 66 was summed based on the following considerations:

- TA-3: The number of firing areas is unknown and thus counted only as one.
- TA-15: The firing points and platforms were counted separately because each was in a distinct location.
- TA-33: The numerous structures used in this TA for initiator testing and gun tests were grouped according to the three main areas in the TA and were not counted individually. The three main areas of the TA are geographically distinct from one another, yet the structures within each area are relatively close together.

The general appearance of firing sites and gun test areas is similar at the LANL. Typically the site consists of a firing pad and control building with devices such as cable trays or manholes for electrical cables extending between the two. Some firing sites or gun test sites have small structures used to house camera equipment or other recording devices that operated during the experiment. Berms or mounds of soil exist at some of the firing sites to restrict dispersion of shrapnel. A few firing sites used shallow, metal-covered pits for recovery experiments. One unusual firing site is the "concrete saucer" in TA-6, which was filled with water during the test as an experiment in material recovery.

Firing sites have an associated impact zone the size of which varies according to the amount of explosives used in the test shots and to the physical setting of the test area. Some firing sites are at the bottom of a canyon where the radius of the zone may be smaller yet the areal extent includes the vertical walls of the canyon. Others are located on mesa tops where there is no physical feature to restrict the radius of the impact zone and the walls of the canyon may also be affected, which would

increase the total surface area. The radii of the impact zones for the 66 firing sites were not determined during the Survey.

The types of materials used at firing sites include radionuclides and/or HEs. According to the CEARP Report (DOE-AO, 1986), 32 of the firing sites may be contaminated with both radioactive materials, typically uranium, and various HEs. Nineteen of the firing sites may have HE contaminants only and 11 may be contaminated with radionuclides only. In four areas, the nature of the tests is unknown and therefore the type of potential contaminants was not identified. Barium, beryllium, and lead are metal contaminants commonly associated with firing sites. Refer to Table D-5 in Appendix D for specific contaminants associated with each site.

Varying amounts of cleanup work have been performed at approximately 29 of the firing sites (DOE-AO, 1986). At some locations, the structures have been removed and therefore some cleanup has been completed, but the possibility of residual soil contamination remains to be addressed. At other firing sites, debris and soil removal was conducted, the extent of which was generally based on levels of radioactivity found in the surrounding soils. No cleanup or removal work has been completed at 37 of the firing sites. Furthermore, the levels of contamination in the impact zone surrounding each site have not been documented.

Information relative to the factors that influence contamination at a firing site was reviewed during the Survey and as a result, six areas were noted to be of particular concern:

- Firing Point 7 in TA-39
- South mesa test shot area in TA-33
- Firing Site in TA-5
- Asphalt Pad Firing Site in TA-6
- "Concrete Saucer" Firing Site in TA-6
- Suspected firing site in TA-8

The following paragraphs provide specific information on each of these sites.

Firing Point 7 in TA-39

Firing Point 7 in TA-39 was first used in the early 1950s to conduct experiments on virtually all types of metals, some of which required the use of HEs. The firing site is located at the base of Ancho Canyon and its zone of impact extends to the top of the adjacent mesas. According to the CEARP Phase I report (DOE-AO, 1986), potential contaminants at this site include: beryllium, mercury, copper, brass, iron, lead, stainless steel, thallium, cadmium, chromium, thorium, and HEs such as RDX, HMX, Baratol, PETN, TATB, Composition B, and cyclotol. The date this firing site was taken out of operation was not provided in the background information.

South Mesa Test Shot Area in TA-33

Beginning in 1947, the south mesa of TA-33 (TA-33-25, 26, 85, 146) was used to conduct test shots and experiments on initiators, a weapon component. The shots ranged in size from those containing 700 pounds of HEs to at least one that contained 2,500 pounds of HE. The types of contaminants usually associated with firing sites include uranium, beryllium, other metals such as lead, and HEs. The impact zone of the firing sites on TA-33 has not been well-defined but it is recorded that shrapnel reached off-site onto the property designated the Bandelier National Monument (DOE-AO, 1986). The date this firing site area was no longer used is not reported in the available background information.

In 1986, LANL conducted a limited cleanup action to remove larger pieces of shrapnel and debris; however, apparently no soil removal was involved. During this effort, surface soil samples were collected; the analytical results were pending at the time of the Survey.

Firing Site in TA-5

TA-5 consisted of a firing site and other ancillary structures, as shown in Figure 4-37, that were cleaned up based on radioactive contaminants in 1985. These cleanup actions were limited to the mesa top and included removal of contaminated soil.

LOCATION AND SKETCH OF INACTIVE FIRING SITE IN TA-5

FIGURE 4-37

Asphalt Pad Firing Site in TA-6

An inactive firing site is located in TA-6 south of Twomile Mesa Road and west of MDA-F. A site location and sketch are provided as Figure 4-38 (Area 1). This structure is an asphalt pad having a sump-like device in the central portion of its 2,500-square-foot area. Previous use of this site has resulted in radioactive contamination of the sump-like structure.

The surface of the pad and the surrounding area were sampled in 1978. Test results indicated uranium contamination, and phoswich readings were 3 to 6 times background (DOE-AO, 1986).

"Concrete Saucer" Firing Site in TA-6

A firing site structure that resembles a large-diameter saucer is still located in TA-6 south of Twomile Mesa Road (see Figure 4-38, Area 3). It was used for shot containment studies beginning in 1944. Radioactive and HE materials were fired from the center point. The sloped-bottom structure was filled with water and used for collection of blast fragments. It is not known exactly when these firing activities were discontinued and there is no information concerning quantities of liquids, HEs, or radioactive materials that were used at this site.

Suspected Firing Site in TA-8

During the Survey, distinctive land surface features were noted in an area west of Buildings 1, 2, and 3 in TA-8. A mound of soil with trenches on two sides exists in this area as depicted in Figure 4-39. Inquiries revealed that this area may be an inactive firing site for up to several hundred test shots.

4.5.1.7 Contaminated Structures

The LANL has identified over 80 contaminated buildings or structures in 30 TAs, some of which are still standing and others that have been removed. A complete inventory of all of these buildings was not developed during the Survey. Instead,

FIGURE 4-38

LOCATION AND SKETCHES OF INACTIVE FIRING SITES AT TA-6

LOCATION AND SKETCH OF SUSPECTED FIRING SITE IN TA-8

FIGURE 4-39

the CEARP Phase I report (DOE-AO, 1986) was reviewed to identify the magnitude of this potential problem.

Eighteen TAs were found to have buildings still standing that are either known to be contaminated or are potentially contaminated due to past spills and/or the nature of the operations that took place inside the building. Radioactive contaminants were identified in seven TAs. Both radioactive and chemical contaminants were identified in five TAs, HE contamination in five TAs, and chemical contaminants only in five TAs. Inorganic contaminants such as barium, beryllium, and mercury, were specifically listed in four TAs. Seven TAs have more than one category of contaminants. A list of the contaminated structures still standing, identified through review of the Phase I report, is available in Appendix D, Table D-6. The LANL continue to use the majority of these buildings or structures, however, for most, documentation on cleanup of past spills or releases in the interior of these structures is lacking.

Collectively, about 100 known or potentially contaminated structures have been removed from 23 TAs. Radioactive and high explosive contaminants were clearly the most prevalent as shown in Table D-7, Appendix D. During some of the removal operations, associated contaminated soil was also excavated. However, documentation that includes analytical results of surrounding soils is rarely available to support these past cleanup operations, particularly those that took place long ago.

Two examples of contaminated structures that have been decontaminated and decommissioned are the former GMX2 site in TA-16 and the trim building in TA-12. The GMX2 site was used for HE processing and in the 1960s, a major project was completed that involved the dismantling and removal of buildings, waste lines, and contaminated soil. According to LANL personnel, soil with an HE concentration of less than 0.5 percent was left in place. The location of the former GMX2 site is shown in Figure 4-40.

The trim building in TA-12, as depicted in Figure 4-41, was also used in processing HE. The building was burned in place during the decommissioning project and noncombustible materials were not removed.

LOCATION OF FORMER GMX2 SITE IN TA-16
LOS ALAMOS NATIONAL LABORATORY

FIGURE 4-40

FIGURE 4-41

LOCATION AND SKETCH OF OLD TRIM BUILDING IN TA-12

4.5.1.8 Miscellaneous

The miscellaneous category of sites includes one-time experiments, underground chambers used for various tests, equipment with no explanation of its past use, and magazines that were only used for storage. A list of these sites is provided in Table D-8, Appendix D, with information on the suspected contaminant. The underground test chambers are discussed in Section 3.2.2.2.

4.5.2 Findings and Observations

4.5.2.1 Category I

None

4.5.2.2 Category II

None

4.5.2.3 Category III

1. Contamination of soil by radioactive and chemical liquid wastes. Former radioactive and chemical liquid waste disposal practices at the LANL have contaminated surface and/or subsurface soils, or potentially have resulted in such contamination, with unknown levels of residual contaminants possibly continuing to affect the environment.

Approximately 175 disposal sites have been identified at the LANL that received liquid effluents in the past which were contaminated with radionuclides or chemicals, or both. These sites were evaluated based on type of waste they received, quantity of waste, duration of use, location relative to public access, and potential for contaminant migration. Based on this review, the 11 sites listed below were noted to be of particular concern:

- MDA-T in TA-21
- Liquid waste disposal in TA-10
- Stormwater collection basins in TA-35

- Pond east of Buildings 89 to 93 in TA-16
- Plating shop outfall from Building 92 in TA-16
- Backfilled ponds adjacent to former Buildings 30 to 34 in TA-16
- Plating shop outfall from Building 52 in TA-22
- Sumps 69 and 70 in TA-46
- Septic tank 59 in TA-8
- Overflow from a cooling tower (TA-21-143) in TA-21
- HE processing outfall from Building 34 in TA-22

The following paragraphs provide specific information on each of these sites:

Material Disposal Area T in TA-21

Past disposal of 18 million gallons of raw and treated process effluent at MDA-T has resulted in radioactive contamination to a depth of at least 100 feet and in surface-soil contamination in an area accessible to the public that is outside the disposal site.

MDA-T is an inactive liquid waste disposal site which consisted of four subsurface absorption beds, approximately 100 shafts, and one pit. Use of this area began in 1945. It is unclear when it stopped receiving wastes.

Records indicate the following waste was disposed of in this area: uranium-233, plutonium-238, plutonium-239, americium-241, mixed fission products, and tritium. The largest amounts were disposed of between 1945 and 1952, when MDA-T received 14 million gallons of untreated waste from the plutonium processing conducted at DP West in TA-21. The concentration of the plutonium in this waste was estimated at 60 counts per minute and the average fluoride concentration was 160 parts per million. However, waste with average concentrations of plutonium of 7,000 counts per minute was received between 1951 and 1952.

Studies have shown vertical movement of radioactive contaminants to a depth of 100 feet (the depth limit of the investigation) and horizontal movement in terms of surface soil downgradient of the disposal area. In the soil sampling, cesium-137 and strontium-90 were found at levels in excess of 7,000 times background while

plutonium-239 was found at 100 times background. High levels of tritium were also found.

Further investigation of this area is planned under Phase II of the CEARP.

Liquid Waste Disposal in TA-10

Former liquid waste disposal practices at the TA-10 "Tank Farm" area in Bayo Canyon have potentially contaminated subsurface soils with radioactive wastes and other hazardous constituents. Liquid wastes were discharged to the surface and subsurface soils, and to the ephemeral stream in Bayo Canyon. Although the site has been closed for approximately 25 years and ownership transferred to Los Alamos County, the level of information concerning the extent of the residual contamination may be insufficient to ensure that the restricted-use agreement is adequate.

The restricted-use agreement between the LANL and the county disallows disturbance of contaminated soils within the demarcated area. However, there is a potential for pulsed migration of residual contamination outside the demarcated restricted zone, driven by:

- the ephemeral stream, which transects the restricted zone,
- and/or, seasonal pore water or perched groundwater.

Furthermore, there are no data on possible nonradiological contaminants that may remain at the former disposal site. These chemicals, such as nitric, hydrochloric, hydrofluoric, and sulfuric acids, metals, and reportedly smaller volumes of organic solvents were disposed of at the site.

During the Sampling and Analysis phase of the Survey, soil and water samples will be analyzed to determine the presence of contamination outside the restricted zone.

Stormwater Collection Basins at TA-35

Two stormwater collection basins on the southern side of TA-35 receive runoff that is potentially contaminated with PCBs and/or radionuclides due to the prevalence of past spills and areas of stained soil in the operational area of the TA.

Two elongated stormwater collection basins are located south of Buildings TA-35-236, 34, and 110. Based on the review of aerial photographs, these basins have existed in TA-35 for at least 20 years. Past operations in TA-35 include manufacturing radioactive sources using materials such as strontium-90, neptunium-237, germanium hydride, beryllium salts, and plutonium oxalate aerosols. Also, PCB-contaminated oil has been used extensively in this TA (DOE-AO, 1986). The two basins apparently have been long-time recipients of surface-water runoff from the process area where spills may have occurred and consequently they may have become contaminated. The western basin is approximately 60 feet long, 10 feet wide, and 8 feet deep. A breakthrough has occurred in the easternmost basin, which allows stormwater to flow down the side of the canyon.

During the Sampling and Analysis phase of the Survey, bottom sediments from these collection basins will be sampled and analyzed to determine the presence of contamination.

Pond East of Buildings 89 to 93 in TA-16

Process wastes containing HE, solvents, and possibly metals from drains in Buildings 89, 90, 91, 92, and 93 were disposed of in a pond east of the buildings, potentially leaving residual contaminants in the sediments.

Buildings 89, 90, 91, and 93 were used for processing HE in the 1950s. Plating operations took place in Building 92. The drains from these buildings reportedly discharged to a natural depression east of this group of buildings. The potential exists for HE, solvent, and possibly metal contaminants from the process wastewater to have accumulated in the pond sediments. A 1957 map of TA-16 depicts this area as a pond, and at the time of the Survey the pond contained water. However, according to LANL personnel, the pond dries out seasonally. The pond is approximately 150 feet in diameter.

During the Sampling and Analysis phase of the Survey, samples of liquid (if present) and sediment from this pond will be collected and analyzed to determine whether contaminants are present.

Plating Shop Outfall from Building 92 in TA-16

Untreated plating shop wastes were potentially discharged to a drainage swale north of Building 92 and residual contaminants may remain as a source of surface-soil contamination.

An area north of Building 92 is suspected of receiving untreated plating shop wastes from operations that took place in Building 92. This building was used in the 1950s and according to a LANL utility line map available during the Survey, an outfall from Building 92 was located on the opposite side of the road. This area is a natural drainage swale and at the time of the Survey, no evidence of an outfall pipe was noted; however, observations were hindered by snow cover.

During the Sampling and Analysis phase of the Survey, soil samples will be collected and analyzed from the drainage area. The analytical results will be compared to background soil sample results to determine if constituents indicative of plating operations are present at elevated concentrations.

Backfilled Ponds Adjacent to Former Buildings 30 to 34 in TA-16

Effluent from HE machining operations in Buildings 30, 31, 32, 33, and 34 was discharged to four ponds that have been backfilled, potentially creating elevated levels of HEs in the pond sediments.

High explosives machining work was conducted in the 1950s in a complex of buildings numbered 30 to 34. The types of HE used are unknown but at a minimum likely included TNT. Apparently, the wastewater from these operations was disposed of in four ponds adjacent to the buildings. The complex of buildings has been removed and the four ponds backfilled. Although some photographs of this work are available, there is no record indicating removal of the sediments, which

were probably contaminated with HE. Thus, potential HE contamination remains in the subsurface soils.

During the Sampling and Analysis phase of the Survey, subsurface-soil samples from the pond locations will be collected and analyzed to determine whether contamination from HEs is present.

Plating Shop Outfall from Building 52 in TA-22

Soils along the drainage from Building TA-22-52 are potentially contaminated as a result of past discharges from that building of etching and plating operations waste. Etching and plating operations were conducted in this building from 1953 to 1984.

These operations as well as photoprocessing and other contributions from the Shops building include sodium hydroxide, hydrogen peroxide, sodium thiosulfate; ferric chloride; thallium; sodium carbonate; perchloroethylene; inorganic constituents such as beryllium, gold, lead, cyanide, nickel, copper, zinc, and cadmium; and acids such as sulfuric, hydrochloric, chromic, hydrofluoric, and phosphoric. The volumes discharged are unknown.

The vegetation in the outfall drainage area appeared stressed during the Survey. Numerous dead pines were observed.

Soil sampling has been performed by the LANL and samples are being analyzed for the presence of specific inorganic constituents and total organic halogens. At the time of the Survey, data analysis was not completed.

Sumps 69 and 70 in TA-46

Two inactive sumps that potentially received wastewater from a laboratory and shop building or a test building are located on the edge of the mesa and may contain contaminants that could leach into subsurface soils or break out on the wall of Canyon del Buey.

Information on the use of two sumps, 69 and 70, is very limited but judging from their location (see Figure 4-13), they may have received waste from Building 58, a laboratory and shop building, or from Building 16, a test building used in the design of a nuclear rocket reactor known as the Rover Program. Potentially the waste may have been contaminated with general laboratory chemicals such as solvents and various reagents or may have contained uranium, since Building 16 is known to be moderately contaminated with this radionuclide (DOE-AO, 1986). The sumps are very close to the wall of the Canyon del Buey and their wastes may have leached into subsurface soils and/or migrated to the canyon side. The sumps are approximately 3 feet in diameter and 8 feet deep. The two sumps are connected, with the overflow from Sump 70 entering Sump 69 (Lugar, 1987). According to the 1983 LANL structure location plan for TA-46, both sumps have been abandoned since 1973, which correlates with the time the Rover Program ended and limited radioactivity cleanup work was conducted at the TA (DOE-AO, 1986).

During the Sampling and Analysis phase of the Survey, sludge from Sump 70 will be sampled and analyzed to determine the presence of radioactive and/or chemical contaminants. Construction details of Sump 70 will also be examined to assess its integrity.

Septic Tank 59 in TA-8

Septic Tank 59 in TA-8 potentially received HE-contaminated waste from laboratories involved in development of explosives, and residual contaminants may remain as a source of pollution to surrounding soils.

TA-8 was first used as a gun-firing site to test projectiles, some containing uranium cover, and later used to develop HEs (DOE-AO, 1986). Wastewater from the old part of TA-8 apparently was disposed of in septic tanks, one of which is abandoned but still in place. The buildings themselves are posted with signs indicating that they are contaminated with HEs and radioactivity; therefore, the drains and associated septic tank are likely to be contaminated as well. It is uncertain whether the tank was connected to a drainfield. The topography in the vicinity of Tank 59 allows surface-water runoff to accumulate and periodically results in flooding. Although the tank has been inactive for years, it contained an estimated 3 to 4 feet

of liquid in June 1987, according to observations made by the Survey Sampling and Analysis team (Lugar, 1987). Thus, the tank apparently receives stormwater, and during flooding conditions, contaminants may be released from the bottom sludges in the tank and result in surface-soil and/or subsurface-soil contamination.

During the Sampling and Analysis phase of the Survey, samples of water and sludge will be collected from Septic Tank 59 and analyzed to determine if hazardous or toxic contaminants are present.

Overflow from a Cooling Tower (TA-21-143) in TA-21

The cooling water in Tower 143 was contaminated with plutonium and possibly contained chromium, which through regular overflow incidents and drift loss potentially contaminated surface soils in the TA and on the wall of Los Alamos Canyon.

The plutonium contamination was caused by plutonium processing conducted in Buildings TA-21-2, 4, and 5. The cooling water was reportedly contaminated in 1952 and 1953. Overflow from the tower was reported to be 30,000 to 40,000 gal/week, with a high of 150,000 gal/week in the summer (DOE-AO, 1986). Presumably, this water was released over the edge of the mesa into Los Alamos Canyon and the potential exists for surface soils to be contaminated with residual levels of plutonium. Furthermore, corrosion control additives used in the cooling tower may have included chromates, in which case, residual levels of chromium may be present in the surface soils too.

TA-21 is currently being addressed by the LANL under Phase II of the CEARP; therefore, soil sampling and analysis will not be performed as part of the Survey.

HE Processing Outfall from Building 34 in TA-22

These two outfall/drain tile systems may have contaminated soils in the marsh area located north of Building 34 in TA-22. This potential contamination may have been caused by the discharges from liquid wastes originating in the building which housed a photo laboratory and a chemistry laboratory that was involved with HE research and shape fabrication. The waste constituents reportedly are acetone; HE

consisting of PETN, possibly RDX and HMX; silver and other inorganics. Volumes or discharge rates were not reported but are not believed to have been excessively high due to the nature of the discharge mechanism -- clay drain tiles which allow the liquid wastes to leach into the soils.

There were also several other items of concern noted during the Survey which may provide additional contamination to the soils of this marsh area. A half-buried 55-gallon drum of unknown contents or origin was observed in the southeast area of the marsh. The northern end of the marsh contained concrete rubble and other miscellaneous debris. These may be indicative of past burial activities in this marsh.

The Sampling and Analysis phase of the Survey will address the presence of contaminants within the near-surface soil/sediments in the marsh. Assuming that some lateral migration has occurred, sampling will also be performed at the downgradient perimeter into the subsurface soils. The analysis of the samples will determine the presence and concentration of HEs, organics, metals, and environmental asbestos.

2. Lack of cleanup of past spills and releases: Past spills and releases that have occurred at the LANL have potentially resulted in surface-soil contamination yet in many cases actions to clean up these areas have not been initiated; therefore hazardous, toxic, and/or radioactive contaminants may remain as a source of pollution.

Past chemical spills and historical incidents of radioactive releases are known or suspected to have occurred in 19 TAs at the LANL. Most of these spills have potentially contaminated surface soils; some may have contaminated canyon walls. The spills were evaluated based on the date of occurrence, the type of substance involved, the potential for migration, and visual evidence of residual soil contamination or stressed vegetation noted during the Environmental Survey. As a result of this review, the four areas listed below were found to be of particular concern:

- Stained soil south of Building 207 in TA-35
- Stained soils north of Building 31 in TA-46

- Spills around Shed 197 in TA-46
- Spill at former TA-32 moving onto DOE property

Each of these areas is described in more detail in the following paragraphs.

Stained Soil South of Building 207 in TA-35

Numerous areas of dark stained soil indicative of past spills that potentially included PCB-contaminated oil exist south of Building 207 and have migrated down the wall of Mortandad Canyon.

Patches of stained soil exist throughout the area south of Building TA-35-207. The source of this contamination is believed to be spills and surface runoff from an upgradient area containing dielectric oil storage tanks. Large quantities of oil are required to operate the Marx generators located in TA-35 and in the past, the oil may have been contaminated with PCBs. Although the oil storage area is currently bermed, water that collects inside the bermed area is directed through an underground pipe to the area around Building 207. As discussed in Section 4.1, some of the soil in and around the storage tanks is grossly contaminated with oil. At least the upper 2 feet of soil on the southern end of the bermed area is heavily discolored by oil saturation. Consequently, drainage from this area has a high probability of being contaminated.

During the Sampling and Analysis phase of the Survey, soil samples will be collected and analyzed from the presumed source (see related finding in Section 4.1.2) and from the stained areas south of Building 207 to determine the type and concentration of contaminants present. In addition, stained areas down the canyon wall and if evident, at the bottom of the canyon, will be sampled to investigate the magnitude of contaminant migration.

Stained Soil North of Building 31 in TA-46

Several areas of soil stained as a result of past releases were observed north of Building 31 in TA-46 on the edge of the mesa, a location that is highly susceptible to migration down the wall of Canyon de! Buey.

Activities either currently or historically associated with Building 31 have resulted in generation of radioactive wastes. In support of these activities, there has been a tank used for cleaning metal containers and components, a drum storage area, and an equipment storage area next to the building. Based on this information, a wide variety of contaminants may be in the surface soils. Building 31 is located extremely close to the edge of the mesa; consequently, contaminants from spills on the northern side of the building are highly susceptible to migration via surface-water runoff down the canyon side.

During the Sampling and Analysis phase of the Survey, discrete spillage areas will be sampled and analyzed to determine the type and concentration of contaminants present.

Spills Around Shed 197 in TA-46

Potentially hazardous chemicals are leaking from equipment and possibly from various containers in Shed 197 and may be a source of surface-soil contamination in the vicinity of a storm drain.

Shed 197 is a storage area containing equipment that has leaked in the past and that appeared to be actively leaking an oil-like substance during the Environmental Survey. A cylinder labeled "Germane-poisonous gas" was stored among the pieces of electrical equipment, and several drums were stored outside the shed on the pavement. Portions of the wooden walls have become stained and darkened from absorbing the substances that have been released. Past spills have also stained the ground on the southeastern corner of the shed, which is upgradient of a stormwater drain. The drain daylights outside the TA fence and stained soils were noted at the discharge point.

During the Sampling and Analysis phase of the Survey, sediments in the storm drain and soils at the drain discharge point will be sampled and analyzed to determine whether contaminants are present and have migrated, via the storm drain, outside the TA fenceline.

Spill at Former TA-32 Moving onto DOE Property

A release of an oily, dark tar-like substance was observed in the old TA-32 area. The area was adjacent to a tank and fuel pump on property that is currently owned by Los Alamos County and used by the County Road Department. The area affected by the spill included DOE property and extended down the wall of Los Alamos Canyon. Signs of vegetation stress were evident.

During the Sampling and Analysis phase of the Survey, surface-soil samples will be obtained from the stained and/or eroded area and analyzed to determine the presence and concentration of contaminants.

3. Potential undetected releases from USTs of hazardous and radioactive liquids to surface and subsurface soils. Some USTs at the LANL formerly used for storage of petroleum products and radionuclides have been abandoned in place or removed. Summary data for these tanks are given in Table 4-32. These abandoned and removed tanks are of concern because little is known of their potential for leakage.
 - Tanks abandoned without removal of contents have a high potential for undetected leakage. The potential for environmental problems associated with these tanks is related to the age of the tanks, the time since abandonment, the amount of material remaining in the tank, and the nature and toxicity of the contents. Of particular concern are those tanks abandoned some years ago. Tanks TA-6-47, TA-8-60, TA-8-61, TA-15-48, TA-15-52, TA-18-104, TA-35-18, TA-35-19, and TA-35-20 were all abandoned more than 13 years ago and are of unknown age and inventory. Concerns over removed tanks are related to the time period when the tanks were removed. Recent tank removals appear to be well-documented with respect to removal of residual contamination. Much less is known about tanks removed many years ago. Of particular concern are tanks TA-1-240, TA-2-29, TA-2-67, TA-16-512, and the tank farm at TA-10. These tanks were all removed 20 or more years ago and the status of residual contamination at these sites is largely unknown.

- Two tanks located at TA-21-107 and TA-21-108 formerly contained radioactive waste. The tanks are over 20 years old and are of unknown capacity. The tanks have been drained but contain a sludge which is suspected to be plutonium contaminated (personal communication with LANL personnel). The tanks are included as part of MDA-A.

During the Sampling and Analysis phase of the Survey, samples will be collected near abandoned tanks TA-6-47, TA-8-60, TA-8-61, TA-35-19, and TA-35-20 and at the DP Road Tank Farm. The objectives of the sampling are to detect any releases of hazardous materials from USTs to subsurface soils, and to determine if abandoned tanks contain residual inventories of hazardous materials.

4. Potential chemical and radioactive contamination of surface soils at open dumps and boneyards. Chemical and radioactive wastes disposed of in open dumps and contaminated equipment stored in boneyards are a concern due to direct exposure of contaminants and have potentially resulted in surface soil contamination via resuspension and/or runoff.

Thirty open dumps and boneyards have been identified at the LANL. All open-dumping areas and open storage areas have potentially resulted in environmental contamination; however, 7 of the 30 LANL sites are of particular concern as sources of pollution based on the type of wastes or contaminated equipment exposed on the surface. These seven sites are:

- Open dump MDA-M in TA-0
- Open dump MDA-Z in TA-15
- Open dump in TA-14
- Boneyard in TA-14
- Boneyard in TA-36
- Incinerator Ash Dump in TA-00L
- Open dump at G Point in TA-15

The following paragraphs provide detailed information on each of these sites.

Open Dump MDA-M in TA-0

Asbestos, potentially hazardous chemicals, and possibly radioactive wastes are exposed in the open dump MDA-M, which is not fenced to prevent access and has no controls to prevent migration of wastes via surface-water runoff or resuspension.

MDA-M was opened in 1947 and remains as an uncontrolled open dump in TA-0. Although there is no inventory of wastes placed in this dump, some general waste types were observed at the dump during the Environmental Survey. These included: material that resembled asbestos; numerous, unlabeled glass bottles with some containing liquids; old, discarded paint, solvent, and trash containers; and piles of concrete and metal construction rubble. In a smaller dump on the side of the road leading to MDA-M, radioactively contaminated waste had been disposed of in the past, according to LANL personnel.

No effort has been made by the laboratory to restrict access to the dump or to control migration of wastes from the disposal area. Movement of contaminants by surface-water runoff is likely to have occurred. Dispersal of asbestos and other contaminants by resuspension is also a concern; however, MDA-M is in a relatively isolated location where workers are not likely to be exposed.

During the Sampling and Analysis phase of the Survey, surface soils around the waste material will be sampled and analyzed to identify potentially hazardous or radioactive contaminants. Soils in the major drainage pathway downgradient from MDA-M will also be sampled to evaluate whether contaminants have migrated by surface-water runoff.

Open Dump MDA-Z in TA-15

Radioactively contaminated material has been disposed of in an open dump, MDA-Z, with no physical controls in place to ensure prevention of direct contact of employees of LANL with the wastes or to reduce the potential of environmental pollution, particularly surface-soil contamination.

MDA-Z was used from 1965 to 1981 for disposal of debris collected from the firing sites at TA-15. Blast mats contaminated with uranium and possibly other

radionuclides have been placed in this dump, along with sandbags and other firing site debris that are potentially contaminated with uranium, beryllium, lead, and mercury. The total volume of wastes disposed of at this open dump is unknown. During the Survey, radiation measurements of up to 20,000 counts per minute were detected at MDA-Z. Contaminants from MDA-Z are available for migration into the surrounding soils by surface-water runoff and/or resuspension.

During the Sampling and Analysis phase of the Survey, soil samples from MDA-Z will be collected and analyzed to determine the presence of radioactive contaminants or potentially hazardous substances.

Open Dump in TA-14

Potentially contaminated debris from the firing sites in TA-14 has been dumped in a drainage pathway near Buildings Q-34 and Q-40 and may be a source of contamination to surface soils down the canyonside.

Firing site debris from TA-14 including sandbags and blast mats have been disposed of along the edge of a paved area and across an erosion gully that leads into Canyon de Valle. During the Survey, several 5-gallon containers and one 55-gallon drum were observed on the canyonside below this dumping area. Firing site debris is commonly contaminated with HEs, metals, and possibly radionuclides; therefore, the wastes placed in this dumping area may be contaminated with one or more of these constituents. Migration of contaminants, if present, may be enhanced because the debris is directly located in a drainage pathway.

During the Sampling and Analysis phase of the Survey, surface soil samples will be collected from the drainage pathway, immediately downgradient of the dump area, and analyzed to determine the presence of contaminants that are commonly associated with firing sites.

Boneyard in TA-14

Storage of radioactive metal ingots, previously used rums, and other debris in a boneyard in TA-14 may result in contamination of surface soils.

During the Survey, a boneyard was visited in TA-14, north of Buildings Q-34 and Q-40. Equipment such as an old Navy cannon and gun parts were stored in this area, along with stockmetal ingots and fourteen 55-gallon drums. Radiation measurements of up to 4,500 counts per minute were noted next to the metal ingots. The drums were once used in an experiment involving sodium and their current condition was poor. The drums were open-topped, slightly rusted, and appeared to have burst sometime in the past. Surface soils in this boneyard are potentially contaminated as a result of this equipment and drum storage.

During the Sampling and Analysis phase of the Survey, surface soils in this boneyard will be sampled to determine the presence of contamination.

Boneyard in TA-36

There is a potential for surface soil contamination and direct contact by LANL workers to radioactive and toxic chemical materials stored in a boneyard in TA-36.

A boneyard in TA-36 is used for storage of radioactively contaminated equipment, old chemical containers, full cans of isopentane, and various other equipment used in tests conducted at the TA. During the Survey, field radiation measurements next to a piece of equipment known as a collimator were up to 14,000 counts per minute, presumably due to the yellow particles seen on the equipment that were believed to be uranium. The boneyard is also used for storage of chemical containers, some full and others apparently empty. The equipment and containers stored (both in the past and currently) may be a source of contamination that either workers could come into contact with or may be washed onto surface soils.

During the Sampling and Analysis phase of the Survey, surface-soil samples will be collected from areas around the stored equipment and containers and analyzed to determine the presence of either radioactive or chemical contaminants.

Incinerator Ash Dump in TA-OOL

Incinerator ash with unknown constituents has been dumped over the edge of the mesa into Pueblo Canyon and is a potential source of toxic contaminants to surface soils downslope via surface-water runoff and erosion.

An incinerator that is now inactive once operated near the airport and was used to dispose of wastes, including combustible and metallic wastes generated by the LANL. An inventory of the wastes taken to this incinerator does not exist and the period of its operation is unclear. However, the ash from the incinerator was disposed of over the edge of the mesa and currently remains there. Fragments of metal and tin cans were evident among the piles of ash at the time of the Survey. Since the constituents of the ash are unknown, this surface dump is a potential source of contaminants that may migrate to adjacent soils.

During the Sampling and Analysis phase of the Survey, surface soils will be sampled downslope of the piles of ash to determine if contaminants are present.

Suspected Dump at G Point in TA-15

A source of radioactively contaminated soil is located at G Point that is available for migration to surface soils or inadvertent direct contact to LANL workers.

During the Survey, field radiation measurements taken in a depression at G Point in TA-15 found that the soil in and around this area is radioactively contaminated. No information was available from LANL personnel regarding this area; however, due to its proximity to the firing site it is reasonable to assume that the depression has been an accumulation point for contaminated soil from Firing Point G. In addition to radionuclides such as uranium, firing site debris is often contaminated with beryllium, lead, and other metals. Therefore, the dump area may be contaminated with these other types of constituents. Also, there is a potential that solvents may be present if spills occurred in the past at the nearby solvent shed.

The disposal practices of Firing Point G have resulted in radioactively contaminated soil and may present a continuing problem of contaminant migration to surface soils through surface-water runoff and/or wind resuspension and a potential problem of worker exposure through inadvertent direct contact.

During the Sampling and Analysis phase of the Survey, surface-soil samples will be collected in and around this depression and analyzed to determine the presence of contaminants.

5. Potential transport of chemical and/or radioactive contaminants from inactive landfills and burial areas. A total of 49 inactive landfills, burial areas, and former burn pits have been identified at the LANL that either are known to contain radioactive and/or chemical waste or potentially contain residual waste which may be a source of contamination to subsurface soil and the vadose zone or, if inadequately covered in the past, may have contaminated surface soils downslope.

The closed landfills, burial areas, and formerly used burn pits at LANL were evaluated during the Survey. Factors such as the types of waste (known or suspected), volume of waste or reported size of the area, location relative to potential migration pathways (i.e. mesa top, edge of mesa top, floor of canyon), and history of use were reviewed. From this evaluation, 12 sites were found to be of particular concern. These sites are as follows:

1. MDA-B in TA-21
2. MDA-C in TA-0
3. Airport landfill in TA-00L
4. Two waste disposal pits in TA-39
5. Area 1 in TA-20
6. Suspected landfill in TA-33
7. Suspected landfill in TA-46
8. MDA-F in TA-6
9. MDA-N in TA-15
10. Suspected landfill, known as the "Cold Dump," in TA-21
11. Suspected burn pit in TA-10
12. Three suspected disposal pits in TA-6

The following paragraphs describe each of these areas in detail.

MDA-B in TA-21

An inactive landfill on the western end of TA-21 known as MDA-B was used for disposal of radioactively and chemically contaminated waste and is a potential source of contamination to subsurface soils and the vadose zone; and, if

inadequately covered in the past, contaminants may have been transported to surface soils downslope.

MDA-B is a 6-acre landfill that was opened in 1945 as the first solid waste disposal area of LANL and closed in 1950 (Reynolds, C., 1987). Radioactive wastes in the landfill likely include plutonium, polonium, uranium, americium, curium, radioactive lanthanum, actinium, and mixed fission products from the reactor known as the Water Boiler. Wastes were reportedly packaged in cardboard boxes or wrapped with paper (Rogers, M. A., 1977). An inventory of the waste volume and curie content is not available. Waste chemicals deemed hazardous by LANL personnel were also placed in MDA-B and include: organics, perchlorates, ethers, solvents, other spent chemicals, and corrosive gases (DOE-AO, 1986).

The volume of waste placed in MDA-B was not recorded. Also, there is an uncertainty whether the landfill is one large, continuous pit or a series of six pits. During its operation, wastes in MDA-B were probably not covered daily. Also, spontaneous fires occurred (Rogers, M. A., 1977) and may be indicative of mixed radioactive and hazardous chemical waste disposal. These past operational practices may have allowed contaminants to migrate beyond the present-day fenced portion of the landfill. The location of the landfill is very close to the edge of the mesa top; therefore the canyon wall on the downslope side of MDA-B may have received contaminated runoff. In addition, wastes placed in MDA-B may be a continuing source of contamination to subsurface soils and the vadose zone.

The LANL CEARP Program is addressing all of TA-21, including MDA-B; therefore, the landfill will not be sampled during the Sampling and Analysis phase of the Survey.

MDA-C in TA-0

An inactive landfill known as MDA-C received radioactively contaminated wastes and free liquids that were chemically contaminated, which may result in contamination of subsurface soils, the vadose zone, and if inadequately covered in the past, surface soils downslope may also be contaminated.

MDA-C is an approximately 12-acre landfill that is fenced and located in TA-0 near the head of Mortandad Canyon. The landfill operated from 1948 to 1974 for disposal of both radioactive and chemical wastes. MDA-C consists of 7 pits and 107 vertical shafts, with the deepest waste burial recorded to be about 25 feet.

The pits were not lined, nor were most of the shafts. Radioactive wastes placed in MDA-C included uranium-233, 234, 235, 236, and 238; plutonium-239; americium-241; tritium; sodium-22; cobalt-60; strontium-90; fission products; and induced activity. The total inventory (decayed through January 1, 1973) was reported to be 49,682 curies. The types of chemical waste placed in the landfill were not specifically recorded, but included a large variety of chemicals, pyrophoric metals, hydrides, powders, and compressed gases. HEs were reportedly not disposed of in MDA-C.

The operational practices used at MDA-C were similar to those used at MDA-B, with the lack of daily cover and the occasional occurrence of spontaneous fires. Consequently, the downslope side of MDA-C, which is the head of Mortandad Canyon, may have received contaminated runoff. Also, the waste placed in MDA-C may be a continuing source of contamination to the subsurface soils and the vadose zone. Only recently in 1984 were surface stabilization measures completed at MDA-C by the LANL, which may help to reduce the potential for downward migration.

During the Sampling and Analysis phase of the Survey, soil gas samples from the perimeter of MDA-C will be collected and analyzed. The results will be used as an indicator of whether contaminants are migrating in the shallow vadose zone. Also, surface soil samples will be collected along the drainage pathway downslope of MDA-C and analyzed to determine the presence of contaminants.

Airport Landfill in TA-00L

The inactive landfill at the county airport received waste from the LANL, some of which was radioactively contaminated and some that was nonradioactive but potentially hazardous, and may be a potential source of contamination to surface and/or subsurface soils and the vadose zone.

The landfill, located near the Los Alamos County Municipal Airport, was opened and operated by the LANL until 1966, at which time ownership was transferred to Los Alamos County. LANL-generated waste placed in the landfill was primarily sanitary wastes from the residences in the townsite. However, reports indicate that 125 pounds of uranium were disposed of at the landfill, of which 25 pounds were recovered and taken to another LANL landfill. Also, HE and chemically contaminated wastes were possibly taken to this landfill, according to a LANL report (DOE, 1986). During the time LANL operated the landfill, open burning of wastes was allowed.

Leachate has been observed flowing out of the landfill, and during the Survey, construction debris was observed protruding from the bank of the landfill that parallels Pueblo Canyon. Consequently, the landfill may be a source of surface soil contamination. Also, through infiltration and leachate generation, the landfill may be a source of contamination to subsurface soils and the vadose zone.

During the Sampling and Analysis phase of the Survey, samples of the shallow subsurface soils at the landfill will be collected and analyzed to determine the presence and concentration of hazardous or toxic chemicals, as an indication of contaminant migration.

Two Waste Disposal Pits in TA-39

Two pits reportedly exist in TA-39, located in Ancho Canyon, that were used for disposal of firing site debris and may be a source of contamination to subsurface or perched groundwater in the canyon. In addition to the firing site debris that was potentially contaminated with radionuclides, HE, and metals, two pits may have received other waste from the laboratory and shops in the TA.

Background information indicates that two waste disposal pits may exist north and northwest of Building 69 in TA-39. These pits are believed to be the precursor to MDA-Y, which is an active waste disposal area located farther north in Ancho Canyon. There are no reports listing actual waste types and quantities placed in the two pits; however, based on the nature of the activities in TA-39 and the current use of MDA-Y (see related finding in Section 4.1.2), the waste is likely to be firing site debris and general office trash with possibly a small quantity of solvents and

alcohols generated in the laboratory and shops at TA-39. Also, based on current practices, the two pits are probably unlined and, during their use, probably remained open with no application of daily cover.

The location of the two pits is not well-defined. Generally, they are believed to be adjacent to, and perhaps beneath, Building 69. A portion of this area has been paved for use as a driveway and as a volleyball/basketball court. Some of the area is not paved. A streambed, which was dry at the time of the Survey, is located immediately north of the suspected waste disposal pits. Past flow in this streambed or perched shallow zones of groundwater in Ancho Canyon may be pathways of contaminant migration from these disposal pits.

During the Sampling and Analysis phase of the Survey, a geophysical study will be performed in an attempt to further define the locations of these two inactive pits. Analytical results from sampling performed at the active disposal area, MDA-Y, will be applied to these inactive pits since they reportedly received the same type of waste.

Area 1 in TA-20

Radioactively contaminated metal scrap and debris may still be buried in an old covered pit or landfill, designated Area 1, in TA-20 and may be a potential source of subsurface soil contamination.

Area 1 was located at the eastern end of TA-20 in Sandia Canyon. This burial pit was apparently used only once in 1945, for the disposal of radioactively contaminated metal scrap and other debris possibly contaminated with beryllium, HEs, and/or uranium. The precise location of the burial pit in Area 1 is uncertain. Based on observations made during the Survey, a depression, approximately 5 feet deep and near the end of a dirt road, was suspected to be the burial pit location.

The LANL collected soil samples in 1985 and later performed a magnetometer study in Area 1, but neither task included the depression observed during the Survey. Since the area covered during the previous LANL work was limited, it is possible that the proper location of the waste burial pit remains uncertain and that wastes are available for migration to subsurface soils.

During the Sampling and Analysis phase of the Survey, additional geophysical studies will be performed. This will determine if anomalous conditions exist that may be indicative of past burial. If an anomalous condition does exist, then subsurface soil samples will be collected and analyzed to determine whether hazardous or radioactive contaminants are present.

Suspected Landfill in TA-33

In TA-33, there is a suspected landfill on the edge of the mesa top, based on observations of exposed debris that may be a source of radioactive and metal contamination to surface soils in the adjacent drainage pathway.

On the southernmost mesa top in TA-33 (Tower Area), near Building TA-33-26, metal fragments and debris were observed along the rim of the mesa that may represent an inactive landfill. This portion of TA-33 was used as a firing site, including tests on mechanisms required for the assembly of weapons. The types of waste generated from these activities typically include debris and soil that is contaminated with radioactive isotopes, usually uranium; beryllium; various other metals, such as lead; and sometimes HE. General practices at the LANL firing sites have included occasional clearing of fragments, etc. in the working area and regrading as needed. It is possible that this waste was placed along the edge of the mesa and gradually accumulated to form the suspected landfill. TA-33 is located far from the formally designated LANL landfills.

The side of the suspected landfill on the edge of the mesa is approximately 80 feet long and has an assortment of debris exposed. Rainfall and snowmelt runoff crossing this face of the landfill and entering the drainage pathway may transport contaminants down the side of Chaquehui Canyon.

During the Sampling and Analysis phase of the Survey, soil samples will be collected from the face of the landfill and in the receiving drainage pathway to determine the presence and, to a limited extent, the migration of contaminants from the suspected landfill.

Suspected Landfill in TA-46

A landfill is suspected to exist in TA-46 on the edge of the mesa draining into Canyon del Buey that is a potential source of radioactive, metal, organic, or asbestos contamination to surface soils.

Based on historical aerial photographs dating back to 1964, the CEARP Phase I report (DOE-AO, 1986), and observations made during the Survey, a landfill is suspected to exist in TA-46 along the edge of the mesa that drains into Canyon del Buey. No waste disposal records exist for this landfill. Concrete rubble, asphalt, and general construction debris were noted to be exposed down the side of the fill area. Assuming the waste placed in the fill included material generated from TA-46, radioactively or chemically contaminated objects/debris may have been placed in this area. Also, the construction debris may have included asbestos that could gradually be exposed due to erosion or that is currently exposed on the surface.

During the Sampling and Analysis phase of the Survey, soil samples will be collected from the face of the landfill and downslope at the head of the canyon and analyzed to determine the presence of contaminants.

MDA-F in TA-6

An inactive landfill known as MDA-F and other nearby disposal pits in TA-6 may be a potential source of radioactive and HE contamination to subsurface soils and the vadose zone.

MDA-F is located within TA-6. Two known locations of past waste burial are presently restricted and fenced off. Two or more other burial sites may exist in this area, as indicated by the CEARP Phase I report (DOE-AO, 1986). Reportedly, preliminary findings of a surface geophysical study conducted under the CEARP support this information, with anomalies identified outside the fenced area.

Several pits were excavated in MDA-F in 1947 for the burial of wastes and contaminated objects. These materials included classified, large metal parts; tub-alloy; HEs; primacord; casings with equipment associated with a plutonium

implosion weapon known as "Fatman"; and other metal parts from the laboratory (DOE-AO, 1986). The size of the additional pit(s) and the total quantity of wastes disposed of is unknown.

This site will not be sampled during the Sampling and Analysis phase of the Survey, since it is continuing to be studied under the CEARP.

MDA-N in TA-15

A small landfill in TA-15, known as MDA-N, is a potential source of HE and chemical contamination to subsurface soils and the vadose zone.

According to LANL records (DOE-AO, 1986), MDA-N existed as of 1965 and was used for disposal of materials or objects that were possibly contaminated with HEs or chemicals. The source of this waste was not reported, nor was other specific information on the type and quantity of waste. The landfill is estimated to occupy 0.1 acre and may be a source of contamination to subsurface soils and the vadose zone.

The landfill is covered with native soil and its boundary is not defined. LANL performed a geophysical study in 1985 or 1986 to better identify the extent of the landfill. The results were pending at the time of the Survey.

During the Sampling and Analysis phase of the Survey, the results of LANL's geophysical study will be reviewed if available or additional work will be performed so that points can be selected to collect subsurface soil samples for analysis to determine the presence of contaminants.

Suspected Landfill, Known as the "Cold Dump," in TA-21

Nonradioactive chemicals and hazardous wastes potentially were disposed of in a landfill in TA-21 known as the "Cold Dump" and may remain as a possible source of subsurface soil contamination.

The "Cold Dump" is presumably located on the northern side of the DP-site access road; however, the exact location and lateral extent are not known. Aerial

photographs from the 1940s indicate that the landfill may have been a series of unlined trenches grouped together north of MDA-B. Presently, this area is sparsely vegetated, with barren soil and tuff bedrock exposed. Several slight depressions were observed throughout the 200-foot by 100-foot area. A larger depression, approximately 40 feet in diameter, occurs in the southeastern portion of the suspect area. These surface disturbances may be indicative of past burial practices.

Records of the waste disposal practices, volumes of material, or specific chemicals disposed of in the landfill are not available. General memos are available in CEARP files that suggest use of this area for disposal of nonradioactive chemicals. Chemicals used in TA-21 that may have been placed in this landfill include but are not limited to lithium chloride; potassium chloride; zinc chloride; calcium salts; cadmium; lead oxides; mercury; oils, some possibly containing PCBs; solvents, ethylene glycol; and phosphoric acid.

Assuming these chemicals were disposed of in the "Cold Dump," then they may have leached into the subsurface soils. Horizontal migration toward the DP Canyon may have occurred along lateral passageways created by relief fractures in ash bedding planes.

During the Sampling and Analysis phase of the Survey, a geophysical study will be performed to determine if anomalous conditions exist that indicate past waste burial in this suspect area. Based on the results of the geophysical study, subsurface soil samples may then be collected for analysis to determine the presence and concentration of hazardous or toxic contaminants.

Suspected Burn Pit in TA-10

A shallow depression in TA-10 was observed during the Survey and is suspected of being a waste burn pit that may be a residual source of radioactive, HE or chemical contamination to subsurface soils.

According to the CEARP Phase I report (DOE-AO, 1986), a burn pit may have been used for waste disposal in TA-10 during its operation as a combined radiochemistry and firing site facility. A 1956 work order authorized excavation of a pit for disposal

and subsequent burning of combustibles. It further states that residual ash and noncombustibles should be removed and disposed of at a radioactive disposal site.

TA-10 was active from 1944 to the early 1960s, at which time it was decontaminated and decommissioned with follow-up cleanup conducted in 1976. Ownership of this area has been transferred to Los Alamos County, and it is open to the public.

During the Survey, a shallow depression 2 feet deep covering an area 10 to 15 feet in diameter was observed in Bayo Canyon, east of the firing sites area. Possibly this is one of the previously used burn pits.

During the Sampling and Analysis phase of the Survey, subsurface soils will be sampled and analyzed to determine the presence of HEs, radionuclides, or hazardous chemicals within the soils.

Three Suspected Disposal Pits in TA-6

Three areas in TA-6 are suspected of being disposal pits containing radioactively contaminated waste that may be a potential source of subsurface soil contamination.

CEARP files (DOE-AO, 1986) indicate the previous use of relatively small disposal pits within TA-6. Specifically, three were mentioned to have received weapons components contaminated with cesium-137 in the early 1950s. Other wastes may also have been disposed of at these areas. During the Survey, three shallow depressions were observed within approximately 70 feet of Twomile Mesa Road. These depressions may be indicative of the past disposal pits.

During the Sampling and Analysis phase of the Survey, surface and shallow-subsurface soils will be sampled and analyzed to determine the presence and concentration of radionuclides, hazardous or toxic chemicals, and HEs that may be in the soil.

6. Potential soil contamination from inactive firing sites. Past use of firing sites at the LANL has resulted in radioactive, metal, and possibly HE contamination of surface soil; however, all potential firing sites have not been identified, the

radial extent of contamination is not known, and some firing sites are located next to ephemeral streams or on the edge of a mesa where contaminant transport is likely to be enhanced.

Sixty-six inactive firing sites are on the LANL, as described earlier in Section 4.5.1. Although the type of soil contaminant varies depending on the type of shots or experiments conducted at the firing site, generally the contaminants include one or more of the following: radionuclides, commonly depleted uranium; metals, such as beryllium and lead; and HEs, some possibly containing barium. The frequency and duration of use would be expected to affect the concentration of contaminants in surface soil, as would the occurrence of shots that did not completely explode (i.e., "low-order" shots). The size of the HE charges used at a firing point and the presence of physical features are two major factors affecting the level and extent of surface-soil contamination in the impact zone of a firing site. Information relative to these factors that influence contamination at a firing site was reviewed during the Survey and as a result, six areas were noted to be of particular concern:

- Firing Point 7 in TA-39
- South mesa test shot area in TA-33
- Firing Site in TA-5
- Asphalt Pad Firing Site in TA-6
- "Concrete Saucer" Firing Site in TA-6
- Suspected firing site in TA-8

The following paragraphs provide specific information on each of these sites.

Firing Point 7 in TA-39

Surface soils at Firing Point 7 in TA-39 are radioactively contaminated and potentially are contaminated with various metals and HEs. Contaminant migration may be enhanced due to the presence of a streambed adjacent to the firing site.

Firing Point 7 in TA-39 was first used in the early 1950s to conduct experiments on virtually all types of metals, some of which required the use of HEs. The firing site is located at the base of Ancho Canyon and its zone of impact extends to the top of

the adjacent mesas. According to the CEARP Phase I report (DOE-AO, 1986), potential contaminants at this site include: beryllium, mercury, copper, brass, iron, lead, stainless steel, thallium, cadmium, chromium, thorium, and HEs such as RDX, HMX, Baratol, PETN, TATB, Composition B, and cyclotol. The date this firing site was taken out of operation was not provided in the background information.

During the Survey, LANL personnel identified uranium on surface soils at the firing site. Other small fragments and debris were also noted. A streambed is adjacent to the firing site with signs of erosion from past runoff leading off the firing pad toward the streambed. Potentially, surface contaminants are transported from the firing site via this drainage pathway.

This site will not be included in the Sampling and Analysis phase of the Survey; instead, the analytical results from sampling the active firing sites (see Section 3.2) will be applied to the inactive firing sites.

South Mesa Test Shot Area in TA-33

Surface soils and the downslope canyon wall may be contaminated with radionuclides, metals, and/or HEs from past experiments conducted at the firing sites on the south mesa of TA-33.

Beginning in 1947, the south mesa of TA-33 (TA-33-25, 26, 85, 146) was used to conduct test shots and experiments on initiators, a weapon component. The amount of HE in the shots ranged from 700 to 2,500 pounds. The types of contaminants usually associated with firing sites include uranium, beryllium, other metals such as lead, and HEs. The impact zone of the firing sites on TA-33 has not been well-defined but it is recorded that shrapnel reached off-site onto the property designated the Bandelier National Monument. The date this firing site area was no longer used is not reported in the available background information.

In 1986, the LANL conducted a limited cleanup action to remove larger pieces of shrapnel and debris; however, apparently no soil removal was involved. During this effort, surface soil samples were collected; the analytical results were pending at the time of the Survey. Metallic and various other debris with unknown constituents were noted during the Survey to be scattered on the surface soils

throughout the area. Drainage from this area flows off the mesa top and enters Chaquehui Canyon. The potential exists for radioactive, metal, and HE contaminants to be present in surface soils and the receiving drainage areas.

This site will not be included in the Survey Sampling and Analysis phase; instead, the results of the sampling effort performed at the active firing sites (see Section 3.2.2.1) will be applied to this firing site.

Firing Site in TA-5

A firing site located in TA-5 was decontaminated and decommissioned in 1985; however, the cleanup effort did not include the wall of the canyon which was likely part of the firing site impact zone and therefore may remain as a source of contaminants to surface soils and the ephemeral stream at the base of Mortandad Canyon.

TA-5 consisted of a firing site and other ancillary structures that were cleaned up based on radioactive contaminants in 1985. These cleanup actions were limited to the mesa top and included removal of contaminated soil; however, no cleanup or sampling has been performed on the canyon-side slope. Due to the proximity of the firing site to the canyon side, it is likely that the canyon wall was part of the impact zone of the firing site and thus may be contaminated. Contaminants suspected to be present are depleted uranium, metals, and various HEs. There is also evidence of runoff drainage down the canyon side into Mortandad Canyon. Transport of contaminants may occur due to this migration pathway.

During the Sampling and Analysis phase of the Survey, soil samples from the canyon-side slope will be collected and analyzed to determine the presence and concentration of radioactive and/or HE contaminants.

Asphalt Pad Firing Site in TA-6

Radioactive contamination remains in a sump and potentially in shallow subsurface soils at a firing site in TA-6 and is available for migration to subsurface soils. This firing site is located in TA-6 south of Twomile Mesa Road and west of MDA-F. This structure is an asphalt pad having a sump-like device in the central portion of its

2,500-square foot area. Previous use of this site has resulted in radioactive contamination of the sump-like structure. The surface of the pad and the surrounding area were sampled in 1978. Test results indicated uranium contamination, and phoswich readings were 3 to 6 times background. During the Environmental Survey, radioactivity measurements taken near this sump were on the order of 200 counts per minute above background levels. The remainder of the pad area measured at or near background levels of activity. The poor condition of the pad may have allowed contaminants to migrate into the environment. The pad has developed cracks and separations over the years. Contaminants may have mobilized via precipitation through the cracks and into the subsurface soils.

"Concrete Saucer" Firing Site in TA-6

Residual radioactive, HE, or metal contamination may exist in the sediments contained in a firing site structure known as the "concrete saucer" or in surrounding soils, continuing to be available for migration.

The firing site structure known as the "concrete saucer" was designed to contain the blast fragments resulting from a test shot. The firing site was first used in 1944. The dates and frequency of its use, and the types and quantities of material in the experiments were not available.

There is a potential for contamination to the surrounding environment due to the procedures at this firing site. Blast fragments may have accumulated outside the perimeter of the concrete saucer. Contaminated liquids may have leaked out of the saucer structure and into the subsurface soils. However, no radioactivity was detected in the surrounding area during the Survey.

During the Sampling and Analysis phase of the Survey, sediment samples will be collected from the bottom of this concrete structure and analyzed to determine the presence of HE, inorganic, or radioactive contamination.

Suspected Firing Site in TA-8

An area of mounded soil surrounded by trenches in TA-8 may be an inactive firing site with potential surface soil contamination.

During the Survey, distinctive land surface features were noted in an area west of Buildings 1, 2, and 3 in TA-8. A mound of soil with trenches on two sides exists in this area. Inquiries revealed that this area may be an inactive firing site for up to several hundred test shots. The CEARP Phase I report (DOE-AO, 1986) indicates that TA-8 was first used in 1943 by the Ordnance Division that performed ballistics tests, some with projectiles containing uranium. Whether this mounded area is related to these early operations is uncertain. Radioactive, metal, and/or HE contaminants may exist in the surface soils if this area was once a firing site.

During the Sampling and Analysis phase of the Survey, surface soil samples will be collected from the suspected firing site and analyzed to determine the presence of contaminants.

7. Potentially inadequate decontamination and decommissioning. Surface and shallow subsurface soils in the vicinity of contaminated structures that have been decontaminated and/or decommissioned may contain residual contaminants.

Two examples of decontaminated and decommissioned buildings are the GMX2 site in TA-16 and the trim building in TA-12. HE processing operations took place at both of these locations. The methods of decommissioning differed, however, as described below. Analytical data for soils indicating the residual levels of HE or other chemicals used in HE processing do not exist for either location.

GMX2 Site in TA-16

Chemical contaminants may remain in surface or shallow subsurface soils in the vicinity of the former GMX2 site in TA-16.

The buildings at the GMX2 site were once used to process HE. In the 1960s, a major decommissioning and decontamination effort was conducted, involving removal of the buildings, their waste lines, and soil contaminated with HEs. LANL files contain photographs of the operation. Discussions with LANL personnel indicated that soils were excavated and removed until a concentration of 0.5 percent HE was reached.

However, no analytical records are available to document that this level of cleanup was achieved or that no other contaminants were present.

During the Sampling and Analysis phase of the Survey, soil samples will be collected in the vicinity of the former GMX2 site to determine the presence and concentration of HE, organic, or inorganic contaminants.

Trim Building in TA-12

Chemical contaminants may remain in surface and shallow subsurface soils in the vicinity of the trim building in TA-12.

Solvents and HE materials were used at the old trim building in TA-12 from 1947 until the mid-1950s. These chemicals and explosives may have contaminated the environment surrounding the trim building from storage, spillage, or small-volume disposal of contaminated effluent. The building itself was burned during decontamination and decommissioning activities in 1960. The noncombustibles were left in place. These ashes and scrap were still visible during the Environmental Survey.

During the Sampling and Analysis phase of the Survey, soil samples will be collected and analyzed to determine the presence of contaminants.

8. Potential for additional, unidentified inactive waste sites. The DOE CEARP effort for the LANL facility included review of the University of California files on the laboratory but did not include the current support contractor, Pan Am World Services, and the formerly used support contractor, Zia.

Zia supported the laboratory from the 1940s to the 1980s and was responsible for maintenance activities including a paint shop, metal shop, furniture repair, etc. For some period of time, these shops were located on land in the town of Los Alamos that was historically owned by DOE (eastern end of TA-1). However, known or potential waste sites associated with these operations were not included in the CEARP effort.

Also, the CEARP effort included over 40 interviews to gather information on inactive sites. With the large number and variety of research and testing activities conducted at the laboratory over the past 40 years, additional interviews may supplement this data base which could potentially lead to identification of additional sites.

9. Potential exposure to chemical contaminants. Chemical contaminants may have been released to soils in the vicinity of the former TA-1 Sigma Building and if so, may present the potential for direct contact of private landowners with contaminants. Chemicals such as lead, chromium, cyanide, organic solvents and degreasers may have been used and possibly spilled in this area.

TA-1 was opened in 1943 and used for some of the first research activities on nuclear weapons conducted at the laboratory up until 1965. In the 1950s, TA-1 was in a transition period as operations were moved to TA-3. All activities ceased in 1965 and the land was transferred to Los Alamos County and to private landowners in 1966. Gradually during this period, structures and buildings associated with TA-1 were removed.

From 1974 to 1976, a major project to identify and remove residual levels of radioactive contaminants in TA-1 was conducted. The details of this operation are described in a 1977 LANL document titled "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico" (LASL, 1977). This work did not include testing for chemical contamination.

A large amount of soil excavation and removal followed by backfilling, was performed in the vicinity of D-Building, which is now the parking lot for a hotel, and along the D-Building waste line. Less soil removal took place on the western end of TA-1, including in the vicinity of the former Sigma Building. This building was used to process normal and enriched uranium and involved casting, machining, and power metallurgy (LASL, 1977). A cooling tower, drum storage areas, and incinerators also existed near the former Sigma Building. Chemicals that are suspected of being used in this area include metals such as lead, chromium, and cyanide, as well as organic solvents and degreasers.

There is a potential that chemicals exist in some soil areas and these areas remain unidentified because the previous site investigation and cleanup work addressed radioactivity only. Also, at the time of the Survey, portions of the former Sigma Building area were being developed as condominiums where earth-moving operations may expose and spread any chemicals that may have been deposited in the early years of production.

In response to this finding presented at the closeout to the Survey, LANL conducted a limited soil sampling effort in the vicinity of the Sigma Building and its cooling tower (HSE-8, 1987). Fourteen samples were collected; 10 surface soils and 4 shallow subsurface soils. Constituents detected using the EP Toxicity test included barium (0.03-2.7 mg/L) and lead (0.1 mg/L). The concentrations identified were below the EPA regulatory level used to classify RCRA wastes. Uranium was detected at 85 nanograms/g in one sample. This level is within the range typically found in Los Alamos County. The volatile 1,1,1-trichloroethane was detected in a soil sample at a concentration of 0.030 mg/L using the Toxicity Characterization Leaching Procedures (TCLP). This concentration is below that which EPA has proposed for classifying a RCRA waste.

This recent testing performed by the LANL used a leaching procedure that is designed to establish whether a substance is a hazardous waste according to RCRA. The major concern found during the Survey regarding TA-1 is that of direct contact by construction workers or by future residents to potentially contaminated soil. Additionally, operations with heavy earth-moving machinery create fugitive-dust problems that could result in an inhalation risk. These aspects of potential human exposure to toxic chemicals that may remain in the soil at TA-1 are not addressed using the RCRA leaching procedures. However, further sampling of this site has been prohibited by a lawsuit issued by the site developer.

4.5.2.4 Category IV

1. Potential soil contamination from "Miscellaneous" sites. A group of inactive sites representing one-time experiments, underground test chambers, single pieces of equipment or objects whose past use is unknown, and storage magazines may be sources of contamination to surface soil.

Approximately 40 sites have been grouped into a category called Miscellaneous. This group of sites includes areas used for experiments, underground test chambers, unusual objects, and storage magazines. There is a potential for contaminants to be present at some of these locations and, with the exception of the underground test chambers (see related finding 3.2.4.3), are possibly minor contributors to surface soil contamination.

PRELIMINARY

REFERENCES

Barr, A., 1987, personal communication with W. Murray, NUS.

Baytos, J. F., 1986. Memorandum from J. F. Baytos (LANL) to A. P. Torres (LANL), Subject: "Analyses of Soil Samples for Residual Explosives from Drainage Ditches at Sump Effluent Outlets," July 1, M-1, Los Alamos, New Mexico.

Bowen, B., 1987. Memorandum from B. Bowen to T. Gunderson, Subject: "July 22, 1986 Tritium Release at TA-33," March 26.

BNA (Bureau of National Affairs, Inc.), 1984. Section 107 Attainment Status Designations, Section 81.332, Environmental Reporter, Washington, D.C.

Carpenter, R.S., 1987. Memorandum from R.S. Carpenter to R. Bohn, Subject: "PCB Sampling," March 24, MEC-DO:RSC87-22, Los Alamos, New Mexico.

Cordell, L., 1978. Regional Geophysical Setting of the Rio Grande Rift, Geological Society of America Bulletin, Vol. 89, pp. 1073-1090.

Delta H Engineering, 1986a. Annual Reports on PCB Handling, the Los Alamos National Laboratory for Calendar Years 1982-1986, Santa Fe, New Mexico.

Delta H Engineering, 1986b. Spill Prevention, Control and Countermeasure Plan, Santa Fe, New Mexico.

Dewart, J., and T. Buhl, 1986. Memorandum from J. Dewart and T. Buhl to T. Gunderson, Subject: "Tritium Release at TA-33," November 14.

Dewart, J., and T. Buhl, 1987. Memorandum from J. Dewart and T. Buhl to T. Gunderson, Subject: "November 18, 1986 Tritium Release at TA-33," January 9.

DOE (U.S. Department of Energy), 1979. Final Environmental Impact Statement, Los Alamos Scientific Laboratory Site, Los Alamos, New Mexico.

DOE (U.S. Department of Energy), 1981. A Guide for Environmental Radiological Surveillance at U.S. Department of Energy Installations, DOE/EP-0023, Washington, D.C.

DOE (U.S. Department of Energy), 1986. Performance and Design Criteria for Systems Used in DOE Facilities to Sample and Measure Airborne Radionuclide Emissions to Comply with 40 CFR 61, Subpart H.

DOE-AO (DOE-Albuquerque Operations Office), 1986. Comprehensive Environmental Assessment and Response Program Phase 1: Installation Assessment, Los Alamos, Draft, June, Albuquerque, New Mexico.

Elder, J.C., E.J. Cox, D.P. Hohner, and A.M. Valentine, 1986. Radioactive Liquid Waste Lines Removal Project at Los Alamos (1981-1986), LA-10821-MS, Los Alamos National Laboratory, New Mexico.

Elder, J.C., and C.L. Knoell, 1986. TA-2 Water Boiler Reactor Decommissioning (Phase 1), Los Alamos National Laboratory, Los Alamos, New Mexico, October.

EPA (U.S. Environmental Protection Agency), 1979. "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, Washington, D.C.

EPA (U.S. Environmental Protection Agency), 1984a. "Compilation of Air Pollutant Emission Factors," Report AP-42, Supplement 15, Third Edition, January.

EPA (U.S. Environmental Protection Agency), 1984b. National Emission Standard for Radionuclide Emissions from Department of Energy Facilities, CFR 4060, Washington, DC.

EPA (U.S. Environmental Protection Agency), 1985. "National Emission Standards for Hazardous Air Pollutants: Standards for Radionuclides. Final Rules," Federal Register 50(25), 5190-5200, February 6.

EPA (U.S. Environmental Protection Agency), 1986a. "Guideline on Air Quality Models Revised," Report EPA-450/2-78-027R, July.

EPA (U.S. Environmental Protection Agency), 1986b. Groundwater Monitoring Technical Enforcement Guidance, Washington, DC.

EPA (U.S. Environmental Protection Agency), 1986c. Environmental Radiation Data Report 44-45 October 1985-March 1986, EPA 520/5-86-018, June.

EPA (U.S. Environmental Protection Agency), 1987. "Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks". Federal Register, Vol. 52, No. 74, pp. 12770-12786, April 17.

FR (Federal Register), 1986. Vol. 51, No. 189, page 34839, September 30, 1986.

FR (Federal Register), April 17, 1987.

Griggs, R.L., 1964. Geology and Ground-Water Resources of the Los Alamos Area, New Mexico, U.S., Geological Survey Water-Supply Paper 1753, p.107.

Guevara, F.A., and Dvorak, R.F., 1986. "An Overview of Airborne Radioactive Emissions at Los Alamos National Laboratory," Unpublished Draft.

HSE-8, 1987. Analytical Results of Verification Sampling, Former Main Technical Area (TA-1), Los Alamos National Laboratory, Los Alamos National Laboratory, May.

International Technology Corporation, 1987. Hydrogeologic Assessment of Technical Area 54, Areas G and L, Los Alamos National Laboratory, 301017.02, Albuquerque, New Mexico.

Kelly, T.E., 1975. Evaluation of Monitoring of Radioactive Solid-Waste Burial Sites at Los Alamos, New Mexico, U.S. Geological Survey Open-File Report 75-406, p. 82.

Kramer (Kramer, Callahan, and Associates), 1977. "Particulate Analysis of Drier Exhaust Emissions at the Zia Company Asphalt Plant, Los Alamos, New Mexico," September.

LANL (Los Alamos National Laboratory), 1982a. Long-Range Site Development Plan, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982b. Environmental Analysis of the Bayo Canyon (TA-10) Site, Los Alamos, New Mexico, LA-9252-MS, Los Alamos National Laboratory, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Environmental Surveillance at Los Alamos During 1983, LA-10100-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Environmental Surveillance at Los Alamos During 1984, LA-10421-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986a. Environmental Surveillance of Low-Level Radioactive Waste Management Areas at Los Alamos During 1985, LA-UR-87-139, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986b. Environmental Surveillance at Los Alamos During 1985, LA-10721-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986c. Meteorological Quality Assurance Program of the Los Alamos National Laboratory's Environmental Surveillance Group.

LANL (Los Alamos National Laboratory), 1986d. RCRA UST Notification Forms sent to U.S. Environmental Protection Agency, 1985-1986.

LANL (Los Alamos National Laboratory), 1987a. Environmental Surveillance at Los Alamos During 1986, LA-10992-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987b. Environmental Aspects of TA-49, Draft 2/27/87, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987c. Los Alamos National Laboratory Waste Management Site Plan, 1986, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987d. Pesticide and Herbicide Inventory July 1986, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987e. PCB Transformer Inventory for Fire Response Personnel, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. RCRA Part B Permit Application, Volume I (Text, Tables, and Figures), Volume II (Appendices), Volume III (Appendices), Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico, LA-6887, December.

LASL (Los Alamos Scientific Laboratory), 1978. Soil Survey of Los Alamos County, New Mexico, LA-6779-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979a. Final Safety Analysis Report for the Transuranic Contaminated Solid Waste Treatment Development Facility, LA-7971-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979b. Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Bayo Canyon, Los Alamos, New Mexico, DOE/EV-0005/15, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1980. Geohydrology of White Rock Canyon of the Rio Grande from Otowi to Frijoles Canyon, LA-8635-MS, Los Alamos, New Mexico.

Lugar, R.M., 1987. Personal Communication from Robert M. Lugar (Team Leader, INEL, for LANL Survey Sampling and Analysis) to Survey team during Sampling and Analysis Joint Conference Meeting.

MHSM (Mason Hangar-Silas Mason Co.), 1977. Disposal of Waste or Excess High Explosives, MHSMP-76-51.

NCRP (National Council on Radiation Protection and Measurements), 1975. Natural Background Radiation in the United States, NCRP Report 45, November 15.

Nyhan, J.W., B.J. Drennon, W.V. Abeele, M.L. Wheeler, et al., 1985. "Distribution of Plutonium and Americium Beneath a 33-yr-old Liquid Waste Disposal Site," Journal of Environmental Quality, Vol. 14, No. 4, October-December (reprint).

Purtymun, W., 1974. "Dispersion and Movement of Tritium in a Shallow Aquifer in Mortandad Canyon at the Los Alamos Scientific Laboratory."

Purtymun, W., J.R. Buchholz, and T.C. Hakonson, 1977. "Chemical Quality of Effluents and Their Influence on Water Quality in a Shallow Aquifer," Journal of Environmental Quality, Vol. 6, No. 1, p. 29.

Reynolds, C., 1987. Memorandum from C. Reynolds (LANL) to DOE Survey Team, Subject: "Near-term Plans for TA-21 Under CEARP Program," HSE 12-87-130, Los Alamos, New Mexico, April 13.

Rogers, M.A., 1977. History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T), LA-6848-MS, Vols. I and II, Los Alamos Scientific Laboratory of the University of California, under contract with U.S. Energy Research and Development Administration, Los Alamos, New Mexico.

Salgado, A.T., 1987. Memorandum from A.T. Salgado (LANL) to Distribution, Subject: "Conceptual Design Report - SPCC," February 18, ENG-9-155-87, Los Alamos, New Mexico.

TERA Corporation, 1984. Seismic Hazard Analysis for the Bendix, Los Alamos, Mound, Pantex, Rocky Flats, Sandia-Albuquerque, Sandia-Livermore, and Pinellas Sites: Final Report, Volume 1, prepared under contract to Lawrence Livermore National Laboratory.

Theis, C.V., and C.S. Conover, 1962. Pumping Tests in the Los Alamos Canyon Well Field near Los Alamos, New Mexico, U.S. Geological Survey Water-Supply Paper 1619-1, p. 24.

USGS (U.S. Geological Survey), 1985. Water Resources Data for New Mexico Water Year 1985, NM-85-1.

Valencia, H.E., 1986. Letter from H.E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Biennial Generators and Hazardous Waste Facilities," April 2, Los Alamos, New Mexico.

Vaughan, W.A., 1985. Memorandum from W.A. Vaughan (Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy) to Distribution, Subject: "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," August 5.

Wenzel, W. J., and R. Romero, 1986. Memorandum from W. J. Wenzel (LANL) and R. Romero (LANL) to D. Barnes (LANL), Subject: "Results of Survey at Buildings 257, 3, 4 at TA-21," October 2, #SE8-86-1094, Los Alamos, New Mexico.

PRELIMINARY

BIBLIOGRAPHY

1987. "Pesticide Usage at Los Alamos During 1986".

Adams, C. S., Jr. 1985. Letter from C. S. Adams, Jr. (LANL) to H. E. Valencia (DOE-LAAO), Subject: "NPDES Permit for Storm Water Runoff," August 13, ADTS-85-218, Los Alamos, New Mexico.

Adams, C. S., Jr. 1985. Letter from C. S. Adams, Jr., (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Status of Hazardous Waste Land Disposal Facilities," November 13, ADTS-85-411, Los Alamos, New Mexico.

Ahlquist, A. J., 1985. Memorandum from A. J. Ahlquist (LANL) to File, Subject: "Tritium Release at TA-41, 1/4-1/5/84," January 17, HSE8-85-60, Los Alamos, New Mexico.

Aragon, J., 1986. Letter from J. Aragon (LANL) to H. E. Valencia (DOE-LAAO), Subject: "1985 Radioactive Effluent/Onsite Discharges/Unplanned Release Reports," March 7, Los Alamos, New Mexico.

Aragon, J., ND. Letter from J. Aragon (LANL) to H. E. Valencia (DOE-LAAO), Subject: "1986 Radioactive Effluent/Onsite Discharges/Unplanned Release Reports," Los Alamos, New Mexico.

Aragon, J., ND. Letter from J. Aragon (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Draft Closure Plans for TA-54 Area L, TA-54 Area G and TA-16 Area P," Los Alamos, New Mexico.

Aragon, J., 1986. Letter from J. Aragon (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Intent to Conduct a Trial Burn at TA-50 Incinerator," April 24, Los Alamos, New Mexico.

Asher, S., 1984. Letter from S. Asher (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Notice of Violation," June 22, Santa Fe, New Mexico.

Baytos, J. F., 1986. Memorandum from J. F. Baytos (LANL) to J. L. Parkinson (LANL), Subject: "Analyses of Soil for Residual Explosives from Core Samples Taken at Pond TA-16-92," October 8, Los Alamos, New Mexico.

Baytos, J. F., 1986. Memorandum from J. F. Baytos (LANL) to A. P. Torres (LANL), Subject: "Analyses of Soil Samples for Residual Explosives from Drainage Ditches at Sump Effluent Outlets," July 1, M-1, Los Alamos, New Mexico.

Baytos, J.F., 1986. Memorandum from J. F. Baytos (LANL) to A. P. Torres (LANL), Subject: "Water Contaminants in the S-Site Retaining Pond TA-16," May 14, Los Alamos, New Mexico.

Bendix Field Engineering Corporation, 1985. Vadose Zone Characterization of TA Area 54, Waste Disposal Areas G and L, Los Alamos National Laboratory, New Mexico, Report 2: "Downhole Instrumentation and Pore-Gas-Sampling Data-Collection Procedures," Grand Junction, Colorado.

Bendix Field Engineering Corporation, 1986. Geophysical Logs for Holes Drilled in 1986, Los Alamos National Laboratory Vadose Zone Characterization,, Grand Junction, Colorado.

Bernard Johnson Inc., ND. Drawing of Seepage Pit Detail at New Detonator Facility, TA-22, LA-XA-C9 Sheet 15 of 120.

Betz, 1980. "Material Safety Data Sheet - Betz 2020 Dianodic II," Trevose, Pennsylvania.

Betz, 1980. "Material Safety Data Sheet - Betz Inhibitor 562C," Trevose, Pennsylvania.

Betz, ND. "Material Safety Data Sheet - Betz Slimicide C-30," Trevose, Pennsylvania.

Blackwell, L.A., ND. Letter from L. A. Blackwell (LANL) to H. E. Valencia (DOE-LAAO), Subject: "1983 Radioactive Effluent/ Onsite Discharges/ Unplanned Release Reports," Los Alamos, New Mexico.

Bohn, R., 1987. Memorandum from R. Bohn (LANL) to R. Carpenter (LANL), Subject: "PCB's Inventory for Mechanical Fabrication Division," January 2, HSE8-86-1441, Los Alamos, New Mexico.

Borduin, L. C., 1983. Letter from L. C. Borduin (LANL) to J. Bresson (DOE-AO), Subject: "Plan for Stabilization of Radioactive Materials Disposal Sites at the Los Alamos National Laboratory," HSE-7C-83-100, Los Alamos, New Mexico.

Bowen, B., 1987. Memorandum from B. Bowen (LANL) to T. C. Gunderson (LANL), Subject: "7/22/86 Tritium Release at TA-33," March 26, HSE8-87-375, Los Alamos, New Mexico.

Buchholz, J., 1986. Memorandum from J. Buchholz (LANL) to C. Nylander (LANL), Subject: "NOD Information," June 26, HSE-7-86-180, Los Alamos, New Mexico.

Buhl, T., 1986. Memorandum from T. E. Buhl (LANL) to T. C. Gunderson (LANL), Subject: "HCl Release at GMR 12/8/86," December 18, HSE8-86-1398, Los Alamos, New Mexico.

Buhl, T., 1987. List of Areas that Have Undergone Clean-Up Since 1980, Los Alamos, New Mexico.

Buhl, T., ND. Memorandum from T. Buhl (LANL) to T. Gunderson (LANL), Subject: "Dose Assessment in TA-33," Los Alamos, New Mexico.

BNA (Bureau of National Affairs, Inc.), 1986. "New Mexico Water Quality Act," Environmental Reporter.

Carpenter, R., 1987. Memorandum from R. S. Carpenter (LANL) to R. Bohn (LANL), Subject: "PCB Sampling," March 24, MEC-DO:RSC87-22, Los Alamos, New Mexico.

Cordell, L., 1978. Regional Geophysical Setting of the Rio Grande Rift, GSA Bulletin, Vol. 89, pp. 1073-1090.

Crismon, W., Jr., 1983. Letter from W. Crismon, Jr. (DOE-LAAO) to J. Ramey (NMOCD), Subject: "Groundwater Discharge Plan- Draft," June 28, ADTS-85-278, Los Alamos, New Mexico.

Crismon, W., Jr., 1983. Letter from W. Crismon, Jr (DOE-LAAO) to J. Sales (EPA-Region VI), Subject: "Incineration of PCB's," November 2, BLS:2258B, Los Alamos, New Mexico.

Crossman, C. K., 1987. Memorandum from C. K. Crossman (NMEID) to G. Laskar, (DOE-AO), Subject: "LANL Site Investigation," March 9, Santa Fe, New Mexico.

DOE (U.S. Department of Energy), 1979. Final Environmental Impact Statement Los Alamos Scientific Laboratory Site, Los Alamos, New Mexico, DOE/EIS-0018, Washington, D. C.

DOE (U.S. Department of Energy), 1986. Performance and Design Criteria for Systems Used in DOE Facilities to Sample and Measure Airborne Radionuclide Emissions to Comply with 40 CFR 61, Subpart H.

DOE-AO (U.S. Department of Energy - Albuquerque Operations Office), 1985. Comprehensive Environmental Assessment and Response Program Phase 2A: Installation Monitoring Plan Development Guidance, Working Draft, October, Albuquerque, New Mexico.

DOE-AO (U.S. Department of Energy - Albuquerque Operations Office), 1986. Comprehensive Environmental Assessment and Response Program, Los Alamos National Laboratory Potential CEARP Sites, June, Albuquerque, New Mexico.

DOE-AO (U.S. Department of Energy - Albuquerque Operations Office), 1986. Comprehensive Environmental Assessment and Response Program Phase 1: Installation Assessment, Los Alamos, Draft, June, Albuquerque, New Mexico.

DOE-AO (U.S. Department of Energy - Albuquerque Operations Office), ND. Comprehensive Environmental Assessment and Response Program (CEARP), Albuquerque, New Mexico.

DOE-AO (U.S. Department of Energy - Albuquerque Operations Office), ND. Section 148 of the Atomic Energy Act, Fact Sheet, Issue No. 1, Albuquerque, New Mexico.

DOE-AO (U.S. Department of Energy-Albuquerque Operations Office), 1986. Comprehensive Environmental Assessment and Response Program Phase 2: Generic Monitoring Plan, Working Draft, Albuquerque, New Mexico.

Davis, A. M., 1985. Letter from A. M. Davis (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "Correction of PCB Feedrate," February 25, Dallas, Texas.

Davis, A. M., 1986. Letter from A. M. Davis (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "Incomplete Part B Permit Application," May 29, Dallas, Texas.

Delta H Engineering, Ltd., 1986a. Annual Reports on PCB Handling, The Los Alamos National Laboratory for Calendar Years 1982-1986, Santa Fe, New Mexico.

Delta H Engineering Ltd., 1985. Area P Landfill Closure Plan, Santa Fe, New Mexico.

Delta H Engineering, Ltd., 1986c. Quality Assurance/Quality Control Manual for Sampling to Comply with the Clean Water Act, Resource Conservation and Recovery Act, and the Toxic Substances Control Act, Santa Fe, New Mexico.

Delta H Engineering, Ltd., 1986b. Spill Prevention Control and Countermeasure Plan, Santa Fe, New Mexico.

Devaurs, M., 1987. Letter from M. Devaurs (LANL) to R. J. Aiken (DOE-ESH), Subject: "Enclosed Information," April 22, ECMO-87-106, Los Alamos, New Mexico.

Devaurs, M., and W. D. Purtymun, 1985. Hydrologic Characteristics of the Alluvial Aquifers in Mortandad, Canada del Buey and Pajarito Canyons, Los Alamos, New Mexico.

Dewart, J., 1984. Memorandum from J. Dewart (LANL) to T. Gunderson and J. Ahlquist (LANL), Subject: "Tritium Release from TA-41," January 11, HSE8-84-27, Los Alamos, New Mexico.

Dewart, J. and T. Buhl, 1987. Memorandum from J. Dewart and T. E. Buhl (LANL) to T. C. Gunderson, Subject: "3/18/87 Tritium Release at Van DeGraff," March 27, HSE8-87-384, Los Alamos, New Mexico.

Dewart, J. and T. Buhl, 1986. Memorandum from J. M. Dewart and T. E. Buhl (LANL) to T. C. Gunderson (LANL), Subject: "Tritium Release at TA-33 10/30-10/31/86," November 14, HSE8-86-1266, Los Alamos, New Mexico.

Dewart, J. and T. Buhl, 1987. Memorandum from J. M. Dewart and T. E. Buhl (LANL) to T. C. Gunderson (LANL), Subject: "11/18/86 Tritium Release at TA-33," January 9, HSE8-87-1466, Los Alamos, New Mexico.

Dodd, A., 1955. Survey of Some Los Alamos County Canyons for Radioactive Contamination, Spring 1953 to Spring 1955, Los Alamos, New Mexico.

Drypolcher, A., 1987. Memorandum from A. Drypolcher (LANL) to D. Garvey (LANL), Subject: "DOE Survey Team Outbriefing 4/10," April 10, 5342577152OFV89, Los Alamos, New Mexico.

Drypolcher, A., 1987. Memorandum from A. Drypolcher (LANL) to J. Aragon (LANL), Subject: "Audits of Off-Site Hazardous Waste Treatment Facilities," January 5, HSE7-87-004, Los Alamos, New Mexico.

Duran, J. D., 1985. Letter from J. D. Duran (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Air Quality Permit Number 632," December 26, Santa Fe, New Mexico.

Duran, J. D., 1986. Letter from J. D. Duran (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Air Quality Permit Number 634," March 19, Santa Fe, New Mexico.

Duran, J. D., 1986. Letter from J. D. Duran (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Air Quality Permit Number 635," March 19, Santa Fe, New Mexico.

Duran, J. D., 1986. Letter from J. D. Duran (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Air Quality Permit Number 636," March 19, Santa Fe, New Mexico.

Elder, J.C., E.J. Cox, E.P. Hohner, and A.M. Valentine, 1986. Radioactive Liquid Waste Lines Removal Project at Los Alamos (1981-1986), LA-10821-MS, Los Alamos National Laboratory, Los Alamos, New Mexico.

ENG-5, 1986. Memorandum from ENG-5 (LANL) to Distribution (LANL), Subject: "Technical Area Numbers and Nomenclatures Report," September 5, ENG-5-86-582, Los Alamos, New Mexico.

EPA (U.S. Environmental Protection Agency), 1984a. Compilation of Air Pollutant Emission Factors, Report AP-42, Supplement 15, Third Edition (January).

EPA (U.S. Environmental Protection Agency), 1984b. National Emission Standard for Radionuclide Emissions from Department of Energy Facilities, CFR40, Part 60, Washington, DC.

EPA (U.S. Environmental Protection Agency), 1986. Guideline on Air Quality Models Revised, Report EPA-450/2-78-027R.

EPA (U.S. Environmental Protection Agency), 1986. Groundwater Monitoring Technical Reinforcement Guidance, Washington, D.C.

EPA Region VI, 1979. NPDES Determination, Dallas, Texas.

LEPA Region VI, 1986. Federal Facility Compliance Agreement, Dallas, Texas.

EPA Region VI, ND. Environmental News, EPA Approval of Incineration of PCB at LASL, Dallas, Texas.

EPA-ORP (U.S. Environmental Protection Agency, Office of Radiation Programs), 1983. Background Information Document, Proposed Standards for Radionuclides, Draft, Washington, D. C.

Ellvinger, J., 1986. Letter from J. Ellvinger (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Findings of January 28-29, 1986 Hazardous Waste Inspection," May 8, Santa Fe, New Mexico.

Ellvinger, J., 1987. Letter from J. Ellvinger (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Completeness Review of Permit Application," January 30, Santa Fe, New Mexico.

Federal Register, 1987. Washington, D.C., April 17.

Field, L., 1986. Memorandum from L. Field (LANL) to A. Drypolcher (LANL), Subject: "QC Report for Samples Sent to Rocky Mtn. Analytical," December 19, Los Alamos, New Mexico.

Fort, D., 1984. Letter from D. Fort (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Progress of EID, Notice of Violations, Summary of Two Meetings," October 26, Santa Fe, New Mexico.

Fort, D., 1985. Letter from D. Fort (NMEID) to H. E. Valencia (DOE-LAAO) and D. Kerr (LANL), Subject: "Compliance Order/Schedule," May 7, Santa Fe, New Mexico.

Fort, D., 1985. Letter from D. Fort (NMEID) to H. E. Valencia (DOE-LAAO) and Dr. D. Keer (Univ. of Calif./LANL), Subject: "Compliance Order/Schedule," May 7, Santa Fe, New Mexico.

Fort, D., 1985. Letter from D. Fort (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Notice of Violation," August 26, Santa Fe, New Mexico.

Fort, D., 1985. Letter from D. Fort (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Penalties for Violations of Compliance Order," October 25, Santa Fe, New Mexico.

Gallegos, A., 1984. Letter from A. Gallegos (DOE-LAAO) to D. Fort (NMEID), Subject: "List of References Provided to NMEID," October 25, Los Alamos, New Mexico.

Gallegos, A., 1986. Memorandum from A. Gallegos (DOE-LAAO) to J. Aragon (LANL), Subject: "Biennial Hazardous Waste Report Forms," February 19, P-0016A, Los Alamos, New Mexico.

Garcia, C. E., 1986. Letter from C. E. Garcia (DOE-AO) to NMEID, Subject: "Notification of Underground Storage Tanks," May 5, Albuquerque, New Mexico.

Garcia, C. E., 1986. Memorandum from C. E. Garcia (DOE-AO) to J. R. Barker (DOE-HQ), Subject: "Inventory of Hazardous Waste Facilities," January 16, Albuquerque, New Mexico.

Garvey, D., 1987. Letter from D. Garvey (LANL) to R. J. Aiken (DOE-ESH), Subject: "Additional Information," March 10, ECMO-87-61, Los Alamos, New Mexico.

Garvey, D., 1987. Letter from D. Garvey (LANL) to R. J. Aiken (DOE-ESH), Subject: "List of Active TA's and Security Levels, SOP's for Water and Wastewater Operations," March 13, ECMO-87-70, Los Alamos, New Mexico.

Good, M., 1982. "Flow Sheet of Discharge Plan Procedures under Part 3 of the Water Quality Control Commission Regulations," April 2, 1980, Annotated March 8.

Graham, J. L., Jr, 1986. Letter from J. L. Graham, Jr. (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "Closure of Administrative Order Docket No. VI-85-028," October 15, Dallas, Texas.

Griggs, R.L., 1964. Geology and Ground-Water Resources of the Los Alamos Area, New Mexico, U.S. Geological Survey Water-Supply Paper 1753, p. 107.

Guevara, F.A., and R.F. Dvorak, 1986. An Overview of Airborne Radioactive Emissions at Los Alamos National Laboratory, Draft.

Gunderson, T.C., R.W. Vocke, and A.K. Stoker, ND. Comprehensive Environmental Assessment and Response Program, Los Alamos, New Mexico.

Hale, C. B., 1985. Letter from C. B. Hale (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "March 14, 1985 Response to Administrative Order No. VI-85-028," April 19, Dallas, Texas.

Harrison, A., 1980. Letter from A. Harrison (EPA-Region VI) to K. R. Braziel (DOE-LAAO), Subject: "Approval for PCB Landfill" June 5, Dallas, Texas.

Holm-Hansen, T., 1986. Memorandum from T. Holm-Hansen (PanAm) to J. J. Lopez (Pan Am), Subject: "Transformers on Sigma Mesa," September 22, PENV-211, Los Alamos, New Mexico.

Holm-Hansen, T., 1987. Letter from T. Holm-Hansen (Pan Am) to D. Garvey (LANL), Subject: "Survey Information," March 9, Los Alamos, New Mexico.

Holm-Hansen, T., 1987. Letter from T. Holm-Hansen (Pan Am) to D. Garvey (LANL), Subject: "Response to Survey Team Findings," April 10, THH87-52, Los Alamos, New Mexico.

Hurdle, R, 1987. Letter from R. Hurdle (LANL) to M. Devaurs (LANL), Subject: "Los Alamos Safety Analysis Reports," January 19, HSE-1-RCH-24, Los Alamos, New Mexico.

International Technology Corporation, 1986. Underground Storage Tank Management Program, Los Alamos National Laboratory, Los Alamos, New Mexico, Volume I - Text, Tables Figures, and Appendices B-F, Draft, Project 301017, Albuquerque, New Mexico.

International Technology Corporation, 1986. Underground Storage Tank Management Program, Los Alamos National Laboratory, Los Alamos, New Mexico, Volume II - Appendix A Draft, Project 301017, Albuquerque, New Mexico.

International Technology Corporation, 1987. Hydrogeologic Assessment of Technical Area 54, Areas G and L, Los Alamos National Laboratory, 301017.02, Albuquerque, New Mexico.

Isbell, D., 1985. Letter from D. Isbell (Zia Company) to Distribution, Subject: "Water Production and Distribution Utility Operators Manual," September 30, Los Alamos, New Mexico.

Kelly, T.E., 1975. Evaluation of Monitoring of Radioactive Solid-Waste Burial Sites at Los Alamos, New Mexico, U.S. Geological Survey Open-File Report 75-405, p.82.

Knudson, M. O., 1985. Letter from M. O. Knudson (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "Administrative Order VI-85-028" February 12, Dallas, Texas.

Knudson, M. O., 1986. Authorization to Discharge Under the National Pollutant Discharge Elimination System, NM0028355, Dallas, Texas.

Kramer (Kramer, Callahan, and Associates), 1977. Particulate Analysis of Drier Exhaust Emissions at the Zia Company Asphalt Plant, Los Alamos, New Mexico," September.

LANL (Los Alamos National Laboratory), 1980. Interim Environmental Surveillance Plan for LASL Radioactive Waste Areas, LA-UR-80-3110, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1981. Decommissioning the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE I), LA-9052-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1981. Environmental Surveillance at Los Alamos During 1980, LA-8810-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 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 the Effluent Receiving Areas of Acid, Pueblo, and Los Alamos Canyons, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1981. Removal of Contaminated Air Scrubber at TA-35-7, Los Alamos National Laboratory, LA-9058-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1981. Welcome to Los Alamos, LALP-81-36, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Booklet on LAMPF, LALP-82-5, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Environmental Analysis of Acid/Middle Pueblo Canyon, Los Alamos, New Mexico, LA-9409-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Environmental Analysis of the Bayo Canyon (TA-10) Site, Los Alamos, New Mexico, LA-9525-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Environmental Surveillance at Los Alamos During 1981, LA-9349-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Final Safety Analysis Report - Tritium Systems Test Assembly at the Los Alamos National Laboratory, SAR-82-1F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Los Alamos Mini-Review, The Hot Dry Rock Geothermal Energy Program, Los Alamos National Laboratory/ Mini-Review.

LANL (Los Alamos National Laboratory), 1982. Safety Analysis Report High Explosives Machining Facility, Building TA-16-260, SAR-81-4F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. Safety Analysis Report High Explosives Pressing Facility, Building TA-16-430, SAR-81-5F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. The Los Alamos Controlled Air Incinerator for Radioactive Waste, Volume II: Engineering Design Reference Manual, LA-9427, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1982. The Los Alamos Controlled Air Incinerator for Radioactive Waste, Volume I: Rationale, Process, Equipment, Performance, and Recommendations, LA-9427, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. Environmental Surveillance at Los Alamos During 1982, LA-9762-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. LA-9831-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. Stack Parameters Annual Review (SPAR), TA-55 FE-16 (South), Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. Stack Parameters Annual Review (SPAR), TA-55 FE-15 (North), Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. Surface Reconnaissance Through 1980 for Radioactivity at Radioactive Waste Disposal Area G at the Los Alamos National Laboratory, LA-9656-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1983. Water Quality on the Vicinity of Fenton Hill 1981 and 1982, LA-9854-PR, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Administrative Requirement 9-1 of Health and Safety Manual, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Environmental Surveillance at Los Alamos During 1983, LA-10100-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies, LA-9957-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Implementation Plan for Hazardous and Radioactive Mixed Waste Management at Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Technical Area Structure Location Plans, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1984. Water and Contaminant Movement: Migration and Barriers, LA-10242-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Closure Plan For TA 40-2 Magazine Container Storage Area for High Explosive Contaminated Wastes, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Closure Plan for TA 22-24 Magazine Container Storage Area for High Explosive Contaminated Wastes, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Closure Plan for TA 3 Building 102 Container Storage Area for Lithium Hydride, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Closure Plan for TA 40 Scrap Detonation Site for High Explosives Wastes, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Core Analyses and Observation Well Data from Mesita del Buey Waste Disposal Areas and in Adjacent Canyons, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Environmental Surveillance at Los Alamos During 1984, LA-10421-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Implementation Plan for Radioactive Waste Management at Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Long-Range Utilities Plan (Draft for Review), UMDO-083, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Memorandum to A. J. Ahlquist (LANL), Subject: "DP Road Tank Farm Sample Results," March 1, HSE8-85-200, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Plants and Their Relationship to Soil Moisture and Tracer Movement, LA-10216-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Pre-Op Soilsa Data Set, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Pre-Op Soilsb Data Set, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Purchase Order Dated 6/25/85 to X-Ray Sales and Service, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Safety Analysis Report Detonation Systems Laboratory, SAR-85-2F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Safety Analysis Report, Target Fabrication Facility, SAR-85-4F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Safety Analysis Report for the Upgraded Weapons Neutron Research Complex, SAR-85-3F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Validation of the TRACR3D Code for Soil Water Flow Under Saturated/Unsaturated Conditions in Three Experiments, LA-10263-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1985. Welcome to Los Alamos, LALP-85-9, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. 1985 Waste Management Site Plan, LA-UR 86990, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. RCRA Underground Storage Tank Notification Forms Sent to U.S. Environmental Protection Agency, 1985-1986.

LANL (Los Alamos National Laboratory), 1986. 1986 Summary of Clean Water Act Compliance, NPDES Permit NM0028355, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. A Joint DOE/NRC Field Study of Tracer Migration in the Unsaturated Zone, LA-10575-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Closure and Post-Closure Plan for TA-54 Area L Landfill at Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Corrective Measures Technology for Shallow Land Burial at Arid Sites: Field Studies of Biointrusion Barriers and Erosion Control, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Industrial Waste Collection System, Liquid Waste Treatment Facility TA-50, and Liquid Waste Treatment Plant, diagrams, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Environmental Surveillance at Los Alamos During 1985, LA-10721-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Evaluation of Geologic Materials to Limit Biological Intrusion into Low-Level Radioactive Waste Disposal Sites, LA-10286-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Federal Facility Compliance Agreement Schedule, July 15, 1986, Industrial Compliance, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Federal Facility Compliance Agreement Schedule, July 15, 1986, Sanitary Compliance Schedule, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. List Entitled, "Septic Tank Check," December 31, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Los Alamos 1943-1945, The Beginning of an Era, LASL-79-78, Reprint, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Low-Level Integrated System Test, LA-10572-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. "MST Procedure 422-REC-R04," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Measurement and Modeling of External Radiation During 1984 from LAMPF Atmospheric Emissions, LA-10766, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Meteorological Quality Assurance Program of the Los Alamos National Laboratory's Environmental Surveillance Group, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-8 Environmental Surveillance Group, June 20, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart LANL, October 1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-1 Radiation Protection, July 14, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-2, Occupational Medicine Group, August 8, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-3, Safety Group, July, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-5, Industrial Hygiene Group, May, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-7, Waste Management Group, July 1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Organization Chart, HSE-9, Health and Environmental Chemistry Group, July 14, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. "Quality Assurance Plan for Water, Soil, Sediments and Water Supply Sampling at Los Alamos National Laboratory," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. "Quality Assurance Plan for the Radiological Air Sampling Network," Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Quality Assurance for Health and Environmental Chemistry: 1985, LA-10813-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. "Radioactive Liquid Waste Lines Removal Project at Los Alamos (1981- 1986)," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Standard Operating Procedure for Waste Management at TA-2, Omega Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Subsurface Moisture Regimes and Tracer Movement Under Two Types of Trench-Cap Designs for Shallow Land Burial Sites, LA-10449-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. TA-2 Water Boiler Reactor Decommissioning (PHASE I), LA-10890-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Technology Development for the Design of Waste Repositories at Arid Sites: Field Studies of Biointrusion and Capillary Barriers, LA-10574-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Telephone Directory- Organizational Listing, June 1986, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. The Los Alamos Controlled Air Incinerator for Hazardous Chemical and Mixed Radioactive Wastes, LA-UR-86-614, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. WX-3 SOP: Ignition , Burning, and Flashing of Explosives and Explosive-Contaminated Material, WX-3 SOP 12.5.1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Water Supply at Los Alamos During 1984, LA-10584-PR, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1986. Water Supply at Los Alamos During 1985, LA-10835-PR, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Administrative Requirement 3-7, Radioactive Contamination Control, Draft 4/10/87, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. An Overview of Airborne Radioactive Emissions at Los Alamos National Laboratory, Draft, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Attachment 1: "Sampling Schedule," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. PCB Transformer Inventory for Fire Response Personnel, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Document Titled Response to DOE Survey Team Findings, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Quarterly Report: Results of December 1986 Pajarito Canyon Observation Well Sampling Conducted Adjacent to Technical Area 54 Waste Disposal Areas L and G, Draft, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Environmental Aspects of TA-49, Draft, 2/27/87, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Environmental Status of TA-49, Draft, March 31, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Environmental Surveillance at Los Alamos During 1986, LA-10992-ENV, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Environmental Thermoluminescent Dosimetry Quality Assurance Program of the Los Alamos National Laboratory's Environmental Surveillance Group, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Hydronuclear Experiments, LA-10902-MS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. List Entitled "Septic Tanks" Containing Tank Number, Structure Designation, Size and Overflow System, April 13, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. List of 55-Gallon Drums at TA16-V Site (2 pages), Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. List of Environmental Monitoring and Special Studies in TA-21, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. List of Text/Captions on Viewgraphs, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. List Showing Removal of PCB Transformers from Service, 1.5-DD-06, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Los Alamos National Laboratory Stack Discharge Report, January 27, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Los Alamos National Laboratory Waste Management Site Plan 1986, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Management Chart, Health, Safety, and Environment Division, January 1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Notes of Los Alamos Site Characterization Program, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Notes on CEARP Media Sampling, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Pesticide and Herbicide Inventory, July 1986, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Notes on Geophysical Surveying, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Organization Chart, Health, Safety, and Environment Division, January 1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Overhead Slides of Solid Waste Management, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Presentation Booklet on LAMPF, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Quality Assurance Plan, Foodstuffs Monitoring at Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Quality Assurance Project Plans, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Root Lengths of Plants on Los Alamos National Laboratory Lands, LA-10865, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Stack Parameters Annual Review (SPAR), TA-48 FE-40, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Summary Report on LAMPF/VAP Discharges, January 22, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Airborne Radioactive Emissions History, TDF (TA50-37FE-1) Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), 1987. Water Quality in the Vicinity of Fenton Hill 1983 and 1984, LA-10892-PR, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Analytical Data from TA-16 Burn Cage Ash, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Analytical Data from TA-16 Burn Site Lagoon, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Discharge Plan for Geothermal Operations at Fenton Hill, Sandoval County, New Mexico, Draft, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Draft Paper Titled "Biomonitoring at the Los Alamos National Laboratory: Preliminary Results," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Drawing of Septic Tank Cross-Section, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Enclosure 10 Part B, Closure Plans TA 14, 15, 36, and 39, TA-16, TA-50-1 BTP, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Environmental Surveillance of Low-Level Radioactive Waste Management Areas at Los Alamos During 1985, LA-UR-87-139, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Four Charts called Flow Charts in TA-55, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. HSE-9 Analytical Results (EP-TOX metals) for Sludge Samples Taken by HSE-8 on 6/6/86 and 6/9/86, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Hazardous Waste Management Facilities at Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Interactions Between the Laboratory and Regulatory Agencies under RCRA, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-11 K Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-15 R Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-18 Pajarito Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-21 DP Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-3 South Mesa, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-35 Ten Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-36 Kappa Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-40 DF Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-41 W Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-55, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-8 Anchor Site West, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, Area H, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-12 L Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-14 Q Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-16 S Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-22 TD Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-39 Ancho Canyon, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-46 WA Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-50 WM Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-6 Two Mile Mesa Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-7 Gomez Ranch Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of DOE sites which may contain RCRA Hazardous Waste but for which characterization is incomplete, TA-9 Anchor Site East, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area F, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Area G, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Area L, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area A, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area AB, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area B, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area C, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area E, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area M, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area N, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area R, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, Material Disposal Area T, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-15-84, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-16 Burning Ground, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-36-Minie Site, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-39-57, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-39-6, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-40 Scrap, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Inventory of Federal Agency Hazardous Waste Activities Form, TA-50-1, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "LANL TA's," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Limits Established by NPDES Permit NM0028355 for Industrial Outfall Discharges," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. List of Buildings (Draft), Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. List of Environmental Permits Under Which the Laboratory Operates, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Los Alamos National Laboratory Hazardous Waste Part B Permit Application Calendar, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Map of TA-54 Area L Locating Drill Holes Adjacent to Surface Impoundments, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. One page describing TBS, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Organization Chart, HSE-10, Chemistry Health Protection, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Organization Chart, HSE-11, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Organizationl Chart, HSE-14, Epidemiology Group, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Partial Response to Question 10," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Partial Response to Question 11," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. RCRA Part B, Permit Application, Volume I, Text, Tables and Figures, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. RCRA Part B, Permit Application, Volume II, Appendices, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. RCRA Part B, Permit Application, Volume III, Appendices, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Radioactive Liquid Waste System Design," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Reconnaissance Sampling at TA-16 Area P, TA-40 Scrap Detonation Site, TA-54 Area L and Area G," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Question 14," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Question 15," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Question 18," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Question 7," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Questions 19 and 20," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to NOD Questions 21 and 22," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. "Response to Question 16," Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Sampling Procedures/Analytical Methods/Chain of Custody/ and Quality Assurance Program, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Surface Impoundment Analytical Results, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Table VI (Site Plan) Chemicals Treated/Disposed of During FY 1986 and Chemical Wastes in Storage, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Topographic Map of LANL showing NPDES Outfalls, RCRA Sites, Active non-RCRA sites, Underground Storage Tanks, Seepage Pits, Active Technical Areas, and Inactive Technical Areas, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), ND. Types of Discharges and Parameters Monitored at the Laboratory Under Its NPDES Permit NM0028355, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1969. 1969 Status Report on the Omega West Reactor, with Revised Safety Analysis, LA-4192, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1970. Geology and Hydrology of Mesita del Buey, LA-4660, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1971. Environmental Studies at S-Site Water and Soil Analysis for RDX-HMX, Barium, TNT, and Boron, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1972. Analyses for Residual Explosives in Drainage Ditch Soil at Sump Effluent Outlets, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1973. Geology of the Jemez Plateau West of Valles Caldera, LA-5124-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1974. Dispersion and Movement of Tritium in a Shallow Aquifer in Mortandad Canyon at the Los Alamos Scientific Laboratory, LA-5716-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1974. Ecological considerations of Depleted Uranium Munitions, LA-5559, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1976. Long-Term Ecological Effects of Exposure to Uranium, LA-6269, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. Continued Studies of Long-Term Ecological Effects of Exposure to Uranium, LA-6742, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T), LA-6848-MS, Vol. I, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T), LA-6848-MS, Vol. II, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. Hydrologic Characteristics of the Los Alamos Well Field, with Reference to the Occurrence of Arsenic in Well LA-6, LA-7012-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1977. Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico, LA-6887, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1978. Environmental Surveillance at Los Alamos During 1977, LA-7263-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1978. Further Studies of Long-Term Ecological Effects of Exposure to Uranium, LA-7162, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1978. Geologic Description of Cores from Holes P-3 MH-1 Through P-3 MH-5, Area G, Technical Area 54, LA-7308-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1978. Soil Survey of Los Alamos County, New Mexico, LA-6779-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Environmental Surveillance at Los Alamos During 1978, LA-7800-ENV, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Final Safety Analysis Report for the Plutonium Handling Facility, TA-55, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Final Safety Analysis Report for the Transuranic Contaminated Solid Waste Treatment Development Facility, LA-7971-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Bayo Canyon, Los Alamos, New Mexico, DOE/EV-0005/15, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Formerly Utilized MED/AEC Sites Remedial Action Program, Removal of a Contaminated Industrial Waste Line, Los Alamos, New Mexico, DOE/EV-0005/14, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. Studies of Long-Term Ecological Effects of Exposure to Uranium IV, LA-7750, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1979. "Unconventional Furnace for Special Waste," Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1980. Environmental Surveillance at Los Alamos During 1979, LA-8200-ENV, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1980. Geohydrology of White Rock Canyon of the Rio Grande from Otowi to Frijoles Canyon, LA-8635-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1980. Radioactivity in Soils and Sediments in and Adjacent to the Los Alamos Area, 1974-1977, LA-8234-MS, Los Alamos, New Mexico.

LASL (Los Alamos Scientific Laboratory), 1980. Radiochemical Analysis of Samples from Beneath a Solid Radioactive Waste Disposal Pit at Los Alamos, New Mexico, LA-8422-MS, Los Alamos, New Mexico.

Lambert, K., 1986. Letter from K. Lambert (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Request for Submittal of Notice of Intent (NOI) for Injection Wells." November 3, Santa Fe, New Mexico.

Lynch, D. J., 1987. "DOE Scrambling to Replace Potentially Hazardous Plant," The Energy Daily, 15, 20, 1.

Martinez, P., 1986. Letter from P. Martinez (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Open Burning Permit for TA-16," June 4, Santa Fe, New Mexico.

MHSM (Mason Hangar-Silas Mason Co.), 1977. Disposal of Waste of Excess High Explosives, MHSM-76-51.

NCRP (National Council on Radiation Protection and Measurements), 1975. Natural Background Radiation in the United States, NCRP Report 45, November 15.

NK, 1986. June 1986 Revised Version of Los Alamos National Laboratory Proposed Plan for Comprehensive Environmental Assessment and Response Program Through Phase 3.

NK, ND. Los Alamos National Laboratory Institutional Plan FY 1987- FY 1992 Preliminary Data, pp 4, and 49.

NK, ND. Markup of LANL Waste Areas.

NK, ND. Markup of Questions and Answers Regarding TA-49.

NK, ND. Markup of second page of L-43A01.

NK, ND. Markup of slide showing geology.

NK, ND. Markup of slide showing the location of wells.

NK, ND. Questions and Answers Regarding TA-49.

NK, ND. Talking Points -- 1958-1961 Testing Moratorium Experiments.

NMEID, 1974. Solid Waste Management Regulations, Santa Fe, New Mexico.

NMEID, 1985. Regulations Governing Water Supplies, Santa Fe, New Mexico.

NM House Energy and Natural Resources Committee, 1987. Substitute for House Bill 105, Santa Fe, New Mexico.

NM Water Quality Control Commission, 1985. New Mexico Water Quality Control Commission Regulations as Amended Through August 22, Santa Fe, New Mexico.

NUS (NUS Corporation), 1985. Los Alamos National Laboratory Hazardous Waste Program Review, C-01-8-28-226, Gaithersburg, Maryland.

NUS (NUS Corporation), 1985. Program Review of Hazardous and Radioactive Waste Management at Los Alamos National Laboratory, Gaithersburg, Maryland.

Nyhan, J.W., et al., 1985. "Distribution of Plutonium and Americium Beneath a 33-Year-Old Liquid Waste Disposal Site," Journal of Environmental Quality, Vol. 14, No. 4, pp. 501-509.

Oak Ridge Operations, 1983. Pathways Analysis and Radiation Dose Estimates for Radioactive Residues at Formerly Utilized MED/AEC Sites, ORO-832, Oak Ridge, Tennessee.

Oak Ridge Operations, 1983. Radiological Guidelines for Application to DOE's Formerly Utilized Sites Remedial Action Program, ORO-831, Oak Ridge, Tennessee.

Olson, B. H., 1984. Final Report Los Alamos Bacteriological Studies of Groundwater, University of California, Irvine, California.

Pache, P., 1983. Letter from P. Pache (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Request for Closure, Post-Closure and Groundwater Monitoring Plans," November 7, Santa Fe, New Mexico.

Pache, P., 1985. Letter from P. Pache (NMEID) to A. Drypolcher (LANL), Subject: "Waiver of Interim Status Ground-Water Monitoring at Areas L and G," November 5, Santa Fe, New Mexico.

Pan Am, ND. Supply Operating Instruction-- Fuels Management, SOI No. 26-03-260, Los Alamos, New Mexico.

Perkins, R., 1985. Letter from R. Perkins (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Notice of Deficiency- Review of Part B Application," September 13, Santa Fe, New Mexico.

Phoenix, J. 1986. Letter from J. Phoenix (DOE-LAAO) to J. Aragon (LANL), Subject: "Air Quality Overview Inspection Report by EPA," September 25, LTP:CEB:0211, Los Alamos, New Mexico.

Phoenix Industrial, ND. Material Safety Data Sheet, pPhoenix 243, Chicago, Illinois.

Phoenix Industrial, ND. Material Safety Data Sheet, pPhoenix 285, Chicago, Illinois.

Phoenix Industrial, ND. Material Safety Data Sheet, pPhoenix 315, Chicago, Illinois.

Phoenix Industrial, ND. Material Safety Data Sheet, pPhoenix 316, Chicago, Illinois.

Phoenix Industrial, ND. Material Safety Data Sheet, pPhoenix 90, Chicago, Illinois.

Purtymun, W., 1974. Dispersion and Movement of Tritium in a Shallow Aquifer in Mortandad Canyon at the Los Alamos Scientific Laboratory.

Purtymun, W., J.R. Buchholz, and T.E. Hakonson, 1977. "Chemical Quality of Effluents and Their Influence on Water Quality in a Shallow Aquifer," Journal of Environmental Quality, Vol. 6, No. 1, p.29.

Ramey, J. D., 1983. Letter from J. D. Ramey (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Discharge Plan Required for Geothermal Fenton Hill," January 10, Santa Fe, New Mexico.

Reynolds, C., 1987. Memorandum from C. Reynolds (LANL) to DOE Survey Team, Subject: "Near-term Plans for TA-21 Under CEARP Program," April 13, HSE12-87-130, Los Alamos, New Mexico.

Reynolds, C., 1987. Memorandum from C. Reynolds (LANL) to R. Vocke (LANL), Subject: "Proposal for Support of HSE-12 Contribution to CEARP for Remainder of FY87," March 18, HSE12-87-93, Los Alamos, New Mexico.

Rocky Mountain Analytical Laboratory, 1986. Analytical Results for Bendix Field Engineering Corporation, Arvada, Colorado.

Roy F. Weston, Inc., 1986. Draft Tables of the LANL Environmental Audit Plan, Albuquerque, New Mexico.

Salgado, A.T., 1987. Memorandum from A. T. Salgado (LANL) to Distribution, Subject: "Conceptual Design Report- SPCC," February 18, ENG-9-155-87, Los Alamos, New Mexico.

Sares, S., 1986. Letter from S. Sares (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Notice of Intent to Discharge," July 1, Santa Fe, New Mexico.

Scholl, L., 1987. Note from L. Scholl (LANL) to M. Devaurs (LANL), Subject: "Fate of Clementine Reactor," April 14, Los Alamos, New Mexico.

Soholt, L., 1987. Memorandum from L. Soholt (LANL) to D. Garvey (LANL), Subject: "Draft of Environmental Surveillance Report for 1986," Los Alamos, New Mexico.

Soholt, L., 1987. Memorandum from L. Soholt (LANL) to D. Garvey (LANL), Subject: "Results of Sampling Storm Water Runoff," Los Alamos, New Mexico.

Soholt, L., 1987. Memorandum from L. Soholt (LANL) to D. Garvey (LANL), Subject: "1986 Results of Drainage Below LAMPF Lagoon Outfall Sampling," Los Alamos, New Mexico.

Stamets, R. L., 1985. Letter from R. L. Stamets (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Approval of Groundwater Discharge Plan at Fenton Hill," June 5, Santa Fe, New Mexico.

Taylor, R. D., 1987. Memorandum from R. D. Taylor (LANL) to K. A. Balo (LANL), Subject: "Oil Disposal," April 7, WX-12-87, Los Alamos, New Mexico.

Taylor, W. H., Jr., 1986. Letter from W. H. Taylor, Jr. (EPA-Region VI) to P. Pache (NMEID), Subject: "Results of Inspection Dated January 27-28, 1986," April 9, Dallas, Texas.

TERA Corporation, 1984. Seismic Hazard Analysis for the Bendix, Los Alamos, Mound, Rocky Flats, Sandia-Albuquerque, Sandia-Livermore, and Pinellas Sites, Final Report, Volume 1, prepared under contract to Lawrence Livermore National Laboratory.

Theis, C.V., and C.S. Conover, 1962. Pumping Tests in the Los Alamos Canyon Well Field Near Los Alamos, New Mexico, U.S. Geological Survey Water-Supply Paper 1619-1, p. 24.

Thorn, R. N., 1986. Letter from R. N. Thorn (LANL) to C. Garcia (DOE-AO), Subject: "Inventory of DOE Hazardous Waste Facilities Under RCRA Section 3016," January 13, Los Alamos, New Mexico.

Tiedman, A. J., 1987. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "FFCA Quarterly Progress Report," Los Alamos, New Mexico.

Tiedman, A. J., 1986. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Draft response to Notice of Deficiency dated May 15, 1986," Los Alamos, New Mexico.

Tiedman, A. J., 1986. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Response to Notice of Intent to Discharge Request," November 7, ADS-86-442, Los Alamos, New Mexico.

Tiedman, A. J., 1986. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Raw Data from Trial Burn of TA-50 Incinerator," December 4, ADS-86-477, Los Alamos, New Mexico.

Tiedman, A. J., 1987. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "NPDES Permit Modification," January 7, ADS-87-6, Los Alamos, New Mexico.

Tiedman, A. J., 1987. Letter from A. J. Tiedman (LANL) to H. E. Valencia (DOE-LAAO), Subject: "Permits for Discharge into Waters of US," January 7, ADS-87-7, Los Alamos, New Mexico.

UNC Technical Services, Inc., 1986. Vadose Zone Characterization of Technical Area 54, Waste Disposal Areas G and L, Los Alamos National Laboratory, New Mexico, GJ-54, Grand Junction, Colorado.

Vaughn, W.A., 1985. Memorandum from W.A. Vaughn (Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy) to Distribution, Subject: "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," August 5.

Valencia, H. E., 1983. Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "NPDES Permit Reapplication," April 7, CM:4-3/4557A, Los Alamos, New Mexico.

Valencia, H. E., 1984. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to NOV Dated 6/26/84," Nov. 1, Los Alamos, New Mexico.

Valencia, H. E., 1984. Letter from H. E. Valencia (DOE-LAAO) to S. Asher (NMEID), Subject: "Response to NOV Dated June 22, 1984," July 24, CRS:07-24-84/0990A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to A. M. Davis (EPA-Region VI), Subject: "Response to Request for Information," April 8, R-00053A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Amendment of Part A Inclusion of TA-50 Incinerator," October 10, R-00026A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Closure Plan for Area P," November 25, R-00076A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Compliance Order/Schedule Dated May 7, 1985 Number 001007," November 22, R-00073A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to NOV Dated August 26, 1985," September 27, R-00009A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Notice of Violation," September 27, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Status of Area L and P," November 25, R-00076A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Amendment to Part B Application," November 25, R-00077A, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Submittal of Amended Part B and Amended Area L Closure Plan," March 27, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Whittington (EPA-Region VI), Subject: "PCB Feedrate at LANL," January 29, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "NPDES Permit," May 23, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to U.S. EPA (Region VI), Subject: "Health Assessment of Public Exposure to Hazardous Waste," August 7, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to U.S. EPA Region VI, Subject: "Part B Permit Application Additions/Revisions (HSWA) Information," June 12, Los Alamos, New Mexico.

Valencia, H. E., 1985. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Notification of Underground Storage Tanks," September 23, LTP:CEB:0202, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to A. M. Davis (HWM-EPA) and D. Fort (NMEID), Subject: "Notice of Deficiency- Response," July 2, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to B. Hale (EPA-Region VI), Subject: "Inspection of NPDES Outfalls," July 29, 5238A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Amended Closure Plans for TA-3-102, TA-22-24, and TA-40-2," February 18, R-00114A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Biennial Generators and Hazardous Waste Facilities," April 2, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Compliance Order/Schedule Docket Number 001007," February 24, R-00117A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Compliance Order/Schedule Number 001007," March 28, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Compliance Order/Schedule Dated May 7, 1985 Number 001007," July 25, 5237A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "DOE's Response to October 30, 1986 Letter from D. Westbrook," November 7, LTP:JAP:0298, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Intent to Discharge," June 3, LTP:CEB:0093, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Notice of Violation Dated October 14, 1986," November 13, LTP:JAP:0299, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Open Burning Permit TA-16," August 20, LTP:CEB:0138, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Part B Permit Application Amendment and Amended Area L Closure Plan," March 27, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Compliance Order Dated May 7, 1985," March 28, NS:03-87/4696A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Compliance Order/Schedule Dated May 7, 1985," May 30, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Information Request Dated November 24 1986," December 19, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Startup Dates for Beryllium Shops," May 29, LTP:CEB:0084, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Trial Burn Dates," May 7, 4791A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to K. Lambert (NMEID), Subject: "Notice of Intent to Discharge Request," November 7, LTP:JAP:0297, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to L. Cathey (EPA-Region VI), Subject: "FFCA Compliance Schedule," September 23, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "NPDES Permit and April 3, 1986 Letter," June 4, 4969A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to U.S. EPA Region VI, Subject: "Semiannual PCB Disposal and Monitoring Report," February 24, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to USEPA (MD 99-RTI), Subject: "National Survey of Hazardous Waste Facilities," April 7, Los Alamos, New Mexico.

Valencia, H. E., 1986. Letter from H. E. Valencia (DOE-LAAO) to D. Fort (NMEID), Subject: "Response to Compliance Order Dated May 7, 1985," February 24, R-00117A, Los Alamos, New Mexico.

Valencia, H. E., 1986. Memorandum from H. E. Valencia (DOE-LAAO) to A. J. Tiedman (LANL), Subject: "Additional Information Request for Part B Application," November 29, LTP:0318, Los Alamos, New Mexico.

Valencia, H. E., 1986. Memorandum from H. E. Valencia (DOE-LAAO) to A. J. Tiedman (LANL), Subject: "Annual Inspection of NPDES Permit," LTP:CEB:0065, Los Alamos, New Mexico.

Valencia, H. E., 1986. Memorandum from H. E. Valencia (DOE-LAAO) to A. J. Tiedman (LANL), Subject: "Request for Information- Part B Application," October 17, LTP:JAP:0254, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to Chief, Regulatory Section US Army Corps of Engineers, Subject: "Notification of Construction," January 20, 6151A, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to M. Burkhardt (NMEID), Subject: "1986 Annual Fuel Consumption Report," February 12, 6352A(2), Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to M. Burkhardt (NMEID), Subject: "Response to NOV Dated October 14, 1986," March 24, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "FFCA Progress Report," February 12, 6352A, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to R. Penny (Los Alamos County Public Health), Subject: "Permit to Install or Modify an Individual Waste System," January 28, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to US EPA, Subject: "NPDES Permit Modification," January 20, Los Alamos, New Mexico.

Valencia, H. E., 1987. Letter from H. E. Valencia (DOE-LAAO) to M. Burkhart (NMEID), Subject: "Notification of Underground Storage Tanks," March 25, 6556A, Los Alamos, New Mexico.

Valencia, H. E., 1987. Memorandum from H. E. Valencia (DOE-LAAO) to A. J. Tiedman (LANL), Subject: "Request for Information of Past Shipments of Waste to Maxey Flats Disposal Site," January 21, LTP:JAP:0396, Los Alamos, New Mexico.

Valencia, H. E., 1987. Memorandum from H. E. Valencia (DOE-LAAO) to J. Barker (DOE-HQ), Subject: "Notification of Underground Storage Tanks," March 31, Los Alamos, New Mexico.

Valencia, H. E., ND. Draft of Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "NPDES Permit Modification," ND, Los Alamos, New Mexico.

Valencia, H. E., ND. Letter from H. E. Valencia (DOE-LAAO) to M. Knudson (EPA-Region VI), Subject: "NPDES Permit Storm Water Runoff- Draft," ND, Los Alamos, New Mexico.

Valentine, A., 1985. Memorandum from A. Valentine (LANL) to A. Stoker (LANL), Subject: "CY-84 Radioactive Airborne Effluent Release Summary," February 26, HSE-1-RE-30, Los Alamos, New Mexico.

Vavruska, J. S., ND. "Research Incineration of Polychlorinated Biphenyls at the Los Alamos National Laboratory," Los Alamos, New Mexico.

Vecchiola, S. F., 1986. Letter from S. F. Vecchiola (IT) to G. M. Daly (LANL), Subject: "Proposed Task Order for Underground Storage Tank Testing," May 21, Albuquerque, New Mexico.

Walker, M. L., 1986. Letter from M. L. Walker (DOE-ESH) to A. Hirsch (EPA-OFA), Subject: "Inventory of Hazardous Waste Facilities," January 31, Washington, D.C.

Walker, M. L., 1986. Letter from M. L. Walker (DOE-ESH) to A. Hirsch (EPA-OFA), Subject: "Inventory of Known Hazardous Waste Facilities," January 31, Washington, D.C.

Walker, M. L., 1986. Letter from M. L. Walker (DOE-ESH) to Director, Health and Environmental Department, Subject: "Inventory of Hazardous Waste Facilities," January 31, Washington, D.C.

Walker, M. L. and S. R. Foley, Jr. 1987. Memorandum from M. L. Walker (DOE-ESH) and S. R. Foley, Jr. (DOE-DP) to Distribution, Subject: "Reaffirmation of Departmental Policy and Request for Information on Discharges to Soil Columns on Compliance."

Wenzel, W. J., and R. Romero, 1986. Memorandum from W. J. Wenzel (LANL) and R. Romero (LANL) to D. Barnes (LANL), Subject: "Results of Survey at Buildings 257,3,4 at TA-21," October 2, HSE8-86-1094, Los Alamos, New Mexico.

Westbrook, D., and P. J. Anderson, 1986. Letter from D. Westbrook and P. J. Anderson (NMEID) to H. E. Valencia (DOE-LAAO), Subject: "Request for Information on TA-50 Batch Waste Treatment Facility (BWTF)," October 30, Santa Fe, New Mexico.

White, J., 1985. Memorandum from J. L. White (LANL) to J. Aragon (LANL), Subject: "Modification of Part B Permit Application," June 6, HSE8-85-648, Los Alamos, New Mexico.

Whittington, R., 1984. Letter from R. Whittington (EPA-Region VI) to H. E. Valencia (DOE-LAAO), Subject: "Approval of Application of Burning PCB's in Incinerator ," May 21, Dallas, Texas.

Zia (Zia Company), 1985. Wastewater Plants Operators Manual, Operation of TA-41 Imhoff Tank and Chlorinator, September 30, 162-10.9, Los Alamos, New Mexico.

Zia (Zia Company), 1985. Wastewater Plants Operators Manual, Operation of TA-3 Wastewater Treatment Plant, September 30, 162-10.1, Los Alamos, New Mexico.

Zia (Zia Company), 1985. Wastewater Plants Operators Manual, Operation of TA-8 Oxidation Pond, September 30, 162-10.10, Los Alamos, New Mexico.

Zia (Zia Company), 1985. Wastewater Plants Operators Manual, Septic Tank Sanitation in Technical Areas, September 30, 162-10.11, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plant Operators Manual, 162-10, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-9 Oxidation Pond and Intermittent Sand Filter, May 5, 162-10.2, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, May 8, 162-10, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-16 Wastewater Treatment Plant, May 8, 162-10.3, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-18 Oxidation Ponds, May 8, 162-10.4, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-21 Extended Aeration Plant, May 8, 162-10.5, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-35 Oxidation Ponds, May 8, 162-10.6, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-46 Oxidation Pond and Intermittent Sand Filters, May 8, 162-10.7, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Wastewater Plants Operators Manual, Operation of TA-53 Oxidation Ponds, May 8, 162-10.8, Los Alamos, New Mexico.

Zia (Zia Company), 1986. Water Production and Distribution Operators Manual, Rev. 5-30-86, Los Alamos, New Mexico.

Zygmunt, S., 1987. Memorandum from S. Zygmunt (LANL) to R. Garde (LANL) Subject: "Incineration of Scintillation Vials- Required Sampling," January 15, HSE7-87-22, Los Alamos, New Mexico.

PRELIMINARY

APPENDIX A

SURVEY PARTICIPANTS

PRELIMINARY

LANL SURVEY PARTICIPANTS
MARCH 30-APRIL 17, 1987

DOE

Team Leader
Assistant Team Leader
Operations Office Representative

R. Aiken
K. Farber/J. Boda
G. Lasker

TECHNICAL SPECIALISTS

Waste Management/Contractor Coord.
Surface Water
Air
Radiation
Inactive Waste Sites

Hydrogeology
Quality Assurance/TSCA
Chemical Materials Storage

P. Alexandro, NUS
A. McClure, NUS
R. Andes, NUS
W. Joyce, NUS
J. Clay, NUS
K. Sichelstiel, NUS
W. Murray, NUS
P. Byrne, NUS
J. English, ICF

PRELIMINARY

APPENDIX B
ENVIRONMENTAL SURVEY PLAN
LOS ALAMOS NATIONAL LABORATORY

PRELIMINARY

ENVIRONMENTAL SURVEY PLAN
LOS ALAMOS NATIONAL LABORATORY

MARCH 30 - APRIL 17, 1987

LOS ALAMOS, NEW MEXICO

PRELIMINARY

1.0 INTRODUCTION

The Environmental Survey is a one-time baseline inventory of existing environmental problems and environmental risks at U.S. Department of Energy (DOE) operating facilities. It will be conducted in accordance with the principles and procedures contained in the Draft DOE Environmental Survey Manual distributed on May 16, 1986.

The Environmental Survey is an internal management tool to aid the Secretary in identifying current and potential environmental problems in all of DOE's facilities and in prioritizing these problems for appropriate corrective actions.

PRELIMINARY

2.0 SURVEY IMPLEMENTATION

The Environmental Survey will be managed by the Team Leader, Richard Aiken, and the Assistant Team Leaders, Joseph Boda and Kenneth Farber. George Laskar will serve as the Albuquerque Operations Office representative on the Environmental Survey team. Technical support will be provided by the following NUS Corporation personnel:

Peter Alexandro	NUS Coordinator/RCRA and Radioactive Waste
Patrick Byrne	QA/TSCA
Andrew McClure	Surface Water
William Joyce	Radiation
Roger Andes	Air
Jennifer Clay	CERCLA
Kurt Sichelstiel	CERCLA
William Murray	Hydrogeology
Joseph English	Solid Waste Management/Underground Tanks

2.1 Pre-Survey Activities

Members of the Survey team began reviewing Los Alamos National Laboratory (LANL) environmental documentation available at the DOE Office of Environmental Audit in January 1987. From that review, a memorandum dated January 9, 1987, was sent to the Albuquerque Operations Office requesting additional information. Messrs. Aiken and Boda (DOE), Alexandro, Joyce, and Ms. Clay (NUS), and Mr. Crocket (Idaho National Engineering Laboratory), conducted a pre-Survey site visit on February 10-13, 1987, to become familiar with the site, to identify any potential environmental problems, and to coordinate plans for the upcoming Survey with DOE/LAAO and University of California personnel. During the pre-Survey visit, the team met with representatives of DOE/LAAO, University of California, Pan Am World Services, and officials of the U.S. Environmental Protection Agency (EPA) and state regulatory agencies. In addition, the team toured the facility and gathered documents assembled by site personnel in response to the information request memorandum. The bulk of the information being supplied in response to the January 9 memorandum was assembled by the University of California in Los Alamos

National Laboratory. Additional information was requested and received from LAAO and University of California during the pre-Survey visit based on the review of the data sent by Los Alamos. This Survey plan is based on the information received by the Survey team as of the middle of March 1987.

2.2 On-Site Activities and Reports

The Environmental Survey of the LANL will be conducted from March 30 through April 17, 1987. The Survey will include the facilities operated by the University of California and Pan Am World Services located on the LANL site. The Agenda for this Survey can be found in Table B-1. Modifications to this agenda will be made during the conduct of the Survey. All modifications will be coordinated with the site officials designated as Survey contacts. The on-site activities of the Survey team will consist of interviews and consultations with, among others, environmental, safety, operations, waste management, purchasing, and warehousing personnel; a review of files and documents unavailable prior to the on-site portion of the Survey; and process-specific and area-specific tours of the facility.

A closeout briefing will be conducted on Friday, April 17, to describe observations and initial findings of the on-site activities. A Preliminary Report of the Survey will be prepared within 4 months from the conclusion of the Survey. Subsequently, an Interim Report will be prepared by the Survey team within 4 weeks of the completion of sample analyses. The Interim Report will have the data from the sample analyses incorporated into the report. The findings from each of the reports from all scheduled Surveys will be updated as appropriate and included in the Final Report to the Secretary, DOE, which is scheduled for completion in 1988.

2.3 Sampling and Analysis

Based on the results of the on-site portion of the Survey, the Survey team will identify any sampling needs. Sampling and analysis for the LANL Survey will be conducted by a team from the Idaho National Engineering Laboratory (INEL). Mr. Bob Lugar will be the INEL Sampling and Analysis team leader. Representatives of the INEL sampling team will be on-site during the third week of the Survey to

TABLE B-1
LANL SURVEY SITE AGENDA

		AIR	RAD	WATER	RCRA	GW	CERCLA*	UST	TSCA/QA
Monday 3/30	AM	Introduction Site Process & Environmental Programs Briefing General Facility Tour							
	PM								
Tuesday 3/31	AM	Air Sampling & Met Station	Record Review RAD Emissions	SPCC Review	Record Review	Air Photo Analysis	W/GW	SPCC Review w/water	W/Air
	PM		Computer Soil DB Soils	Areas G, L	W/Water	Air Photo Analysis	W/ GW	UST Program Overview Record Review	PCB TA-00 TA-2
Wednesday 4/1	AM	TA-3, 102 66, 29, 141	W/Air	Observe Sampling	W/Air	Finish Photos	A B TA-21 W/1	TA-21 w/CERCLA-1	TA-3 (PCB)
	PM	147 TA-48	W/Air	Record Review (Sampling)	W/Air	Meeting w/ Hydro personnel	TA-43, TA-7 TA-41, TA-29 TA-2	w/CERCLA-1	TA-3 (PCB)
Thursday 4/2	AM	TA-53	W/Air	TA-53 (Lagoons) TA-3, 40	W/Water	Observe Sampling (Photo Wells, Canyon Wells, Springs)	A B TA-33, TA-12	TA-3	W/Air
	PM	TA-16 Burn, 54, 205, Power Plant	W/Air	W/Air	W/Air		TA-39, TA-27 TA-49, TA-20	TA-35	W/GW
Friday 4/3	AM	TA-14 Burn Pads TA-15	W/Air	TA-16, 267, 450 410, 300-307, 342	W/Water	TA-54 Area G&L	A B TA-50, TA-22 TA-55, TA-4	TA-16	Chem Purchase Storage TA-14 TA-15 TA-16
	PM	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review

*CERCLA will be performed by an A & B team which will visit different sites

TABLE B-1

LANL SURVEY SITE AGENDA (Continued)

		AIR	RAD	WATER	RCRA	GW	CERCLA*	UST	TSCA/QA
Monday 4/6	AM PM	TA-50-1 TA-55 TA-50-37	W/Air W/Air W/Air	TA-50-1 TA-51-(T + Pt)	W/Air 50-69	Mortandad Canyon Sandia Canyon	<u>A</u> TA-52, TA-5 <u>B</u> TA-46, TA-1 TA-18, TA-32	TA-50 W/Water TA-18 TA-46 W/CERCLA-1	Pesticide/Herb Storage W/Air
Tuesday 4/7	AM PM	TA-41, 4, 47, 1 TA-2, 1, 63	W/Air W/Air	Observe Sampling Potable Water Supply Review	W/Air TA-9	Fenton Hill Fenton Hill	<u>A</u> TA-36 TA-31 TA-45 TA-14 TA-19 TA-16 TA-11	TA-15 TA-53 TA-6, TA-8 TA-22, TA-54	W/Water W/Water Pest/Herb Application
Wednesday 4/8	AM PM	Review	Review	Review	Review	Review	Review	Review	Review
Thursday 4/9	AM PM	TA-21 TA-33, 86 TA-3, 22	W/Air W/Air TA-49	W/Air TA-3, 29 W/Air	W/Air W/Rad	White Rock Canyon Record Review	<u>A</u> TA-37 TA-10 TA-38 TA-8 TA-13 TA-9AE	TA-33 W/Rad TA-49 W/Rad	Asbestos Records & Disposal Asbestos Records & Disposal
Friday 4/10	AM PM	TA-35, 7, 27, 124, 213	TA-3, 16, 40	NPDES Outfalls Sample Request Preparation	Container Storage TA-22, 24, 96 Sample Request Preparation	White Rock Canyon Sample Request Preparation	<u>A</u> TA-15 TA-25 <u>B</u> TA-25	TA-10, TA-42 TA-48 Sample Request Preparation	Analytical Lab (RAD) HSE-9 Sample Request Preparation

*CERCLA will be performed by an A & B team which will visit different sites

TABLE B-1

LANL SURVEY SITE AGENDA (Continued)

		AIR	RAD	WATER	RCRA	GW	CERCLA*	UST	TSCA/QA	SAMPLING
Monday 4/13	AM	TA-46, 31, 154	Record Review Maps/Drawings	Record Review Sewer Plans	W/Air	Acid/Pueblo Canyon	A- TA-6 B- TA-22 TA006	TA00L DP Road Tank Farm, and Western Steam Plant	Observe Sampling NPDES	Logistics/ Health & Safety
	PM	TA-3, 34, 35, 39	Record Review	Solidary Wst Trie Plants	Area J, H	Revisits & Record Review	TA-40	TA00L Mortandad Canyon TA00L Bayo Canyon		w/Air & UST
Tuesday 4/14	AM	TA-36, 39, 40	W/Air	Cooling Water Trie Practices	Disc W/ Waste Mgmt	Sampling Tour	A- TA-53 B- TA00L	TA00L Landfill Solid Waste Management	TA-28 (CERCLA) TA-46	Sampling Tour
	PM	Revisit	Revisit	Septic Tanks	Radwaste Certification	Sampling Tour	TA-59 TA00L TA-48	TA00L Landfill Solid Waste Management	TA-23 (CERCLA) TA-25 (CERCLA)	Sampling Tour
Wednesday 4/15	AM	Asphalt Plant	Laundry TA-43	W/Rad Photo Waste (TA-40, TA-8)	Revisits & Record Review	Sampling Tour	Revisits & Record Review	Revisits & Record Review	Analytical Lab (Inorgan) HSE-9	Sampling Tour
	PM	Document Review	TA-42 (CERCLA) TA-18 (CERCLA) TA-26 (CERCLA)	Revisits	Revisits & Record Review	Sampling Tour	Revisits & Record Review	Revisits & Record Review	Analytical Lab (Organic) HSE-9	Sampling Tour
Thursday 4/16	AM	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Debrief	Debrief	Debrief	Debrief	Debrief
	PM	Debrief	Debrief	Debrief	Debrief Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Debrief
Friday 4/17	AM	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out
	PM	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out

*CERCLA will be performed by an A & B team which will visit different sites

initiate the planning for the LANL sampling effort. The INEL sampling team will draft a Sampling Plan based on the sampling needs identified by the Survey team.

The Assistant Team Leader, Kenneth Farber, will coordinate the review of this Sampling Plan with the Albuquerque Operations Office and EPA's Laboratory at Las Vegas, which has quality assurance (QA) responsibility for the Survey's sampling and analysis efforts. Sampling is projected to start in October 1987, and will take between 3 and 5 weeks to complete. Analysis of the samples will be conducted by the INEL following protocols provided in the Survey Manual, supplemented by the LANL Sampling Plan. Results of the Sampling and Analysis phase will be transmitted to the Survey Team Leader for incorporation into the Interim Report.

PRELIMINARY

3.0 AIR

3.1 Issue Identification

The air-related Survey activities will involve an assessment of the air emission sources in the facility, the administrative and technological emission controls applied to the sources, and the ambient air monitoring systems. The emphasis of the Survey will be on operational and procedural practices associated with the emission sources and the emission control equipment, fugitive sources of emission, both within and outside the process buildings, and mitigative procedures applied to fugitive emission sources.

The general approach to the Survey will include a review of existing air permits, applications pending, and standard operating procedures. Processes and control equipment will be inspected for compliance with DOE as-low-as-reasonably-achievable (ALARA) requirements for radionuclide emissions. The Survey will also review the nonradiological air contaminants from the different processes in the facility, evaluate any existing controls applied to the air contaminant emissions, and assess the need for additional monitoring or emission controls to characterize or reduce the environmental consequences of the emissions.

The existing ambient air monitoring system will be evaluated to assess if it is adequate to characterize environmental impacts of the air emissions from the facility. The activities involved in this part of the Survey will include the inspection of the ambient air quality samplers, a review of documentation applicable to the ambient air data acquisition, and an evaluation of the processing procedures used to ensure the accuracy of the data. The primary emphasis will be on an assessment of the use of these data to characterize the environmental impacts of plant operations and the defensibility of the reported data.

Areas of particular interest will include emissions of the criteria pollutants (i.e., particulates, sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, and lead) as well as regulated hazardous air pollutants (e.g., radionuclides, beryllium, asbestos, hydrogen fluoride, and mercury). Powerhouses, incinerators, burning grounds, and test firing sites will be of interest. In addition, the use of organic

solvents will be assessed as a potential or actual source of emissions to determine if they are adequately characterized, monitored, and controlled. A focus of the organic emissions assessment will be those substances considered to be hazardous or toxic air contaminants.

Fugitive emissions from the resuspension of contaminated soils will be evaluated as a potential means of the airborne release of radionuclides and hazardous materials from the facility. Consideration will be given to historical and current operations to determine the potential for soils contamination and windborne releases.

3.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records may be examined at the LANL:

- Air permits (Registrations, Installation, and Operation);
- Source and emissions inventories;
- Emission test data, emission calculations, etc.;
- Descriptive documentation on add-on emission controls;
- Standard operating procedures for process and control equipment;
- Correspondence between regulatory agencies relative to air issues;
- Reports on accidental releases of airborne substances;
- Ambient air monitoring program procedures relative to:
 - calibration procedures and records,
 - laboratory procedures and QA,
- Other records as determined on-site.

4.0 RADIATION

4.1 Issue Identification

The radioactive portion of the Survey will involve an assessment of the facility-wide radioactive emissions, emissions controls, emissions effluent monitoring, and the associated impact on the environment. The assessment will include discharges to the atmosphere, surface water, groundwater, soils, and off-site disposal. The assessment will be conducted on a priority basis based on the quantity of emissions, the relative importance of reported impacts, and processes performed within a facility. For example, the Los Alamos Meson-Physics Facility (LAMPF) will be among the first to be visited since the atmospheric emissions and direct radiation from this facility reportedly contribute over 95 percent of the population dose.

The assessment will be based on observations of processes and operations within a given facility, effluent control and monitoring equipment, and waste disposal, along with discussions with operational and supervisory personnel. Operational reports, incident reports, records and other data associated with continuous, intermittent, and accidental releases will be reviewed. Also examined will be the radioactive dose assessment methodologies and biological pathway assessments. Of particular importance will be the potential of radioactive releases via unmonitored release pathways to the environment.

The computerized soil analytical data base will be examined. The environmental monitoring program will be reviewed using both observations of monitoring stations, sample collection, and analysis procedures and review of prior annual reports and other DOE reporting requirements.

The radiological Survey will be coordinated with the air, water, waste management, inactive waste site, and hydrogeology Surveys to ensure that potential direct radiation environmental problems are identified and radiation aspects of other Survey activities are coordinated.

4.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the LANL:

- Radionuclide environmental monitoring data (atmospheric, surface water, groundwater, solid, and vegetation);
- Radionuclide effluent monitoring system design, monitoring data, and reports;
- Radiological accident reports and data;
- Laboratory procedures and analytical methods;
- Dose assessment methodologies;
- Plot plans with monitoring locations;
- Radiological food pathway assessment strategies;
- Other records as determined on-site.

5.0 SURFACE WATER/DRINKING WATER

5.1 Issue Identification

LANL process activities that generate wastewaters will be reviewed through a detailed process evaluation lasting several days. Discrete process liquid discharge points will be identified and evaluated to develop an inventory of wastewater sources. A review of the present condition of the wastewater collection and treatment systems will be made. Liquid waste treatment, process, collection, and handling equipment will be examined and records of operations will be reviewed. The objective of the review is to build a Survey information base for the identification of physical evidence of existing or potential environmental contamination.

Activities generating process wastewaters and other liquid wastes will be inspected. Site surface drainage features, including culverts and channels, will also be observed. Sampling of surface waters and plant wastewaters will also be observed.

Extensive reviews will also be made of possible undetected sources of contaminants flowing to the sanitary sewage systems. This will require review of most plant production schematic drawings, visits to the respective areas around production facilities, and a thorough tour of plant buildings, yard areas, and grounds, particularly areas where the ground surface is or was known to be contaminated.

Other information sources and visitation points that will be examined are

- Wastewater streams and treatment plant performance and/or effluent quality information; this will include observation of sample collection and analysis techniques used for the monitoring;
- Residuals (sludge and sediment) disposal from the wastewater treatment plants (both the technical and the administrative aspects);
- Spill protection provisions for fuels and hazardous materials storage units, including review of the Spill Prevention, Control, and Countermeasures

(SPCC) Plan and of such physical controls as tank containment dikes and runoff/runoff drainage control for potential contaminants;

- Water quality information concerning raw and treated domestic and process waters;
- Types of contaminants that may be in septic tank effluents;
- Potential or actual flooding problems during or immediately after heavy rainstorms;
- Equipment related to drinking water treatment and distribution.

5.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records may be examined at the LANL:

- Detailed drawings of the process, storm, and sanitary sewer systems and the domestic and process water systems both within buildings and in yard areas;
- Detailed drawings of the process and sanitary wastewater treatment units;
- Detailed drawings of the domestic and process water supply treatment, storage, and distribution systems;
- Additional schematic diagrams and/or descriptions of all production processes;
- SPCC Plan for the site, covering all fuel and hazardous material storage units;
- Analytical data used for preparation of the surface water monitoring or similar reports;

- Discharge monitoring reports and any problem area mitigation studies;
- Records of drinking water quality both on- and off-site;
- Operators logbooks and reports for wastewater treatment plant operations;
- Sampling logbooks and laboratory tracking reports;
- Treatment plant and monitoring equipment maintenance records and/or logs;
- Process reports and/or final reports for ongoing research and development (R&D) studies of wastewater control and treatment options;
- Internal memos and correspondence relating to surface water/drinking water problems;
- Other records as determined on-site.

6.0 HAZARDOUS/RADIOACTIVE/SOLID WASTES

6.1 Issue Identification

The procedure for the hazardous/radioactive/solid waste Survey is to review known sources or activities and identify any additional sources or activities that have the potential to result in contamination of environmental media.

The waste portion of the Survey will concentrate on those facilities mentioned in LANL Part A&B Resource Conservation and Recovery Act (RCRA) notifications and the waste management site plans. Specifically, the radioactive and hazardous waste staging areas, burial sites, and explosive waste treatment areas will be examined. In addition, the team will devote a significant portion of the time on-site to a detailed process-by-process investigation of hazardous or mixed waste generation, treatment, storage, and release points.

Hazardous wastes that have been identified in existing documentation (e.g., high-explosive wastes, beryllium and lithium compounds, spent plating solutions) will be tracked through the system and waste-related site activities and records will be reviewed to develop an inventory of LANL waste management practices.

The review of radioactive and nonhazardous solid waste will proceed in a manner similar to that for hazardous wastes. Known waste stream generators, and handling activities such as the Radiochemistry Laboratory, the Sigma Building, CMR Building and waste certification processes will be a focus of the Survey. The detailed process tour described above will gather information on radioactive and nonhazardous solid wastes to delineate any previously unidentified sources of waste that have the potential to result in environmental contamination.

Discussions will be held with individuals knowledgeable of current and past waste management practices. This will be accomplished during the process tour, and in the process of reviewing facility records and documentation. The objective is to develop an understanding of past and existing waste management activities that may serve as the basis for problem identification by the Survey team.

Existing documentation indicates the disposal of waste in many waste pits and shafts in Technical Area 54 (TA-54), TA-16, and other portions of the site. In particular, Areas G, L, P, H, and J will be subjected to a comprehensive waste management evaluation. The review of solid/hazardous/radioactive waste will be coordinated with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and hydrologic surveys to identify any possible releases that may pose a threat to the environment.

6.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be reviewed at the LANL:

- Waste analysis plans and information regarding the use of the plan by facility generators;
- Any additional inspection documentation (state and Federal);
- Groundwater monitoring, sampling, and analytical documentation;
- Any release notification or occurrence documentation;
- Waste inventory documentation (quantities and sources);
- Any enforcement action documentation;
- Groundwater monitoring system construction documentation;
- Internal facility inspection documentation;
- RCRA manifests;
- Correspondence with regulatory agencies on solid waste;
- Records dealing with the reuse/recycling of wastes;

- Records of on-site collection, transport, and storage systems;
- Records of waste oil management;
- Records of tank inspection; and
- Other records as determined on-site.

PRELIMINARY

7.0 HYDROGEOLOGY

7.1 Issue Identification

Preliminary review of the data available for the LANL indicates that the principal aquifer for the area occurs at substantial depth beneath the site. The current water table is approximately 800 to 1,200 feet below the land surface. The intervening unsaturated zone is composed primarily of the Bandelier Tuff, a volcanic ash and pumice deposit. The moisture content of the tuff is extremely low.

The LANL site is dissected by a series of canyons that were cut by intermittent streams. The floors of these canyons contain a layer of alluvial material that varies in thickness from the canyon head toward the discharge to the Rio Grande. A perched water zone occurs in the alluvial material. This perched water zone is fed seasonally by runoff and direct infiltration and, in some canyons, is fed year-round by LANL discharges from sanitary or industrial waste systems.

The Survey effort will focus on a number of uses, including evaluation of previous studies of site hydrogeology, assessment of the adequacy of the environmental monitoring program, evaluation of the potential for contamination from the waste disposal areas, and point source discharges; potential for transport of contaminants in the alluvial aquifers that occur in the canyons, and the potential effects of vapor phase transport in the vadose zone.

Waste disposal areas at the LANL have received solid, hazardous, and radioactive wastes generated by site operations since the 1940s. In some cases, the wastes were segregated but at other locations, they were not. Some liquid wastes were solidified by being mixed with cement before disposal. At some locations liquids were disposed of in pits and shafts. Both the liquid and vapor phases will be evaluated for transport of organics. During the Survey, the team's hydrogeologist will review studies that address interface transport throughout the site and in particular in TA-54.

The potential for transport of contaminants in the perched water zones has been studied to some extent and water quality is monitored at some locations. A review of the monitoring and the previous studies will be undertaken as will be visual examinations of canyon areas to observe outfall locations, to identify seeps and springs, to locate potentially contaminated areas, and to observe environmental monitoring practices.

7.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the LANL:

- Historic air photos - sets of photos for the entire site at a scale of 1" = 200' (if available) for every 4 years to be examined on March 31, 1987;
- Well and spring sampling procedures and schedules;
- Monitored parameters, data, and results;
- Current status of the groundwater monitoring Waiver Request and the Compliance Order studies relative to TA-54; and
- Other records as determined on-site.

8.0 INACTIVE WASTE SITES AND RELEASES

8.1 Issue Identification

The Survey will identify environmental problems and potential risks associated with the historic handling, storage, and disposal of hazardous substances at the LANL. The Survey will focus on current and future risks related to past land disposal practices and past spills/releases.

The LANL is currently developing the draft Phase 1 Installation Assessment Report, prepared under the Comprehensive Environmental Assessment and Response Program (CEARP) for the facility. Based on information provided to date, the CEARP effort has identified over 300 sites or groups of sites that may be considered potential CERCLA or RCRA sites and could possibly result in a risk to public health or the environment.

As part of the LANL Environmental Survey, some of the background information sources used in developing the Phase 1 report will be reviewed, including the material gathered through interviews. Records indicating the types and quantities of materials disposed of in the inactive sites will be evaluated as well as the facility design and methods of waste containment. Copies of facility maps showing individual site locations have been requested from the LANL for each site in the Phase 1 Report. Information available through historic aerial photography will be assessed to identify disturbed land areas and to further define site locations and associated changes in appearance over time. Assistance from LANL staff will be required to ensure that adequate historic aerial photographs are available for review. The Survey team requests that the LANL assemble groups of photographs as described in Section 7.2 for team members to review at the onset of the Survey.

Sites that have undergone some type of remediation will also be addressed. Documentation of the cleanup measures taken at inactive sites will be reviewed, including the plan for cleanup/decontamination, analytical results of the materials removed, and concentration levels where remediation was accepted as sufficient. Also, inactive aboveground and belowground tanks or containers that

may have held hazardous substances will be located and their status assessed as part of the review of chemical storage tanks, discussed in Section 9.0. Former storage areas and staging locations will be included in this effort. Visual inspections will be conducted for a number of sites included in the Phase 1 Report, in addition to any newly identified sites, to note surface features and to locate monitoring points. Sites will be evaluated in terms of the potential to cause a present or future risk to workers, the neighboring population, or the environment.

8.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be reviewed at the LANL:

- Phase 1 Report;
- Information sources used to develop the Phase 1 Report;
- Maps depicting the specific location (or estimated location) for each site described in the Phase 1 Report;
- Historic aerial photographs (see Section 7.2);
- Historic files on past operations, substances used, and methods of handling and disposal;
- Files on past off-site waste handling and disposal;
- Records of facility expansion and building rubble disposal;
- Descriptions of corrective actions, including sketches, analytical results, and final destination of materials removed;
- Diagrams of inactive waste management facilities, including buried tanks and structures;

- On-going CERCLA-related studies, particularly results of field sampling and analysis work referred to in the Phase 1 effort or planned in the next CEARP phases;
- Other records as determined on-site.

PRELIMINARY

9.0 TOXIC AND CHEMICAL SUBSTANCES AND QUALITY ASSURANCE

9.1 Issue Identification

The toxics survey will include all raw materials and process-related chemicals used on the LANL site. Use, handling, and disposal of polychlorinated biphenyls (PCBs), asbestos, pesticides, and hazardous substances will be within the scope of this effort. In addition, this Survey effort will include a review of active and inactive chemical storage tanks and drums.

All toxic and hazardous substances purchased, used, or manufactured on the site will be evaluated. Tracking, control, and management of these substances will be reviewed. Records of usage will be evaluated to determine the potential for environmental contamination.

The inventory of PCB and PCB-contaminated electrical equipment in use at the facility will be reviewed for completeness. The condition of this equipment, its potential for leakage, and the quantity of contaminated fluids will be identified. Disposal practices will be reviewed for current and past inventories to determine the method of disposal and location of disposal sites. Procedures for PCB analysis, removal, handling, and disposal will be reviewed. Inspection and reporting requirements for PCB transformers will be evaluated in an effort to focus the Survey team's attention on potential problem areas.

The use of asbestos as insulation at the LANL will be reviewed to identify pathways of contamination. Also, asbestos removal and disposal practices will be evaluated, and disposal sites visited, to define potential areas of concern.

Pesticides usage on the site will be reviewed, including application records, storage and disposal practices, and environmental monitoring, to assess the risk for environmental contamination.

The Survey will examine site information pertaining to LANL underground and aboveground storage tanks. The review will focus on tank volume, contents,

construction, age, history, and leak detection capabilities. Similarly, the Survey will review chemical storage facilities to determine the potential for releases.

The QA Survey of the environmental program will be primarily an evaluation of the sampling and analytical capabilities at the LANL. The intent will be to verify and review the QA procedures for obtaining process/effluent and environmental samples, performing the analytical work to identify the concentration of pollutants, and the handling and reporting of data. All aspects of the QA program relating to environmental management at the LANL will be reviewed, including operator training, equipment and instrument calibration/maintenance, precision and accuracy studies, blank, split, and spike sample analyses, sample handling and chain-of-custody procedures, data reduction and validation, data reporting and documentation, and calculation and logbook reviews.

The procedures for sampling and analysis will be monitored to ensure proper implementation and conformance to accepted requirements. Quality assurance plans will be reviewed for the sampling and analytical activities, as well as for any internal QA audits that have been completed.

The QA programs currently in force at the LANL will be evaluated. QA procedures imposed on any outside sampling or analytical laboratories will also be reviewed in this study effort.

9.2 Records Required

In addition to those documents reviewed prior to the Survey, the following records will be examined at the LANL:

- Toxic substances labeling and tracking system;
- Procedures for handling, control, and management of toxic substances;
- Inventory of toxic chemicals and purchasing records of chemical substances;

- PCB annual inventory documents (1978 to 1986);
- Inventory of current PCB-contaminated electrical equipment;
- PCB handling, storage, and disposal records and procedures;
- Locations of buildings containing asbestos, including usage;
- Asbestos use, handling, and disposal records, including method and location of disposal;
- Pesticide training, handling, storage, disposal records, and environmental monitoring;
- Analytical laboratory and environmental sampling QA plans and procedures manuals;
- QA audits and reports of laboratory and sampling program;
- QA results for prepared and analytical samples;
- Operator training records (laboratory and sampling);
- Instrument maintenance and calibration records (laboratory and sampling);
- Laboratory and sampling calculations and workbooks;
- Precision and accuracy studies; and
- Other records as determined on-site.

APPENDIX C

SUMMARY OF SURVEY ACTIVITIES

PRELIMINARY

TABLE C-1

SUMMARY OF SURVEY ACTIVITIES

	AIR	RAD	WATER	RCRA	GW	CERCLA*	UST	TSCA/QA
Monday 3/30	AM Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing	Introduction Site Process & Environmental Programs Briefing
	PM General Facility Tour	General Facility Tour	General Facility Tour	General Facility Tour	General Facility Tour	General Facility Tour	General Facility Tour	General Facility Tour
Tuesday 3/31	AM Air Sampling & Met Station	Record Review RAD Emissions	SPCC Review	Record Review	Air Photo Analysis	W/GW	SPCC Review w/water	W/Air
	PM Computer Soil DB Soils	Computer Soil DB Soils	Areas G, L	W/Water	Air Photo Analysis	W/ GW	UST Program Overview Record Review	PCB Inventory TA-3
Wednesday 4/1	AM TA-3, 35 66, 141, 147	W/Air	Observe Sampling	W/Air	Finish Photos	A B TA-21 W/1	TA-21 w/CERCLA-1	TA-0 (PCB)
	PM TA-3-29 TA-48	W/Air	Record Review (Sampling)	W/Air	Meeting w/ Hydro personnel	TA-43, TA-7 TA-41, TA-29 TA-2	w/CERCLA-1	TA-2 (PCB) TA-53
Thursday 4/2	AM TA-53	W/Air	TA-53 (Lagoons) TA-3, 40	W/Water	Observe Sampling (Road Wells, Canyon Wells, Springs)	A B TA-33, TA-12	TA-3	W/Air
	PM TA-16 Burn, 410, Power Plant	W/Air	W/Air	W/Air		TA-39, TA-27 TA-20	TA-35	W/GW
Friday 4/3	AM TA-14 Burn Pads TA-15 TA-16-205	W/Air	TA-16, 267, 450 300-307, 342	W/Water	TA-54 Area G&L	A B TA-50, TA-42 TA-35, TA-4 TA-5	TA-16	Chem Purchase Storage TA-14 TA-15 TA-16
	PM Revisit/Record Review TA-3-102	Revisit/Record Review Briefing on TA-49	Revisit/Record Review TA-3-102	Revisit/Record Review	Revisit/Record Review Briefing on TA-49	Revisit/Record Review	Revisit/Record Review	Revisit/Record Review

* CERCLA will be performed by an A & B team which will visit different sites

TABLE C-1

SUMMARY OF SURVEY ACTIVITIES (Continued)

		AIR	RAD	WATER	RCRA	GW	CERCLA ^a	UST	TSCA/QA
Monday 4/6	AM	TA-50-1 TA-55	W/Air	TA-50-1	W/Air	Mortandad Canyon	A TA-52 B TA-5	TA-50 W/Water	Pesticide/Herb Storage
	PM	TA-50-37	W/Air	TA-51-(T + Pt)	50-69	Sandia Canyon	TA-46 TA-18 TA-32	TA-18 TA-46 W/CERCLA-1	W/Air
Tuesday 4/7	AM	TA-41, 4, 47, 1	W/Air	Observe Sampling	W/Air	Fenton Hill	A TA-36 B TA-31	TA-15	W/Water
	PM	TA-2, 1, 63	W/Air	Potable Water Supply Review	TA-9	Fenton Hill	TA-14 TA-16 TA-11	TA-6, TA-8 TA-22, TA-54	Pest/Herb Application
Wednesday 4/8	AM	Review	Review	Review	Review	Review	Review	Review	Review
Thursday 4/9	AM	TA-21 TA-33, 86	W/Air W/Air	W/Air TA-3, 29	W/Air TA-37 TA-38	White Rock Canyon	A TA-37 B TA-10	TA-33 W/Rad TA-49 W/Rad	Asbestos Records & Disposal
	PM	TA-3, 22	TA-49	W/Air	W/Rad Record Review	Record Review	TA-8 TA-9AE	TA-13	Asbestos Records & Disposal
Friday 4/10	AM	TA-35, 7, 27, 124, 213	TA-3, 16, 40	NPDES Outfalls	Container Storage TA-22, 24, 96	Palmito Canyon	A TA-15 B TA-25	TA-10, TA-42 TA-48	Analytical Lab (RAD) HSE-9
	PM	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation	Sample Request Preparation

*CERC^a A will be performed by an A & B team which will visit different sites

TABLE C-1

SUMMARY OF SURVEY ACTIVITIES (Continued)

		AIR	RAD	WATER	RCRA	GW	CERCLA*	UST/RAD	TSCA/QA	SAMPLING
Monday 4/13	AM	Pan Am TA-3	TA-5, 3, 39, 40	Record Review Sewer Plans	W/Air	Acid/Pueblo Canyon	A TA-6 TA-22 B TA-006	TA-00L DP Road Tank Farm, and Western Steam Plant	Observe Sampling NPDES	Logistics/ Health & Safety
	PM	TA-3, 34, 102, 39	TA-48, EMR	Sanitary Wst Trt. Plant	Area J, H	Revisits & Record Review	TA-40	TA-00L Mortandad Canyon TA-00L Bayo Canyon		w/Air & UST
Tuesday 4/14	AM	Ambient Sampling Locs	W/Air Records TA-36, 39, 40	Cooling Water Trt. Practices	Disc W/ Waste Mgmt	Sampling Tour	A TA-53 TA-3 B TA-00L	TA-00L Landfill Solid Waste Management	TA-28 (CERCLA) TA-46	Sampling Tour
	PM	Air	Revisit w/Air	Septic Tanks	Radwaste Certification	Sampling Tour	TA-59 TA-48	TA-00L Landfill Solid Waste Management	TA-23 (CERCLA) TA-25 (CERCLA)	Sampling Tour
Wednesday 4/15	AM	Document Review	Laundry TA-43	W/Rad Photo Waste (TA-40, TA-8)	Revisits & Record Review	Sampling Tour	Revisits & Record Review	Revisits & Record Review	Analytical Lab (Inorganic) HSE-9	Sampling Tour
	PM	Document Review	TA-42 (CERCLA) TA-18 (CERCLA) TA-26 (CERCLA)	Revisits	Revisits & Record Review	Sampling Tour	Revisits & Record Review	Revisits & Record Review	Analytical Lab (Organic) HSE-9	Sampling Tour
Thursday 4/16	AM	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Debrief	Debrief	Debrief	Debrief	Debrief
	PM	Debrief	Debrief	Debrief	Debrief Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Revisits & Record Review	Debrief
Friday 4/17	AM	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out
	PM	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out	Close-out

* CERCLA will be performed by an A & B team which will visit different sites

APPENDIX D

**POLLUTION SOURCES AND CONTROL TABLES
FOR INACTIVE WASTE SITES AND RELEASES
SECTION 4.5**

PRELIMINARY

CONTENTS

<u>Table</u>	<u>Title</u>	<u>Tab</u>
D-1	Former Liquid Waste Disposal Sites with Waste Characteristics and Current Condition, LANL	1
D-2	Spills and Unplanned Releases with Waste Characteristics and Current Condition, LANL	2
D-3	Open Dumps and Boneyards with Waste Characteristics and Current Condition, LANL	3
D-4	Inactive Landfills with Waste Characteristics and Current Condition, LANL	4
D-5	List of Inactive Firing Sites with Information on Contaminants and Current Condition, LANL	5
D-6	List of Contaminated Structures Still Standing with Information on Contaminants and Current Condition, LANL	6
D-7	List of Contaminated Structures that Have Been Removed with Information on Contaminants and Current Condition, LANL	7
D-8	List of Miscellaneous Inactive Waste or Release Sites with Waste Characteristics and Current Condition, LANL	8

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Structure Number	Description	Date	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 2							
No #	Trap in the effluent line of the TA-2 reactor known as the Water Boiler	1944-1974	Radionuclides	Unknown	NV	Drain trap was located in pit SE of the reactor. Status unknown.	1950: 25 R/hr in effluent; 1954: 100 R/hr in effluent draining from trap
TA-2-19, -32, -35, 43, 48, 62; lines 117, 118, 119; and 2 delay tanks	Exterior equipment associated with gaseous effluent (stack) line	1944-1974	Alpha and beta/gamma radionuclides, including Cs-137	970 m ³ of low-level radioactive waste removed	V	Structures and contaminated soils removed in an SFMP-funded project conducted in 1985 and 1986	Surface and subsurface soil samples taken during cleanup
Area A	Suspected leachfield	No Date	Potentially received waste from chemical waste treatment shack containing radionuclides, uranyl nitrate, and perfluoric acid	Unknown	NV	Area cleaned up in 1985-1986 decommissioning project funded under SFMP. Soil remaining after cleanup contained 53-67 Ci/g of beta/gamma emitters, with no alpha emitters. Area backfilled	1985: U235 fuel detected during cleanup; initial activity found was 2-4 nCi/g in soil

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 2 (Continued)								
Area C	Secondary pit	1985-1986	Radioactively contaminated wet soil from cleanup of another hotspot area (Area B) that had readings of 4 mR/hr		Unknown	V	Area cleaned up in the 1985-1986 decommissioning project funded under SFMP. Soil allowed to drain dry in this pit, prior to removal to TA-54. Pit bottom was scraped out. Remaining soil contained 40-87 pCi/g of beta/gamma emitters. Area backfilled	See Status
No #	Discharge from Omega Site to stream	1954	Beta and/or gamma emitters		Unknown	NV	Location and specific source of discharge not identified.	1954: Soil samples from stream with above-background rad readings
No #	Overflow from septic tank	1957	Laboratory drains, photographic developing wastes, laboratories		Unknown	NV	Location not specified. In mid-1970s, Omega Site sanitary system was connected to TA-41 Treatment Plant; therefore this septic tank is assumed to be inactive. Uncertain if it is still in place	None Known
No #	Discharge from Omega Site to stream	1961	Sodium-24		Unknown	NV	Point of discharge not reported	None Known
No #	Deionizer system effluent discharge to stream	Pre-1963	All radioactive liquid effluent from deionizer system		More than 6 years, rate unknown	NV	Point of discharge not reported. Practice has been discontinued	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Three

Structure Number	Description	Date	Waste Characteristics		Quantity	Current Status or Condition	V/NV**	Previous Sampling
			Type					
TECHNICAL AREA 2 (Continued)								
No #	Coolant water discharge to stream	1963	4.5 x 10 ⁻⁴ microcuries/cm ³ of sodium-24; 9.4 x 10 ⁻⁴ microcuries/cm ³ of manganese-56		3 gpm-duration unknown	NV Point of discharge not reported. Effluent/stream infiltrated into ground 5 to 10 ft from point of release.		None Known
No #	Occasional discharges	1963	Radioactive chromium, zinc, and antimony		Several curies	NV Point of discharge not reported.		None Known
No #	Reactor storage tank liquid discharge to stream	1964	Liquid contained 2 mCi of chromium-51, 0.43 mCi of antimony-124, 0.2 mCi of iron-59, 0.2 mCi of manganese-54		125 gallons	NV Point of discharge not reported.		None Known
No #	Resin bed regeneration liquid discharge to stream	1964	Short-lived radionuclides and 2.5 mCi manganese-54		1,000 gallons	NV Point of discharge not reported.		None Known
No #	Liquid from reactor fuel handling pit discharge to stream	1970	Radionuclides		Unknown	NV Point of discharge not reported.		None Known
		1972	Sodium-24, manganese-56, copper-64		Unknown	NV Point of discharge not reported.		None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 3							
No #	Discharge outside Van de Graaff Laboratory	1952	Trichloroethylene, acetone, alcohol	Unknown	NV	Wastes from degreasing operation discharged outside. Location not specified	None Known
No #	Platform W of TA-3-31, chemical warehouse	1950s- 1980	Liquid from washing carboys (presumably containing various chemicals)	Unknown	NV	Platform removed in 1980	None Known
No #	Liquid waste disposal on W end of TA-3-30, general warehouse	1950s	Vacuum pump oil; 150-200 lb mercury; possibly beryllium, tritium, and transuranics	See Type	V	Wastes drained down side of canyon. A portion of area has been paved.	1986: Soil Samples tested for Hg, results pending
No #	Drainage ditch in Administration Building parking lot	1968	Stoddard solvent from ironworkers shop and acid and caustics from operations in TA-3-38	Unknown	NV	Practice discontinued in 1968	None Known
No #	Ditch N of TA-3-382 leading to Sandia Canyon	1986	Petroleum products	Unknown	NV	Practice discontinued in 1986. Soil removed and placed on Sigma Mesa. Canyon side not included in cleanup	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 3 (Continued)							
TA-3-15	Septic tank for Van de Graaff Laboratory	Pre-1975	Radiionuclides, darkroom wastes, and general laboratory wastes	Unknown	NV In 1975, tank was connected to industrial waste lines. Prior to this time, tank may have discharged to the canyon on the south side	None Known	
TA-3-45	Cesspool for Van de Graaff Laboratory	Pre-1954	Sanitary waste	Unknown	NV Removed in 1964.	None Known	
TA-3-689	Septic tank near TA-3-282	1964	Unknown	Unknown	NV Present status not known.	None Known	
TA-3-141	Drains leading to area S of building	No Date	Uranium	Unknown	V Soils in seepage area may be contaminated due to use of uranium in building.	None Known	
No #	Power plant blowdown	1950-1970s	Hexavalent chromium in blowdown	28,000 - 288,000 gpd	NV Blowdown discharged to Sandia Canyon	1972: 34 ppm hexavalent chromium in discharge; 1968: average 10-15 ppm total chromium in stream	

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date *	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 3 (continued)							
TA-3-66	Pit used to contain leak from chilled water system at Sigma Building	1972	Fluoride	Pit capacity was 200,000 gallons	NV	Pit was used to precipitate fluoride from solution. Closure process for pit was not reported.	None Known
No #	Lined lagoon on Sigma Mesa	?-1987	Treated effluent from TA-50 containing small quantity of radionuclides	Unknown; lagoon capacity was 25,000 gal	V	Lagoon is fenced and contained rainwater/snowmelt. Synthetic liner is underlain with sand/bentonite mixture. Lagoon was used in an experiment. At time of use, no leakage detected. No further plans exist to use lagoon; lagoon no longer monitored	None Known
No #	Open pit on E end of Sigma Mesa	No Date	Drilling mud	Unknown	V	Pit remains open. Drilling mud has dried	None Known
No #	Pit S of Building TA-3-271	Pre-1987	Asphalt, sealant, possibly solvent	Unknown	V	Period of operation unknown. Pit located near edge of mesa and has been covered with soil.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 4							
TA-4-17	Latrine	Mid-1940s	Sanitary wastes	Unknown	V	Remains inactive.	None Known
TECHNICAL AREA 5							
TA-5-13	Acid septic tank	1945	Toxic chemical and HE contamination	Unknown	V	Unknown; in 1959 it was reported to be free of radioactivity but listed as having toxic/chemical contamination. However, the tank was not found during LASCOP's site cleanup activities, which included removal of soils.	1959, 1985 (LASCOP)
TA-5-8	French drain from storage building	Mid-1940s	Uranium	Unknown	V	Remains inactive. During cleanup, soils surrounding French drain were removed.	1985 (LASCOP)
TECHNICAL AREA 6							
No #	Sump and drain for TA-6-10	Mid-Late 1940s	PETN	Unknown	V	Remains inactive. Recommended for removal; unknown if removed when TA-6-10 was D&D'd	Excavated at two points in 1950- no trace of nitrates.
TA-6-41	Septic tank	Mid-Late 1940s	PETN	Unknown	V	Remains inactive. Sludge vacuumed out and buried at Missa del Buey. Tank removed, washed, and placed at Area P with other debris from TA-6.	1965: Sludge sample contained HE

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 6 (Continued)								
TA-6-20	Ladies Lavatory	Mid-Late 1940s	Sanitary wastes		Unknown	NV	Remains inactive. Removed in 1955, slight depression at former location.	None Known
TA-6-40	Septic tank serving Bldgs. 1 and 3	Mid-Late 1940s	Possible chemical and HE contaminants		Unknown	V	Remains inactive but in place.	None Known
TA-6-43	Septic tank serving Bldg. 6	Mid-Late 1940s	Possible chemical and HE contaminants		Unknown	V	Still actively used for sanitary discharges from Bldg. 6; however, possible contamination resulted from past discharges when Bldg. 6 was used for a laboratory and shop. It is presently used for offices and storage.	None Known
TECHNICAL AREA 8								
GT Site	Drains from buildings	1967	Water-miscible solvents, acids, and plastics		Unknown	NV	Locations not specifically identified.	None Known
TA-8-22	Discharge into open outfall leading into woods N of building	Since 1950	Photoprocessing wastes, including silver		Unknown	V	Discharge still active; however, a silver recovery unit is currently used.	None Known
TA-9-81	Septic tank	1970	Drain from Isotope Building (TA-8-24)		Unknown	NV	Abandoned in 1970. Not located during Survey	None Known
TA-8-59, 67	Septic tanks	? - 1971	Potentially received toxic materials from Laboratory Building (TA-8-1)		Unknown	V	Manhole of abandoned tank TA-8-59 was located - overflow may enter into a storm drain. TA-8-67 not located.	None Known
TA-8-64	Septic tank	1949	Potentially received high explosives and radionuclide contaminants from operations performed in nearby buildings (TA-8-1, 2, 3)		Unknown	NV	Abandoned in 1949. Not located during Survey	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 8 (Continued)								
No #	Two sumps outside Bldg. TA-8-3	1972	High explosive contaminants		Unknown	NV	Building is inactive. Location of sumps uncertain	None Known
TECHNICAL AREA 9AE								
No #	Disposal field	No Date	Unknown		Unknown	NV	Reportedly a seepage pit. Use and location are unknown but TA has been D&D'd.	None Known
TECHNICAL AREA 13								
No #	Discharge from TA-10-1, the Radiochemistry Building	1945-1963	Strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, and possibly other organic and inorganic contaminants		Unknown	V	Received liquid wastes from drain of Bldg. TA-10-1 and flowed into tank farm.	None Known
No #	Disposal pit NE of TA-10-21	1545-1963	Strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, organic and inorganic contaminants		Unknown	V	Received liquid wastes from drain of Bldg. TA-10-1 and flowed into tank farm.	None Known
TA-10-41, 42, 43	Tank farm acid and contaminated materials pits	1945-1963	Strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, organic and inorganic contaminants		Unknown	V	Pits drained through outlet pipe and into soil	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITIONS, LANL
Page Ten

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 10 (Continued)							
TA 10-50, 51	Tank farm acid sewer manholes	1945-1963	Sulfuric, nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, organic and inorganic contaminants	Unknown	V	Pits drained through outlet and into soil. Also at TA 10-50 a pipe ran to creek bed	None Known
TA 10-39	Tank farm acid septic tank	1945-1963	Sulfuric, nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, organic and inorganic contaminants	Unknown	V	Waste periodically discharged directly into stream channel by applying pressure to tanks	Tank removed 1963; soil removed between pits 39 and 50
No #	Decontamination holes near leachfield	1945-1963	Nitric acid and hydrochloric acid	Unknown	V	Acids were poured into these holes	None Known
No #	Three unknown pits found in 1963	1945-1963	Radioactive chemicals, acids, organics and inorganics	Unknown	V	One pit 12-inch-diameter 2 ft S of pit 42; second pit 2 ft square, 40 ft E of pit 41; third pit 6 ft S of acid sewer manhole	1976: Rad 10-20 mR/hr
No #	Common clay drain between pits 41, 42, and 43, 10 ft below ground surface	1945-1963	Radioactive chemicals, acids, organics and inorganics	Unknown	V	Drain located 10 ft below grade and removed during cleanup of TA	1976: 20 mR/hr
No #	Leachfield below acid pit 43	1945-1963	Radioactive chemicals, acids, organics and inorganics	Unknown	V	Leachfield located under acid pit 43. During cleanup, excavation extended to 20 ft, but it was uncertain whether entire leachfield was removed	1976: D&D'd

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Eleven

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 10 (Continued)							
TA 10-24, 25	Source wash area and liquid discharge near structure	1945-1963	Radioactive source wash and liquid discharge	Unknown	V	Free of contamination to 4 ft.	Bldg D&D'd
TA 10-48	Board-lined pits 25 ft square, 10 ft deep	1945-1963	Gloves, bottles, lab equipment and strontium-90 "soup"	117 Ci into pits and tank farm	V	Excavated to 26 ft to remove radioactive contamination; however, levels above background were found at a depth of 30 ft below grade	D&D'd
TA-10-38, 40	Sanitary septic tanks	1945-1963	Sanitary waste	Unknown	V	Wastes periodically discharged directly into stream channel by applying pressure to tanks; removed 1963	None Known
No #	Leachfield near TA 10-41 and streambed	1945-1963	Strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, organic and inorganic contaminants	Unknown	V	It is unknown whether leachfield was removed	None Known
No #	Pipes between acid pits 42 and 43	1945-1963	Radioactive chemicals, acids, organics and inorganics as above	Unknown	V	Removed in 1963	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twelve

Structure Number	Description	Date *	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 11								
TA-11-20	Septic tank	? - 1987	Possible photoprocessing wastes		Unknown	NV	Active. Tank overflow allowed to seep into surrounding soil.	None Known
TA-11-13	Septic tank	? - 1987	Unknown		Unknown	NV	Unknown.	None Known
TECHNICAL AREA 13								
TA-13-12	Septic tank with drainfield	Pre - 1951	Unknown		Unknown	NV	Removed in 1951. Documentation on removal not available. Uncertain whether drainfield was also removed.	None Known
TECHNICAL AREA 14								
No #	Outfall	Present	HE and photoprocessing chemicals		Unknown	V	Active flows from septic tank 1a from Bldg 6	None Known
TECHNICAL AREA 15								
No #	Sanitary drain or outfall from Bldg 92	1958	Chemicals or HES		Unknown	V	No evidence of drain location noted around Bldg 92	None Known
No #	Dry well serving Bldg 194	1978	Degreasers, sulfuric acid, chromates, and hydrochloric acid		Unknown	V	Reportedly 4 ft diam. and 50 ft deep. Currently covered with soil	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
 Page Thirteen

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 15 (Continued)								
No #	Sump or ditch from Bldg 50	1960s	Acids		Unknown	NV	Bldg 50 is a machine shop and laboratory Drains/sump status reportedly inactive but still in place.	None Known
No #	Outfall from Bldg. 40	No Date	Photoprocessing and printing circuit operations waste		Unknown	NV	Unknown.	None Known
TA-15-63	Septic tank with outfall for Bldg. 40	1958	Unknown. Operations in building included photoprocessing and printing circuit work.		Unknown	NV	Unclear if this outfall is the same as mentioned above. Tank listed on 1983 engineering drawing.	None Known
TA-15-147	Septic tank serving Bldg 8	1958	High explosives from Shop Bldg.		Unknown	NV	Inactive, but still in place.	None Known
No #	Discharge area for floor drains in Bldg 20	1950 - ?	High explosives		Unknown	NV	Location unknown.	None Known
TA-15-51	Septic tank with drainfield for Bldg 20	No Date	Unknown		Unknown	NV	Status unknown Tank listed on 1983 engineering drawing.	None Known
TA 15-72	Septic tank with outfall for Bldg 27	1958	Unknown. Building was control room for Firing Points E and F.		Unknown	NV	Firing points inactive. Tank listed on 1983 engineering drawing.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
 ** V. DOE Survey team representative(s) visited site; NV. DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Fourteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 16							
No #	Overflow line from Bldg 195	1995		Unknown	NV	Discharge point was in an open area SE of building. No record of cleanup provided.	None Known
No #	Sumps serving 200, 300, and 400 process areas and sumps that served buildings which are now torn down	No Date	High explosives	Unknown	NV	Some sumps in these process areas are inactive and potentially contaminated. Total number and location of these inactive sumps were not specifically reported. Sumps are usually located in the front of the buildings. No record of cleanup provided.	None Known
No #	Four ponds W of Bldgs TA-16 through 34	1940s	High explosives	Unknown	V	Ponds received wastewater from the HE machining buildings. They have been backfilled with soil. No report documenting the ponds' closure available.	None Known
No #	Tank or pond W of Bldgs. TA- 16-89 through 93	1970	Trace gross beta emitters	Unknown	V	Tank or pond received liquid from floor drains of buildings and has been removed. No record of procedures used was available.	1970: Gross beta found in liquid.

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Fifteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 16 (Continued)							
No #	Pond E of Bldgs. TA-16-89 through 93	1950s	HEs, potentially received electroplating wastes also	Unknown	V	Pond received wastewater from HE process Bldgs. 89, 90 and 91; and possibly wastes from Bldgs 92 and 93 that were used for electroplating. Pond contained water at the time of Survey, but can be dry based on the season.	1986: HE detected in sediment.
No #	Discharge from Bldg. TA-16-92	1950	Electroplating wastes	Unknown	V	Drains from buildings existed to the north. A drainage swale exists N of the buildings but no visual signs of contamination were noted.	None Known
No #	Possible liquid waste disposal area around Bldg. TA-16-450	1952	Electroplating wastes	Unknown	NV	Building was once used for electroplating. Method of liquid waste disposal unknown.	None Known
No #	Possible liquid waste disposal around Bldg. TA-16-10	1960	Hydrochloric acid, sodium chloride, ferrous chloride, and chromic acid	Unknown	NV	Building was used to clean copper-clad steel plates. Method of liquid waste disposal unknown.	None Known
TECHNICAL AREA 18							
No #	All acid drains in TA-18	No Date	Uranium-233 and 235, beryllium, mercury, possibly some organics, photoprocessing chemicals, and acids	Unknown	V and NV	An acid waste holding pit next to Bldg. 30 has been removed but status of other drains in the TA is unknown.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Sixteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 18 (Continued)							
TA-18-39, 42, 105, 120	Septic tanks serving Kivas 1, 2, and 3	No Date	Radionuclides, oil	Unknown	V and NV	Systems still active. Tank 39, serving Kiva 1, reportedly has associated drainfield. Perched groundwater exists in this canyon in addition to a surface stream that runs along the SW side of Kiva 1. Potential for contamination from these tanks and drainfield has not been addressed. Only Tank 120 has specifically been reported to contain oil.	None Known
TA-18-40, 41, 43, 152	Sanitary septic tanks serving Bldgs 1, 28, 31, and 31	No Date	Unknown	Unknown	NV	Systems potentially contaminated based on past operations in buildings. Tanks inactive but still in place	None Known
TA-18-168	Kinglit reactor solution	No Date	Enriched uranyl sulfate solution	Unknown	V	Reactor is no longer present. Its solution was stored in a 6-inch-diameter pipe buried next to Bldg 168. Solution has been removed and pipe was flushed with approximately 200 gal of water. Pipe remains in place	None Known
TECHNICAL AREA 39							
TA-19-6	Septic tank	1944-1962	Sanitary waste	Unknown	V	Remains inactive. Possibly a drainfall also exists, as indicated by surface disturbance. No record indicating removal of tank.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Seventeen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 20							
TA-20-27	Septic tank	No Date	Unknown	Unknown	V	Removed prior to 1985.	None Known
TECHNICAL AREA 21							
No #	Gravel seepage pit N of main DP West facilities	1947	Plutonium	28 µg/day	NV	Duration of use believed to be at least 2 years. Location not specified.	None Known
No #	Gravel seepage pit on S side of DP West	1947	4,000 L/day fluoride containing 0.18 µg/L of plutonium	See Type	NV	Duration of use believed to be at least 2 years. Location not specified.	None Known
No #	Pit located 15 ft outside door of Rm. 322 in Bldg. TA-21-3	1947	Plutonium, ethylene glycol, phosphoric acid	1.8 mgd of plutonium	NV	Duration of use believed to be at least 2 years. No visual evidence of pit location currently exists.	None Known
No #	Underground pit between TA-21-2 and 3	1978	Plutonium	Unknown	V	Pit may have received wastewater from washing containers from Hanford that were contaminated with plutonium. Location no. further specified Area was visited during the Survey but there was no visual evidence of a pit. Uncertain whether pit has been cleaned up.	None Known
TA-21-55, 56, 106,	Septic tanks with outfalls to S Canyon rim	Mid-1950s	Radionuclides	Unknown	NV	Tanks were abandoned in mid-1960s.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Eighteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21 (Continued)							
TA-21-163	Septic tank with outfalls to N Canyon rim	Mid-1950s	Radionuclides	Unknown	NV Tank abandoned in 1966.		None Known
TA-21-53, 125	Septic tanks (no outfall)	Mid-1950s	Potential for contamination unknown	Unknown	NV Tanks abandoned in 1966.		None Known
TA-21-62, 142	Septic tanks (no outfall)	Mid-1950s	Potential for contamination unknown	Unknown	NV Tanks removed in 1965.		None Known
TA-21-143	Cooling tower outfall for Bldgs 4 and 5	1950s - 1970s	Plutonium-contaminated cooling water, also possibly containing chromates	Rate ranged from 30,000 - 150,000 gpw	V Cooling tower removed. Unclear whether surface soils were addressed during the removal of the tower.		1970: 30cpm/mL in discharge
TA-21-70	Acid pit	1957	Concentrated acid used to digest classified paper	Unknown	NV Pit removed in 1967.		None Known
No #	Five liquid waste wells on NE corners of Buildings TA-21-2, 3, 4, 5, 150	1966	Assumed to be radioactively contaminated	Unknown	NV Wells removed during major cleanup of TA-21 (1978-1981). Extent of residual contamination unknown.		None Known
No #	Sump pumps on S end of Bldgs 2 and 3	1979	Assumed to be radioactively contaminated	Unknown	NV Status unknown.		None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Nineteen

Structure Number	Description	Date	Waste Characteristics		Quantity	Current Status or Condition	Previous Sampling
			Type				
TECHNICAL AREA 21 (Continued)							
No #	Various sumps	1974	Assumed to be radioactively contaminated		Unknown	NV Locations not specified.	None Known
No #	Steam plant dry wells	1987	Unknown		Unknown	NV Reportedly no longer used.	None Known
No #	Inactive industrial waste liner and drains	No Date	Radionuclides		Unknown	NV Locations uncertain. Possible leaks have not been thoroughly studied. Some lines or portions of lines removed.	None Known
MDA-T	4 absorption beds used to dispose of process wastewater	1945-1967	Trenches received 14 million gal of untreated process waste water from 1945 to 1952 that contained plutonium and fluoride (avg. conc. 160 ppm). From 1952-1967, trenches were periodically used to dispose of several hundred gal of treated wastewater. Americium, TRU wastes, and 10,500 gal of ammonium-citrate-contaminated effluent also disposed of in this area.		See Type	V The four trenches are 115 ft and 20 ft x 4 ft deep. Americium wastes were placed in shafts 20 to 65 ft deep and 4 to 8 ft in diameter. TRU wastes mixed with cement were placed in 158 buried corrugated metal pipes that were removed in FY86. Area is fenced with some surface stabilization. Stormwater drainage currently directed over the top of area. Erosion noted along N side of area.	Extensive.
MDA-U	2 absorption beds used to dispose of Filter Building effluent	1948-1968	Actinium-227, polonium -210		Unknown	V Trenches are approximately 100 ft long, 20 ft wide, depth unknown. Some contaminated soil removed in 1985 but removal was incomplete. Depth of excavation marked with a plastic sheet and area back filled. Site is fenced.	Assumed during limited cleanup.

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21 (Continued)							
MDA-V	Three absorption beds used to dispose of laundry wastewater	1945-1963	345; strontium-90, barium-140, lanthanum-140; unknown quantity strontium-90, plutonium-239, and polonium	Unknown	V	Pits were reportedly 25 ft x 200 ft (depth unknown) and are known to have overflowed in the past. Area has been fenced with some surface stabilization in 1985. Piles of sewage sludge present on top of a portion of the area. Erosion gullies noted on S side of MDA-V along fence line and down canyon side.	None Known
TECHNICAL AREA 22							
TA-22-25	Process Bldg. outfall	Mid-1950s	PETN; acetone solvents	Unknown	V	Inactive outfall; area was restricted due to possibility that recrystallized PETN is in area soils; building not used for many years	None Known
TA-22-52	Shops Bldg.	1953-1984	HE, beryllium, perchloric acid, sodium thiosulfate, gold, hydrogen peroxide, ferric chloride, lead; sulfuric, hydrochloric, chromic, hydrofluoric, and phosphoric acids; thallium, sodium carbonate; cyanide, nickel, copper, zinc, cadmium	Unknown	V	Etching and plating operations moved from Bldg. 52 in 1984; therefore outfall also inactive.	1986: CEARP soils sampled along drainage
TA-22-77	Contaminated wash pad	No Date	Potential high explosives and unknown contaminants	Unknown	NV	Use unknown.	None Known
TA-22-50	Septic tank with outfall/drain-tile system(s) from HE processing in Building 34. Outfall and septic tank in marsh area	Late 1950s-Early 1970s	High explosives, solvents, and inorganic contaminants	Unknown	V	Inactive. One drain-tile system may still be actively used under NPDES permit.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-One

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 22 (Continued)								
No #	Outfall from TA-22-1	1950s?	High explosives		Unknown	V	Inactive. Lush growth on hillside S of Bldg. 10 and dead Typha plants at shallow depression at bottom of hillside	None Known
No #	Two dry wells	1984-?	Organics, hydrochloric acid, copper, ferric chloride, sodium carbonate, sodium hydroxide		Each 25 ft deep, 6-ft diameter	NV	Assumed to be inactive. Tank received effluent from Bldg. 91.	None Known
TA-22-42	Septic tank	1945-mid-1950s	High explosives		Unknown	V	Inactive.	None Known
TA-22-51	Septic tank with drainfield	1945-1973	High explosives		Unknown	V	Inactive. Lush growth on slope S of Bldg. 1 received effluent from Bldgs. 32, 4, 5 and Bldg. 1.	None Known
TECHNICAL AREA 24								
TA-16-507	Chemical sump pit	1959	High explosives, various chemicals		Unknown	V	Removed in 1960; area looks like an open field	None Known
TA-16-504	Septic tank	1945-1963	Potential photoprocessing wastes, beryllium residue, and/or spent solvents such as amyl acetate, ethylene dichloride, and dioxane		Unknown	V	Removed in 1963; area looks like an open field	None Known
TECHNICAL AREA 25								
TA-16-526, 527	Septic tank and pump pit serving V Site	1972	High explosives		Unknown	NV	Inactive. A-1972 reference reports that tank was suspected to be contaminated with HEs. Possible contaminants in pit 526 unknown.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Two

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 25 (Continued)							
TA-16-793 through 799	Industrial waste system serving V-Site and portions of TA-16	1970-71	High explosives	Unknown	NV	Structures still present.	1970: No detectable radioactive contamination found
TECHNICAL AREA 26							
TA-26-5	Septic tank	1946-1965	Uranium-233 and 235, tritium	Unknown	V	Inactive tank that received vault drainage. Tank believed to have been removed.	1986: LASCSP phosphor survey
TA-26-6	Settling sump	1946-1965	Uranium-233 and 235, tritium	Unknown	V	Inactive sump that received drainage from a vault believed to have been removed.	1986: LASCSP phosphor survey
TECHNICAL AREA 29							
TA-29-4	Latrine	1951-1957	Sanitary waste	Unknown	V	Reportedly removed in 1957.	None Known
TECHNICAL AREA 31							
TA-0-7	Septic tank	1945-1954	Potential petroleum or toxic chemicals	Unknown	V	Inactive. Located on small bench near edge of canyon side and is accessible to public. Tank contained some liquid during Survey visit.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 32							
TA-32-7, 8	Septic tanks	1945-1954	Radioactive	5' x 8' x 6'	V	Still in place, western tank has standing water; and center of eastern tank is caved; no outfalls observed.	None Known
TECHNICAL AREA 33							
TA-33-32, 74	Sanitary septic tank, drain, unnumbered industrial waste liner, and tilefield serving Bldg. 21	1951-1960	Plutonium and beryllium released in a 1960 accident; potentially uranium	See Status	V	The building and an estimated 2.5m ³ of soil contaminated with plutonium (80 pCi/g gross alpha) associated with industrial waste tilefield removed in 1974 and taken to TA-54. Cleanup was based on rad only. No clean-up measures taken down the side of the canyon wall at the point of the outfalls.	See Status
TA-33-31, 78, tile field (No #)	Sanitary septic tank, drain, and unnumbered tilefield serving Bldgs. 19, 20, 39, 113, and 114	1947-?	Mercury, uranium (depleted and natural), tritium, trichloroethylene, benzene, beryllium, lead	Unknown	V	Tilefield (90 ft x 80 ft) is located in NE section of Area 6 - drainage would flow SE. Whether this is inactive is uncertain.	None Known
No #	Two drains from Bldg. 39	No Date	Uranium, lead, organics	Unknown	NV	Status unknown.	None Known
No #	Drain from Bldg. 20	No Date	Uranium, beryllium	Unknown	NV	Status unknown	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Four

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
* F C H N I C A L A R E A 33 (Continued)							
No #	Drain from Bldg. 16	1950s	Coolant from cutting operations, potential radionuclides, barium titrate, PbZnO ₃ mixed with PbTiO ₃ epoxy resins	Unknown	V	Building still exists. No cleanup in area of drainage reported.	None Known
No #	Sump or settling tank from Bldg. TA-33-23, Trim Building	No Date	High explosives	Unknown	V	Trim Building has been decontaminated and is used by a researcher. Cleanup measures taken at the sump are unknown.	None Known
No #	Drains from TA-33-26 X-unit chamber and from firing pad	No Date	Uranium, beryllium in runoff	Unknown	V	Drainage pathway is distinctive and flows down canyon wall.	1985: Soil samples contained uranium
No #	Drains from firing sites TA-33-24, 25	1950s-1960s	Uranium in runoff	Unknown	V	Drains daylight at canyon wall. No record of cleanup.	None Known
No #	Drains from TA-33-86 X-unit chamber	1947 - ?	Radionuclides, possibly including uranium	Unknown	V	Drains daylight at White Rock Canyon wall. No record of cleanup.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Five

Structure Number	Description	Date*	Waste Characteristics		Quantity	Current Status or Condition	Previous Sampling
			Type				
TECHNICAL AREA 33 (Continued)							
No #	Septic tank with tilefield and two other unnumbered drains serving Bldg 87	1947	Unknown	Unknown	Unknown	V Building is listed as a laboratory. Two drains daylight near a gun mount. Septic system tilefield flow is near MDA-D, used for underground tests.	None Known
TECHNICAL AREA 35							
No #	Two stormwater collection basins	No Date	Potential runoff contaminated with PCBs, radionuclides, or beryllium	Unknown	Unknown	V Basins are located on edge of mesa top. One discharges directly to the canyon.	None Known
TA-35-8, 9, 12, 22, 28, 31, 36, 41, 78, 96, 97, lines 49, 70, 71, 90, 91, 92	Tanks, sumps, pits, and waste lines	Variable	Radionuclides	Unknown	Unknown	NV Structures removed. At some locations, contaminated subsurface soil is known to remain.	At time of removal, samples were collected at some locations.
TA-35-10	Building housing waste tanks	1951-1984	Radionuclides	Unknown	Unknown	V Building and waste hold-up tanks removed in 1984. Excavated to 18-20 ft below grade. Remaining soil contained 356 pCi/g gross beta prior to back fill. Location remains unvegetated and shows signs of soil erosion.	See Status

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Six

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 35 (Continued)								
No. #	Outfall from Bldg. TA-35-10	1951-1963	1951-1954: 2.2 Ci (radionuclide not specified). 1955-1963: 0.123 Ci Sr-90, 9.039 Ci unidentified beta-gamma emitters (decayed through 12/81). Other spills and accidental releases are known to have occurred but are not quantified	See Type		V	Inactive outfall that discharged to Mortandad Canyon. Extent of area affected estimated in 1980 to be 10,000 m ² - accuracy of estimate unknown. Elevated rad reading noted during Survey at one location in vicinity of former outfall.	1952-1970: Direct radiation measurements and limited soil sampling
No #	Bldg. 25 outfall to canyon	1950s	Nonradioactive discharge from the Sodium Building	Unknown		NV	Unknown.	None Known
No #	Bldg. 34 outfall to canyon	1950s	Sodium testing building condensate return line - nonradioactive. Other unknown	Unknown		NV	Unknown.	None Known
TA-35-14, 76	Septic tanks	1950s-1975	Sanitary waste. Other unknown	Unknown		NV	Abandoned in 1975.	None Known
No #	Bldg. 26 drain to canyon	No Date	Unknown	Unknown		NV	Drain partially removed in 1985. No radioactive contamination identified	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Seven

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 35 (Continued)							
No #	Cooling tower outfall to canyon	No Date	Unknown	Unknown	NV	Cooling tower inactive. Discharge mentioned in old NPDES permit.	None Known
No #	Former lagoon	No Date	Unknown	Unknown	V	Former lagoon location is currently under N end of Bldg. TA-35-85. No information on lagoon removal.	None Known
TECHNICAL AREA 36							
TA-36-61	Septic tank at IJ Firing Point	No Date	Potential HIEs and residual uranium	Unknown	NV	IJ is considered active, therefore, presumably tank still exists.	None Known
TA-36-17, No #	Septic tank at Bldg. 1 and unnumbered drains	1957-1987	Potential photolab wastes, uranium-238 solvents, hydrochloric acid, and metal machine shop wastes	Unknown	NV	Origin of drains emptying off cliff unknown. Septic tank assumed to be active.	None Known
TA-36-49	Sump pit at Bldg. 48	No Date	Zinc chloride, acids, glue	Unknown	V	Still exists. Covered by wooden boards.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

SECRET

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Eight

Structure Number	Description	Date	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 39							
Unnumbered sump identified during Survey	Sump that received Bldg. 4 wastes	Pre-1986	High explosives from Trim Building	Unknown	V	Sump (approximately 16 ft ²) removed in May-June 1986, including gravel, pipes, and traps. Material contaminated with HEs burned at firing site. Remaining soils tested and explosives not detected.	See Status
TECHNICAL AREA 41							
TA-41-11	Septic tank	1986	Radionuclides	Unknown	V	Inactive, but still exists and is considered contaminated.	None Known
TA-41-7	Sanitary Treatment Plant tank and outfall	1955	Radionuclides	216-244 dth/l	NV	In 1955, effluent was sampled and found to contain 216-244 dpm/L gross alpha. Plant is active.	See Status
TECHNICAL AREA 42							
TA-42-2	Ash residue tank	1951-1978	Lanthanum-140 ashes from offgas cleanup of incinerator; dry sludge with 130 nCi/g plutonium-239	140,000-L tank; 2,600 L dry sludge	V	Inactive. Sludge disposed of at TA-54; details on disposal of tanks, foundations, and soils removal are lacking.	1979 (sludge)
TA-42-3	Ash residue tank	1951-1978	Lanthanum-140 ashes from offgas cleanup of incinerator; wet sludge with 1,000 nCi/g plutonium-237	140,000-L tank; 2,600 L wet sludge	NV	Inactive sludge mixed with cement, then disposed of at TA-54; details on disposal of tanks, foundations, and soils removal are lacking.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twenty-Nine

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 42 (Continued)							
TA-42-4	Septic tank	1951-1978	Radioactive wastes	Slurry: > 1x10 ⁶ cpm/L gross alpha; > 1x10 ⁶ cpm/L gross beta; 39x10 ³ cpm/L gross gamma	V	Inactive. Slurry liquid drained to filter trench and on to outfall.	1978 after D&D.
No #	Filter trench and outfall	1951-1978	Radioactive wastes	Unknown	V	Inactive contaminated liquids flowed into Mortandad Canyon; soils surrounding trench (1,200 m ²) were excavated and disposed of at TA-54; up to 400 pCi/g soil remains at depth. Excavation backfilled.	1978 after D&D.
TECHNICAL AREA 45							
TA-45-1	Wash rack	1951-1966	Vehicle decontamination waste liquids	Unknown	V	Inactive; 516 truckloads of debris and soils removed during D&D of this and ancillary lines, manholes, etc.	1967, 1982
TA-45-2	Wastewater Treatment Plant system	1951-1966	Radioactive liquid wastes from TAs 1, 3, 4B; plutonium and fission products high in gross beta and gamma	Unknown	V	Inactive. See above D&D activity. D&D completed July 1967 and area transferred to Los Alamos County present occupant is County Roads Dept.	1967, 1982

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Thirty

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
T E C H N I C A L A R E A 45 (Continued)							
No #	Treated waste outfall	1951-1966	Low-level plutonium	Unknown	V	Inactive. Canyonside/cliff comprised of tuff was jackhammered -- debris removed via 94 truckloads.	1967, 1982
No #	Untreated waste outfall	Pre-1951	Plutonium	Unknown	V	Inactive	None Known
TA-45-3	Lift station overflow outfall	1951-1956	Plutonium	Unknown	V	Inactive. Overflow was to acid canyon.	1967, 1982
TA-45-5, 6	Manholes	1951-1966	Radioactive waste	Unknown	NV	Inactive. LASL memo of 1966 states they should be removed. Current status unknown.	None Known
No #	Acid canyon	1951-1966	Plutonium	Unknown	NV	Further cleanup performed in 1982. Subsurface contamination remains in areas of TA-45 where influent waste lines were once located.	1982
T E C H N I C A L A R E A 46							
No #	Drain from Bldg. 24	1958	50% hydrochloric acid 50% nitric acid	Unknown	NV	Drain reportedly went to a storm drain that emptied over mesa rim.	None Known
TA-46-61	Acid sump manhole	1960	Bldg. 31 acid wastes	Unknown	NV	Assumed to still exist.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Thirty-One

Structure Number	Description	Date	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46 (Continued)							
TA-46-81	Open concrete tank N of Bldg. 31	1963-1973	Water used to clean metal containers	Unknown	NV	Potentially discharged to Canyon del Buey. Removed in 1973.	None Known
No #	Effluent from Bldg. 1, Rm. 8	1965	Metallurgical polishing effluent containing uranium	Unknown	NV	Disposal location unknown.	1965: Effluent contained 24-49 mg total uranium.
No #	Effluent from Arc Jet Facility	1969	Lithium hydroxide	50-100 lb/yr lithium	NV	Discharge location unknown.	None Known
TA-46-53	Septic tank near Bldg. 31	1974	Plutonium potentially contaminated with uranium, organics, and beryllium	Unknown	V	Tank reportedly pumped out twice in 1974. Tank still exists.	1973: 21,822 dpm/L gross alpha
TA-46-8, 22, 49, 66, 94	Septic tanks	Pre-1973	Potential radioactive contamination, organics, and beryllium	Unknown	NV	Abandoned in 1973. Tank 94 backfilled.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Thirty-Two

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46 (Continued)							
TA 46-69, 70	Sumps	Pre-1973	Potential uranium, organics, and general chemicals	Unknown	V	Located on the edge of a mesa near a laboratory used in Rover Program. A few dead trees noted downgradient, but there is no information regarding an overflow from these sumps. Abandoned in 1973.	None Known
TA 46-149	Pit	1973	Battery acid that was possibly neutralized with lime	25,000-gal capacity	NV	Unable to locate during Survey.	None Known
No #	Pond	? - 1987	Salt solution	Unknown	NV	Lined pond still contains salt solution but is no longer used for tests.	None Known
TECHNICAL AREA 50							
Lines 44, 45, 45A, 46, 47, 48, 48A, 49, 54, 55, 67	Waste lines	Pre-1981	Radioactively contaminated waste	Unknown	NV	Lines removed in 1981 and 1984 (2 projects) and disposed of in Area G.	During removal operations

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-1 FORMER LIQUID WASTE DISPOSAL SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Thirty-Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 53							
No #	Disposal pit	No Date	Thick brownish liquid of unknown origin	Unknown	V	Inactive. Formerly located SE of TA-53-2 but has been removed and backfilled. Location of final disposal unknown.	None Known
TECHNICAL AREA 57							
No #	Disposal areas for geothermal investigations	1973 - ?	Drilling mud and cuttings from Fenton Hill Site	Unknown	V	Disposal in borrow pits on Forest Service land and on private property.	None Known
No #	Drilling mud pits	1973 - ?	Drilling mud and cuttings which may include arsenic, cadmium, beryllium, lithium, and fluorine	Unknown	V	Mud pits are typically removed following drilling operations; however, the degree of cleanup and the residual contamination are unknown	None Known
TECHNICAL AREA 59							
TA-59-4	Septic tank and drainfield	Mid-1960s-1979	Sanitary, photographic wastes	Unknown	V	Inactive; was located 115 ft SW of Bldg. 1; removed in 1979 when facility was hooked up to TA-50 Wastewater Treatment Plant.	Unknown if surrounding soils were tested during removal.

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 2							
TA-2-49	Cooling tower drift loss	1977	hexavalent chromium	0.5 lb/hr of operation	V	Cooling tower is active but no longer uses potassium dichromate. No visual signs of contamination	None Known
TECHNICAL AREA 3							
TA-3-66	Leak in chilled water system of Sigma Building	1972	Soluble fluoride	600-700 lb	NV	Release flowed into Sandia Canyon. Some degree of cleanup conducted.	1972 High of 48 ppm fluoride in liquid
TA-3-218, 253	Former capacitor storage area near buildings	No Date	PCBs	Unknown	NV	Potential location of past spills or leaks. All of the PCB-marked capacitors and many of the others removed.	None Known
TA-3-287	Drum and capacitor storage area outside building	? - 1987	Oil-like stains on ground, possible PCB contamination	Unknown	V	Drums and capacitors still present	None Known
TA-3-282	Capacitor, transformer, equipment storage area outside building	1986	PCBs	Unknown	NV	Leaks observed in 1986. Since that time, most or all PCB-contaminated capacitors reportedly removed along with several inches of soil.	None Known
TA-3-316	High-Voltage Test Facility with a Marx generator	1969	Possible PCB contamination	Unknown	NV	A fire occurred and dielectric oil was lost. It is unknown if the oil contained PCBs or if other toxic materials were formed as a result of the combustion.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 3 (Continued)								
TA-3-382	Storage area near building	1986	Oil, others unknown		Unknown	NV	Stains observed in 1986. Current status unknown.	None Known
TA-3-38, 383, 446	Possible spills and leaks	No Date	Unknown		Unknown	NV	Warehouse complex where spills potentially occurred in the past. Buildings still active.	None Known
TA-3-22	Steam/power plant	No Date	Chromate drift loss		Unknown	NV	Status unknown. Assume that a chromate-based corrosion inhibitor is no longer used.	None Known
No #	Past spills/leaks around Pan Am Buildings	No Date	Possibly oils, PCBs, lead and acid from batteries		Unknown	NV	Spills potentially occurred in the past from storage of drums, transformers, and batteries. Locations not specified but some cleanup reportedly has taken place.	None Known
TA-3-25, 58, 127, 156, 187, and 285	Cooling towers	No Date	Blowdown and/or drift loss from cooling towers contaminated with hexavalent chromium and some radionuclides.		Unknown	NV	Cooling towers still active.	None Known
TECHNICAL AREA 5								
TA-5-5	Shop and darkroom spills	1945-1959	Metals, HEs, radionuclides, cesium		Unknown	V	Building was D&D'd during LASCP (1985); no observable evidence of residual soil contamination noted during Survey	1959: no rad, only HE in building; none known on soils

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 6							
No #	Possible dumping ground	Mid-1940s	Flammable liquids and toxic solvents from barrels	Unknown	NV	Inactive; old safety order required collecting these wastes in barrels, then dumping them in an area reportedly halfway between TA-6 & TA-22	None Known
TECHNICAL AREA 8							
TA-8-10	Main Ranch House	1950	Radioactive materials may have been stored in the house and then potentially released	Unknown	V	House removed in 1950 - general location visited. No rad readings above background. No visual signs of contamination	None Known
No #	Spill at "Main Building"	1951	Plutonium	Unknown	NV	Building number not provided.	None Known
TA-8-24	Spills at Isotope Building	1954 and 1955	Strontium-90 spilled at loading dock	Unknown	NV	Building still in use. Strontium-90 spill cleaned up but potential exists for residual contamination to be present at loading dock.	None Known
TECHNICAL AREA 10							
No #	Spills near laboratory buildings	1945-1963	Strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acids; lanthanum, barium, cadmium, platinum, benzene, and carbon tetrachloride; other organic and inorganic contaminants	Unknown	V	Inactive. Laboratory wastes were occasionally spilled near laboratory buildings	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 15								
TA-15-183	Broken capacitor	1963	PCBs		Unknown	NV No information on cleanup provided.		None Known
No #	Spill	No Date	Vacuum pump oil		Unknown	NV Location not specified		None Known
No #	Spill next to PHERMEX	No Date	Oil		Unknown	V Occurred in a ditch outside PHERMEX that actively receives cooling water.		None Known
Identified during Survey	Spill NE of Bldg. 185	1987	Dark-stained, oil-like spill		Unknown	V Dark stained soil in drainage ditch next to a high-voltage amplifier and transport boxes noted during Survey.		None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

UNCLASSIFIED

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 16							
No #	Various spills and releases around process buildings in TA-16	No Date	High explosives, such as composition B, TNT, AP, TNT, peroxide, barium nitrate, ammonium nitrate, and Cyclotol 70/30; carbon tetrachloride; thallium and thallium compounds; phosphene; lithium fluoride; toluene; fluoride; toluene diisocyanate; uranium/niobium alloy; methyl ethyl ketone; beryllium; perchloroethylene; mercury; chloroacetic anhydride; boric acid; borax; ammonium picrate; trinitroresorcinol; alpha, beta, gamma, delta, epsilon, and zeta isomers of 1,2,3,4,5,6-hexachlorocyclohexane; anthracene; butyl acetate; dimethyltoluene; "potting compound" plastics; phenolic resins; butyl phthalate; trimethyl phosphate; and lead powder	Unknown	NV	Locations not specified. Contaminants listed are not specific spills but rather materials used in the TA	None Known
TA-16-28, 189, 262	Cooling towers	See Status	Drift loss containing chromates	Unknown	NV	Cooling towers removed in 1968, 1960, and 1957, respectively.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 18							
No #	Transformer at TA-18-136	1982	PCBs	See Status	NV	Spill cleaned up in 1982. Approximately 50 m ³ contaminated soil was disposed of in Area G. No information on PCB levels remaining in soil reported.	Assumed during cleanup
No #	Stream running through TA-18	1963	Unknown	Unknown	NV	Location of where wastes were reportedly occasionally released to stream not specified	None Known
TECHNICAL AREA 21							
TA-21-223	Pumping station	Pre-1970	Radionuclides	Unknown	NV	Occasionally the station overflowed and contaminated liquids were released down the canyon. No record of cleanup provided	None Known
MDA-T and MDA-V	Overflow of seepage pits	1956	Radionuclides	Unknown	V	When in use, these liquid waste disposal sites occasionally overflowed.	None Known
TA-21-152, 166, 167, 220	Cooling towers	Pre-1970s	Drift loss from towers, contaminants unknown	Unknown	V and NV	Current status is unknown.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 21 (Continued)								
No #	Spill	1972	Radioactively contaminated oil		Unknown	NV	Spill occurred at an incinerator used for burning batch waste. Measurements of up to 20,000 cpm alpha were recorded. No information on cleanup provided.	See Status
TA-21-5	Release from a fire	1959	Assumed to be radioactively contaminated		Unknown	NV	No information on cleanup provided.	None Known
TA-21-35	Waste tank leak on W side of Bldg 35	1955	Assumed to be radioactively contaminated		Unknown	NV	No information on cleanup provided.	None Known
TA-21-2, 3	Paved surfaces between N sides of building	1955	Assumed to be radioactively contaminated		Unknown	V	Area cleaned up and repaved. No visual signs of contamination noted.	Assumed during cleanup.
TA-21-257	Area around building	1972	Assumed to be radioactively contaminated		Unknown	V	No report of cleanup provided at time contamination was found.	None Known
TA-21-257	Spill	1976	Radioactively "retrievable paste"		Unknown	NV	Reportedly, area was decontaminated	Assumed during cleanup
TA-21-2 or 257	Area around building	1977	Americium-241		Unknown	V	Contamination occurred as a result of a transport trailer leak. Levels up to 50,000 cpm/100 cm ² were noted. Records indicate plans to clean up but no information available to document that it was completed.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
T E C H N I C A L A R E A 21 (Continued)								
TA-21-257	Leak from tank vent	1982	Plutonium, americium, uranium		Unknown	NV	Contamination reportedly cleaned up	Assumed during cleanup
No #	Stack emissions from DP Site	1945-1978	Plutonium-239		Unknown	NV	Soil samples from TA-21 contain elevated levels of Pu-239. A 1980 report indicates that area of contamination is 300,000 m ²	See Status
T E C H N I C A L A R E A 22								
No #	Random disposal of solvents and flammables	1949-?	Toxic solvents and wastes, flammables		Unknown	NV	Inactive. Common practice was to empty liquids daily into barrels. When these barrels were full they were dumped on ground between TA-22 and TA-6. Practice has been discontinued for many years.	None Known
T E C H N I C A L A R E A 33								
No #	Accidental releases, predominantly in TA-6	Varied	Radionuclides		Unknown	NV	Numerous past releases have occurred. Total environmental contamination not quantified.	None Known
No #	Spill/release	1960s	Beryllium, beryllium oxide		Unknown	NV	Releases occurred as a result of three malfunctioned tests. Elevated levels of beryllium found in soil and on equipment. Locations not specified. No information on cleanup.	See Status

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 33 (Continued)							
No #	Potential spill	1958	Radioactive oil, PCBs	Unknown	NV	A vacuum pump, believed to have been SE of Bldg 21, was damaged during a test and may have leaked.	None Known
TECHNICAL AREA 35							
No #	Spills or releases on S side of TA-35	1956	Alpha emitters, uranium, strontium-89, strontium-90	Unknown	NV	Contaminated soil identified on S side of TA-35. No further information available.	Limited
No #	Spills or releases E of Bldg. 10	Pre-1983	Cesium-137, strontium-90, plutonium-238 and 239, and uranium	Unknown	V	Contaminated soil identified in 1983 on E side of former Bldg. 10 that held radioactive wastes.	Limited
No #	Pond overflow S of Bldg. 125	1987	PCB-contaminated oil, other unknown	Unknown	V	No cleanup measures had been performed at time of Survey.	None Known
No #	Spill in culvert S of Bldg. 125	1987	PCB-contaminated oil, other unknown	Unknown	V	No cleanup measures had been performed at time of Survey.	None Known
No #	Spills at oil storage area near Tank 153	1987	PCB-contaminated oil, other unknown	Unknown	V	No cleanup measures had been performed at time of Survey.	None Known
No #	Storm drain outfall with stained soil located S of Bldg. 86 (E of Bldg. 207)	1987	PCB-contaminated oil, other unknown	Unknown	V	No cleanup measures had been performed at time of Survey.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION. LANL
Page Ten

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 35 (Continued)							
No #	Canyon side S of Bldg. 207 with numerous areas of stained soil	1987	PCB-contaminated oil, other unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
No #	Stormwater basin and erosion path S of Bldg. 34	1987	PCB-contaminated oil, other unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
No #	Stained soils at capacitor/drum storage area S of Bldg. 67	1987	PCB-contaminated oil, other unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
No #	Stained soils around two oil storage tanks on W side of Bldg. 29	1987	PCB-contaminated oil, other unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
No #	Potential spills from rusting capacitors stored under trailer on E side of Bldg. 29	1987	PCB-contaminated oil, other unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
No #	Stained soil (black and yellow) in drainage ditch on SE corner of Bldg. 29	1987	Unknown	Unknown	V No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known
TECHNICAL AREA 36							
No #	Occasional dumping	No Date	Dithelene (nitric acid, nitrobenzene, water mixture)	Unknown	NV No cleanup measures had been performed at time of Survey.	No cleanup measures had been performed at time of Survey.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Eleven

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 39								
TA-39-55	Former incinerator location	1955-1965	Classified waste, potentially a few magnesium shavings		Unknown	V	Incinerator located S of Bldg 2 removed in 1977. No visual signs of contamination. Location of ash disposal unknown.	None Known
Identified during Survey	Spills near TA-39-2	Pre-1978	Solvents, alcohol		Unknown	V	Potentially small quantities of waste solvents or alcohols were spilled or dumped outside buildings. Parking area now paved. No visual signs of contamination.	None Known
TECHNICAL AREA 40								
TA-40-9	Oil and solvent spill	No Date	Gun cleaning oil and solvents (trichloroethane, 1,1,1-trichloroethane)	4' x 8' surface area		V	Inactive. Bare patch of soil is approximately 4' x 8'.	None Known
No #	Beryllium release	1958	Beryllium	Unknown		NV	Inactive. An operator worked a small piece of beryllium with no local exhaust ventilation.	None Known
TECHNICAL AREA 42								
TA-42-1	Incinerator	1951-1978	Low-level plutonium-contaminated waste burned	Unknown		V	Reportedly, incinerator never worked properly. Stack effluents were high in radioactivity. In 1978, incinerator was D&D'd.	1977 prior to D&D, post-D&D in 1978

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Twelve

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46							
No #	Ditch SW of Bldg 1	1961	Cesium metal and oxide	Unknown	V	Location visited, no elevated rad readings noted	None Known
No #	Cooling tower for Bldg 1	1971	Drift loss containing corrosion control additives - reportedly biodegradable and nontoxic	10,500 gpy	NV	Still exists (1986 photo)	None Known
No #	Cooling tower for Bldg 87	1971	Drift loss containing corrosion control additives - reportedly biodegradable and nontoxic	453,000 gpy	NV	Assumed to still exist.	None Known
No #	Spill east of Manifold 71	1987	Oil-like substance	Unknown	V	Dark stains around approx. 15 drums. Runoff goes to a ditch and then to the edge of the canyon	None Known
No #	Spill next to Shed 197	1987	Oil-like substance	Unknown	V	Storage shed with 2 pieces of electrical equipment leaking - stains evident leading to a storm drain	None Known
No #	Spill near Bldg 158	1987	Oil-like substance	Unknown	V	Dark stains in a ditch, drainage eventually leads off mesa edge.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Thirteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46 (Continued)							
No #	Spill	1957	Mercury	Unknown	NV	Location not identified.	1957: 10-15 times permissible levels
No #	Spills N of Bldg. 31	1987	Oil like substances, oilier unknown	Unknown	V	Numerous stained surface soil areas. Runoff flows over edge of mesa.	None Known
No #	Spills S of Bldg. 31	1987	Unknown	Unknown	V	Green stains on surface soils next to loading dock noted during Survey. Stained area very small.	None Known
TA-46-36	Spills or leaks on E and W side of Bldg. 36	1987	Oil-like substance, drums labeled chloroethane and Shekoni	Unknown	V	Dark stained surface soil noted adjacent to electrical parts and approximately five drums. Runoff drains to a ditch that leads to the edge of the mesa. Markings on tape placed on drums indicate that they may have been sampled in 1986 (e.g. Sample #8605225).	Uncertain, See Status

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-2 SPILLS AND UNPLANNED RELEASES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Fourteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 50							
No #	Sump overflow	1975	Radionuclides	50,000 pCi gross alpha	NV	Sump LD-2 overflowed and contaminants followed drainage path into Ten-Site Canyon. Soil sampled in canyon drainage; mid-section found to have 300 pCi/g gross alpha. Bottom of canyon found to have a high of 70 pCi/g. Unclear whether area was cleaned up.	See Status
TA-50-1	Spill NE side of TA-50-1	No Date	Radionuclides	Unknown	NV	Spill reportedly cleaned up; low levels of activity remain.	Assumed during cleanup

** Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

UNCLASSIFIED

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 0							
MDA-M	Surface dump N of TA-9AE	1947-1987	Paint and solvent cans, clear glass bottles containing liquids, pipes, and debris with asbestos exposed, pieces of concrete and rubble, potentially items contaminated with uranium and/or HEs	3 2 acres	V	Open dump with no cover, no control of runoff/runoff, and no fencing to control access	None Known
TECHNICAL AREA 3							
No #	Pan Am boneyard and storage areas on Sigma Mesa	? - 1987	Transformers, electrical equipment, metal joints, asphalt debris, 150 used empty drums, utility poles, cable, insulators, other equipment	See Type	V	Storage areas are located along an unpaved road on the end of Sigma Mesa. Drums are side-stacked inside a locked, fenced area. Remaining areas are open.	None Known
No #	Dumping on canyon rim near head of Sandia Canyon	No Date	Concrete, building material, friable asbestos- covered pipe	Unknown	V	Some cleanup has taken place.	None Known
No #	Dump S of Bldg 40 along edge of Twomile Canyon rim	?-1987	Building rubble	Unknown	NV	Dump is visible on 1964 aerial photograph	None Known
No #	Dump at end of road across Twomile Canyon	?-1987	Soil, rubble	Unknown	V	Numerous piles of soil and scattered pieces of debris. No elevated rad readings noted	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 4							
No #	Dumping of firing site debris	Mid-1980s	Natural and depleted uranium, aluminum or steel contaminated with uranium, also possibly beryllium and HES	Unknown	V	Radioactive contaminants above background levels cleared from area during 1985 cleanup	See Status
TECHNICAL AREA 8							
Identified during Survey	Surface debris	? - 1987	Metal fragments	Unknown	V	Small area with debris exposed on ground; no other information available.	None Known
TECHNICAL AREA 10							
No #	'Up-canyon dump'	1957	HE wastes from firing sites	Unknown	NV	During 1957, wastes were burned and ashes removed and disposed of at MDA-C. Area not used after 1957	None Known
TECHNICAL AREA 11							
No #	Open dump S of Bldg 4	? - 1987	Concrete, building debris	Unknown	V	Debris is exposed on surface at head of a canyon	None Known
No #	Boneyard near former Target Area	? - 1987	Pieces of iron, a gun, other equipment	Unknown	V	Potential for contamination unknown	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 13							
No #	Canyon shelf NE of firing site	1987	HEs and/or radionuclides	Unknown	V	Founds of debris (concrete, metal) along edge of canyon. No radiation readings above background. Uncertain whether canyon shelf was ever cleaned up relative to HE and rad contamination	None Known
TECHNICAL AREA 14							
No #	Canyon rim dump near Bldg. Q-34	? - 1987	HEs, other unknown	Unknown	V	Dumping of sandbags and several 55-gal drums over rim edge behind Bldg. Q-34.	None Known
Identified during Survey	Boneyard	? - 1987	Guns, cannons, metal, radionuclides, sodium	Unknown	V	Boneyard contained open-top, contorted, 55-gal drums filled with liquid. Uncertain whether liquid was waste or water collected from precipitation. Metal debris noted with 4,500 cpm rad reading	None Known
TECHNICAL AREA 15							
Identified during Survey	Open pit at Firing Point G	1987	Uranium, other firing site debris	Unknown	V	Small, rectangular pit across road from TA-15-28 with elevated rad readings. No other information available.	None Known
No #	Two surface burning areas	1980	Oil-soaked uranium turnings	Unknown	NV	Potentially two areas used for burning oil/uranium turnings. One was 100-150 yd W of E-F, the other on E-F site proper.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 15 (Continued)								
No #	Dumping along edge of canyon S of Firing Points E and F	1985	Radioactively contaminated soil, metal frames and boxes contaminated with 300-500 cpm alpha, and site is the location where a concrete chamber exploded. The chamber was contaminated with 1mR/hr beta-gamma and 7,000 cpm alpha.	Unknown	Unknown	V	An old roadbed leading to edge of mesa is evident. Rad-contaminated shrapnel noted during Survey. Extent of contamination unknown.	See Type
MDA-Z	Open dump off road leading to Firing Point G and PHERMEX	?-1987	Uranium, lead, beryllium	Unknown	Unknown	V	Dump contains approximately 15 blast mats with elevated rad readings, concrete debris, and sandbags. Up to 20,000 cpm noted in area.	None Known
TECHNICAL AREA 16								
No #	Burning ground	1948 - ?	Unknown	Unknown	Unknown	NV	Area located W of Anchor Ranch Road. Area apparently was used for at least 10 years. LANL personnel noted that there is no visual evidence of site remaining.	None Known
MDA-R	Burning ground	Pre-1965	High explosives	Unknown	Unknown	V	Site is 3.27 acres located N of Bldg 260. In the 1960s, area was graded and debris was disposed of over edge of canyon. At time of Survey, snow cover limited field observations.	None Known
No #	Surface dumping E of West James Road and NW of Bldg 540	? - 1987	Concrete and other debris	Unknown	Unknown	NV	Status unknown	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITIONS, ON, LANL

Page Five

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21							
No #	Canyonside dumping	? - 1987	Concrete, asphalt, and building debris	Unknown	V	Materials have been pushed off edge of canyon. Erosion is evident.	None Known
TECHNICAL AREA 33							
No #	Surface dump near Area 6 in TA-33	? - 1975	100 capacitors containing PCBs, uranium, beryllium, and other metals	6,500 ft ² in size	NV	Excavated in 1974 and 1975 and disposed of in TA-54. Post-cleanup rad survey in 1975 showed no contaminants remaining at dump location. Uncertain whether cleanup extended down canyon side and along runoff pathways	See Status
No #	Two canyonside dumps at Gun Mount Area	? - 1987	Foam, wooden debris, wires, potentially contaminated with uranium and/or beryllium	Unknown	V	Debris scattered down the canyonside.	None Known
TECHNICAL AREA 35							
No #	Open dump on N side of TA-35	? - 1987	Concrete, asphalt, conduits, reinforcing rods, soil	Unknown	V	Surface debris scattered in wooded area near edge of canyon	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 36							
No #	Boneyard near Minie Firing Site	? - 1987	Witness plates, collimeters, empty Freon containers, 10 full 5-gal cans of isopentane, 2 test chambers, 20-25 empty sealant cans, and assortment of other equipment	Unknown	V	Equipment found with up to 14,000 cpm reading. Storage conditions do not prevent deterioration of containers or possible migration of contaminants.	None Known
TECHNICAL AREA 40							
No #	Canyonside dumping	pre-1966	HES with wood and other debris	Unknown	V	Materials disposed of below canyon rim, S of TA-40-15 Firing Site. No information available regarding cleanup	None Known
TECHNICAL AREA 46							
No #	Boneyard E of Bldg. 158	? - 1987	Lead and cement bricks, 12 55 drums, miscellaneous equipment	See Type	V	Open storage area with stained soil noted during Survey	None Known
TECHNICAL AREA 53							
No #	Lead bricks	? - 1987	Lead	12 bricks	V	Bricks randomly scattered S of TA-53-2. Site reportedly inactive.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-3 OPEN DUMPS AND BONEYARDS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 00L								
TA-00L-3	Airport incinerator ash/debris	1987	Ash, metal scrap, and cans from incinerated materials of unknown origin		150' x 50' x ~5' thick	V	Ash and residual metal scrap from incinerator dumped from mesa rim onto canyon side. Wastes remain on canyon side.	None Known
TA-00L-13	Surface dump off East Jemez Road	1948	Building debris		Unknown	V	Debris dumped into canyon. No information available regarding cleanup.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

UNCLASSIFIED

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 0							
MDA-C	Landfill with 7 pits and 107 shafts	1948-1974	Radioactive contaminants including U-233, 234, 235, 236 and 238; Pu-239; Am-241; H-3; Na-22; Co-60; Sr-90/Y-90; fission products and induced activity. Chemicals including pyrophoric metals, hydrides, powders, vessels containing sodium-potassium alloys or compressed gases; di- or triethylbenzene, and nickel carbonyl	49,682 Ci decayed through 1-1-73. Chemicals unknown	NV	MDA-C is monitored for radioactivity but no chemical studies have been performed. MDA-C was found to be a source of tritium contamination to honeybees via vegetation in 1973. In 1976, 26 hot spots of gamma activity were found on surface soils. Surface stabilization work was conducted in 1984	See Status
TECHNICAL AREA 2							
No #	Burn pit	1945	Combustible wastes	Unknown	NV	Location unknown	None Known
TECHNICAL AREA 3							
No #	Possible landfill E of TA-3-41, Fire Station No 1	No Date	Potentially contains remains of old TA-3 buildings destroyed in 1949	Unknown	NV	Reportedly, concrete and wire are exposed on surface.	None Known
Possibly TA-3-12, along with others not designated	Burn pits (total number uncertain)	1945	HEs and nonexplosive, combustible materials	Unknown	NV	Locations not specified. 1940s photograph shows possible burn pit near trailer court on East Jemez Road	None Known
No #	Potential landfill near water tower	No Date	Unknown	Unknown	NV	Reportedly, debris and wire are exposed on surface	None Known

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Two

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 6								
No #	Disposal pit	1947	Classified objects, large metal parts, 5 lb uranium, blocks of HE and primacord		70' x 40'	NV	Location on Twomile Mesa - possibly 850 ft NW of concrete saucer.	None Known
MDA-F	Landfill	1947, 1949	Classified objects, large metal parts; tuballoy; HE; primacord; casings and equipment from a plutonium implosion weapon known as "Fatman"; and other metal debris		Fenced areas ~45 ft ² One pit may be 40' x 20' x 10'	V	Two fenced areas depict location of landfill. However, initial geophysical survey data indicate presence of additional burial areas outside the two fences.	Mag. and GPR surveys; A411 study boreholes
No #	Disposal pit	1950	Weapon components and classified material		6' x 6' x 6'	V	Area is between MDA-F and Twomile Mesa Road	None Known
No #	Two disposal pits	1951-1952	Defective weapon components contaminated with Cs-137		2' x 2' x 4'	V	Reportedly located near disposal pit used in 1950 and may contain up to 236 weapon components	None Known
Possibly part of MDA-F	Disposal pit	1957	Classified units		Unknown	V	Location of pit uncertain, possibly within fenced area of MDA-F	Mag and GPR surveys and A411 study boreholes
Identified during Survey	Three depressions suspected to be waste burial areas south of Twomile Mesa Road	No Date	Unknown - possibly radioactively contaminated weapon components, classified objects, and/or HE		See Section 4	V	Three depressions were noted during the Survey, one approximately 10 ft in diameter, the other two approximately 20 ft. Based on the numerous accounts of small pits used for waste disposal in TA-6, these depressions are suspected of being areas of subsidence as a result of waste disposal	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V DOE Survey team representative(s) visited site; NV DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 7							
No #	Burial pit(s)	1944-1945	Unknown	Unknown	V	Shallow depressions -- possibly three pits, some debris exposed on surface	None Known
TECHNICAL AREA 8							
No #	Pit W of Bldg TA-8-21	No Date	Potentially received uranium	Unknown	NV	Location uncertain.	None Known
NIDA-Q	Small pit S of Bldg. TA-8-1	Pre-1964	Gun barrels, 80 inert projectiles, 50 steel blocks with 3" projectiles, 3" and 6" expended casings, bomb parts	See Type	V	Location marked by a wooden stake. Pit is reportedly approximately 30 ft ² in size. No visual signs of surface contamination.	1964. Metal detector used to locate site 1984. Surveyors located site
TECHNICAL AREA 9AE							
No #	Burn pit	1949	Classified materials	Unknown	NV	Pit was reportedly 20 ft x 40 ft x 3 ft deep. Location unknown.	None Known
No #	Waste pit	No Date	Unknown	Unknown	NV	Location described as being on "high side" of TA-9. remains unclear.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 10								
No #	Burn pit, suspected to be in a small depression observed during the survey	1956	Unknown combustible material possibly contaminated with radioisotopes	Unknown	V	Residual ash and noncombustibles were reportedly removed for disposal to radioactive disposal site. TA-10 has been D&D'd and is now owned by Los Alamos County. Whether sampling occurred in this specific area is uncertain.	See Status	
TECHNICAL AREA 12								
No #	Burn area	1962	Excelsior and kerosene added to HES	Unknown	V	High explosives found in 1962 and burned at a location 150-200 ft E of firing pit/structure TA-12-4. Radiation readings of 50-80 μ R/hr detected in a small pit E of TA-12-4 during Survey	1962: See Status	
TECHNICAL AREA 13								
No #	Burn pits	1951	Unknown	Unknown	NV	Location unknown	None Known	
TECHNICAL AREA 15								
MDA-N	Pit	No Date	Remnants of several structures that had been exposed to explosives and chemicals suspected chemical waste disposal	Unknown	V	Covered landfill. Boundaries not marked by fencing.	1985 or 1986: Geophysical survey, report pending	
TECHNICAL AREA 16								
No #	Buried metal	1965	Assumed to be contaminated with HES, based on nature of operations in TA-16	One object	NV	Location 543 00 W51 00 Object removed and disposed of at MDA-P	1965: Object removed	

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 18							
No #	Burial 1.5 miles N of Kiva 1	1946	MDA-1 Tank with no elevated radioactive readings and no ammunition	One tank	NV	Tank reportedly buried 6 ft below land surface. Uncertain whether area was marked with a sign or fence.	None Known
TECHNICAL AREA 20							
No #	Disposal pit Area 1	1945	Uranium, beryllium, HEs, and radioactively contaminated metal scrap	5 ft deep	V	Records unclear as to whether wastes have been removed. Preliminary geophysics data did not include likely location of the pit	1986: Soils and geophysics
No #	Disposal pit Area 2	1945	Uranium, beryllium, HEs, and gun barrels	Bulldozed trench	V	Preliminary geophysics data indicate anomalous conditions.	1986: Soils and geophysics
No #	Disposal pit Area 3	1945	Uranium, beryllium, HEs, three No. five gun barrels, and radioactive material contaminated by Dumbos.	Bulldozed trench	V	Preliminary geophysics data indicate anomalous conditions.	1986: Soils and geophysics
TECHNICAL AREA 21							
MDA-B	Landfill on W end of TA-21	1945-1950	Solid wastes contaminated with plutonium, polonium, uranium, americium, curium, and actinium	See Station	V	MDA-B is a 6-acre landfill and is either one large pit or numerous small pits. Chemical wastes were placed on E end; radioactively contaminated wastes were placed in remaining area. Site is fenced, about 273 ft paved; other 1/3 has been re-covered and seeded. MDA-B is scheduled for additional CEARP Phase 2 study	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Six

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 21 (Continued)								
No #	Burial of ash from incinerators	1960s-1970s	Radioactively contaminated ash (average 53,750 cpm/g gross alpha)		Unknown	NV	Location not specified, current status unknown	None Known
MDA-A	Four disposal pits in addition to liquid waste disposal	1977	Waste contaminated with plutonium, polonium, and other radionuclides		See status	V	Some surface stabilization performed at MDA-A in 1985. Solid waste pits are on E end of area and are estimated to be 172 x 134 x 22 ft. MDA-A is scheduled for additional CEARP Phase II study.	None Known
No #	Suspected landfill	pre-1954	Nonradioactive and chemical wastes		Unknown	V	Bare to sparsely vegetated area with shallow depressions that may be indicative of waste burial	None Known
TECHNICAL AREA 22								
No #	Disposal pit	1946	Classified objects, shapes and possibly radioactive materials		Unknown	V	Survey observed general area; exact location not found.	None Known
TECHNICAL AREA 27								
No #	Burial pit	1945	Uranium gun assemblies and ammunition		Unknown	V	Exact location unknown; should be near base of cliff, possibly under highway/road fill.	1964: Metal detector; 1986: Mag survey

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Waste Characteristics		Quantity	Current Status or Condition	Previous Sampling
			Type				
TECHNICAL AREA 33							
MDA-E, TA-33-59	MDA-E consists of 6 pits and 1 destroyed underground chamber. Only Pit 3 is included under landfills because it apparently received waste, whereas the other pits were used for testing purposes (see also Table D-8).	1949-1960s	Pit 1: Polonium/beryllium fired targets (240 Ci); Pit 2: 70-210 (60 Ci); Pit 3: Can of beryllium dust immersed in kerosene; Pit 4: Unspecified radionuclides; Pits 5 and 6: Unknown - may not have been used; Underground Chamber: HE, polonium Total: Several hundred kilograms of uranium.	See Type	V	Pits and chamber have been covered and are fenced but there is a potential that one pit remains outside fence. Two partially filled underground test chambers are located outside fence and are not considered part of MDA-E because they were reportedly never used.	Monitored for rad under IWMP; elevated tritium found in soil moisture
No #	Burn pit	1950s	Potentially used to burn black powder and propellant powders. Propellants used at TA 33 included LA-148 and LA-248. LA-148 was a mixture of potassium perchlorate, fluorocarbon, TMT (tetramethylammonium perchlorate), fluorel, and 680 Hafon (TELL which was dissolved in methyl ethyl ketone, partly dried, and extruded. LA-248 consisted of potassium perchlorate epoxy, a binder made up of Epon 872, PNDA, and maleic anhydride; sodium fluoride; and acicular aluminum.	Unknown	NV	Location unknown.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 33								
No #	Two burial pits	1985	Not radioactive sawdust, vermiculite, transformer shell, building debris, telephone poles, and fencing that had been used in firing site areas and may be contaminated with beryllium.	Unknown	V	One pit is on South Mesa, the other on East Mesa. Dimensions not reported. Pits were used in 1985 cleanup operation and are now inactive.	None Known	
No #	Suspected landfill at Tower Area	No Date	Radioisotopes, beryllium and other metals, firing site debris	Unknown	V	Landfill is on edge of mesa S of TA-33-26 and W of MDA-E. Debris is exposed on top and face of landfill. Runoff flows down canyon side.	None Known	
TECHNICAL AREA 35								
MDA-X	Covered pit S of TA-35-2	No Date	Gold-lined pressure vessel that contained plutonium nitrate solution.	Unknown	V	Location not specifically marked. Pit contains LAPRE II defueled reactor vessel and fuel storage reservoir. No other information on residual contamination available, but environmental dosimetry records in 1985 indicate that Cs-137 in MDA-X is causing radiation levels in its vicinity to be about 60% above local background levels.	See Status	
MDA-W	Buried steel cylinders	1972	Sodium coolant with traces of fission products (sodium-22, cesium-137, cobalt-58, tantalum-182) and plutonium-239	500-650 lb (approx. 80 gal) of sodium and potassium Pu-239 estimated less than 1 ppm	V	Stainless steel tubes 4 inches in diameter and 120 ft long, cased in steel and buried. Site is marked by concrete monument.	None Known	

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
T E C H N I C A L A R E A 36								
No #	Pit at Lower Slobbovia	Late 1950	Used to explode detonators with nitromethane.	248 cans of detonators	NV	Location uncertain.	None Known	
No #	Burning pit across road from Minie Firing Site	1959	Pit received ash from burning combustibles at Minie Firing Site. Uranium and HEs were possibly used at firing site and thus may be in pit.	Unknown	NV	Possibly used in 1959. Site not found by CEARP personnel.	None Known	
MDA-AA	Burning pit at Lower Slobbovia	? - 1987	Pit received ash from burning combustibles at firing site. Uranium and HEs were possibly used at firing site and thus may be in pit.	Unknown	V	Three inactive burning pits reportedly exist. They are covered and not marked. One active pit also exists.	None Known	
No #	Two pits near Bldg. 12	1956	Ash from burning tuballoy.	Unknown	NV	Location is uncertain but suspected to be in vicinity of MDA-AA. Pits used in 1956.	None Known	
No #	Burial Area near Bldgs. 9 and 10	?-1986	Unknown	Unknown	NV	Site not located by CEARP personnel.	None Known	
T E C H N I C A L A R E A 39								
No #	Two covered pits	No Date	Packing boxes, laboratory benches and shelves, firing site debris, general trash. Suspect chemicals.	Unknown	V	Reportedly 2 pits were used. One is located under Bldg. 69 and the driveway; the other under a volleyball court. A streambed is adjacent to volleyball court area. No visual evidence of pit locations was noted.	None Known	
Inactive portion of MDA-Y	Covered pit	No Date	Firing site debris, cables, test stand remains, office-type trash, packing boxes. Suspect chemicals.	Dimensions illegible in CEARP.	V	Location of covered pit not marked but CEARP report is N of an active pit, which is also named MDA-Y. Based on 1986 aerial photograph, a disturbed area is located N of the active pit. A streambed (dry at time of Survey) runs immediately E of these pits.	None Known	

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-4 INACTIVE LANDFILLS WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Ten

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46							
No #	Suspected landfill	Pre-1987	Asphalt, concrete, other unknown	Unknown	V	Fill is located on edge of mesa, and surface debris is exposed; drainage flows into Canyon del Buey	None Known
TECHNICAL AREA 00L							
TA-00L-4	Airport Landfill	1940s - 1980s	Municipal, "noncontaminated" LANL D&D debris, uranium, oils, and HES	100 lb uranium	V	Operations taken over by Los Alamos County in 1966.	None Known
TA-00L-8	North Mesa Gun Mount	1946	Uranium-contaminated, bolt-down Navy-style gun mount	One	NV	Exact location unknown - buried on North Mesa	None Known
TA-00L-12	DP Road small disposal pits	No Date	Paper towels, chemical waste, and plastics from D Building	30' x 30' depth unknown	V	Reportedly, disposal pits are in Knights of Columbus parking lot and are covered with concrete. Uncertain whether wastes were removed prior to pits being covered.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-5 LIST OF INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 4							
TA-4-10	Firing site	Mid-1940s	Natural and depleted uranium, beryllium, and other heavy metals; terbium and terbium oxide; and HES	0.5 to 1,000 lb shot ≈ 6 per day	V	Firing pit and support structures removed during cleanup activities under LASCP.	1985 (LASCP): Soils during and after cleanup activities
No #	Firing areas (total number uncertain)	Pre-1949	PETN, azide, detonator testing	<0.5 lb HE per test	NV	Locations not specified. Old TA-3 demolished	None Known
TECHNICAL AREA 5							
TA-5-7, 9, 15	Firing pits, X-unit chamber, and steel barricades	Late 1940s	Natural or depleted uranium, beryllium, cadmium, uranium-contaminated aluminum and steel, and HES	Unknown	V	D&D activities under the 1985 LASCP involved cleanup of depleted uranium in soils on mesa surface and in subsurface soils. Mortandad Canyon side not cleaned or sampled	See Status
TECHNICAL AREA 6							
TA-6-37	Firing site on concrete saucer	1944-?	Natural uranium and PETN	Unknown	V	Within saucer structure there are standing water and cattails. No detectable levels of radioactivity around perimeter of area observed during Survey	1978 Phoswich Survey results negative

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 LIST OF INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 6								
No #	Firing site on an asphalt pad	Mid-late 1940s	Uranium and PETN		Unknown	V	Asphalt pad with sump still intact. Sump has radioactivity levels slightly above background (180 cpm).	1978 phoswich survey results negative
No #	"Jumbino": shot containment vessel	Mid-late 1940s	Radioactive contaminants		Unknown	V	Location of vessel when in use is unclear, but may have been West of concrete saucer and North of Twomile Mesa Road.	None Known
TECHNICAL AREA 7								
No #	Firing Pits 1 and 2	1944-1945	Short-lived radionuclides, PPS, Comp B, and TNT		Unknown	V	Berm around pits is intact.	None Known
TECHNICAL AREA 8								
No #	Gun firing sites and ballistic test sites	1943	Uranium, dural, boron carbide		Unknown	V	Structures have been removed, so locations were estimated from remaining concrete bases. No radiation readings above background noted. No visual signs of contamination.	None Known
Identified during Survey	Suspect firing site	No Date	High explosives, radionuclides		Unknown	V	A mounded area surrounded by trenches was observed during Survey. According to LANL personnel, site may have been used for several hundred test shots. No other information available.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 9AE							
TA-9AE-4, 5	Two firing sites known as Far Point	1944-1959	Steel, torpex, tamped tetryl, Comp B, pentolite	Unknown	NV Abandoned in 1959 and removed in 1963. No further information on possible residual contamination available.	None Known	
No #	Recovery pit located NE of Far Point	1944-1960	High explosives	Unknown	NV Hexagonal steel-lined pit with a roof was used for firing charges. Abandoned in 1960, removed in 1963. No further information on possible residual contamination available.	None Known	
TECHNICAL AREA 10							
Firing Points 1 and 2, TA-10-13, 14, 22 through 25	Southeast Firing Area and ancillary structures including X-unit chambers, electronic chambers, control buildings, and battery buildings	? - 1963	Radioactive lanthanum, natural and depleted uranium, Sr-90, lead, aluminum, and beryllium	Available inventory (CEARP file): 3,380 kg depleted U; 2,000 kg natural U; 39.6 Ci Sr total release from both SE and NW Firing Areas	V Sweep and washdown of firing pads was standard operational procedure - washwater flowed into natural drainage. Structures removed in 1963. In 1976, the asphalt pads and contaminated soil removed under FUSRAP. Site currently belongs to Los Alamos County.	1976 FUSRAP	

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 10								
Firing Points 3 & 4, TA-10-15, 16, 26 through 29	Northwest Firing Area and ancillary structures including X-unit chambers, control buildings, and battery buildings	1945-1963	Radioactive lanthanum, natural and depleted uranium, strontium-90, lead, aluminum, and beryllium	Available inventory (CEARP file): 3,380 kg depleted U; 2,000 kg natural U; 39.6 Ci Sr total release from both SE and NW Firing Areas		V	Sweep and washdown of firing pads was standard operating procedure - washwater flowed into natural drainage. Structures removed in 1963. In 1976, asphalt pads and contaminated soil were removed under FUSRAP. Site currently belongs to Los Alamos County.	1976 FUSRAP
TECHNICAL AREA 11								
No #	Firing chamber between TA-11-2 and 3	1945	HEs, natural uranium, and aluminum	Up to 200 lb shots		V	Structure no longer exists.	None Known
TA-11-14	Firing pit	1957	Potential HE contamination	Unknown		NV	Location uncertain. One reference states that it was removed in 1956; another reference reports that it was abandoned in place in 1963.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 11								
No #	Firing chamber between TA-11-2 and 3	1949	HEs, natural uranium, and aluminum		Up to 200 lb shots	V	Structure no longer exists	None Known
TA-11-14	Firing pit	1957	Potential HE contamination		Unknown	NV	Location uncertain. One reference states that it was removed in 1956; another reference reports that it was abandoned in place in 1963.	None Known
No #	Target area S of Bldg. 24	1959	Unknown		Unknown	V	Targets used in firing projectiles from an air gun. Also used as launch impact areas for large (155 mm) projectiles. Some targets still present.	None Known
Identified During Survey	Target area N of Bldg. 24	Pre-1965	Unknown		Unknown	NV	Nature of former uses/tests performed in this area was not clear. Cleared area still present. Potential for residual contamination uncertain.	None Known
TECHNICAL AREA 12								
TA-12-4	Large bridgelike steel firing pit	1947-mid-1950s	HE contamination		Unknown	V	Firing structure still in place. No radioactivity observed on structure.	None Known
No #	Firing site E of large steel pit	1947-mid-1950s	High explosives		Charges up to 200 lb	V	Structures associated with firing site burned in 1960. Noncombustible materials remain. No record of cleanup available.	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 LIST OF INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 13								
TA-13-3, 4	"Battleship" bunkers used in test shots	1947	HEs, polonium		Unknown	V	Steel bunkers still present and used for worker protection during current machining operations	None Known
TA-13-6	Experimental chamber	1948	Possible HE contamination		Unknown	NV	Building removed by 1950. No documentation on removal or possible residual contamination.	None Known
TECHNICAL AREA 14								
TA-14-12	Instrument chamber and firing point	1944-1952	Pentolite, torpex, tamped tetryl, Comp B, TNT, Baronal		Unknown	V	Inactive.	None Known
TA-14-17	Firing pedestal	1944-1952	Pentolite, torpex, tamped tetryl, Comp B, TNT, Baronal		Unknown	V	Inactive.	None Known
TA-14-2	Closed firing chamber	1944-1973	Pentolite, torpex, tamped tetryl, Comp B, TNT, Baronal, and uranium		Unknown	V	Chamber burned in 1973 and noncombustibles taken to radioactive disposal pit at TA-54 and MDA-G; minimal radioactively contaminated material went to MDA-P and MDA-J.	1973: Walls, floors, ceiling between 1,000-12,000 dpm/60cm ²
TA-14-5	Open firing chamber	1944-Present	Pentolite, torpex, Comp B, TNT, Baronal, tamped tetryl, RaLa, strontium, cyanogen, hydrogen cyanide		Unknown	V	Presently used for control equipment storage. No records of cleanup available, although in 1959 structure was found to be contaminated with HEs.	1959: No rad, but HE detected

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 14 (Continued)								
TA-14-14	Firing chamber	1944-1957	Pentolite, torpex, Comp B, TNT, Baronal, tamped tetryl, Rala, strontium, cyanogen, hydrogen cyanide		Unknown	V Inactive		None Known
TA-14-15	Firing chamber	1944-1957	Pentolite, torpex, Comp B, TNT, Baronal, tamped tetryl, Rala, strontium, cyanogen, hydrogen cyanide		Unknown	V Inactive		None Known
TA-14-25 through 29	Pull boxes with associated firing pad	1944-1987	Pentolite, Baronal, TNT, tamped tetryl, Comp B, torpex		Unknown	V Inactive		None Known
TECHNICAL AREA 15								
No #	Blast test in "The Gulch" 1 mile below R Site	1944	Charges of up to 300 lb of Comp B and 500 lb of ammonium picrate		See Type	NV Location unclear, status unknown		None Known
		Pre-1947	HEs (charges up to 50 lb)		See Type	NV Locations unknown. Abandoned in 1947		None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA A 15 (Continued)							
TA-15-14, 74	Firing Points A and B	1947-1957	Uranium	Unknown	NV	No structures remain. No further documentation of cleanup available.	1965: HE and rad not detected in soils
TA-15-34, 35	Firing Points C and D	1947-mid-1950s	High explosives	Unknown	NV	Locations uncertain. Reportedly no structures remain and areas could not be defined during the Survey. No cleanup documentation	None Known
TA-15-26, 36	Firing Points E and F	1940s - 1980s	Steel, aluminum, lithium hydride, uranium, mercury, lead, beryllium, barium, cadmium, gold, tritium, HMX, RDX, TAT, PETN, Cyclotol, Baratol, thorium	Over 10,000 kg uranium fired in test shots	V	Two mounds of soil remain along with control bunker. Mounds of soil are known to be contaminated with uranium and metals.	1985: Be slightly elevated, elevated lead, and uranium in ppt range in surface soils.
TA-15-28	Firing Point G	1949-1967	Uranium and HEs	Unknown	V	Inactive; control bunker still exists. No documentation on cleanup.	None Known
TA-15-17	Firing Point H	1949-late 1950s	Uranium and HEs	Unknown	V	Inactive; control bunker remains. Signs of animal intrusion which has exposed soil with elevated radiation readings (25,000-30,000 cpm)	None Known

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 18								
No # and TA-18-5	Firing site and associated battleship structure	1944-?	Natural uranium, aluminum, marble, copper, lead, cadmium, HES		Unknown	NV	Firing site designed for small charges consisting of a few pounds each, located on W wing of canyon. No information available on potential residual soil contamination.	None Known
No # and TA-18-2	Firing site and associated battleship structure	1944-?	Natural uranium, aluminum, marble, copper, lead, cadmium, HES		Unknown	V	Firing site designed for charges of up to 2 tons, located on E wing of canyon. Drop tests and ballistics tests may also have been conducted, one of which scattered HE. No information available on potential residual soil contamination.	None Known
No #	Firing site	1944-?	High explosives		Unknown	NV	Firing site designed for charges of several hundred pounds, located on S wing of canyon. No information available on potential residual soil contamination.	None Known
TECHNICAL AREA 20								
TA-20-6	Steel lined pit	Mid-1940s	HEs, beryllium, uranium		25 or 200 lb charges 7 tons/week	V	Survey team observed approximate location. Pit had been removed and buried in either TA-2 or 3	CEARP 1986 soils phoswich
TA-20-2	Navy gunfiring site	Mid-1940s	HEs, beryllium, uranium		Unknown	V	Fixed into steel plates mounted on cliffs in N spur of canyon	CEARP 1986 soils phoswich

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Ten

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 20 (Continued)							
No #	Dumbos	Mid-1940s	HEs, beryllium, uranium	Unknown	NV	Exact location of use not clear. These were shot containment vessels. Number of tests conducted uncertain.	None Known
TA-20-13	20-mm gun for initiator timing tests	Mid-1940s	High explosives	Unknown	NV	Location unknown.	None Known
TA-20-32 thru 43	Pull boxes		Unknown	Unknown	V	Removed in Sept 1985	None Known
TECHNICAL AREA 23							
No #	Deep firing pit	1945-1952	Unknown	Unknown	NV	All of this TA is within confines of present TA-9. LANL personnel stated that there is no visual evidence of the old firing pit. No record of cleanup available	None Known
TECHNICAL AREA 27							
No #	5 firing pits	1944-1947	Uranium and Comp B	Unknown	V	Pits 1, 4, and 5: Uranium detected in soil at background levels. Pits 2 and 3: detected at levels 2 to 10 times background Uranium	1985. Soils tested- see Status

* Date given is either period of operation or date of reference indicating that contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Eleven

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 33							
No #	Test shot	1954	Tritium	10,000 Ci	NV Location not specified		1954: No positive findings detected by following cloud
No #	Test shots (2)	1952	Polonium	Unknown	NV Location not specified. Cleanup initiated after shots.		None Known
TA-33-25, 26, 85, 146	South Mesa test shot areas - Tower area	1947 - ?	HEs, beryllium, beryllium oxide, polonium, uranium from test firing for shrapnel shots, Navy gun penetrator testing, and initiator implosion shots	Shots ranged from 700-2,500 lb HE	V In 1985, LANL conducted limited cleanup in area for radionuclides. Small shrapnel fragments, cable tray, wire, and debris remain at site. Only half-scale shots were conducted on this mesa.		1986: Soil samples collected; results pending
TA-33-89, 97, 98, 116, 117, 118, 127, 130, 135, 136	East Mesa test shot area - Gun Firing Area	1947 - ?	HEs, beryllium from a 1966 malfunctioning gun test, beryllium oxide, polonium, and uranium	Largest shot was 5,000 lb HE	V In 1985, LANL conducted limited cleanup in area for radionuclides. Site has been abandoned. Full-scale shots for initiation development were conducted on this mesa.		1986: Soil samples collected; results pending
TA-33-61, 62, 64, 65	Test shot area near TA-6	1947 - ?	HEs, radionuclides, beryllium	Unknown	V In 1985, LANL conducted limited cleanup in area for radionuclides only. Site is abandoned.		None Known

* Date given is either period of operation or date of reference indicating that contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Twelve

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 36							
TA-36-36	Drop tower	1953	U-238	Unknown	V	No longer used; located at Lower Slobbovia, an active firing site.	None Known
Identified during Survey	Possible firing site	No Date	Depleted uranium, HEs, and metals	Unknown	V	Radioactively contaminated surface soil (400-600 cpm) noted during Survey. Site is near IJ Firing Points.	None Known
TECHNICAL AREA 39							
TA-39-7	Firing site	Early 1950s?	Beryllium, mercury, aluminum, copper, brass, iron, lead, stainless steel, thallium, cadmium, chromium, thorium, RDX, HMX, Baratol, PETN, TATB, Comp B, Cyclotol	Unknown	V	Inactive. Dry streambed near firing site. Located at base of canyon wall.	1957: 0.8 µg/g Be in soil.
TA-39-8	Firing site	Early 1950s?	Beryllium, mercury, aluminum, copper, brass, iron, lead, stainless steel, thallium, cadmium, chromium, thorium, RDX, HMX, Baratol, PETN, TATB, Comp B, Cyclotol	Unknown	V	Inactive. Runoff drainage pathway from firing site is evident. Elevated rad readings in surface soil. Piece of depleted uranium noted on firing pad.	1957: 1.0 µg/g Be in soil.
TECHNICAL AREA 40							
No #	Firing pit	1950?	High explosives	Unknown	V	Inactive. This was a detonator firing site with a 1'-2'-deep depression surrounded on NW side by 20'-high rock face.	1985: Soils for As, Ba, Cd, Cr, Pb, Hg, Se and Ag - all below detection limits

* Date given is either period of operation or date of reference indicating that contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-5 INACTIVE FIRING SITES WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Thirteen

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 00L							
TA-00L-1	Townsite firing range	1940s - 1970s	Lead from bullets	Unknown	V	Inactive. Buildings removed; concrete steps, slabs, and dirt catchment mounds not removed. Lead shots possibly not removed.	None Known
TA-00L-7	Barranca Mesa	1966	Ordnance material	Unknown	V	Ordnance-type material recovered and removed from an old cistern in 1965.	None Known
TA-00L-11	Impact areas, ordnance activities	1944-1948	HEs, ammunition	Unknown	V	Inactive. Military activities at: <ul style="list-style-type: none">• Rendija Canyon (impact zone, not well marked for restricted access)• Barrancas (impact, restricted access)• 37mm cannon (unknown use)• TA-20 (tank practice during war years)• TA-27 (impact zone)• Pajarito Canyon (impact zone)	None Known

* Date given is either period of operation or date of reference indicating that contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 2							
No #	Water Boiler Reactor Vessel in Building TA-2-1	1944-1987	Uranium sulfate, beryllium, uranyl nitrate solution	Unknown	NV	Reactor was defueled in 1974. External structures have been decommissioned but the reactor vessel remains at the TA.	None Known
TA-2-1	Omega West Reactor	1956-1987	Enriched uranium	Unknown	V	Still in operation.	None Known
TECHNICAL AREA 3							
TA-3-16, 17, 18	Van de Graaff Laboratory	1950s-1987	Tritium, induced activity, lead, nickel, cadmium, tellurium, hafnium, selenium, indium	Unknown	NV	Extent of interior contamination unknown. 1986 reference reports that tritium and induced activity are the contaminants. Other substances are known to have been used in the building. Building is still actively used.	None Known
TA-3-29	CMR Laboratory	1950s-1987	Plutonium, uranium, transuranics, fission products, induced activity, tellurium, other radionuclides, beryllium salt, beryllium, germanium hydride, lithium hydride, various acids and solvents, and chemical carcinogens	Unknown	NV	Specific areas and extent of contamination unknown. 1986 reference reports radioactive contaminants are present. Other substances are known to have been used in the building. Building is actively used.	None Known
TA-3-31	Chemical Warehouse	1953	Beryllium nitrate	Leaks from the bottles	NV	No information on cleanup of these leaks. Warehouse also handled natural uranium. Building is still in use.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date *	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 3 (Continued)							
TA-3-39, 102	Shop/Fabrication Building	1953-1987	Cadmium, beryllium, thallium, antimony, bismuth, lead, lithium fluoride, enriched uranium, depleted uranium, 235-U, 238-U, lithium hydride	Unknown	NV	No specific information on spills inside the building is available. Buildings are in use.	None Known
TA-3-40	Physics Building	1954-1987	Beryllium, plutonium, mercury, tritium, transuranics, fission products, activation radioisotopes, trichloroethylene, darkroom wastes, spray booth wastes, epoxy resins, soldering and plating wastes, printed circuit shop that used HCl, ferric chloride, nickel, copper, gold, pyrophosphate solutions, HBF ₄ , and Pb Sn fluoroborate	Unknown	NV	Plutonium and mercury spills reportedly cleaned up 1986 reference reports that building is contaminated with various radionuclides. Extent of interior contamination is unknown. Numerous activities have occurred in building. Building is in use.	None Known
TA-3-43	Administration Building	1956	231-protoactinium	Unknown	NV	Early activities involved various solvents, chemicals, metals, and tests (including combustion) of PCB-contaminated oils. Only one spill reported to have occurred in the building (1956: 231-protoactinium) and it was cleaned up. No other information available. Building is in use.	None Known
TA-3-35	Fabrication/Press Building	Mid-1950s - 1984	Uranium-235	Unknown	NV	Contamination of building is assumed due to history of operations. Further information is not available.	None Known
TA-3-66	Plating, foundry, milling, ceramics and powder metallurgy, and fabrication building	Mid-1950s - 1987	235-U, normal U, tritium, lead, PbO, Nb ₂ O ₅ , Ta ₂ O ₅ , Fe ₂ O ₃ , ZrO ₂ , HfO ₂ ; chromium, nickel, copper and cyanide plating solutions; trichloroethylene, toluene, diisocyanate, methyl chloroform, and benzene	Unknown	NV	Contamination of building is assumed due to history of operations. Further information is not available.	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Three

Structure Number	Description	Date*	Waste Characteristics		Quantity	V/NV**	Current Status or Condition	Previous Sampling
			Type					
TECHNICAL AREA 3 (Continued)								
TA-3-141	Rolling Mill Building	1950s-1987	Uranium		Unknown	NV	Contamination of building is assumed due to history of operations. No further information is available	None Known
TA-3-216	Weapons Test Support Facility	1960s	Polystyrene and arsenic crystal growing		Unknown	NV	No specific information on spills that occurred inside the building is available. Building is still present	None Known
TA-3-159, 160, 161	Explosive forming facility, firing chamber, and bunker	1960s	High explosives were used in small indoor firing chamber		Unknown	NV	Structures still present. Status of potential contamination is unknown	None Known
TECHNICAL AREA 5								
TA-5-20	Underground Calibration Structure	1960s-1987	Unknown		Unknown	V	Inactive. Structure remains in place, underground, and partially back filled with soil	None Known
TECHNICAL AREA 6								
TA-6-1	Carpenter Shop	Mid-1940s - ?	Unknown		Unknown	V	Active. Intact; used for storage. Ground surface erosion observed underneath building	None Known
TA-6-3	Laboratory and Storage	Mid-1940s - ?	High explosives and chemical contamination		Unknown	V	Currently used for storage	None Known
TA-6-6	Assembly Facility (Laboratory and Shop)	Mid-1940s - ?	High explosives and chemical contamination		Unknown	V	Building is still present	None Known
TA-6-9	Laboratory	Mid-1940s - ?	High explosives testing		Unknown	V	Inactive, yet remains intact	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

NV DOE Survey team representative(s) did not visit site

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 7							
No #	Weapons stockpile (five)	1944-1945	Unknown	Unknown	V	Inactive, roofs lying on ground randomly throughout field	None Known
TECHNICAL AREA 8							
TA-8-1	Laboratory Building	1945-?	Materials handled included high explosive, triphenyl & alpha-naphthyl phenyl oxalate, styrene, methyl chloroform, thallium iodide	Unknown	V	Still present, inactive. Warning signs posted indicating that the building may contain contaminants. Ducts and exhaust fans may have been removed.	None Known
TA-8-2	Process Building	1945-?	High explosives	Unknown	V	Still present, inactive. Warning signs posted indicating that the building may be contaminated	None Known
TA-8-3	Laboratory Building	1945-?	High explosives	Unknown	V	Still present, inactive. Warning signs posted indicating that the building may be contaminated	None Known
TA-8-21, 22, 23, 24, 26, 27, 31, 32, 70	Radiographic Facilities	1956 - 1987	Materials handled included high explosives, plutonium, uranium, various other materials including arsenic, beryllium, lithium hydride, titanium oxide, and lead	Unknown	NV	Buildings are actively used and were not visited. A 1985 reference states that Building 23 is contaminated with medium levels of induced activity, fission products, transuranics, and uranium. Buildings 24 and 26 are suspected of being contaminated; and Building 70 is contaminated with low levels of uranium.	1954 - 10,000 cpm in Building 24 1979 - 200-500 cpm in Building 21

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 11							
TA-11-24	Air Gun Building	No Data	Barium	Unknown	V	Data are lacking on contamination	None Known
TECHNICAL AREA 14							
TA-14-6	Control Building, Shop and Darkroom	1944-Present	Unknown	Unknown	V	Building is still present and may be used for storage.	None Known
TA-14-23	Control Building	Early 1950s-Present	Unknown	Unknown	NV	Actively used for storage of HE scrap. Less than 55 gallons are stored at any one time.	None Known
TA-14-38	Camera Building	1960-Present	Unknown	Unknown	V	Active	None Known
TA-14-40	Instrumentation Building	1960-Present	Unknown	Unknown	NV	Active	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

UNCLASSIFIED

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 15							
TA-15-233	Former Betatron Building	1965	Beryllium	Unknown	NV	Spill was reportedly cleaned up in 1969	None Known
TA-15-50	Shop and Laboratory Building	1961	Beryllium-contaminated oil in diffusion pumps	Unknown	NV	No information on cleanup provided	None Known
TECHNICAL AREA 18							
TA-18-129	Reactor Sub-assembly Building	No Date	Beryllium used in building	Unknown	NV	No specific information on spills inside building. Building is still present.	None Known
TA-18-14 ¹	Ultrasonic Cleaning Building	1966	Beryllium used in building	Unknown	NV	No specific information on spills inside building. Building is still present.	None Known
TA-18-23, 32, and 116	Kivas 1, 2, and 3 (Assembly Buildings)	1955-1957	Plutonium, uranium -233 and -235	Unknown	V and NV	Occurrences of contamination reported in Kivas 1 and 2 in 1955, 1956, and 1957. Reports of cleanup are not available. Kivas are still in use.	None Known
TA-18-26, 30, 119, 122, 129, 168	Vault, laboratory and office, storage buildings, reactor sub-assembly building, and dynamic critical assay facility	1962 and 1984	Assumed to be contaminated with radionuclides	Unknown	V and NV	These buildings have been listed as contaminated (some in 1962, others in 1984). No other information is available.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21							
TA-21-150, 2, 3, 4, 5	DP West Buildings	1945-1978	Plutonium and transuranic elements	Unknown	V	In 1978-1981 a project known as the Los Alamos DP West Plutonium Facility Decontamination Project took place involving a \$4.4 million cleanup. The sides of Buildings 3 & 4 were not decontaminated because uranium recovery work was still ongoing. The buildings are still standing and are secured within a special fence due to potential radioactive contamination. Entry inside the buildings is restricted because of contamination and thus buildings were not entered during the Survey. The DP West facility will be further addressed under Phase II of CEARP.	See Status
TA-21-286	Storage for plutonium solutions	Post-1972	Plutonium nitrate	Unknown	NV	Leak inside building was reportedly cleaned up.	None Known
TA-21-146	Process Airflow Filter Building	No Date	Radionuclides	Unknown	NV	Status is unknown.	None Known
TA-21-21	Vault	No Date	Unknown	Unknown	NV	Apparently still used. Contamination status unknown	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21 (Continued)							
TA-21-61	Laboratory	Pre-1969	PCBs, uranium-235	Unknown	NV	Building once used to store oils containing PCBs. Also used to process U-235. Exhaust system and drains may be contaminated. No documentation on cleanup.	None Known
TA-21-66	Slab	1969	Fission products	Unknown	NV	Slab was reportedly contaminated. Current status is unknown.	None Known
TA-21-30	Salt Preparation Building	No Date	Sodium chloride, lithium chloride, potassium chloride, zinc chloride, acrylonitrile, hydrogen chloride, chlorine gas, calcium salts, cadmium, lead oxide, and mercury	Unknown	NV	No information on specific spills inside the building was reported. Current status is unknown.	None Known
TA-21-14	Instrument Building	No Date	Asbestos	Unknown	NV	Originally, this building was a power plant. Currently used by Pan Am. Asbestos reportedly removed when Pan Am occupied building.	None Known
TA-21-152	DP East Laboratory	1947-1969	Polonium, actinium, uranium-235, niobium, and beryllium	Unknown	NV	Specific information on spills inside buildings is limited. Bldg 152 is still standing.	None Known
TA-21-155	Furnace Building	1986	Tritium, highly reactive metal tritides	Unknown	NV	Building once was used for storage, currently referred to as a furnace building and handles tritium.	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 22							
TA-22-1	Loading Building (Prefabricated steel building)	1945 to Mid-1950s	PETN, MDX, tetryl, PBX solvents	Unknown	V	Special assemblies still intact, was also used for a Laboratory and photoprocessing	None Known
TA-22-2	Magazine	1945-1987	High explosives	Unknown	NV	Active. Now part of TA-40.	None Known
TA-22-3	Magazine	1945-1987	High explosives	Unknown	NV	Active. Now part of TA-40.	None Known
TA-22-5	Warehouse	1950-1987	High explosives	Unknown	NV	Active, contamination status unknown.	None Known
TA-22-34	Laboratory	Early 1950s-1987	High explosives, photoprocessing chemicals and solvents	Unknown	V	Active, contamination status unknown.	None Known
TA-22-91	Detonator Support Building	1984-1987	Sodium carbonate, sodium hydroxide organics, hydrochloric acid and ferric chloride	Unknown	NV	Active, contamination status unknown	None Known
TA-22-93	Detonator Explosives Building	1984-1987	High explosives	Unknown	NV	Active. Manufactures explosives for detonators	None Known
TECHNICAL AREA 23							
No #	Assembly operations	1945	Uranium, lead, high explosives	Unknown	V	Specific building(s) were not identified. Most buildings are still standing.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Ten

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 33							
TA-33-86	Contaminated Laboratory Building	1947-1948	Tritium releases occurred inside building and exited via ventilation system	Ranged from 658 - 7,170 curies	NV Building is still active.		1974: Interior swipes show elevated tritium
TA-33-40	Contaminated Saw Building	1951	Uranium released during operation of a slit saw	Unknown	V During tuballoy cutting operations in 1951, air samples from the breathing zone contained uranium 7.5 times the maximum permissible levels. Operations have ceased but the building is still standing.		See Status
Nc #	Contaminated structure	1954	Polonium	Unknown	NV Leaking assembly in Area 6 (location not further specified). Assembly was bagged and removed, and the area oiled. Other cleanup measures not reported.		1954: 2,000,000 cpm at time of incident
TA-33-19	Contaminated Laboratory and Office Building	1954	Mercury	Unknown	NV Building still exists. Mercury reportedly cleaned up but its final disposition is unknown.		None Known
Nc #	Contaminated building	1956	Trichloroethylene	Unknown	NV Spill occurred in "Main Shop Building" from a large degreasing tank. Location and cleanup measures not further specified.		None Known
TA-33-110	Incinerator	No Date	Unknown	Unknown	V Incinerator is inactive but still in place.		None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Eleven

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 35							
TA-35-2	Contaminated Laboratory	Late 1940s-1987	Materials used in the building include alpha sources, radioactive lanthanum, strontium-90, neptunium-237, germanium hydride, beryllium salts, plutonium oxalate aerosols, tritium, lithium tritide, uranium-235, gold, sodium, sodium potassium	Unknown	NV	Inside of building was not visited. Some cleanup work was performed in past. Amount of residual contamination is unknown.	Limited
TA-35-7	Contaminated Air Filter Building	Pre-1981	Fission products, strontium-90, cesium-137, low-level TRU material	Unknown	NV	Building was cleaned up by 1981. Residual contaminants may exist in the walls. Portions are currently in use.	Assumed during cleanup
TECHNICAL AREA 39							
TA-39-4	Trim Building	? - 1987	High explosives	Unknown	NV	Trim Building is still active - potential for contamination is uncertain.	None Known
TECHNICAL AREA 41							
No #	TA-41 Operational buildings	No Date	Lithium hydride, uranium, plutonium, americium, beryllium and beryllium oxide, tritium, arsenic, mercury, lithium hydride, various organics	Unknown	V	TA was visited during Survey but not specific buildings. TA is largely covered by buildings and pavement. No visual signs of spills. Potential for contamination inside buildings is uncertain.	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-6 LIST OF CONTAMINATED STRUCTURES STILL STANDING WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Twelve

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 46							
TA-46-1	Ducts and drains in Laboratory Building	1986	Uranium	Unknown	NV Interior of building was not visited in use	Building is still	None Known
TA-46-16	Cells 1 and 2 in the Test Building	1986	Uranium	Unknown	NV Interior of building was not visited in use	Building is still	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

MINI-MART

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 2							
TA-2-3	"Chem Shack"	Pre-1971	Uranium nitrate, perchloric acid	Unknown	V	Building was removed in 1971 and area now occupied by Building 63. No visual signs of contamination. Uncertain whether soils were contaminated and/or removed.	None Known
TECHNICAL AREA 3							
TA-3-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	Buildings, Hutment, Production shop, magazine and Burn Pit	1943-1949	High explosives, including PETN and Azide	Unknown	NV	Buildings were located on the north end of the present Administration Building parking lot. They were removed in 1949. No information available on the potential for residual soil contamination.	None Known
TECHNICAL AREA 4							
TA-6	Process and Trim Building	Mid-1940s	HE	Unknown	V	Inactive firing pit and support structures removed for reconstruction and final D&D during LASCP.	Soils during & post RA (LASCP)
TA-4-7	Darkroom and Laboratory	Mid-1940s	Radioactive photoprocessing chemicals	Unknown	V	Inactive firing pit and support structures removed for reconstruction and final D&D during LASCP	Soils during & post RA (LASCP)
TA-4-5	Storage Building	Mid-1940s	Unknown	Unknown	V	Inactive firing pit and support structures removed for reconstruction and final D&D during LASCP	Soils during & post RA (LASCP)

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 5							
TA-5-1	Laboratory Building	1945-Unknown	High explosives	Unknown	V	Inactive; D&D'd.	1959, Mesa soils, under LASCP
TA-5-6	Laboratory Building	1945-Unknown	High explosives	Unknown	V	Inactive; D&D'd.	
TECHNICAL AREA 6							
TA-6-10	Laboratory Building drain	1944-1950s	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-13	Small explosives lab	1945- Mid-1950s?	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-14	Pressing Hutment	1945- Mid-1950s?	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-15	Boiler House	1945- Mid-1950s?	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-38	Generator Building	1945- Mid-1950s?	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-49	Ramp and Building	1945- Mid-1950s?	High explosives; PETN; beryllium, mercury, silver, and cadmium	Unknown	V	Inactive detonator manufacturing and testing; D&D'd; burned 1960	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Three

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 6 (Continued)							
TA-6-38	Generator Building	1945- Mid-1950s	Unknown	Unknown	V	Inactive; removed 1980	None Known
TA-6-2	Generator Building	1945- Mid-1950s	Unknown	Unknown	V	Inactive; intact.	None Known
TA-6-11	Laboratory	1945- Mid-1950s	High explosives: PETN, beryllium, mercury, cadmium	Unknown	NV	Inactive; D&D'd 1972.	None Known
TA-6-13	Small explosives laboratory	1945- Mid-1950s	Unknown	Unknown	NV	Inactive; destroyed by burning on January 16, 1960	None Known
TA-6-14	Storage Building	1945- Mid-1950s	Unknown	Unknown	NV	Inactive; abandoned.	None Known
TECHNICAL AREA 9AE							
TA-9AE-1, 2, 3, 6, 11, 18, 7, 8, 9, 10, 12, 13, 14, 16, 19	Buildings	1959	High explosives and radioactive contamination	Unknown	V	Buildings were burned in 1960. In 1965 the residues were removed. Efforts included removal of sumps and drains. Area currently looks like an open field.	None Known
TECHNICAL AREA 10							
TA-10-35	RaLa Separation Building	Mid-1940s to 1963	Lanthanum-140, barium-140, cesium-140, and strontium-90	Unknown	V	Inactive RaLa used for X-ray source at firing sites. This building commenced operations in 1950.	None Known
TA-10-1	Radiochemistry Building	Mid-1940s to 1963	Lanthanum-140, barium-140, cesium-140, strontium-90; nitric, hydrochloric, hydrofluoric, and sulfuric acid; cadmium; platinum; benzene; carbon tetrachloride; organic and inorganic impurities	Unknown	V	Combustible sections burned in sparse area, the contaminated wall buried "in Bayo Canyon"	None Known

* Date given is either period of operation or date of reference indicating contamination was present.
** V, DOE Survey team representative(s) visited site. NV, DOE Survey team representative(s) did not visit site.

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 10 (Continued)							
TA-10-4	Storage Building	Mid-1940s-1963	Suspected strontium-90 and HE contamination	Unknown	V	Moved to a clearing and burned in 1960	Ashes 1-12 mR/hr
TA-10-6	Storage Building	Mid-1940s-1963	Suspected strontium-90 and HE contamination	Unknown	V	Burned in place in 1960	Ashes 1-12 mR/hr
TA-10-31	Cell Building	Mid-1940s-1963	Suspected strontium-90 and HE contamination	Unknown	V	Burned in place in 1960	None Known
TA-10-3	Storage Building	Mid-1940s-1963	Suspected slight radioactive contamination	Unknown	V	Moved to a clearing and burned in 1960	None Known
TA-10-5	Storage Building	Mid-1940s-1963	Suspected slight radioactive contamination	Unknown	V	Moved to a clearing and burned in 1960	None Known
TA-10-19	Storage Building	Mid-1940s-1963	Suspected slight radioactive contamination in inaccessible places	Unknown	V	Placed in streambed and burned in 1960	None Known
TA-10-32	Welding Shop	Mid-1940s-1963	Suspected slight radioactive contamination in inaccessible places	Unknown	V	Placed in streambed and burned in 1960	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Five

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 10 (Continued)							
TA-10-10	Magazine	Mid-1940s - 1963	HE-contaminated	Unknown	V	Burned in place in 1963	None Known
TA-10-11	Magazine	Mid-1940s - 1963	HE-contaminated	Unknown	V	Burned in place in 1963	None Known
TA-10-2	Storage Building	Mid-1940s - 1963	Contained a large source shield	Unknown	V	Burned in place in 1963; shielding taken to contaminated dump	None Known
TA-10-8	Inspection Building	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Burned in place in 1963	None Known
TA-10-14	Battery Building	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Burned in place in 1963	None Known
TA-10-12	Laboratory Building	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Burned in place in 1963	None Known
TA-10-34	Static Test Building	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Burned in place in 1963	None Known
TA-10-21	Personnel Building	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Debris taken to contaminated landfill	None Known
TA-10-20	Warehouse	Mid-1940s - 1963	Suspected slight radioactive contamination	Unknown	V	Inactive; concrete slab still in place	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 11							
TA-11-7, 8, 9	Storage magazines	1959	Contaminated with high explosives	Unknown	NV Removed in 1960		None Known
TA-11-10	Shelter	1959	Contaminated with high explosives	Unknown	NV Removed in 1960		None Known
TECHNICAL AREA 12							
TA-12-1	Trim Building	Mid-1950s	HE contamination	Unknown	V Burned 1960; noncombustible remains left in place		None Known
TA-12-5	Generator Building	Mid-1950s	Old 55-gallon drum ready	Unknown	V Burned 1960		None Known
TA-12-6	Junction shelter	Mid-1950s	None reported	Unknown	V Burned 1960		None Known
TECHNICAL AREA 13							
No #	P-Site Building	1947	High alpha activity - possibly polonium Potential for beryllium to have been present	Unknown	NV Location not specified Most buildings were removed by 1950		None Known
No #	"Hot" Building	1948	Unknown - probably radionuclides	Unknown	NV Location not further identified All buildings except TA-13-2, 3, and 4 (alias TA-16-476, 477, 478), which were the laboratory and two bunkers, have been removed		None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Seven

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 14							
TA-14-3	Control Room	1944-1952	Unknown	Unknown	V Inactive		None Known
TA-14-4	Explosive Preparation Building	1944-1952	HE: pentabellite, torpex, tamped tetryl, Comp B, RDX, Baranol	Unknown	V Inactive		None Known
TA-14-7	Electric Shop	1944-1952	Unknown	Unknown	V Inactive		None Known
TA-14-10	Storage Building	1947-1952	Unknown	Unknown	V Inactive		None Known
TECHNICAL AREA 18							
TA-18-15	Magazine	No Date	Uranium and beryllium oxide	Unknown	V	General vicinity where magazine was reportedly located was visited during Survey. The structure was once used for storage but was removed sometime after 1971. The area is an open, relatively flat field. No visual signs of contamination.	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site

WARRANTY

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Eight

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 19							
TA-19-1	Laboratory Building	1944-1962	Radioactivity, trimethylborate toluene	300 Ci of cobalt-60 source	V	Inactive; transferred to Zia in 1962; assigned to LAAO in same year.	1962 for rad only; one shelf contaminated
TA-19-2	Battery Building	1944-1956	Radioactivity, trimethylborate toluene	Unknown	V	Inactive transferred to Zia in 1962; assigned to LAAO in same year.	1962 for rad only; one shelf contaminated
No #	Shelter Building	1944-1962	Unknown	Unknown	V	Location unknown.	1962 for rad only; one shelf contaminated
TECHNICAL AREA 20							
TA-20-11	Hot Storage	No Date	Radioactivity	Unknown	V	D&D'd prior to 1985; foundation blocks in place	No radioactivity observed during Survey

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Nine

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21							
No #	Storage facility	1973	Plutonium	> 10 nCi Pu	NV	Retrievable storage facility used during removal of Building TA-21-12. Assumed to no longer exist.	None Known
TA-21-12	Filter Building	1945-1972	Plutonium-239	Unknown	NV	Building removed in 1973. Some debris and large metal items went to MDA-A. Approximately 30 cm of soil removed from beneath building and back-filled. Subsurface soil contamination may still remain.	None Known
TA-21-22	Warehouse	1957-1966	Unknown	Unknown	NV	Used to store contaminated equipment. Removed in 1967. No information on removal.	None Known
TA-21-6	Machine shop and cafeteria	1957-1966	Unknown	Unknown	NV	Contamination reported in corridor in 1957, and possibly in floor drains. Removed in 1966. No information on removal.	None Known
TA-21-35, 93, 145, 147, 185, 192, 255, and 271	Waste Treatment Facility	1952-1967	Contaminated with alpha-emitting radionuclides	Unknown	NV	Facility was removed and disposed of on Mesita del Buey. No information on removal or possibility of residual soil contamination.	None Known
TA-21-151	DP East Laboratory	1947-1966	Polonium, actinium, uranium-235, niobium, and beryllium	Unknown	NV	Specific information on spills inside building is limited. Removed in 1966. No information on its removal.	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Ten

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 21 (Continued)							
TA-21-153	Filter Building	1957-1978	Plutonium-235, actinium-227 and its daughters	Unknown	NV	Building shut down in 1970 and decommissioned and removed in 1978.	1969: 10,000 cpm alpha found
TA-21-20	Laundry	1945-1963	Plutonium	Unknown	NV	Removed in 1965. Potential for residual soil contamination unknown.	None Known
TECHNICAL AREA 22							
TA-22-4	(Prefab Steel Building)	1945-1984	High explosives	Unknown	NV	Inactive; landfill special assemblies removed in 1984	None Known
TA-22-26	Old Ranch Building used for storage	Pre-1940s	Unknown	Unknown	V	Inactive; removed prior to 1984	None Known
No #	Log cabin	Pre-1940s	Unknown	Unknown	V	Approximate location observed	1959: no contamination
TECHNICAL AREA 23							
TA-23-1	Laboratory	1945-1952	HE	Unknown	NV	Inactive; all of this TA is within the confines of present TA-9	None Known
TA-23-2	Office Building	1945-1952	Unknown	Unknown	NV	Inactive; all of this TA is within the confines of present TA-9	None Known

* Date given is either period of operation or date of reference indicating contamination was present
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT, LANL
Page Eleven

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 23 (Continued)							
TA-23-4	Laboratory	1945, 1957	HE	Unknown	NV	Inactive; all of this TA is within the confines of present TA-9	None Known
TECHNICAL AREA 24							
TA-16-495	Contaminated shelf in building	1957	High explosives, uranium	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-497	Old magazine	1957	High explosives, strontium-90	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-499	Building	1957	Alpha, HE contamination	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-500	Building	1957	High explosive, uranium	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-490	Old T-Site Lab	1959	High explosive	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-491	T-Site Hutment	1959	High explosive	Unknown	V	Removed in 1960, area looks like an open field	None Known
TA-16-492, 493, 494	Hutments	1959	High explosive	Unknown	V	Removed in 1960, area looks like an open field	None Known

* Date given is either period of operation or date of reference indicating contamination was present
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Twelve

Structure Number	Description	Date*	Contaminant Characteristics		V/V**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 25							
V-(TA-16-528)	Pit (electrical)	Pre-1945	High explosive and beryllium	Unknown	NV	Removed in 1945. No documentation on removal or possible residual contamination.	None Known
V-3	Building	Pre-1945	Beryllium	Unknown	NV	Removed in 1945. No documentation on removal or possible residual contamination.	None Known
TECHNICAL AREA 27							
TA-27-2	Control Building	1944-1947	Radioactivity: beryllium, thorium, uranium	Unknown	V	Inactive; D&D'd	
TECHNICAL AREA 31							
TA-31-1	Receiving dock	1945-1954	Unknown	Unknown	V	Inactive; removed and area replaced with Eastern Area housing	None Known
TA-31-2 through 5	Warehouses	1945-1954	Unknown	Unknown	V	Inactive; removed and area replaced with Eastern Area housing	None Known

* Date given is either period of operation or date of reference indicating contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-7 LIST OF CONTAMINATED STRUCTURES THAT HAVE BEEN REMOVED WITH INFORMATION ON CONTAMINANTS AND CURRENT CONDITION, LANL
Page Thirteen

Structure Number	Description	Date*	Contaminant Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 31 (Continued)							
TA-31-7	Warehouse	1945-1954	Unknown	Unknown	V	Inactive; removed and area replaced with Eastern Area housing	None Known
TA-31-8	Transformer storage	1945-1954	Possible	Unknown	NV	Inactive; removed and area replaced with Eastern Area housing	None Known
TECHNICAL AREA 32							
TA-32-1	Laboratory Building	1945-1954	Radioactivity	Unknown	V	Inactive; no records on D&D; was for biologic effects	None Known
TA-32-2	Laboratory Building	1945-1954	Radioactivity	Unknown	V	Inactive; no records on D&D	None Known
TA-32-3	Office Building	1945-1954	Radioactivity	Unknown	V	Inactive; no records on D&D	None Known
TA-32-5	Laboratory Building	1945-1954	Radioactivity	Unknown	V	Inactive; no records on D&D	None Known

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 4							
TA-4-1, 2 and 8	Magazines	Mid-1940	Natural and depleted uranium, aluminum or steel, beryllium, HE	Unknown	V	Inactive; cleared from area. Soils were sampled following the removal of the buildings	See Status
TECHNICAL AREA 5							
TA-5-2	Magazine	1945-1953	High explosives	Unknown	V	A routine survey of abandoned structures determined that the structure was free of radioactivity but contaminated with HE. The structure was removed and disposed of at Airport Landfill.	1959, 1985 (LASCP)
TA-5-3	Magazine	1945-1953	High explosives	Unknown	V	Inactive with no visible signs of contamination. A routine survey of abandoned structures determined that the structure was free of radioactivity but contaminated with HE.	1959, 1985 (LASCP)
No #	Animal irradiation experiment	1955	Cobalt-60	Unknown	V	Inactive. Location unknown.	None Known
No #	P-Division experiment	1979	Kerosene, heavy metals	Unknown	V	D & D'd under LASCP.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Two

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 6							
No #	Large mound	Mid-1940s to Mid-1950s	Unknown	Unknown	V	Inactive, use is unknown. Mound is still intact located 500-700 ft SE of "concrete saucer."	None Known
TA-6-16, 17, 21 through 30	Magazines (12)	Mid-1940s to Mid-1950s	PETN, beryllium, mercury, silver, and cadmium	Unknown	V	Inactive; detonator manufacturing and testing; D&D'd; burned 1960	None Known
TA-6-4	Magazine	Mid-1940s to Mid-1950s	PETN, beryllium, mercury, cadmium	Unknown	V	Inactive; D&D'd 1972.	None Known
TECHNICAL AREA 7							
No #	Pulse-explosive-driven-generator	No Date	Unknown	Unknown	V	Inactive with no evidence of contamination observed	None Known
No #	Berm with inclined pipes	1944-1945	Unknown	Unknown	V	Inactive. Berm and pipes remain in place	None Known
TECHNICAL AREA 8							
No #	Machinist's equipment	1950	Radionuclide	Unknown	NV	Location unknown.	None Known
Identified during Survey	Metal box-like structure	1987	Organic solvents suspected	Unknown	V	Structure located west of Bldg TA-8-2. Strong odor was noted during the Survey. No other information available.	None Known
TA-8-66	Steam manhole	?-1987	Asbestos	Unknown	V	Pipes lined with asbestos under a partially collapsed wooden cover.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.
 ** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Three

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 11							
MDA-5	Experimental 10-foot square plot	Mid-1970s - ? Release	Barium nitrate, boric acid high explosives	Unknown	V Active		None Known
TECHNICAL AREA 12							
TA-12-8	Radiation test structure	1958	Radiation source used HE and strontium-90	1,000 Ci RaLa	V	One test structure still in place.	None Known
No #	Acetylene gas gun	1968	Acetylene bottles	Two	V	Used in motor locator experiments.	None Known
No #	Vertical aluminum pipe	No Date	Unknown	Unknown	V	6" liquid in aluminum 18"-dia. vertical pipe open to 2- ft depth.	None Known
TECHNICAL AREA 14							
TA-14-9	Magazine	1944-1952	Unknown	Unknown	V	Inactive.	None Known
TA-14-11	Magazine	1944-1952	High explosives	Unknown	V	Inactive	None Known
TA-14-1	Magazine	1944-1960	HE: pentallite, torpex, tamped tetryl, Comp B, TNT, Baranol	Unknown	V	Burned in 1959.	1959. free of rad
TA-14-13	Magazine	1944-1960	High explosives	Unknown	V	Burned in 1959.	1959. free of rad

* Date given is either period of operation or date of reference indicating contamination was present.

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site.

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Four

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 14 (Continued)							
TA-14-22	Magazine	1950 - Present	HE: pentolite, Baronol, TNT, tamped tetryl, Comp B, torpex	unknown	NV	Active; 55-gal storage of HE scrap	None Known
TA-14-30	Magazine	1950 - Present	HE: pentolite, Baronol, TNT, tamped tetryl, Comp B, torpex	Unknown	V	Inactive	None Known
No #	Trash burning area	1950s	Depleted uranium, beryllium, lead	Unknown	V	Inactive; grassy berm E of TA-14	None Known
TECHNICAL AREA 15							
TA-15, 264, 265, 270, 271, 272, 273	Series of holes on the north side of Three Mile Canyon	1968-1972	TNT, beryllium, lithium, lead	4,000 lb < 200 grams 200 Ci unknown	V	Inactive 150-ft-deep holes Two holes used, one for calibration, the other for a test with 500 lb of plastic bonded HE Holes covered with wood and/or metal plates	None Known
TECHNICAL AREA 22							
TA-22-6	Boiler	1950-1984	Unknown	Unknown	NV	Inactive; removed 1984	None Known
TA-22-7 to 24 and 35 to 41	Magazine(s)	Mid-1950-Present	High explosives	Unknown	V	Active; replanting grass on earth cover	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL

Page Five

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 23							
TA 23-2	Magazine	1945-1957	HE	Unknown	NV	Inactive; all of this TA is within the confines of present TA-9	None Known
TECHNICAL AREA 28							
TA 28-1, 2, 3, 4, 5	Magazines	1947 - Recent	HE propellant	10,000 lb limit	V Active		None Known
No #	Old metal can disposal	1964	Floor sweeping	75 lb each	NV	These were removed from the cliff side and disposed of.	1964
TECHNICAL AREA 29							
TA 29-1, 2	Magazine	1951-1957	HE	Unknown	V	Inactive; burned in 1957.	None Known
No #	Incinerator	1930s	Refuse burning	Unknown	V	Used by Civilian Conservation Corps; no contamination suspected	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

SECRET

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITION, LANL
Page Six

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 32							
TA 32-9	Incinerator	1945-1952	Radioisotopes	Unknown	V	Inactive; no records on D&D.	None Known
TECHNICAL AREA 33							
TA 33-4 & 6, alias MDA-D	Two underground test chambers	1948 and 1952	High explosive, polonium, uranium, beryllium	1952 test: 600 mCi of Po-210	V	Two 6 ft x 8 ft x 46 ft-deep concrete-lined shafts that have been backfilled. No fence.	None Known
MDA-E, TA-33-59	6 pits and 1 destroyed underground chamber. Pit 3 is included under landfills (Table D-4). The remaining portion of MDA-E was used in underground testing	1949-1960s	Pit 1: Polonium/beryllium fired targets (240E); Pit 2: Polonium-210 (60 Ci); Pit 3: Can of beryllium dust immersed in kerosene; Pit 4: Unspecified radionuclides; Pits 5 and 6: Unknown - may not have been used. Underground Chamber: HE, polonium Total: Several hundred kilograms of uranium	See Type	V	Pits and chamber have been covered and are fenced but there is a potential that one pit remains outside fence. Two partially filled underground test chambers are located outside fence and are not considered part of MDA-E because they were reportedly never used.	Monitored for rad under IWMP; elevated tritium found in soil moisture
TECHNICAL AREA 36							
No #	Burned area near Buildings 9 and 10	?-1986	Unknown	Unknown	NV	Site not found by CEARP personnel	None Known
No #	Containment Vessel 5 of IJ Firing Site	?-1987	Potentially contaminated with plutonium	Unknown	V	Abandoned in place - possibly contaminated	None Known

* Date given is either period of operation or date of reference indicating contamination was present

** V, DOE Survey team representative(s) visited site, NV, DOE Survey team representative(s) did not visit site.

TABLE D-8 LIST OF MISCELLANEOUS INACTIVE WASTE OR RELEASE SITES WITH WASTE CHARACTERISTICS AND CURRENT CONDITIONS, LANL
Page Seven

Structure Number	Description	Date*	Waste Characteristics		V/NV**	Current Status or Condition	Previous Sampling
			Type	Quantity			
TECHNICAL AREA 40							
No #	Burning cage	1961 - mid 1985	Oils, solvents, paper and wood contaminated with HE	3' diameter 4' high	V	Inactive, wire-cage-type incinerator in 105 ft-diameter leveled area.	1985: As, Ba, Cd, Cr, Pb, Hg, Se and Ag all below detection limits
TECHNICAL AREA 45							
No #	Building debris	No Date	Construction building debris	Unknown	NV	Inactive, not observed during Survey - may be practice of Los Alamos County Roads Dept	None Known
TECHNICAL AREA 00L							
TA-00L-17	ULR-139 Incinerator	No Date	Burned classified documents and possibly radioactively contaminated wastes	Unknown	V	Inactive ² . Radiation measurements of 40 to 100 cpm recorded during Survey.	None Known

* Date given is either period of operation or date of reference indicating contamination was present.
** V, DOE Survey team representative(s) visited site; NV, DOE Survey team representative(s) did not visit site

END

DATE FILMED

11 / 16 / 90