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RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

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ENVIRONMENTAL INFORMATION DOCUMENT

RADIOACTIVE LIQUID WASTE TREATMENT FACILITY

LOS ALAMOS NATIONAL LABORATORY
Los Alamos, New Mexico

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1.0 INTRODUCTION

1.1 Purpose and Need for Agency Action

At Los Alamos National Laboratory (LANL), the treatment of radioactive liquid waste is an integral function of the LANL mission: to assure U.S. military deterrence capability through nuclear weapons technology. As part of this mission, LANL conducts nuclear materials research and development (R&D) activities. These activities generate radioactive liquid waste that must be handled in a manner to ensure protection of workers, the public, and the environment.

Radioactive liquid waste currently generated at LANL is treated at the Radioactive Liquid Waste Treatment Facility (RLWTF), located at Technical Area (TA)-50. The RLWTF is 30 years old and nearing the end of its useful design life. The facility was designed at a time when environmental requirements, as well as more effective treatment technologies, were not inherent in engineering design criteria. The evolution of engineering design criteria has resulted in the older technology becoming less effective in treating radioactive liquid wastestreams in accordance with current National Pollutant Discharge Elimination System (NPDES) and Department of Energy (DOE) regulatory requirements. Therefore, to support ongoing R&D programs pertinent to its mission, LANL is in need of capabilities to efficiently treat radioactive liquid waste onsite or to transport the waste offsite for treatment and/or disposal.

1.2 Scope and Purpose of an Environmental Information Document (EID)

The purpose of this EID is to provide the technical baseline information for subsequent preparation of an Environmental Impact Statement (EIS) for the RLWTF. This EID addresses the proposed action and alternatives for meeting the purpose and need for agency action.

The proposed action and alternatives are discussed in Section 2.0. This section describes construction and design engineering, process engineering, engineering controls, and administrative controls for the proposed action and its alternatives. It provides parallel discussions of the engineering aspects to provide a comparative analysis of alternatives, including the proposed action.

Section 3.0 addresses the actions or projects technically connected or associated with the proposed action and alternatives. Section 4.0 addresses the natural and human environment affected by the proposed action for the two preferred sites. An evaluation of the environmental impacts associated with the proposed action is beyond the scope of this study. The appendixes present relevant supporting information including an appendix addressing potential accident events for the RLWTF project.

1.3 Wastestream Characterization

The existing RLWTF consists of a main treatment facility and a pretreatment facility co-located in Building 1 at TA-50. Influent wastestream characteristics for the RLWTF are given in Section 2.2.1 for the main treatment facility and for the pretreatment facility.

Extensive wastestream characterization studies are currently being performed by Merrick & Company. The scope of this study includes an evaluation of the radioactive wastewater collection system for the existing TA-50 RLWTF and the composition and quantity of radioactive liquid waste currently generated and anticipated to be generated in the future. Based on this study, treatment technologies will be re-evaluated for applicability to the treatment of current and future wastestreams. At the current time, the preferred treatment technologies are those described under the proposed action in Section 2.1.

1.4 Regulatory Framework

The regulatory framework associated with the proposed action and alternatives consists of regulations promulgated by EPA, DOE, Occupational Safety & Health Administration (OSHA), and NMED. These regulations include the Code of Federal Regulations (CFR), DOE Orders, and applicable state requirements.

The regulatory framework associated with on-site treatment of wastes at a DOE facility designed specifically for treatment of radioactive liquid wastes encompasses the following aspects:

Project Management. Project management requirements are governed by DOE Order 1330.1C Computer Software Management; DOE Order 4700.1 Project, Management Systems; and DOE Order 5700.6C, Quality Assurance. These orders provide the minimum requirements to be considered at all phases associated with projects.

Design/Construction. Design/construction is governed by general design criteria given in DOE Order 6430.1A, General Design Criteria. This order provides the general design criteria for DOE facilities and establishes responsibility and authority for development and for implementing this criteria.

Facility Operations. Operational requirements include environmental, safety, and health (ES&H) guidelines promulgated by EPA, DOE, and OSHA. Health and safety operational requirements that address operational safety issues, OSHA requirements, and the health and safety of the general public are provided in the following DOE orders.

- DOE Order 5820.2A — Radioactive Waste Management
- DOE Order 5480.1B, Change 4 — Environmental, Safety, and Health Program for DOE Operations
- DOE Order 5480.4, Change 3 — Environmental Protection, Safety, and Health Protection Standards
- DOE Order 5480.5 — Safety of Nuclear Facilities
- DOE Order 5480.7 — Fire Protection
- DOE Order 5480.11, Change 2 — Radiation Protection for Occupational Workers
- DOE Order 5480.21 — Unreviewed Safety Questions
- DOE Order 5480.22 — Technical Safety Requirements
- DOE Order 5480.23 — Nuclear Safety Analysis Reports
- DOE Order 5480.24 — Nuclear Criticality Safety

Environmental Protection. Environmental protection requirements are provided in the CFR, DOE orders, and state regulations. These following documents identify the minimum environmental requirements, authorities, and responsibilities for DOE operations to ensure compliance with applicable federal, state, and local environmental protection laws.

- DOE Order 5400.1, Change 1 — General Environmental Protection Program
- DOE Order 5400.2A — Environmental Compliance Issues Coordination
- DOE Order 5400.3 — Hazardous and Mixed Waste Program
- DOE Order 5400.4 — CERCLA Requirements
- DOE Order 5400.5 — Radiation Protection of the Public and the Environment
- DOE Order 5440.1D — National Environmental Policy Act Compliance Program
- DOE Order 5480.1B, Change 4 — Environmental, Safety, and Health Program for DOE Operations

- DOE Order 5480.4, Change 3 — Environmental Protection, Safety, and Health Protection Standards
- DOE Order 5820.2A — Radioactive Waste Management
- Title 40 CFR 122 — National Pollutant Discharge Elimination System
- NM AQCR — New Mexico Air Quality Control Regulations
- NM WQCCR — State of New Mexico Water Quality Control Regulations

Waste Management. Waste management requirements for management of radioactive liquid waste, radioactive low-level solid waste, transuranic (TRU) solid waste, and hazardous waste are provided in the following regulations (Parsons 1993b).

- DOE Order 5820.2A — Radioactive Waste Management
- DOE Order 5400.3 — Hazardous and Radioactive Mixed Waste Program
- DOE-AL 5480 Series — Albuquerque Operation Office
- Title 40 CFR 260 Series — Resource Conservation and Recovery Act (RCRA)
- EIB/HWMR-6 — New Mexico Hazardous Waste Management Regulations
- EIB/RPR 1 — New Mexico Radiation Protection Regulations
- EIB/SWMR-3 — New Mexico Solid Waste Management Regulations

The regulatory framework associated with the transportation of waste offsite is not addressed; this alternative was dismissed as a viable alternative based on a Valued Engineering Study (See Section 2.5) (LANL 1992f).

1.5 EID/SID Integration

This EID will be associated with the Safety Information Document (SID) for the proposed RLWTF project with regards to the potential accident event identification/selection process. Appendix A of this document provides a qualitative discussion regarding the potential accident events associated with the proposed action and Alternatives 1 through 3 discussed in Section 2.0. The potential accident events addressed in Appendix A are consistent with those identified/selected in the SID for the proposed RLWTF project. The detailed quantitative accident analysis for these potential accident events is performed in the SID. The quantitative accident analysis consists of accident scenario development associated with the potential accident events, accident scenario screening, and subsequent risk assessment associated with the credible accident scenarios.

The consistency between the EID and the SID with regards to potential accident events identification/selection constitutes the preliminary relationship for future NEPA/SAR integration. The relationship that should exist is with regards to accident analysis; consistency should be maintained between the approaches in NEPA documents and those in the SAR.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

The proposed action consists of construction and operation of a RLWTF at TA-63 and a Pretreatment Facility (PTF) at TA-50. The six alternatives include

1) continued operation of the existing RLWTF at TA-50;
2) retrofitting the existing RLWTF and construction of a PTF at TA-50;
3) privatization of the RLWTF and the PTF;
4) transporting waste offsite for final treatment and/or disposal;

5) utilizing an alternative LANL site for the new RLWTF.

Alternatives to the proposed action were developed and/or selected based on a preconceptual planning phase associated with the proposed RLWTF project. This preconceptual planning phase is addressed in the Value Engineering Study performed by LANL for the proposed RLWTF project (LANL 1992f). The proposed action or the preferred alternative will be developed further during the Conceptual Design Report (CDR) phase associated with the RLWTF project.

2.1 Description of the Proposed Action

The proposed action consists of the following waste management projects.

- Design, construction and operation of a RLWTF at TA-63. The project includes extending of the existing radioactive liquid waste lines from TA-50 to the RLWTF at TA-63 and extension of effluent discharge lines from the RLWTF at TA-63 to the existing outfall pipe at Mortandad Canyon. The project contains provisions for decontamination and decommissioning (D&D) of the TA-63 RLWTF after its useful life.

- Design, construction and operation of a PTF at TA-50 to treat radioactive, chloride, caustic, and acidic process wastes from the Plutonium Facility (PF-4) at TA-55 prior to treatment at the TA-63 RLWTF. The project includes replacement of the radioactive liquid waste lines between PF-4 at TA-55 and the PTF at TA-50. The project also includes provisions for D&D of the TA-50 PTF after it's useful life.

- D&D of the existing RLWTF at TA-50.

- D&D of the existing liquid waste lines from PF-4 at TA-55 to the existing RLWTF at TA-50.

- Design, construction, and operation of segregation/collection treatment systems at LANL designed specifically for radioactive liquid wastes that do not conform to the waste acceptance criteria (WAC) for the RLWTF at TA-63 or the refurbished facility and the PTF at TA-50 (LANL 1993a).

2.1.1 Construction and Operation of a Radioactive Liquid Waste Treatment Facility at TA-63

2.1.1.1 Project Objectives

The project objectives for the RLWTF project are to design, construct and operate facilities that would

- ensure that LANL's future treatment of radioactive and industrial liquid waste is environmentally sound and effective;

- comply with ES&H laws and regulations to protect employees, the public, and the environment;

- further protect the employees and the public from radiation exposure by incorporating the as low as reasonably achievable (ALARA) principle;

- provide process flexibility to meet future radioactive or industrial liquid waste generator needs; and

- provide facilities that would have an effective operational life of 30 to 40 years (LANL/DOE 1993).

2.1.1.2 RLWTF Description

The TA-63 RLWTF would replace the existing RLWTF at TA-50. The RLWTF would treat low-level radioactive liquid waste generated at LANL (See Table 2-1). The effluent stream from the RLWTF would be discharged to the environment through an NPDES permitted outfall. The solid low-level radioactive waste (sludge) from the treatment process would be stabilized and disposed of in an on-site waste disposal facility. The solid TRU waste (sludge) from the treatment process would be stabilized and disposed of offsite at the Waste Isolation Pilot Plant (WIPP).

Siting and Construction. The RLWTF would be located at TA-63. This site was selected based on a siting study conducted by LANL. The study evaluated 4 candidate locations for the RLWTF project, and the TA-63 site was chosen as the most viable site (See Section 2.6). The selection criteria included: surface faulting, site size, SWMU's, site development cost,impacts to existing and future generators, efficient land use, impacts of the pretreatment facility location, public hazards analysis, gravity flow, access, utilities availability, other environmental impacts, and visual impacts. The site is located on Mesita Del Buey which slopes to the southeast. Drainage from the site is to the east into Cañada del Buey. The site is bounded by Pajarito Road on the south and west sides, Puye Road to the north and Cañada del Buey to the east.

Construction of the RLWTF at TA-63 would require clearing approximately 10 acres of land for buildings, parking, and site circulation. The RLWTF would be approximately 62,500 ft^2 in area. The site would require paving approximately 2 acres of land for parking, staging, and site circulation. Two access roads would be constructed; one would provide access from Pajarito Road (south of the site) to Puye Road (north of the site) along the rim of Cañada del Buey. This road would be approximately 1,900 ft in length and require clearing approximately 3 acres of land for construction. The other road would connect Puye Road with Pecos Road at TA-50. This road would be approximately 2,030 ft in length and require clearing approximately 2 acres of land for construction. The construction of utility lines to service the facility would be a common utility corridor. The utility corridor would contain natural gas, water, electrical primary power, telephone, and communications. The corridor would extend from Pajarito Road to the west of the site to the main treatment plant and would be approximately 600 ft in length (ICF KE 1991).

Architectural. The RLWTF would consist of approximately 128,159 ft^2 of space to accommodate liquid waste management, analytical chemistry laboratory, and technical support operations. The space summary for each major function is shown in Table 2-2.

The RLWTF would house all functions under a high bay area except the technical support area, which would occupy two floors of the facility. A mechanical penthouse would be included in the design. Personnel access to the process and laboratory areas would be controlled through change rooms. Equipment access to these areas would be provided through a vehicular air lock.

The building is classified by the Uniform Building Code (UBC) as a Type I FR with a Group H-7 occupancy.

The interior construction would vary with the needs of the building functions within. The process area, which would consist of hard and smooth surfaces able to resist the harsh environment, lend itself to wash-down and decontamination activities. Typical office/laboratory interior surfaces would be provided in other spaces.

The exterior of the building would provide the physical security required for a low hazard facility. A low maintenance exterior would be utilized. The building would be constructed in adherence with DOE requirements to prevent low-level radioactive releases.

Table 2-1
Wastewater Sources to Existing RLWTF (TA-50)

TA-2	Omega Site
TA-3	South Mesa Site (Including CMR and MSL)
TA-16	"S" Site
TA-21	Defense Program (DP) Site
TA-35	Ten Sites (Including TFF)
TA-43	Health Research (HRL1)
TA-48	Radioactive Chemistry Site
TA-50[1]	Waste Management Site
TA-53[1]	Meson Physics Facility
TA-55[1]	Plutonium Facility
TA-59	ES&H (Including PF-4 and NMSF)
TA-54[1,2]	Workoff Facility

[1] Source of acid, caustic, chloride, and TRU radioactive liquid wastes.
[2] Future waste source.

Source: H&R TA 1993

Table 2-2
Space Summary

Function	Net Square Feet
Liquid Waste Management	54,072
Analytical Chemistry	5,450
Technical Support	11,517
Technical/Electrical	57,120
Total	128,159

Source: ICF KE 1993

Structural. The RLWTF is classified as an Important or Low Hazard Facility in accordance with DOE guidelines. It would be designed to withstand natural phenomena (i.e., earthquakes, wind, and flood) for a low hazard classification in accordance with UCRL-15910, Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards. Structural elements will be detailed for ductile behavior. Expansion joints would be located throughout the structure to control lateral movements.

The RLWTF would be a braced steel-framed structure with a reinforced concrete foundation. The below-grade portions of the facility would be of reinforced concrete construction.

Mechanical. The heating, ventilation, and air conditioning (HVAC) system would provide the required environmental conditions for equipment operation, health and safety, and personnel comfort. The system would maintain heating, cooling, and ventilation with required pressure differentials between primary and secondary confinement zones. Primary confinement is provided by the process equipment and its enclosure. Secondary confinement is provided by the building structure containing the process equipment and the associated ventilation system.

The primary confinement area would be served by a once-through, constant-volume supply air system. Air drawn through the primary confinement area would be filtered through high-efficiency particulate air (HEPA) filters and vented through a dedicated, independent exhaust air system.

The secondary confinement areas would be served by multiple variable-volume supply air systems. Outside air would be drawn into the secondary confinement area through HEPA filtration. Exhaust air would be vented through HEPA filters and released to the environment through dedicated exhaust stacks.

Areas with no potential for contamination (i.e., administrative offices and technical support areas) would be maintained at a pressure higher than atmospheric pressure to assure that air from primary and secondary confinement areas are not allowed to flow into them. These areas would be served by a separate standard commercial HVAC system.

The RLWTF central plant would be separate from the main facility. The central plant would house gas-fired boilers, chillers, and other mechanical equipment.

Fire Protection System. The RLWTF would be protected by automatic fire protection systems that conform to DOE Order 6430.1A and to National Fire Protection Association (NFPA) codes. The RLWTF would be protected by a wet pipe-sprinkler system designed for an Ordinary Hazard Group 2 occupancy. The HVAC ventilation exhaust system would be protected with automatic deluge, water spray cooldown systems that are actuated by thermal detectors. The system would cool the exhaust air to a temperature below the maximum operating temperature of HEPA filter elements. The floor of the RLWTF processing area would be recessed to prevent the spread of contaminated sprinkler water from the processing area to other areas of the building.

Electrical. The electrical system for the RLWTF would consist of power distribution, grounding, lightning protection, lighting and communication systems.

- Primary power for the RLWTF would be supplied from a 13.2 kV primary circuit originating from the TA-0-324 Eastern Technical Area (ETA) substation located approximately one mile east of the site. The power would be routed to a new 15 kV rated outdoor switching station located near the facility.

- The grounding.system would ensure personnel and equipment safety in case of electrical equipment failure. The system would conform to the requirements of the National Electric Code (NEC) and DOE Order 6430.1A.

- The communication system for the RLWTF would consist of a telephone, non-secure data, and an evacuation and public address system. The public address system would consist of an integrated evacuation and telephone-accessed paging system. The system would not be redundant and would be powered by normal building power. It would include tone generators for building evacuation, fire, and ventilation failure, with speakers located to ensure coverage of all areas of the facility.

- The RLWTF would be protected from lightning strikes by a lightning protection system designed in accordance with DOE Order 6430.1A.

- Lighting would be provided for the interior and exterior of the RLWTF as well as for emergency and exit lighting (ICF KE 1991).

2.1.1.3 Extension of Radioactive Liquid Waste Transfer Lines

The proposed action would include

1) routing of radioactive liquid waste transfer lines from the terminus of the existing radioactive liquid waste lines at TA-50 (Manhole WM-72) to the RLWTF at TA-63; and
2) routing an effluent discharge line from the RLWTF at TA-63 to the existing LANL NPDES permitted outfall (Outfall No. 051) in Mortandad Canyon (LANL 1990a).

The radioactive liquid waste line system from TA-50 to the RLWTF at TA-63 (2,250 ft length) would consist of direct-buried, double-encased lines. The pipeline system would be a gravity flow system with a primary and secondary line. The primary (inner) waste line would be constructed of stainless steel. The secondary containment (outer) line would be constructed of polyvinyl chloride (PVC). Underground vaults would be located at regular intervals and wherever major directional changes occur along the pipe line. The vaults would provide space for thermal expansion of the piping and a location for leak detection. The underground vaults would be watertight and of reinforced concrete construction. The manhole cover access would be sealed. The effluent discharge pipe line would be a direct-buried gravity flow system, approximately 2,760 feet in length.

2.1.1.4 RLWTF Process Description

The RLWTF would be designed to treat 22 million liters (5.8 million gallons) of wastewater per year. The facility would treat wastes on a batch basis, so that actual waste treatment time may be considerably less than the design basis maximum. Each batch of waste would require approximately 2-3 days for complete treatment.

The RLWTF would include two parallel-process treatment trains containing identical equipment; one may operate as a spare, or they could both be used at the same time. The facility would be designed to incorporate new treatment processes when necessary to upgrade the facility's capabilities or to treat new wastestreams.

The RLWTF treatment train would use several treatment processes in series. A number of treatment processes are being evaluated for use in the facility. A choice of treatment processes would be determined in a later design phase of the project. The preferred treatment process at present consists of neutralization, chemical oxidation, mixing/settling, pressure filtration, evaporation, ion exchange, filtration, off-gas treatment, TRU waste solidification, non-TRU waste solidification, and carbon adsorption. A simplified process flow diagram for the TA-63 RLWTF is shown in Figure 2-1, and the treatment processes are discussed below. The process descriptions in the text are accompanied by a number in parenthesis (e.g., #1) that corresponds to the number in the process flow diagram.

Neutralization. Influent radioactive wastewater would enter a receiving tank (#1) where it would be neutralized with acid or caustic solution to a pH of approximately 7. The neutralized wastewater would be stored in aboveground storage tanks (#2), which would service both of the parallel-process trains. Effluent from the facility that exceeds NPDES discharge limits would also be recycled and stored in these tanks before re-processing.

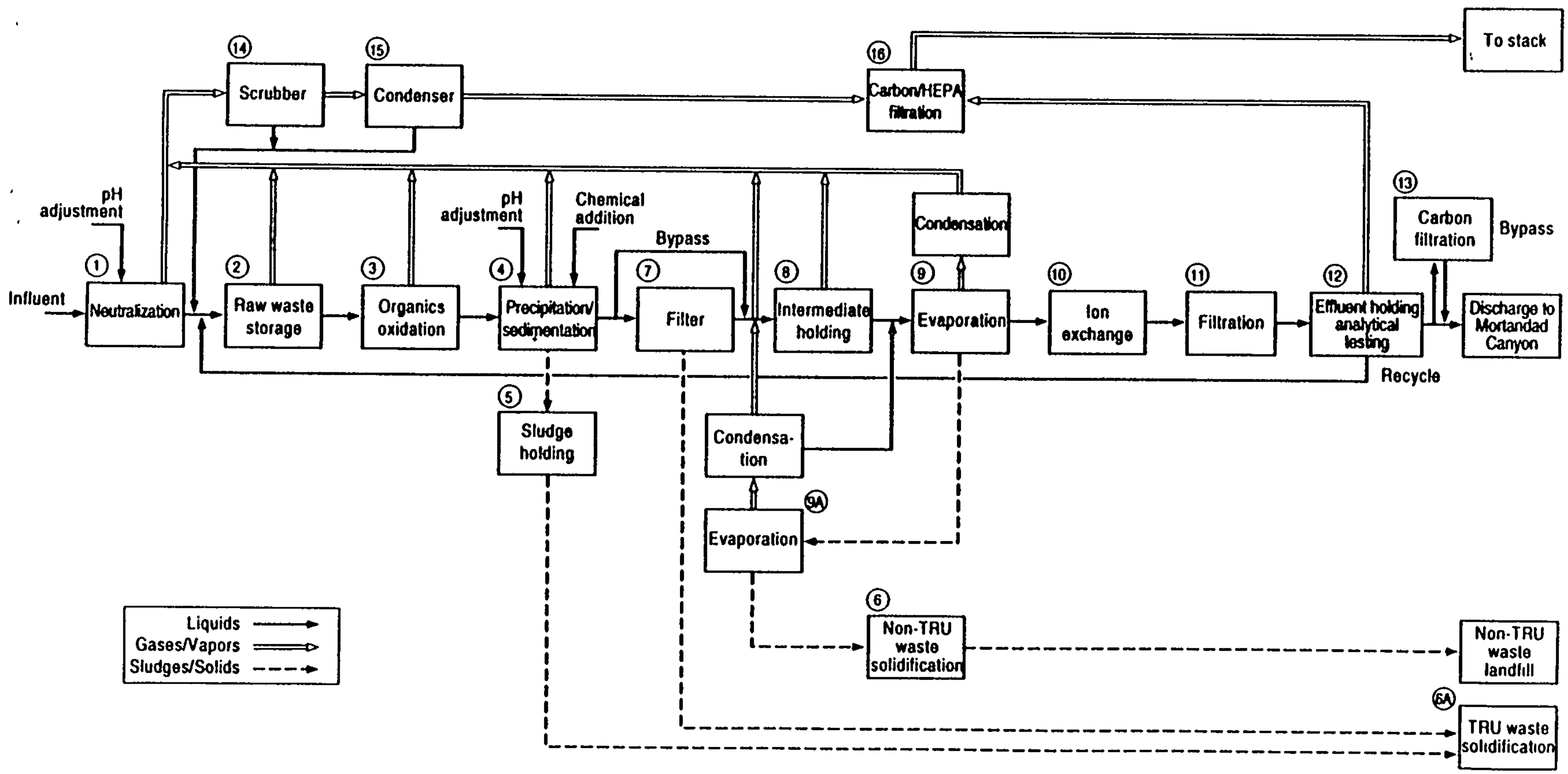
Oxidation. Wastewater batches having high chemical oxygen demand (COD) levels would be treated in an oxidation unit (#3). The oxidation unit would use an oxidant to break down organic compounds. Ozonation combined with ultraviolet treatment is the proposed oxidation technique at the present. Other technologies would be evaluated before a final selection is made for the process design. The oxidation step would reduce the COD level of the waste water. All metal constituents in the waste water would be transformed to their highest oxidation state in the process. Metals in their highest oxidation state are generally less soluble and therefore more efficiently removed by precipitation. Oxidation of organics breaks up any chelates and eliminates organic interference with the precipitation process.

Precipitation/Sedimentation. From the oxidation unit, the water would enter the two precipitation/sedimentation units (#4), which will be operated either in series or parallel. The units would remove alpha-emitting radionuclides (primarily americium and plutonium) by precipitating with lime and iron sulfate and absorbing them into recycled sludge. Heavy metals would also be partially removed by precipitation. The unit would consist of sludge contactors, flocculators, and lamella plate clarifiers. The sludge contactors mix the wastewater with sludge to facilitate absorption of radionuclides into the sludge. The pH of the sludge contactor effluent would be adjusted to optimize precipitation. The fluid would then be sent to the flocculators, causing an aggregation of small particles into larger masses that would more easily precipitate from solution. All of the precipitation units would be enclosed in jackets of circulating water to maintain constant temperature. Chemical additives would be added to enhance the removal efficiency of the flocculators. The resultant water and sludge would be separated in the lamella plate clarifiers. Some of the sludge would be recycled to the sludge contactors to enhance absorption of radionuclides, while the bulk would be sent to the sludge holding tank (#5). The sludge from the process would undergo TRU waste solidification (#6A). The liquid concentrate would be returned to the sludge contactors for re-processing before being passed on to the pressure filters.

Filtration. Clarified water from the lamella/settler units would pass through a filtration unit (#7). This polishing step would remove any residual TRU sludge or particulate not removed by the sludge contactors and the lamella plate clarifiers. After filtration, the water would be sent to holding tanks (#8). The holding tanks would mitigate flow rate variations in the system and also serve as quality control sampling points.

Evaporation. Wastewater leaving the holding tanks would enter the evaporation unit (#9). This treatment unit would concentrate the contaminants in the wastewater and produce two streams (water vapor and a concentrated contaminant sludge) for further treatment. The unit would consist of three separate evaporators (two falling-film evaporators and a thin film evaporator). One falling-film evaporator would act as a backup for the other during maintenance or emergency shutdowns. The two could also be used in parallel for increased processing capacity.

Figure 2-1
Proposed action-process flow diagram for the TA-63 RLWTF



The falling-film evaporators would provide the initial concentration of the sludge by vaporizing the water, leaving behind a concentrated liquid. The water vapor would be condensed and stored in an evaporator condensate tank for further processing. The thickened liquid concentrate from the falling-film evaporator would pass to the thin film evaporator, which would concentrate the fluid to a sludge. Condensed water from the thin film evaporator would be returned to the falling-film evaporator for re-processing. The sludge from the thin film evaporator would be solidified (#6) by a non-TRU sludge solidification process.

Ion Exchange and Filtration. Water vapor from the falling-film evaporators would be condensed and processed in the mixed-bed ion exchange unit (#10), to remove metal ions entrained during evaporation. Cations (positively charged ions) and anions (negatively charged ions) would exchange with hydrogen or hydroxide ions respectively, present in the unit's resin beds. The metal ions would remain bonded to the ion exchange resin and remain in the unit until the bed is removed for regeneration. The hydrogen and hydroxide ions combine to form water which would exit the ion exchange unit with the water. A filter (#11) downstream of the ion bed would remove residual resin and/or particulate picked up from the columns. The water would be pumped to a holding tank for analysis (#12).

Effluent Sampling, Carbon Adsorption and Discharge. Effluent samples from the effluent batch holding tanks would be sampled to characterize the effluent before discharge. If analytical testing of an effluent batch reveals residual organics, the batch would be processed through the carbon adsorption beds before discharge. The carbon adsorption unit (#13) would serve as a polishing step to treat effluent that contains residual organic compounds.

If the effluent is in compliance with the NPDES permit discharge limits, it would be pumped into Mortandad Canyon via Outfall #051. If the effluent is not in compliance with the NPDES discharge limits, it would be diverted back into the waste storage tanks for further treatment.

TRU Waste and Non-TRU Waste Solidification. Waste sludges produced by the RLWTF would be solidified by one of several processes under consideration. Cementation has been used at LANL in the past to solidify waste sludges. One of the candidate processes being reviewed is microwave vitrification, which would utilize high-energy microwaves to melt the sludge and form a stable mass for disposal. The best process to use would be determined during the conceptual design phase of the project. TRU waste would be solidified, sampled, and analyzed for compliance with the WIPP waste acceptance criteria (WAC) and stored for eventual shipment to WIPP. Non-TRU sludge would be solidified, sampled, and analyzed for compliance with the applicable WAC for eventual burial in a designated landfill at LANL.

Off-Gas Treatment System. Untreated vapors from all tanks and condensers would be sent to the off-gas treatment system, which consists of a scrubber, a condenser, carbon filters, and HEPA filters. Vapors from the treated liquid in the effluent holding tanks would be treated by carbon adsorption and HEPA filters. The system would be designed to meet the emission and air quality standards of the National Emission Standards for Hazardous Air Pollutants (NESHAP) and to control the release of radioactive material as required by DOE Order 5400.5. The off-gas from the facility would also be monitored in compliance with DOE and EPA requirements.

A scrubber (#14) would remove organic vapors by bringing the off-gas into contact with a scrubbing solution of water and chemicals. Following the scrubber, a condenser (#15) would remove excess water from the off-gas to prevent saturation of the carbon absorber and HEPA filters. Carbon absorber units (#16) would remove residual organic compounds, and the HEPA filters (#16) would remove residual particulate in the off-gas before discharge through an exhaust stack to the atmosphere (Parsons 1993a).

2.1.1.5 Waste Acceptance Criteria

The TA-63 RLWTF and the TA-50 PTF WAC would be developed after completion of the wastestream characterization study (Merrick & Company, in process). The study would evaluate the radioactive wastewater collection system and the composition and quantity of radioactive liquid waste currently generated and anticipated to be generated in the future. The WAC would provide guidance for waste acceptance to all waste generators networked to the RLWTF waste collection system.

Development of the WAC would be dependent on the final treatment technologies selected for the TA-63 RLWTF. The technologies would be a function of influent wastestream characteristics and effluent discharge limits for the facility. An evaluation of alternative treatment technologies is discussed in Appendix D. The treatment technologies discussed in Section 2.1.1.4 currently are the preferred technologies.

2.1.1.6 Instrumentation, Controls, and Monitoring Systems

Underground Piping Leak Detection System. The underground piping system consists of primary (inner) and secondary (outer) piping. The secondary piping provides for containment of leaks in the primary piping. The piping system is designed to slope continuously to provide a free-flow gravity system. Leaks would be detected in leak detection vaults located at various intervals throughout the system. Level switches would be provided at each vault to transmit alarm signals to the radioactive liquid waste collection system computer.

Process Control System. The process control system consists of all the instrumentation and equipment necessary to control the waste processing equipment. Operators would interact with the process equipment at a control panel located in the process area and at a monitor located in the control room. The monitor would be connected to the radioactive liquid waste collection system computer. All process monitoring information, including process measurements (pH, fluid level in tanks, pressure, etc.), valve status and position, alarms, and other information relevant to waste processing, would be accessible at both the panel in the process area and at the monitor in the control room.

HVAC Control System. The HVAC control system would be a stand-alone system. Operators would interact with the HVAC control system at various control panels located near the HVAC equipment. These panels would control pressurization, fans, and startup and shutdown of HVAC equipment. The system would be equipped with pressure differential indicators to monitor the pressure drop across HEPA filters and would activate alarms if the pressure drop indicates compromised HEPA filter function. Pressure differential sensors would also continuously monitor the pressure gradients between the primary and secondary confinement areas and outside ambient air pressure.

Radiation Monitoring. Primary and secondary confinement areas and the HVAC exhaust stacks would be continuously monitored for airborne contamination. The exhaust stacks would be monitored by fixed-head and continuous air monitors (CAMs). A vacuum pump would continuously draw air through the fixed-head samplers and the CAMs. An uninterruptible power supply would provide power to backup stack-monitoring vacuum pumps to assure that stack sampling would continue in the event of a power failure. Each stack would be monitored independently, and each would be supplied with its own power back-up system. All aspects of each system would be redundant.

The process area would be monitored by fixed-head samplers. An in-line gamma radiation monitor would be placed between the mixer/settler units and the effluent storage tanks. Monitors would be connected to the central control computer and would have local readouts.

Alpha-radiation hand and foot monitors would be placed at all entrances to control areas for personnel monitoring.

Fire Protection System. The fire protection system would be designed to meet all applicable NFPA requirements. It would consist of a fire alarm panel; deluge controls for HEPA filters; and detection and alarm devices, including manual pull stations, speakers, thermal detectors, flow switches and supervisory switches. The panel would provide notification of all alarm, supervisory, and trouble signals to the central alarm station. The panel would be equipped with its own dedicated battery-power backup. Operators could activate the facility-wide sprinkler system manually (ICF KE 1991).

Storm Water Controls. Storm water controls for the main treatment facility at TA-63 would consist of run-on and runoff controls in conjunction with a control point for monitoring of storm water runoff. The control point would be a holding tank or a retention pond located approximately 800 ft southeast of TA-63 RLWTF. Storm water controls would also be required during the construction phase in accordance with 40 CFR 122.26.

2.1.1.7 Administrative Controls

Administrative controls would conform to the requirements of the Safety Analysis Report (SAR) prepared in accordance with DOE Order 5820.23, Safety Analysis Reports. These controls would be addressed in the Operational Safety Requirements/Technical Safety Requirements (OSR/TSR) defined for the facility in accordance with DOE Order 5480.22, Technical Safety Requirements. Administrative Controls would be implemented through site-specific SOPs, SWPs, and operating instructions.

A site-specific Emergency Preparedness Plan would be developed in accordance with LANL Administrative Requirement (AR) 1-2. Other LANL ARs would be implemented as appropriate to ensure the administrative controls.

2.1.1.8 Decontamination and Decommissioning of the Existing TA-50 RLWTF

The proposed action includes D&D of the existing TA-50 RLWTF. The existing facility would be decontaminated and decommissioned in accordance with the "DOE Policy for Acceptance of Facilities for Environmental Restoration, August 15, 1990." In accordance with this draft policy, the existing facility would be decommissioned to a safe configuration for turnover to EM-40 for D&D.

2.1.1.9 Decontamination and Decommissioning of the TA-63 RLWTF

The proposed action also includes D&D of the TA-63 main treatment facility after its useful life. The facility would be designed to allow for D&D of equipment and areas in normal and accident conditions during the operating life of the facility. In addition, the facility would incorporate design features in accordance with DOE Order 6430.1A to facilitate these D&D activities. The following features would be incorporated into the design of the facility.

Confinement barriers. All process-area floors would be lower than floors in adjacent rooms to eliminate liquid spill contamination of the adjacent rooms and air locks.

Protective coatings. All floors, walls, and ceilings would have a smooth, impervious, seamless finish to eliminate places for contaminated material to accumulate. Corners inside rooms would be rounded, and junctions between floors and walls would be covered. All wall, ceiling, and floor coverings would be washable.

Layout. The building layout would assure separation and isolation of contaminated systems, space for maintenance, and accessibility for equipment removal.

Lighting fixtures. All lighting fixtures in the HVAC secondary confinement areas would be sealed to prevent contamination.

HVAC system. The HVAC system would include features such as the following to assure easy replacement and/or decontamination:

- HEPA filters would be located near the process off-gas vent to minimize long runs of contaminated duct work.

- Pre-filters would be placed at exhaust inlets in the process area and change rooms to minimize the potential for internal duct contamination.

- Exhaust duct work from the waste treatment process off-gas would be specially welded to facilitate decontamination. It also would be flanged at connectors to simplify dismantling.

- Duct work carrying potentially contaminated exhaust would have few ledges, protrusions, or crevices that could collect contaminated material.

- The primary air exhaust fan would be fabricated of special materials to facilitate decontamination.

These design features, in conjunction with others, would allow for Greenfield D&D of the facility after its useful life. In accordance with the Greenfield D&D concept, the site would be decontaminated and decommissioned and returned to its initial pristine environment for unrestricted use. D&D activities would be performed in accordance with DOE orders and guidelines being implemented at the time of D&D (LANL 1993c).

2.1.2 Design, Construction and Operation of a Pretreatment Facility (PTF) at TA-50

2.1.2.1 PTF Description

The PTF at TA-50 would replace the existing pretreatment facility located in the existing TA-50 RLWTF. The PTF would be a stand-alone facility housing all necessary processing and support systems for independent operations. The facility would pretreat segregated acidic, caustic and chloride radioactive liquid wastes generated by PF-4 at TA-55. The effluent stream from the PTF would be piped to the TA-63 RLWTF for secondary treatment.

Siting and Construction. The PTF site is located at TA-50, adjacent to the southwest corner of TA-50-1. The site is bordered on the west and south sides by an existing paved access road. The east side of the site is bordered by existing low-level radioactive waste storage tank Waste Management (WM)-90. The north side of the site is bordered by existing vault WM-66.

The PTF would require construction of an approximately 6,900 ft^2 building. The lower level of the building would be below grade, requiring excavation of approximately 2,000 yd^3 of soil material. The site would require paving approximately 2,000 ft^2 for truck loading and storage space. Paving would also accommodate for a north access to the proposed facility (Fluor Daniel 1989).

Architectural. The PTF is classified as a Moderate Hazard Facility in accordance with DOE guidelines. The PTF would be designed to withstand natural phenomena (i.e., earthquake, wind, and flood) for a Moderate Hazard classification in accordance with UCRL-15910. The gravity-load-resistant system consists of open-web steel joists supporting steel decking, concrete slab, and roofing. The open-web steel joists are supported by reinforced concrete masonry unit walls. These walls would be supported by a reinforced concrete foundation supported on welded tuff strata.

Architectural. The PTF design calls for a two-level rectangular structure containing a first floor with a second-level mezzanine over the eastern half of the building. The overall building size is 67.3 ft by 102 ft by 30 ft high with approximately 6,865 gross ft^2 of space.

Mechanical. The HVAC system would provide the required environmental conditions for equipment and the health, safety, and comfort of personnel. The system maintains heating, cooling, and ventilation with the required pressure differentials between primary and secondary confinement zones. Primary confinement is provided by the process equipment and their enclosures. Secondary confinement is provided by the building structure containing the process equipment and the associated ventilation system.

The ventilation system would provide continuous air flow from the outside environment into the building, provide air flow from non-contaminated areas of the building to potentially contaminated areas (secondary confinement areas), and provide air flow to normally contaminated areas (primary confinement areas). The air flow is always toward areas of higher potential hazards (hazardous material or radiation).

The primary confinement area would be served by a once-through, constant-volume supply air system. Air drawn through the primary confinement area would be filtered through HEPA filters and vented through an independent exhaust air system to an exhaust stack dedicated to the primary confinement HVAC system.

The secondary confinement areas would be served by multiple variable-volume supply air systems. Outside air would be drawn into the secondary confinement areas through HEPA filtration. Exhaust air would be vented through HEPA filters and released to the environment through exhaust stacks dedicated to the secondary confinement HVAC systems.

Areas with no potential for contamination (office, administrative, and technical support areas) would be maintained at a pressure above atmospheric pressure to assure that air from primary and secondary confinement areas are not allowed to flow into them. These areas would be served by a separate HVAC system of standard commercial design.

Fire Protection System. The PTF would be protected by automatic fire protection systems that conform to DOE Order 6430.1A and to the NFPA codes. The PTF would be protected by a wet-pipe sprinkler system designed for an Ordinary Hazard Group 2 occupancy.

The HVAC ventilation exhaust system would be protected with automatic-deluge, water spray cool-down systems that are actuated by thermal detectors. The system would cool the exhaust air to a temperature below the maximum operating temperature of HEPA filter elements. The floor of the processing area of the PTF would be recessed to prevent the spread of contaminated sprinkler water from the processing area to other areas of the building.

Electrical. The electrical system for the PTF would consist of power distribution, grounding, lightning protection, lighting and communication systems.

- Primary power for the PTF would be tapped from an existing 3.2 kV circuit running north of the building site. The power would be routed to a substation, where the voltage would be reduced to 480 V and connected to three motor control centers for distribution.

- The grounding system would ensure safety to personnel and equipment in case of electrical equipment failure. The grounding system would conform to the requirements of the National Electric Code (NEC) and DOE Order 6430.1A.

- The communication system for the PTF would consist of telephone, non-secure data, and on evacuation and public address system. The public address system would consist of an integrated evacuation and telephone-accessed paging system. It would include tone generators for building evacuation, fire, and ventilation failure, with speakers located to ensure coverage of all areas of the facility.

- The PTF would be protected from lightning strikes by a lightning protection system.

- Lighting would be provided for the interior and exterior of the facility as well as for emergency and exit lighting. (Fluor Daniel 1989)

2.1.2.2 Replacement of Radioactive Liquid Waste Lines

The proposed action includes two options for replacing existing underground radioactive liquid waste lines from PF-4 at TA-55 to the PTF at TA-50.

Direct-Buried Radioactive Liquid Waste Lines. This option includes replacing the existing waste line system from PF-4 at TA-55 to the existing TA-50 RLWTF with a new system consisting of five buried pipe lines. Four of the lines would be used for routine transfer of acid, caustic, chloride, and low-level wastes. The fifth line would serve as a common spare for acid, caustic, or low-level radioactive waste transfer. Each line would be a double containment system consisting of a 2-in diam inner pipe enclosed within a 4-in diam pipe. The inner pipe transferring the acid, caustic, and low-level wastes would be constructed of stainless steel; the chloride line would be constructed of fiberglass-reinforced polyester. The outer pipe for the five waste lines would be constructed of PVC.

The gravity-flow waste transfer lines would slope from PF-4 at TA-55 to the PTF at TA-50. The primary (inner) waste lines would be designed for higher temperatures to allow for steam cleaning of the waste lines, if necessary. The secondary (outer) containment lines would be designed to maintain a consistent temperature. Expansion loops would be provided in underground vaults to accommodate thermal expansion of the primary line.

Underground vaults would be located along the nominal 1,600 ft route from PF-4 at TA-55 to the PTF at TA-50. Vaults would be provided at each junction where a building waste line connects to the main waste line and wherever a major change in direction occurs along the route. The vaults provide space for thermal expansion of piping, a point to block off the flow of waste from an individual building, and a location for leak detection.

The underground vaults would be watertight and constructed of reinforced concrete. The manhole cover access would be sealed (Fluor Daniel 1989).

Containment Tunnel with Radioactive Liquid Waste Lines. This option includes construction of an 8-ft diam underground utility tunnel from PF-4 at TA-55 to the TA-50 PTF. The utility tunnel would provide secondary containment for five liquid waste lines. Four of the lines would be used for routine transfer of acid, caustic waste chloride waste, and low-level wastes. The fifth line would serve as a common spare for acid, caustic, or low-level radioactive waste transfer. The acid, caustic, and low-level waste lines would be 3-in. diam pipe constructed of stainless steel. The chloride waste line would be a 3-in. diam pipe constructed of fiberglass- reinforced polyester. The tunnel would be corrosion resistant, watertight, and accessible through maintenance manholes. Special security measures would be incorporated into the tunnel, since it would be below the perimeter alarm system at PF-4. Leak detection of the liquid waste lines within the tunnel would be by visual inspection (LANL 1990a).

2.1.2.3 Pretreatment Process Description

Pretreatment would involve nitrate removal, neutralization, and treatment in a mixer/settler unit as described above for TA-63 RLWTF. Pretreatment would ensure that the wastewaters from the PTF would meet the influent WAC for TA-63 RLWTF. The process flow diagram for the pretreatment process, described below, is shown in Figure 2-2.

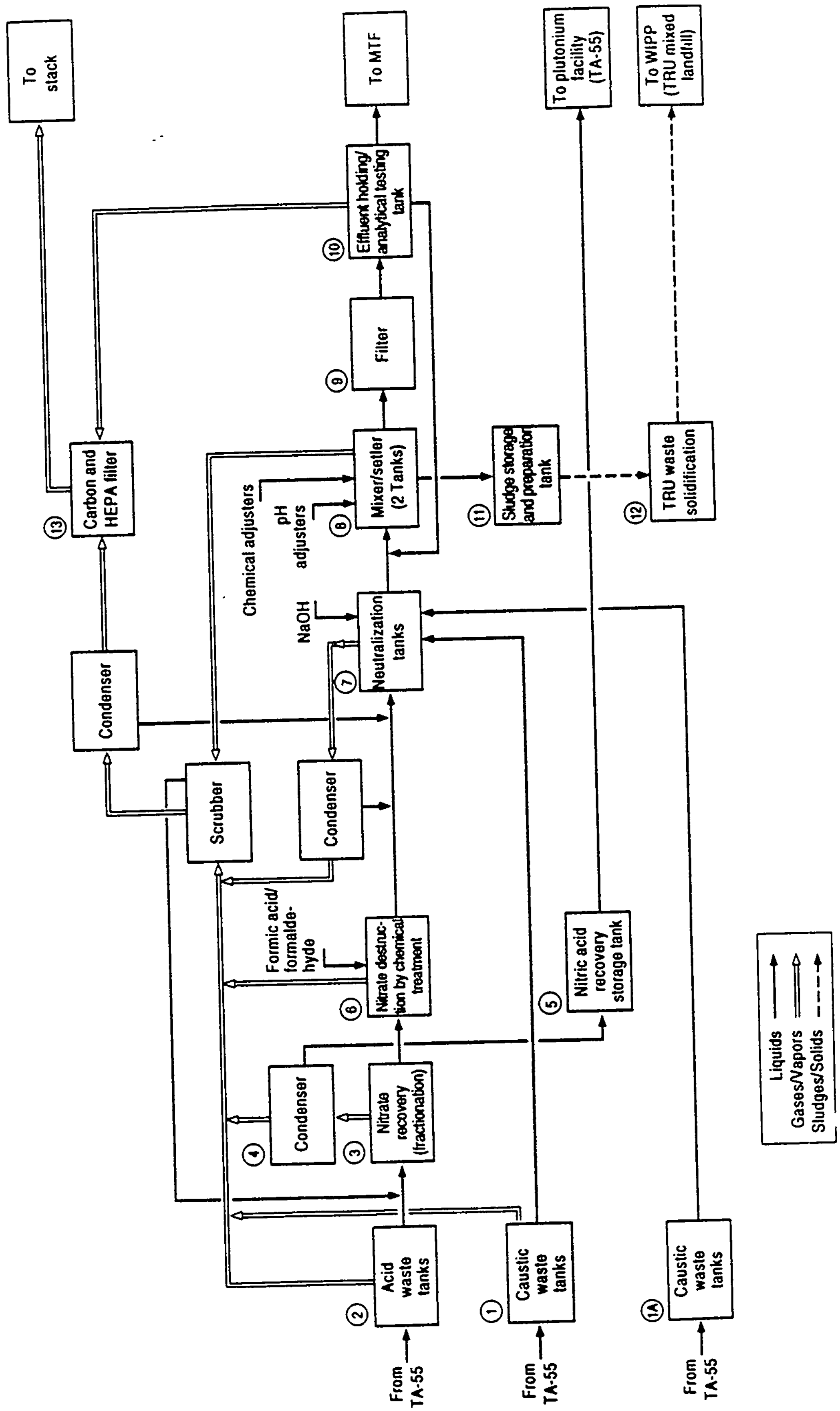
Nitrate Removal. Acid and caustic process wastes would enter the PTF and would be stored in tanks dedicated for acid and caustic waste (#1 and #2, respectively). Chloride waste would be neutralized in a separate tank. A jacket of chilled water would cool each tank to remove heat generated by the neutralization reactions. From these tanks, the wastewater would be sent to the nitric acid recovery unit. This unit consists of a fractionator (#3) for separation of nitric acid from solution and a condenser (#4) to concentrate the nitric acid. The concentrate from the unit would consist of 12 N (756 g/l) nitric acid. The condensate from the unit would be stored in a storage tank (#5) for eventual re-use at PF-4.

Following nitric acid recovery, the wastewater would enter a nitrate destruction unit (#6). This unit would reduce the total dissolved solids levels in the wastewater by destroying residual nitric acid. The unit would use formic acid and formaldehyde in a mixing tank to break down the acid to nitrogen (N_2) and oxides of nitrogen, with the organics in solution forming carbon dioxide and water.

Neutralization. The de-nitrified wastewater would be mixed with caustic wastewater from TA-55 in a 378 l (100 gal.) neutralization tank (#7). Sodium hydroxide would be added to adjust the pH to approximately 7. Vapors produced by the neutralization process would be condensed and returned to the neutralization tank for re-processing.

Actinide Precipitation, Filtration, Sludge Solidification, and Off-Gas Treatment. The remaining processes in the PTF would be identical to those described for the TA-63 RLWTF. The wastewater would pass from the neutralization tanks to a mixer/settler unit (#8), through filtration (#9), to effluent holding tanks (#10). The effluent from the process would be held in the holding tanks for verification of compliance with the TA-63 RLWTF WAC. If it is determined the criteria are met, the effluent would be sent to the TA-63 RLWTF for final treatment and discharge. Wastewater batches that do not meet the criteria would be re-processed through the PTF. Sludge from the pre-treatment process, which would be contaminated with transuranics, would

Figure 2-2
Proposed action-process flow diagram for the TA-50 PTF



be solidified (#11 and #12) for eventual shipment to WIPP. Off-gas treatment would involve the same steps as described for the TA-63 RLWTF, passing through carbon and HEPA filtration (#13) before release to the atmosphere (Fluor Daniel 1989).

2.1.2.4 Waste Acceptance Criteria

The TA-50 PTF WAC would be developed after the completion of the wastestream characterization study (Merrick & Company, in process). Refer to Section 2.1.1.5 discussion.

2.1.2.5 Instrumentation, Controls and Monitoring Systems

The PTF would have the same instrumentation, control, and monitoring systems as the TA-63 RLWTF discussed in Section 2.1.1.5., with the exception of the radiation monitoring and stormwater controls. These are discussed below.

Radiation Monitoring. In addition to the radiation monitoring discussed in Section 2.1.1.6, radiation monitoring for the PTF would include a neutron and gamma radiation monitoring system. This system would consist of sensors, transmitters, alarms and electronic devices to monitor the radiation in the facility and in facility effluents. Neutron monitors would be placed on all process vessels that would handle radioactive or potentially radioactive materials. The monitors would be equipped with local readouts and also be connected to the control room computer.

Storm Water Controls. Storm water controls would consist of run-on and runoff controls in conjunction with a monitoring control point. The monitoring control point would be a holding tank or retention pond located at the head of Ten Sites Canyon. Storm water controls would also be required during the construction phase in accordance with 40 CFR 122.26.

2.1.2.6 Administrative Controls

Administrative controls for the PTF would be the same as for the TA-63 RLWTF as discussed in Section 2.1.1.6.

2.1.2.7 D&D of the TA-50 PTF

The TA-50 PTF, like the proposed TA-63 RLWTF, would also be designed to facilitate D&D during and after the useful life of the facility as discussed in Section 2.1.1.9. The Greenfield D&D concept also pertains to final D&D of the PTF.

2.1.3 Construction and Operation of Segregation/Collection Treatment Facilities

Segregation/collection treatment facilities would be designed and constructed to treat wastestreams that do not conform to the WAC for the TA-63 RLWTF and the TA-50 PTF. Currently, three alternatives are being considered for treatment of wastestreams not conforming to the WAC:

Alternative 1	Treat wastestreams at the source of generation. This alternative is designed specifically for tritiated wastestreams that must be treated prior to treatment at the TA-50 PTF and/or the TA-63 RLWTF.
Alternative 2	Treat wastestreams at a centralized treatment facility located at TA-63. This alternative would involve construction of a new facility aside for the TA-63 RLWTF.

Alternative 3 Treat wastestreams via a combination of Alternative 1 and 2.

2.2 Alternative 1 - No-Action Alternative

The no-action alternative consists of continued operation and use of the existing RLWTF at TA-50 with no improvements or modifications. The existing facility is discussed in the following sections.

2.2.1 Facility Description

The existing RLWTF is located at TA-50. It consists of a pretreatment facility and a main treatment facility. Both the pretreatment and the main treatment process systems are located in Building 1. Building 1, built in 1963, was initially a T-shaped structure. Over the years, the building has been modified and several additions have been constructed. In 1966, laboratories, ion exchange, and a pretreatment function were added; in 1984, ventilation equipment was added (ICF KE 1993).

The RLWTF at TA-50 currently consists of the following operations:

- Radioactive liquid waste treatment operations
- Pretreatment operations for acid and caustic wastes from TA-55
- Analytical chemistry laboratories
- D & D operations
- technical support (H&R TA 1993)

Influent to the existing RLWTF consists of wastewater collected from facilities located at TAs across the LANL site, as shown in Table 2-1. Effluents from the facilities are transferred to the existing RLWTF by a passive gravity-flow collection system.

The chemical and radioactive constituents in the influent to the main treatment facility are given in Tables 2-3 and 2-4, respectively. These tables are based on average concentration values obtained for the main treatment facility in 1991 and 1992. The radionuclide constituents in the influent to the pretreatment facility are given in Table 2-5. Data are based on the average concentration values obtained for the pretreatment facility in 1991 and 1992 (LANL 1991a, 1992a).

Architectural. The current facility occupies approximately 47,500 gross ft^2 on three levels consisting of a basement, first floor, and penthouse. The initial structure was built in 1963 and includes several additions and major modifications made since then.

The existing Building TA-50-1 has poor relationships among functions, with a lack of required air locks for providing separation between "hot" and "cold" area functions. General circulation between spaces is weak, with no real isolation created by air locks and change rooms. Security and control in and out of the facility is lacking; the building envelope is insufficiently insulated, and the architectural finishes are old and showing signs of age and need for replacement.

Structural. The existing facility is not designed in accordance with current seismic building code requirements. The structure is not designed for ductile-type behavior and does not conform to

Table 2-3
Average Chemical Concentrations for Influent — Main Treatment Facility

Influent Constituent Name	Symbol	Concentration (mg/l) 1991	1992
Arsenic	As	0.0037	0.0064
Barium	Ba	0.1	0.083
Cadmium	Cd	0.01	0.0049
Calcium	Ca	24.0	13.0
Chloride	Cl-	74.0	45.0
Chromium	Cr	0.1	0.1
Copper	Cu	1.2	0.4
Cyanide	CN-	0.2	0.059
Flourine	F	4.0	2.0
Lead	Pb	0.3	0.4
Magnesium	Mg	4.8	3.0
Mercury	Hg	0.01	0.092
Nickel	Ni	0.3	0.3
Ammonia (as N)	NH3 (N)	6.3	3.0
Nitrite (N)	NO2 (N)	0.0017	0.0043
Nitrate (N)	NO3 (N)	119.0	52.0
Phosphate	PO4	5.7	4.0
Potassium	K	34.4	16.0
Selenium	Se	0.0037	0.0
Silver	Ag	0.02	0.0064
Sodium	Na	2,100.0	52.0
Sulfate	SO4	32.3	17.0
Zinc	Zn	0.5	0.3
Chemical Oxygen Demand	COD	110.0	55.0
Total Dissolved Solids	TDS	3,570.0	498.0
Total Cations		52.6	5.0

Source: LANL 1991, 1992a

Table 2-4
Average Radioactivity Concentrations for Influent—Main Treatment Facility

Radionuclide		Activity (nCi/l) 1991	1992
Beryllium	^{7}Be	1.5	NR*
Vanadium	^{48}V	0.05	NR
Manganese-52	^{52}Mn	0.08	NR
Manganese-54	^{54}Mn	0.19	0.21
Cobalt-56	^{56}Co	0.06	NR
Cobalt-57	^{57}Co	0.27	0.29
Cobalt-58	^{58}Co	0.25	NR
Cobalt-60	^{60}Co	NR	0.27
Zinc	^{65}Zn	0.16	NR
Arsenic	^{74}As	2.0	NR
Selenium	^{75}Se	9.3	NR
Rubidium	^{83}Rb	1.7	NR
Strontium-85	^{85}Sr	3.9	4.3
Yttrium	^{88}Y	3.7	NR
Zirconium-88	^{88}Zr	3.6	NR
Strontium-89	^{89}Sr	0.45	0.88
Strontium-90	^{90}Sr	7.2	0.06
Zirconium-95	^{95}Zr	1.9	NR
Niobium	^{95}Nb	3.6	NR
Cesium	^{137}Cs	5.6	0.02
Uranium	^{234}U	1.26	0.02
Plutonium-238	^{238}Pu	13.1	70.0
Plutonium-239	^{239}Pu	26.7	12.2
Americium	^{241}Am	9.0	3.5
Gross Alpha		49.2	82.7
Gross Beta		27.0	3.4

*NR = not reported

Source: LANL 1991, 1992a

Table 2-5
Average Radionuclide Activity of Influent—
Pretreatment Facility

Radionuclide	Concentration (mCi/l)			
	Caustic Waste		Acid Waste	
	1991	1992	1991	1992
$^{238, 239, 240}Pu$	1.9	0.35	0.05	0.02
^{241}Am	0.64	0.22	0.12	0.03
Gross Alpha	2.5	0.57	0.17	0.05

Source: LANL 1991, 1992a

Mechanical. The design of the existing facility's mechanical system does not conform with current health and safety requirements for HVAC standards as set forth by DOE Order 6430.1A, the Uniform Mechanical Code and Uniform Plumbing Code for non-reactor nuclear facilities, and current LANL engineering design standards. The mechanical system that services the facility consists of air supply systems, building exhaust systems (combining Zone 1 and Zone 2 exhaust), natural gas-fired boilers, and associated pumping systems.

Fire Protection System. The fire protection system was upgraded in 1980 to replace aging equipment, add signaling devices, and bring it up to compliance with current NFPA codes and DOE requirements.

Electrical. The electrical system of the existing facility has exceeded its useful life by 10 years. The electrical switchgear, installed when the facility was constructed, is not replaceable, and the original manufacturer no longer makes replacement parts. In addition, the facility has no emergency power source, and as a result, process and safety equipment are not operable during power outages.

- Electrical power presently serves Building 1 at a primary distribution voltage of 13.2 kV from the Eastern Technical Area substation.
- The grounding and lightning systems are old; however, they are in compliance with NFPA and DOE Order 6430.1A requirements.
- Lighting systems for the existing facility are served by three different voltage levels. This is the result of numerous, separate upgrades over the past 30 years and indicates probable unavailability of spare circuits in existing panelboards. Emergency lighting is inadequate with respect to NFPA 101, minimum foot-candle requirements for emergency egress (ICF KE 1993).

2.2.2 Existing RLWTF Process Description

The existing RLWTF at TA-50 consists of the main treatment facility and a pretreatment facility co-located in Building 1. The existing main treatment facility treats all low-level radioactive liquid waste generated from various waste sources throughout LANL. The main treatment facility is operated in a batch mode in quantities that provide processing at a rate of 125 gallons per minute for approximately four hours per day. Radioactive wastewater containing TRU waste generated at the PF-4 at TA-55 requires pretreatment prior to treatment at the main treatment facility.

Influent to the RLWTF is managed via two tank systems. Raw radioactive waste for the main treatment facility is managed in large underground tanks plus a 100,000-gal. aboveground tank (TA-50-90). The raw influent from TA-55 is managed in a second tank system situated in an underground concrete vault. This system, which consists of two 2,600-gal. tanks (TA-50-67, 68), holds untreated caustic and acidic wastes from TA-55. The pretreatment facility processes and the main treatment facility processes are described in the following section.

2.2.2.1 Main Treatment Facility

Influent from various sources to the RLWTF (not including the TA-55 raw effluent) are received (#1) and piped to a large holding tank (#2) where the wastestreams are stored prior to processing. A small fraction of liquid waste is transported to the facility via truck from several remote and/or dispersed generators. The process flow diagram for the main treatment facility is shown in Figure 2-3, and the processes are described below.

Neutralization. Waste from the influent receiving/holding tank systems described above is transferred to conditioning tanks (#3). The waste is neutralized with a caustic sodium hydroxide (NaOH) solution and routed to the first of the precipitation, flocculation, and clarification stages of the serial clarifiers.

Precipitation/Flocculation/Clarification. From the feed conditioning tank, the wastewater is pumped in batches to a flash mix tank (#4) where lime, iron sulfate, and flocculating agents are added. From the mixing tank, the waste flows to a mixer/settler (#5), where the wastestream would be clarified by gravity settling of the flocculated solids. The floc settles to the bottom of the mixer/settler, forming a sludge bed containing most of the alpha-emitting radionuclides. The clarified liquid overflows to the second-stage (serial) clariflocculator where the same precipitation, flocculation, and clarification processes are repeated. The second-stage clarifier overflow is then routed to a sand filter. Sludge from the clariflocculator sludge beds is then transferred to sludge holding tanks (5A).

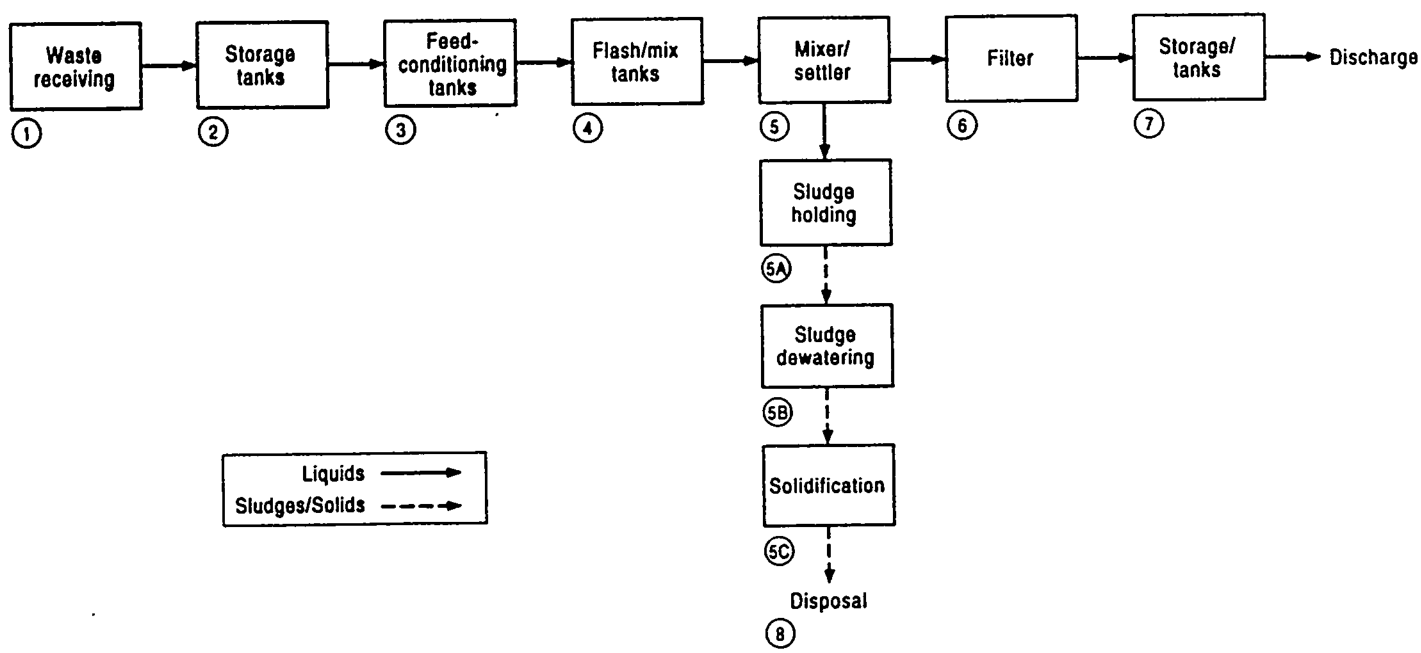
Filtration. After the precipitation/flocculation/clarification process, the wastestream is gravity-filtered through anthracite/sand filtration beds (#6) to remove any remaining suspended particles. In the filter, carbon dioxide (CO_2) is injected to lower the pH and prevent scale formation. The filtered effluent then flows to two effluent release/holding tanks (#7).

Effluent Storage/Sampling. A composite sample of the effluent in the effluent storage tanks (#7) is taken to determine gross-alpha particle radioactivity. If the gross-alpha activity of the sample is less than 4,000 disintegrations/minute/liter, the treated effluent is released to Mortandad Canyon via Outfall #051. If effluent discharge limits are not met, the effluent is rerouted to the raw waste tanks for reprocessing through the main treatment process.

Sludge Dewatering. Sludge solids collected in holding tanks (#5A) are pumped to a vacuum filter, dewatered (#5B), and packaged (#5C) in 55-gal. drums for disposal (#8) at TA-54, Area G.

Ancillary Treatment Processes. The main treatment facility also contains two unit operations not routinely used in normal processing. These are 1) an ion exchange operation consisting of two strong cation units and two weak cation units, and 2) a vertical wiped-film evaporator.

Figure 2-3
Alternative 1: Process flow diagram for the existing TA-50 RLWTF



The ion exchange unit is designed to remove positively charged metal ions such as plutonium, americium, cesium, and strontium and have the capability of being regenerated. The wiped-film evaporator is designed to reduce the volume of regenerated fluids or waste effluent from the pretreatment process that handles TA-55 plutonium process wastewater.

Ancillary process units are not routinely used in the treatment scheme and are therefore not shown in the flow diagram (Parsons 1993a,b).

2.2.2.2 PTF Process Description

The caustic and acid wastestreams from TA-55 are stored in separate, dedicated holding tanks (TA-50-67,68). These tanks receive waste until a sufficient quantity for processing has accumulated. The pretreatment operation is conducted in a batch mode. The process flow diagram for the pretreatment system is similar to that for the main treatment facility; the processes are described below.

Neutralization. The two wastestreams from TA-55 are neutralized in cooled neutralization tanks. The caustic stream is first neutralized with a portion of the acidic wastestream. The remaining acidic wastestream volume is then neutralized by the addition of a caustic (NaOH) solution. Agitators are used to ensure adequate mixing.

Precipitation/Flocculation/Clarification. From the neutralization tanks, the waste is transferred to a flash mixer, where iron sulfate and/or lime is added, along with a coagulation aid. The resulting iron hydroxide and/or calcium sulfate precipitate settles to the bottom of the clariflocculator, taking with it radionuclides. The clarifier liquid is then pumped through a sand/anthracite filter.

Sludge Washing. Sludge that accumulates in the clariflocculator basin is transferred to settling tanks. In the tanks, the sludge undergoes a washing process, consisting of decanting, adding water and mixing, followed by settling. The decant is rerouted through the sand/anthracite filter, and treated sludge is solidified.

TRU Sludge Solidification. The sludge is solidified by cementation using a tumbler/mixer operation and placed in 55-gal. drums for subsequent storage at TA-54 Area G (Parsons 1993a,b).

2.2.3 Waste Acceptance Criteria

Waste acceptance criteria are currently implemented for the existing RLWTF at TA-50.

2.2.4 Instrumentation and Engineering Controls

Process Control System. The process control system consists of all the instrumentation and equipment necessary to control the waste processing equipment. There are two operator interface units, one in the control room and one in the computer room adjacent to the control room. Each operator interface unit consists of a monitor display connected to the radioactive liquid waste collection system computer. All process monitoring information (i.e., valve status and position, alarms, etc.), waste transfer pipeline monitors, and certain waste collection systems may be accessed at both monitor interfaces.

Underground Piping Leak Detection System. The underground piping system consists of primary (inner) and secondary (outer) piping. The secondary piping provides for containment of primary piping leaks. The piping system is designed to slope to provide a free-flow gravity system. In the event of an inner pipe leak, gravity would transport liquids through the outer pipe to the next lowest manhole, where the liquids are collected in a sump. Manholes are sealed inside and out to prevent leakage. Monitors in each manhole detect leaks of radioactive liquid and transmit an alarm to the control room computer at TA-50-1. The alarm system is connected via telephone to a continuously manned utility control center.

HVAC Control System. There is no HVAC control system for the existing facility. Room pressures throughout the building are checked manually by use of magnetic differential gauges and by periodic smoke tests. Process exhaust systems are HEPA filtered prior to being released to the stack. Pressure drops across HEPA filters are monitored manually by magnehelic differential pressure gauges.

Radiation Monitoring System. Continuous air monitors (CAMs) are located in several areas at TA-50-1. These instruments provide an audible alarm locally if the level of airborne radioactivity exceeds 40 counts per minute. The CAM filters are changed daily, and the instruments are checked with a standard radiation source weekly. All CAMs are calibrated on a yearly basis.

Fire Protection System. Building TA-50-1 is equipped with a wet-pipe sprinkler system that covers several zones. This system activates an audible building alarm when it is activated. The computer room is equipped with a halon system that triggers alarms locally and at TA-3 when it actuates.

A carbon-dioxide fire smothering system is provided for the gas-fired oil heater that serves the vertical wiped-film evaporator. This system is actuated by a smoke detector in the heater stack or by a high-temperature signal from a temperature switch that monitors the heater stack. A pressure switch in the carbon dioxide injection line interfaces with the building fire alarm panel. The system can also be actuated manually (H&R TA 1993).

Storm Water Controls. Storm water controls consist of run-on and runoff controls. Alternative 1 does not have a control point (i.e., holding tank or retention pond) for monitoring of stormwater runoff.

2.2.5 Administrative Controls

Administrative controls are currently instituted through applicable LANL ES&H ARs, SOPs, special work permits, and operating instructions. SOPs and operating instructions document specific tasks and potentially hazardous operations and emphasize necessary precautions. Special work permits (SWP) are prepared for limited-term or one-time potentially hazardous operations or activities. Generally, SWPs cover radioactive work or limited egress/confined space entry not covered by SOPs (H&R TA 1993).

A site-specific Emergency Preparedness Plan, developed in accordance with AR 1-2, is implemented for the existing RLWTF.

2.2.6 Decontamination & Decommissioning of the Existing RLWTF

D&D of the existing TA-50 RLWTF for this alternative would consist of the same approach discussed under the proposed action in Section 2.1.1.8.

2.3 Alternative 2 - Retrofit Existing RLWTF and Construct a PTF at TA-50

This alternative consists of refurbishing the existing RLWTF and constructing a PTF at TA-50. The Pretreatment Facility for this alternative is the same PTF included under the proposed action.

2.3.1 Project Objectives

The project objectives associated with this alternative are the same as those discussed in Section 2.1.1.1 for the proposed action.

2.3.2 Facility Description

2.3.2.1 Radioactive Liquid Waste Treatment Facility

Retrofitting the existing TA-50 RLWTF consists of renovating and reusing the existing structure and treatment process areas. The retrofit design concept also includes adding new facilities and tank storage areas. Facility additions include a change room and lobby, a chemistry laboratory, a vehicle airlock, hot and cold warehouses, a mechanical building, an emergency generator, and a cooling tower. Tank storage additions include two aboveground holding tank systems. The civil site plan showing the proposed additions is shown in Figure 2-4 (ICF KE 1993).

The retrofit concept would be based on a phased construction approach. The first phase would involve constructing new process and storage areas and then transferring the current operation there. The second phase would involve decontaminating and modifying the existing plant to provide for additional space and process units.

Architectural. Architectural aspects associated with retrofitting the existing RLWTF were divided into two activity groups: 1) refurbishment and demolition, and 2) new construction. The latter would account for approximately 86,040 gross ft^2. The refurbishing activity would account for approximately 37, 417 net ft^2.

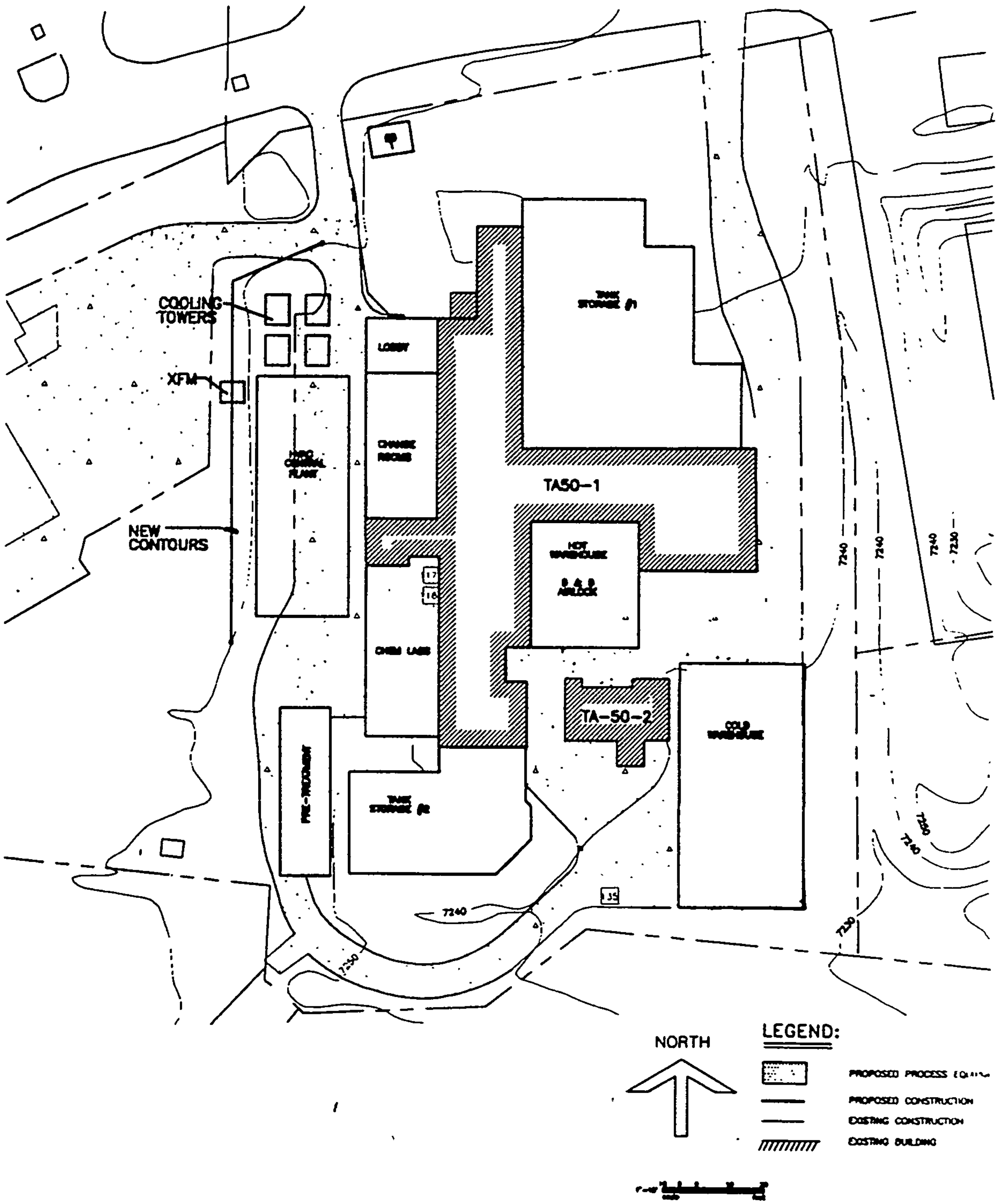
Structural. The existing facility would be refurbished to comply with DOE Order 6430.1A in accordance with guidelines for Important or Low Hazard structure classification. Structural modifications to the existing facility would include replacement of the existing nonductile concrete frame with a ductile shear wall system. Proposed additions/new construction would also be designed in accordance with DOE Order 6430.1A standards.

Mechanical. The existing facility HVAC and plumbing and piping systems would require upgrading to comply with current standards set forth in DOE Order 6430.1A , the Uniform Mechanical Code and Uniform Plumbing Code for non-reactor nuclear facilities, and current LANL engineering design criteria. To accomplish compliance with applicable HVAC standards, an HVAC central plant facility would be constructed.

Fire Protection System. The wet-type fire protection sprinkler system for the existing facility would be modified for the new partition layout and new facility areas. Each floor would be provided with a zone alarm indication by a flow switch on fire protection piping. As much of the existing system as possible would be reused; new piping and sprinklers would be added for new additions. Two additional fire protection alarm risers and wet-type fire sprinkler systems would be installed to provide protection for the new building additions to the main plant. A wet- type fire protection system would be provided for the HVAC central plant and for the cold warehouse.

Electrical. The existing power distribution system serving Building 1, including the unit substation and all distribution equipment, would be replaced as part of the architectural and structural refurbishment. In addition, an emergency/backup power system would be installed in accordance with DOE 6430.1A and NPFA 110. The sources would consist of on-site permanent diesel generator and one or more UPS.

Figure 2-4
Civil site plan for the proposed additions-refurbished RLWTF



- A new unit substation with a capacity of 3,000 kVA (mineral oil-filled type transformer) would be required to serve the RLWTF plant expansion. The existing 15 kVA rated pad-mounted switching station now serving the plant would be available for tapping the 13.2 kV line for primary service to the new 3,000 kVA unit substation.

- A grounding system would be installed to ensure personnel and equipment safety in case of electrical equipment failure. The ground system would conform to the requirements of the NEC and DOE 6430.1A.

- The communication system for the refurbished facility would consist of telephones, non-secure data, and an evacuation and public address system.

- A lightning protection system designed in accordance with DOE Order 6430.1A would be installed.

- New lighting systems to be installed include fixtures, switches, and controls for the refurbished and expanded plant (ICF KE 1993).

2.3.2.2 Pretreatment Facility

The PTF associated with this alternative would be identical to the PTF discussed in Section 2.1.2.1 for the proposed action.

2.3.3 Process Description

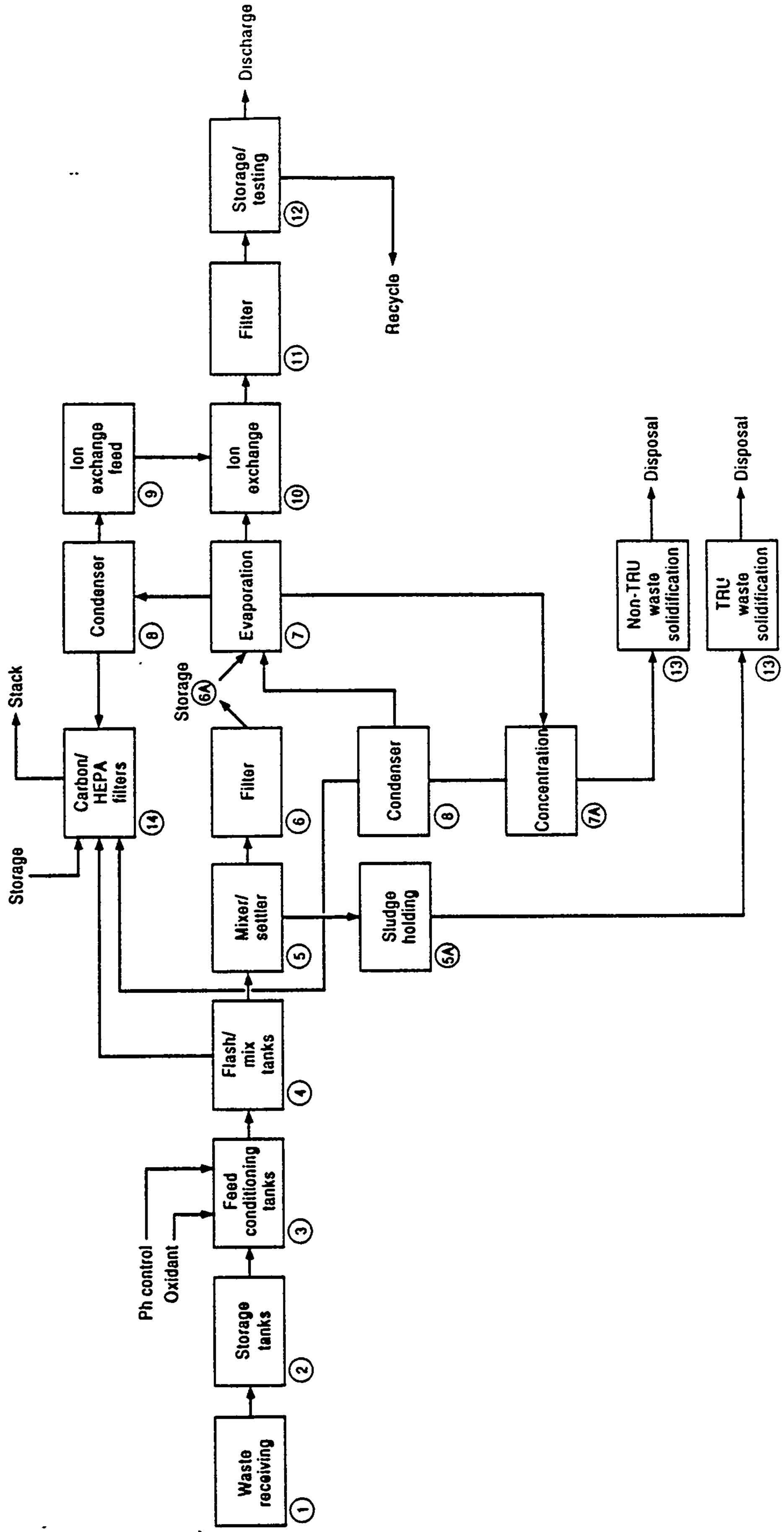
2.3.3.1 Radioactive Liquid Waste Treatment Facility

The main treatment facility associated with the existing TA-50 RLWTF would be modified and designed to treat wastewater at a rate of 76 liters (20 gallons) per minute during seven days per week of continuous operation. A nine-day holding period would be allowed in order to monitor effluents from the treatment process before they would be discharged to the environment (the holding period is necessary for analysis of strontium-90 effluents). This rate of wastewater treatment is based on the maximum rate of production during 1991; it does not allow for future increases in wastewater influents from LANL operations. Influent storage to provide for a 20- to 30-day interruption of processing would be provided. The process flow diagram for the modified plant, described below, is shown in Figure 2-5.

Neutralization. Waste from the LANL radioactive waste line system and effluent from the TA-55 pretreatment plant would be received in a waste receiving/storage tank (#1). The liquid waste pH would be adjusted to between 7.5 and 8; this range is compatible with the mild steel construction of the facility tanks and is optimum for oxidation of organics that may be present. From the receiving tank, the waste would be fed to one of four equalization and holding tanks (#2).

Oxidation. The waste would then be transferred to one of three feed conditioner tanks (#3). These tanks would be operated sequentially, with one tank being filled, one being conditioned, and one used as storage for feed to the main treatment process. The oxidation process would take place in the conditioning tanks. A mild oxidant would be added in a dry form to destroy organic chelating agents and thus free up radioactive contaminants so that they could be more easily precipitated in subsequent treatment step.

Figure 2-5
Process flow diagram for the refurbished TA-50 RLWTF



Precipitation/Flocculation/Clarification. From the feed conditioning tank, the wastewater would be pumped to the flash mix tanks (#4) where lime, iron sulfate, and flocculating agents would be added. From the mixing tanks, the waste would flow to mixer/settlers (#5), where gravity settling of the flocculated solids would clarify the wastestream. The clarified liquid would be sent through cross-flow filters (#6), which would remove most of the remaining solids in the wastestream. Solids that collected on the filters would be removed by a continuous scouring cross-flow of a portion of the waste feed stream, and the solids would be recycled into the mixer/settler system. The filtered liquid would then be held in interim storage tanks (#6A). The pH would be adjusted, if necessary, to prevent scaling during transfer and storage.

Evaporation. Steam evaporators (#7) would be used in the next treatment step to remove 90% of the water in the wastestream. The vapor would be condensed, (#8). The condensate from the process would be collected in holding tanks (#9) in preparation for treatment in the ion exchange units. Prior to being sent to the ion exchange columns, the condensate would be treated with activated carbon to remove any residual organic compounds.

Ion Exchange. Mixed-bed ion exchange columns (#10) would remove any remaining metal ions, including radionuclides, in the wastestream. Redundant columns would be provided to allow continuous processing while a column was being regenerated.

Filtration. After ion exchange, the water would be filtered (#11) to remove any fine particles that escaped the ion exchange beds. Filter types are being evaluated for this step of the process. The water would be stored in tanks (#12) for nine days pending confirmation by the analytical laboratory that it meets NPDES discharge specifications. Wastewater that did not meet specifications would be recycled to storage for reprocessing. During the processing of recycled wastewater, the facility would process 57 liters per minute (15 gallons per minute) of fresh waste feed, utilizing influent storage as equalization tanks during this period.

Solidification. TRU sludge from the bottom of the mixer/settler would be stored (#5) and transferred to the solidification process area, where it would be solidified by one of several processes under consideration. Concentrate from the evaporator would be transferred to a concentrator (#7A) which would remove additional water before the non-TRU wastestream, was sent for solidification (#13). Sludge would be solidified by a new process rather than the cementation process currently in use. Solidification of both TRU and non-TRU waste would be accommodated by this process.

Off-Gas Treatment System. Off-gas from all condensers and treatment tanks would be processed through an off-gas treatment system that would include carbon and HEPA filtration (#14) before release to the environment through the facility exhaust stack. The stack would be continuously monitored for radioactivity (ICF KE 1993).

2.3.3.2 Pretreatment Facility Process Description

The PTF associated with this alternative would be identical to the PTF discussed in Section 2.1.2.3 for the proposed action.

2.3.4 Waste Acceptance Criteria

Waste Acceptance Criteria for the refurbished TA-50 RLWTF and the PTF at TA-50 would be developed after completion of the wastestream characterization study (Merrick & Company, in process). Refer to Section 2.1.1.5 and 2.1.2.4 discussions.

2.3.5 Instrumentation, Controls, and Monitoring Systems

The refurbished RLWTF and the PTF associated with this alternative would have the same instrumentation, controls, and monitoring systems as the TA-63 RLWTF and the TA-50 PTF that comprises the proposed action discussed in Sections 2.1.1.6 and 2.1.2.5, with the exception of storm water controls. These are discussed below.

Storm Water Controls - Storm water controls would consist of run-on and runoff controls in conjunction with a control point for monitoring of stormwater run-off. The control point would be a holding tank or a retention pond located at the head of Ten Sites Canyon. Storm water controls could also be required during the construction phase in accordance with 40 CFR 122.26.

2.3.6 Administrative Controls

Administrative controls for the refurbished RLWTF and the PTF in Alternative 2 would be the same as for TA-63 RLWTF and the TA-50 PTF discussed in Section 2.1.1.6 and 2.1.2.5, respectively.

2.3.7 D & D of the Refurbished RLWTF and the PTF at TA-50

Alternative 2 includes D&D of the refurbished main treatment facility and the new pretreatment facility at TA-50. These facilities would be upgraded and/or designed to facilitate D&D activities during and after the useful life of the facility. Upgrade and/or design of the refurbished main treatment facility and the new pretreatment facility would incorporate design features as discussed in Section 2.1.1.8.

The refurbished main treatment facility would be decontaminated and decommissioned in accordance with the reuse alternative. D&D activities consist of removing all process equipment, holding tanks, and associated piping for subsequent turnover of the facility to LANL for restricted reuse. D&D activities would be performed in accordance with DOE orders and guidelines being implemented at the time.

The TA-50 PTF would be decontaminated and decommissioned in accordance with the Greenfield D&D approach. This approach is discussed in Section 2.1.1.8 (LANL 1993c).

2.4 Alternative 3 - Privatization of the PTF and RLWTF

This alternative would consist of two options, which are discussed in the following sections.

2.4.1 Design, Construction, and Operation of the PTF and RLWTF for LANL

For this option, LANL would procure the services of a subcontractor to design, construction, and operate of the PTF and the RLWTF. LANL would be responsible for preparing procurement documentation and subsequent procurement of the subcontractor. LANL's primary role would be an oversight role as opposed to a direct management role.

The subcontractor would be responsible for design, construction, and operation of the PTF and the RLWTF. The subcontractor would be required to comply with regulatory requirements listed in Section 1.3 in conjunction with meeting the project objectives given in Section 2.1.1.1.

2.4.2 Operation of the PTF and RLWTF for LANL

For this option, LANL would procure the services of a subcontractor for operation of the PTF and RLWTF. LANL would be responsible for the design and construction of the facilities. The subcontractor would manage and operate the facilities in accordance with the regulatory requirements listed in Section 1.3 in conjunction with meeting the project objectives given in Section 2.1.1.1. LANL would assume an oversight of facilities operation.

2.5 Alternative 4 - Transport of Waste Offsite

Alternative 4 includes transportation of liquid radioactive waste from the various waste generators at LANL (listed in Table 2-2) to commercial or DOE treatment or disposal facilities elsewhere in the U.S. This alternative was evaluated in the Value Engineering Study (1992) for the RLWTF project. It was determined not to be a viable alternative due to anticipated transportation and public issues and concerns. Transportation off site poses risks to workers, the general public, and the environment that could be avoided with on-site treatment and disposal. In addition, low-level waste shall be disposed of at the site where it is generated, if practical, in accordance with DOE Order 5820.2A (LANL 1992f).

2.6 Alternative 5 - Utilize Alternative On-Site Location for RLWTF

Four sites were identified as candidate sites for siting of the proposed RLWTF. The sites selected were 1) TA-63, 2) the south side of Mortandad Canyon, 3) east of TA-52, and 4) south of Pajarito Road. These four sites were selected based on two initial screening criteria: the sites had to be vacant, and the site had to be downgradient from existing radioactive liquid waste generators. The four sites were then screened using the 13 siting criteria listed in Table 2-6.

Based on this screening process, the TA-63 and Mortandad Canyon sites were determined to be the most viable sites for the proposed RLWTF. The TA-63 site was selected as the preferred site and is discussed under the proposed action in Section 2.1. The Mortandad Canyon site would be a viable alternative to the TA-63 site. Both sites have siting constraints with respect to the siting criteria; these are summarized in Table 2-7. With regards to the faulting at the TA-63 site, it was determined that there are no surface rupture-type faults on the site. Consequently, the TA-63 site was selected as the preferred site. The locations of the preferred TA-63 site and the alternative Mortandad Canyon site are shown in Figure 2-6 (ICF KE 1992).

Table 2-6
Siting Criteria for Proposed RLWTF

- Surface Faulting
- Area
- Conflict with Potentially Contaminated Areas (SWMUs)
- Site Development Costs
- Impacts to Existing and Future Waste Generators
- Efficient Land Use
- Impacts of the Pretreatment Facility Location
- Public Hazard Analysis
- Gravity Flow
- Access
- Utilities Availabiltiy
- Visual Impacts
- Other Environmental Impacts

Source: ICF KE 1992

Table 2-7
Siting Constraints for the Two Viable Sites

TA-63 Site	Mortandad Canyon
Surface Faulting	Site Size
Solid Waste Management Units	Efficient Land Use
Impacts on PTF Location	Utilities Availability
Visual Impacts	Other Environmental Impacts
Access	Access

Source: ICF KE 1992

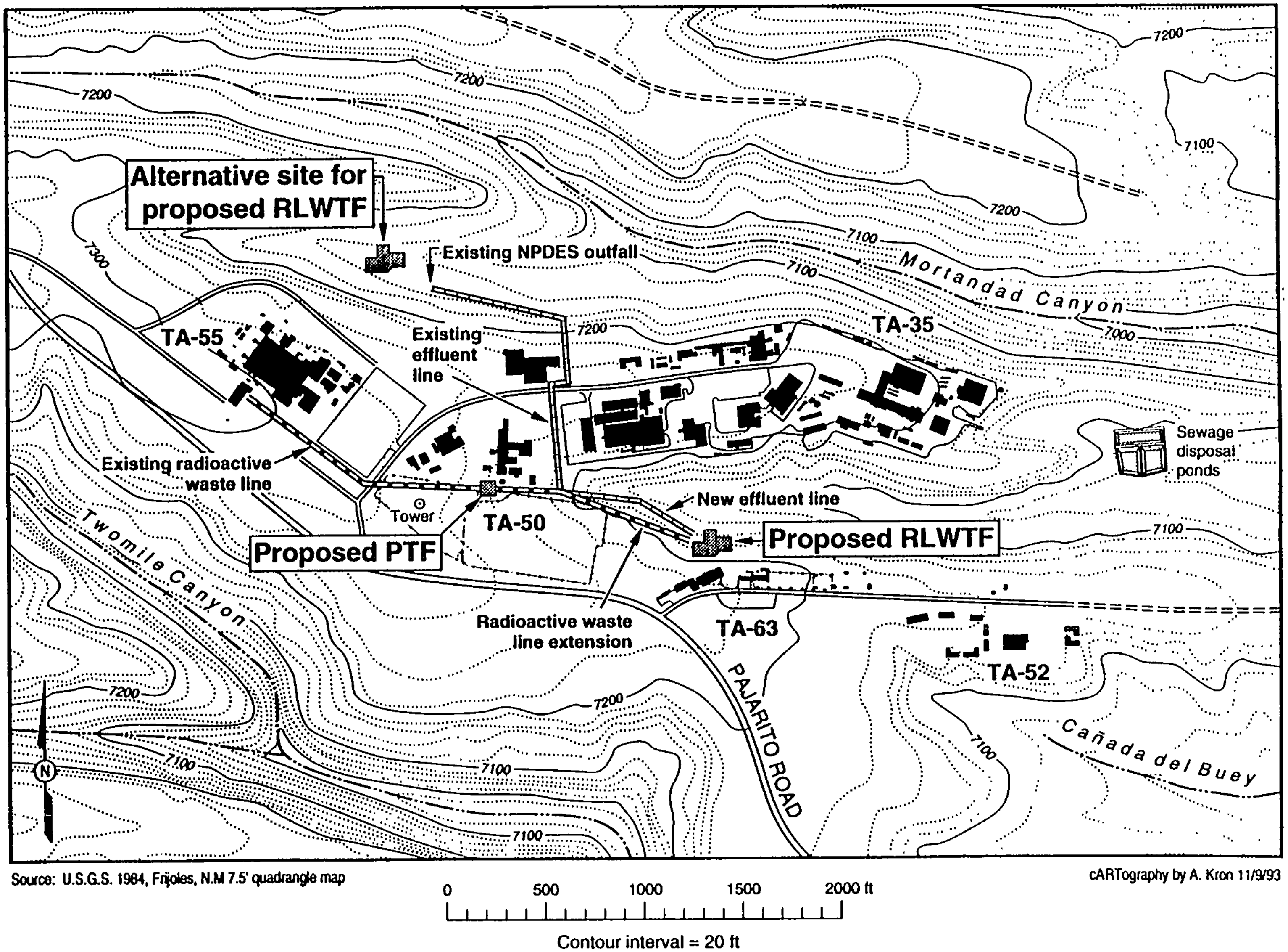


Figure 2-6
Approximate location of the proposed TA-63 RLWTF site and the alternative Mortandad Canyon site

3.0 CONNECTED ACTIONS

This section addresses the connected actions for the proposed action and alternatives discussed in Section 2.0. For purposes of this study, connected actions are discussed with regards to technical association and not from the aspect of NEPA integration.

3.1 Proposed Action

As discussed in Section 2.1, the proposed action consists of construction and operation of a RLWTF at TA-63 and a PTF at TA-50. Connected actions or projects associated with the proposed action are summarized in Table 3-1.

3.2 Alternatives to the Proposed Action

Alternative 1 and Alternative 2 have the same connected actions as the proposed action, with the exception of the proposed HWTF.

Alternative 3 and Alternative 5 have the same connected actions as the proposed action.

For Alternative 4 and Alternative 6 there are no connected actions.

Table 3-1
Connected Actions to the Proposed Action

Action	Description of Action	Connection/Association to the Proposed Action
Proposed Hazardous Waste Treatment Facility (HWTF) at TA-63	Develop waste treatment processes for treatment of hazardous and mixed wastes currently stored at various LANL locations.	The HWTF would be located approximately 600 ft southeast of the proposed TA-63 RLWTF. Consequently, the two facilities would have a common stormwater monitoring control point (See 2.1.1.6, Stormwater Controls)
Expansion of Area G at TA-54	Expand existing Area G to nearby acreage on Mesita de Buey.	[1] Sludge from the proposed TA-63 RLWTF treatment process would be solidified and packaged for subsequent disposal at Area G. [2] Breached waste containers buried at Area G would be recovered and repackaged. Some of these container may require washdown; the washdown may produce radioactive wastewaters requiring treatment at the proposed TA-63 RLWTF.
Acceptance of TRU waste at Waste Isolation Pilot Project (WIPP)	Transport TRU waste to WIPP	Sludge generated from the proposed TA-50 PTF would be solidified and packaged for subsequent transport to WIPP.

4.0 AFFECTED ENVIRONMENT

4.1 Natural Environment

4.1.1 Geographic Location/Setting

4.1.1.1 LANL Region

LANL and the associated communities of Los Alamos and White Rock are situated in Los Alamos County in north-central New Mexico. This region is located approximately 100 km (60 mi) NNE of Albuquerque, 40 km (25 mi) NW of Santa Fe, and 30 km (20 mi) SW of Española (Figure 4-1). Most of Los Alamos County is situated on the eastern slope of the Jemez Mountains on the Pajarito Plateau. The plateau slopes gently downward in an east-southeast direction for more than 24 km (15 mi), ending in a series of scarps dropping to the Rio Grande to the east of the plateau.

The plateau is comprised of numerous alternating narrow mesas and canyons that extend from the base of the Jemez Mountains (approximately 2380 m [7800 ft] above sea level), to just above the Rio Grande (approximately 1890 m [6200 ft]). The canyons are 46 m - 91 m (150 ft - 300 ft) deep and 91 m - 183 m (300ft - 600 ft) wide. The LANL site occupies approximately 111 km^2 (43 mi^2) of the Pajarito Plateau (DOE 1979, LANL 1991b).

Most LANL and community developments are confined to mesa tops. The surrounding land is largely undeveloped, with large tracts of land north, west, and south of the LANL site held by the National Forest Service, the Bureau of Land Management, the National Park Service, General Services Administration, and Los Alamos County. San Ildefonso Pueblo borders LANL to the east.

4.1.1.2 Proposed RLWTF Project Area

The proposed and alternative site for the RLWTF are located in the center of the LANL site within an area encompassing TA-63 and TA-35 (Figure 4-2). The proposed project site at TA-63 is located on top of Mesita del Buey, in the north-central sector of LANL. The alternative site at TA-35 is directly north and adjacent to TA-63, at the top of a small tributary drainage to the upper regions of Mortandad Canyon. The proposed siting for the Pretreatment Facility is located at TA-50, directly NW of TA-63.

The general RLWTF project area (TA-63, TA-35, and TA-50) is situated along Pajarito Road near the center of the northern half of LANL. Located on Mortandad Mesa, the general area is bounded by Mortandad Canyon on the north, Two Mile and Pajarito canyons to the south, and the western extent of Cañada del Buey to the east. Mesa top elevations range from about 2225 m (7,300 ft) at the western boundary to 2073 m (6,800 ft) at the eastern edge of the mesa. Canyon bottom elevations in the area range from 2073 m to 2196 m (6,800 ft - 7,200 ft) (LANL 1992c,d).

4.1.2 Climate and Meteorology

The climate in the LANL region is characterized as a semiarid, temperate mountain type (Bowen 1990). Climate characteristics are variable season-to-season as well as year-to-year. Figure 4-3 provides the most current (1992) temperature, precipitation, and snowfall annual amounts for the area.

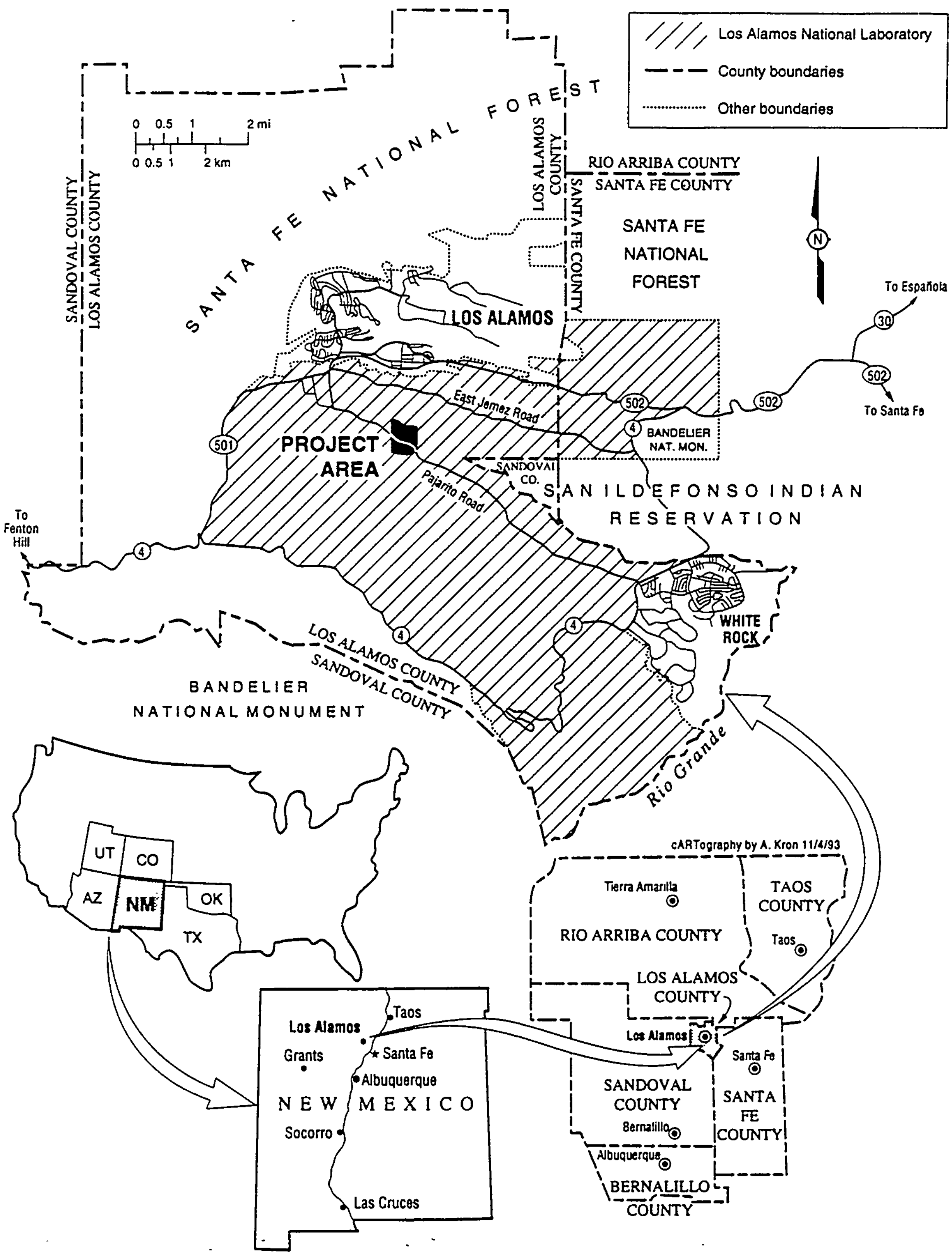


Figure 4-1
Location map of Los Alamos National Laboratory

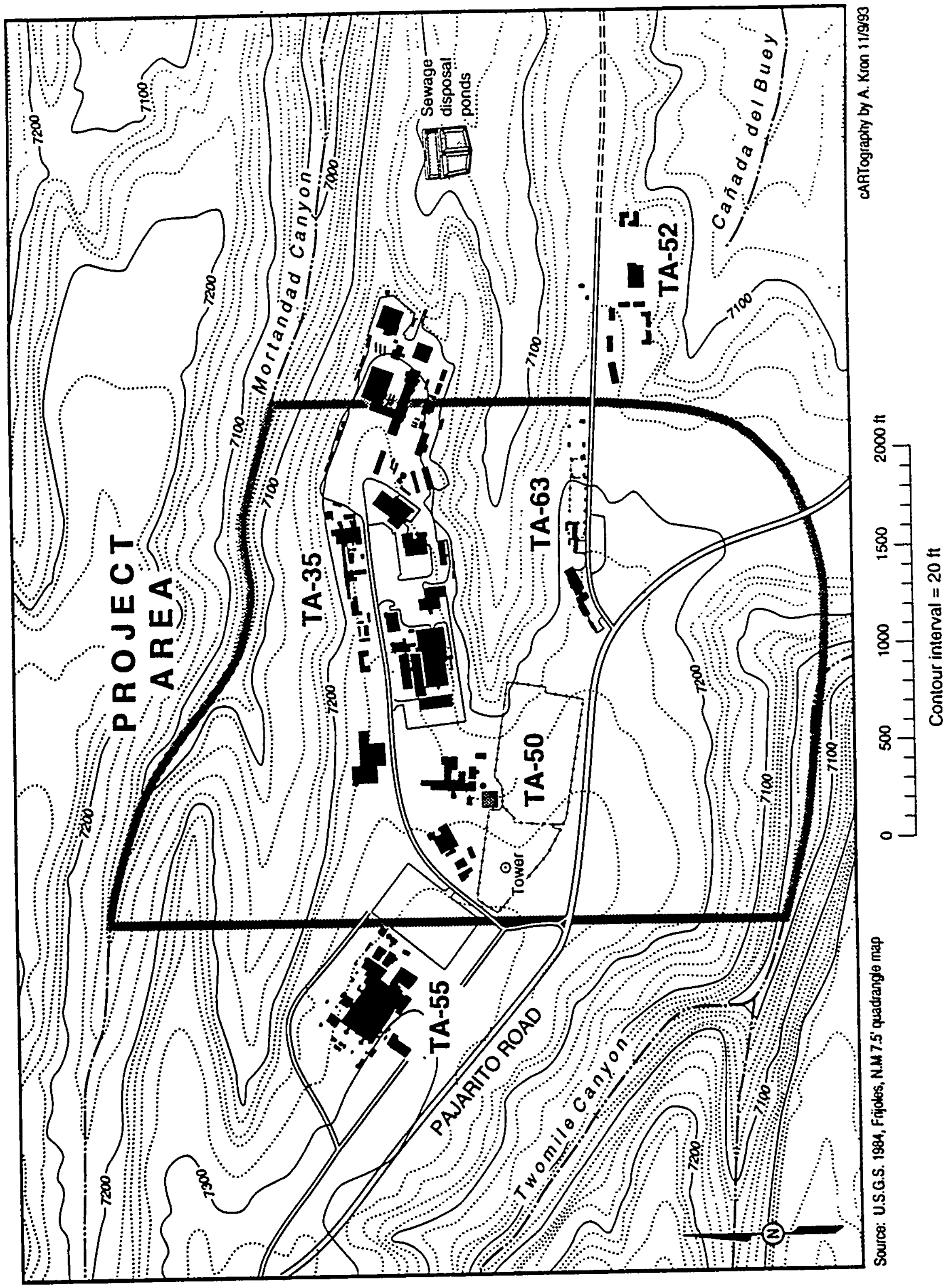


Figure 4-2
Location of the proposed RLWTF project area

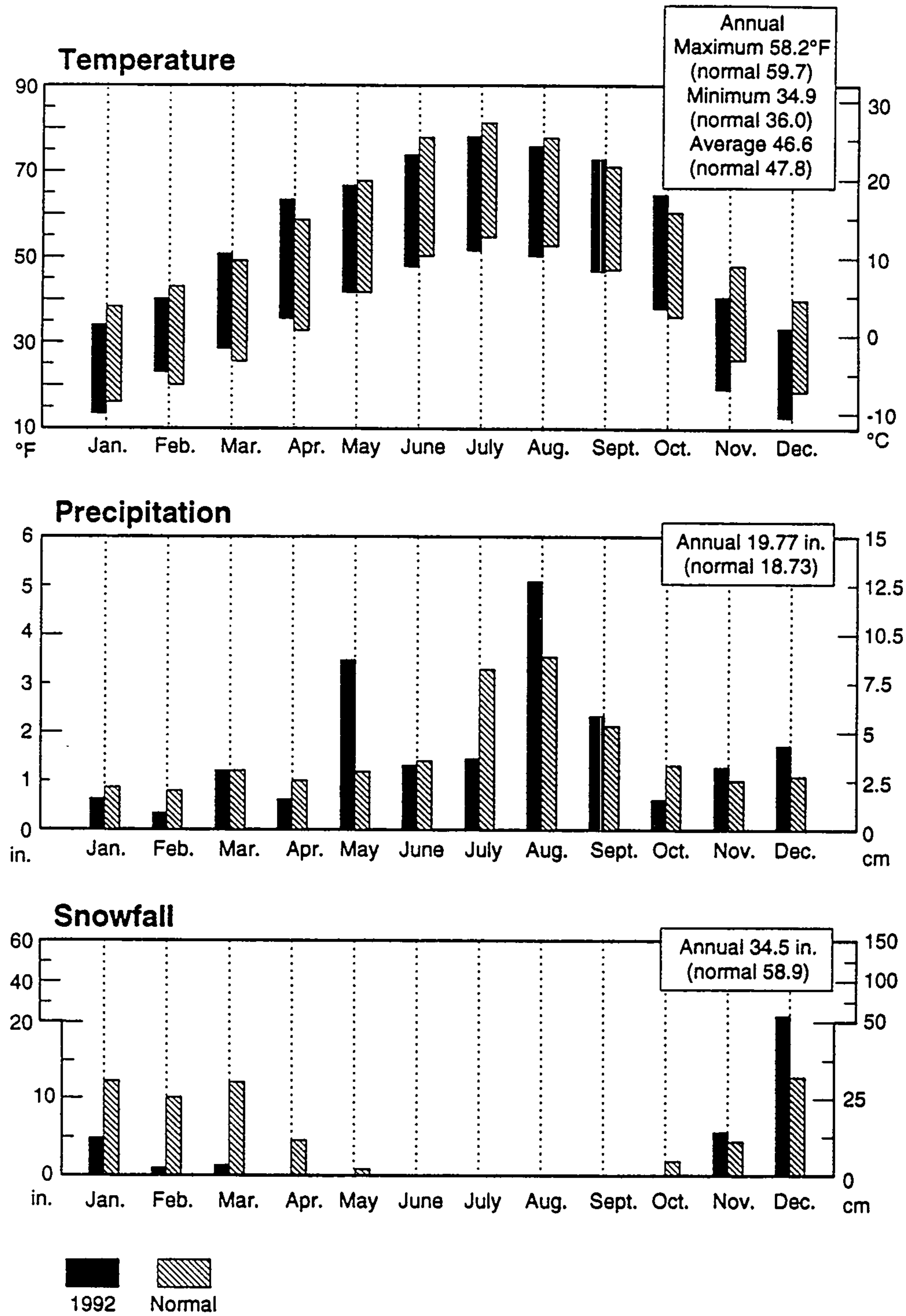


Figure 4-3
Temperature, precipitation and snowfall amounts for LANL area

4.1.2.1 Precipitation

LANL Region. The total precipitation for LANL, including rainfall and water-equivalent snowfall, averages about 46 cm (18 in.) per year. Year-to-year accumulations, however, have varied as much as 59 cm (24 in.) for the past 69 years. This variation is typical for semiarid, temperate mountain climates.

The heaviest periods of precipitation occur from July through August (monsoon season) and November through March (winter season) (Bowen 1990). Moisture enters north-central New Mexico along two predominant atmospheric pathways. During most of the year, moisture is transported from the Gulf of Mexico (1300 km [800 mi] to the southeast). Gulf air masses travel across relatively smooth terrain over most of the distance to north-central New Mexico. They often contain abundant moisture and account for most of the precipitation received during the regional monsoon season. During the winter season, moisture is transported from the region of the Pacific Ocean 1300 km (800 mi) to the west and 1050 km (650 mi) to the southwest. This subtropical moisture crosses mountain ranges in southern California and Northern Arizona, causing uplift and removal of much of the moisture from the air and resulting in lower accumulations of winter precipitation.

Proposed RLWTF Project Area. The proposed project area experiences precipitation regimes consistent with the regional weather patterns. The project area receives 36 cm to 46 cm (14 in-18 in.) of precipitation per year, with approximately 15 cm to 20 cm (6 in to 8 in.) occurring in the form of rainfall during the summer months. Summer thundershowers in the area are often brief and intense. Depending on intensity, these storms may result in significant quantities of surface runoff. The project area winter precipitation usually occurs in the form of snowfall, with the annual average totaling 130 cm (51 in.).

4.1.2.2 Temperature

LANL Region. The LANL region experiences relatively mild and variable annual temperatures. Because of the 2255 m (7400 ft) elevation, temperatures in LANL are typically cool, even though the region is situated at a relatively low latitude (35° 32' N). Temperatures vary across the Pajarito Plateau with change in altitude, time of day, and local surface winds. Temperatures average 3°C (5°F) higher than the average in and near the Rio Grande valley and -3°C to -5.5°C (5°F to 10°F) lower than the average in the nearby Jemez Mountains. Daily temperatures vary most during the summer and winter months. The region's thin, dry air and frequent clear skies allow both strong daytime heating and nighttime cooling, resulting in differences in the daily temperature range of as much as 14°C (25°F) in June, and 12°C (21°F) in December and January. In addition, rising air moving up the large slope of the Pajarito Plateau can result in adiabatic cooling. Conversely, air moving down the plateau can result in adiabatic warming. Southerly or easterly winds can cool the air as it rises over the plateau, and westerly winds can warm the air as the air descends. A change in wind direction can cause local temperature to rise or fall as much as 3°C-6°C (5°F-10°F) over a relatively short period of time.

Winter temperatures typically range from -9°C to -4°C (15°F to 25°F) during the night and from 1° C to 10°C (30°F to 50°F) during the day. Cold Arctic air masses occasionally invade the LANL area from the north and east. During the early winter months, temperatures occasionally drop to nearly -18°C (0°F) or below. These cold temperatures are often the result of a regional cold-air mass, fresh snowfall, light winds, and clear skies. Most winter days, however, are sunny with light winds. High wind-chill factors are not common in the LANL region because strong winds usually do not occur at the same time as very cold ambient temperatures.

Summer temperatures provide warm days and cool nights. Daily afternoon temperatures are typically in the 21°C to 32°C (70°F to 80°F) range, occasionally reaching 32°C (90°F). Even after the warmest days, the relatively thin air, light winds, clear skies, and dry atmosphere enable nighttime temperatures to drop into the 10°C to 15°C (50°F to 60°F) range (LANL 1991b).

Proposed RLWTF Project Area. Temperatures in the proposed RLWTF project area range from 10°C to 32°C (50°F to 90°F) during the summer and -9°C to 10°C (15° to 50°F) during the winter (LANL 1992c).

4.1.2.3 Prevailing Winds

LANL Region. The north-central New Mexico region lies at the southern edge of a band of strong westerly winds common over central North America. Throughout the year, the LANL region is affected by these winds, with relatively light westerly surface winds averaging 3 m/s (7 mph). The strongest winds typically occur from March through June, when intense seasonal storms and cold fronts move through the region. During this season, sustained winds are southwesterly through northwesterly and can exceed 11 m/s (25 mph) with peak wind gusts exceeding 22 m/s (50 mph). During the monsoon season, prevailing winds are southwesterly through northwesterly and can reach velocities of as much as 34 m/s (76 mph). Prevailing winds during the monsoon season are primarily the result of intense thunderstorms and usually do not last for long periods. December through January (the winter season), day and night winds are usually light and the result of local cold air drainage and warm air surface currents across the Pajarito Plateau.

On sunny days, large-scale, thermally driven (convective) upslope winds develop over the Pajarito Plateau. These upslope winds are generally less than 3 m/s (6 mph) and blow from a south-southwesterly direction. At night these winds reverse direction, as cooler air flows down the plateau towards the Rio Grande Valley. Downslope winds can reach speeds of 3-3.5 m/s (6-8 mph) and blow in a north-northwesterly direction.

North-central New Mexico also experiences large-scale winds that, depending on direction, can cause either up- or down-channel winds in the Rio Grande Valley. These winds occur approximately 1,000 feet above the basin of the Rio Grande Valley and either blow from the west-northwest to the east-northeast or east-northeast to the west-southwest. The channel winds, in turn, affect the direction and magnitude of the day and night winds across the Pajarito Plateau. When large-scale winds blow from the west-southwest to the east-northeast, surface winds in the Rio Grande Valley are upslope, and both day and night slope winds become more south-southwesterly on the eastern slopes of the Pajarito Plateau. Conversely, when these large-scale winds blow from the east-northeast through the west-southwest, surface winds in the Rio Grande Valley are downslope, and day and night slope winds become more north-northeasterly on the eastern slopes.

The most current (1991) prevailing wind characteristics (speed, direction and duration) for the annual-day, annual-night and annual-total are represented graphically by the wind roses in Figure 4-4. Wind roses are circles with lines extending from the center that represent the direction from which the wind blows. The length of each line is proportional to the frequency at which the wind blows *from* the indicated direction. Each direction is one of 16 primary compass points (for example, N and NNE) and is centered on a 22.5° sector. Each spoke consists of different widths representing different wind speed classes. The frequency of calm winds (winds with speed less than 0.5 m/s [1 mph]) are found in the circle's center. Day and night are defined by sunrise and sunset times).

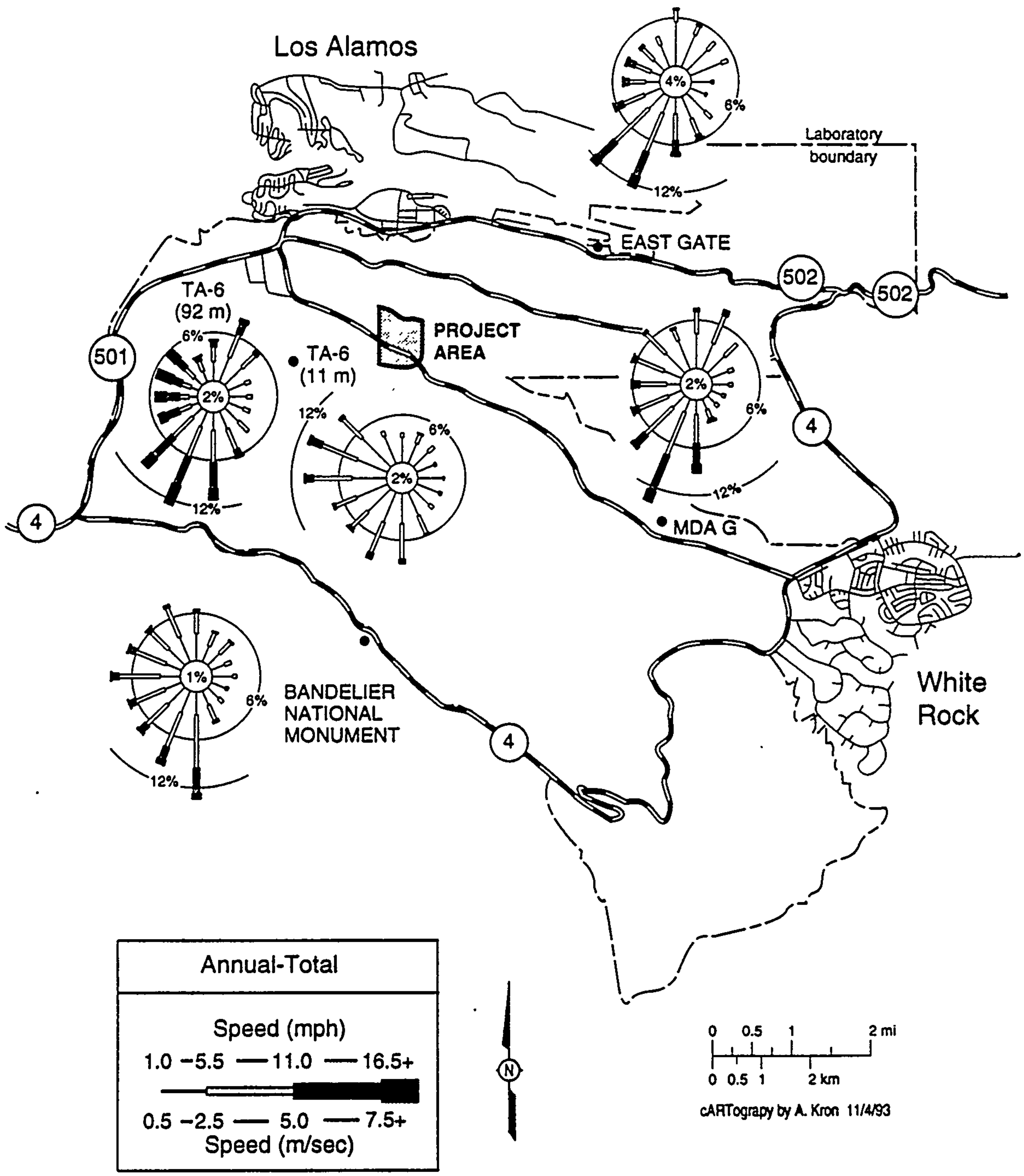


Figure 4-4
Wind roses for the LANL area

Proposed RLWTF Project Area. Prevailing winds in the LANL region are affected by a number of factors including large-scale atmospheric wind patterns, regional weather disturbances (such as local thunderstorms and cold fronts), complex surface terrain, and local cold air drainage across the Pajarito Plateau. These factors interact variably to establish the prevailing wind patterns for the proposed project area. Currently, no site-specific data is available for the proposed RLWTF project area (LANL 1991b).

4.1.3 Geology and Soils

The LANL region includes a diverse composite of geologic formations and deposits resulting from a long and variable geologic history. These geologic features are the result of the dynamic layering of volcanic and sedimentary deposits, coupled with the effects of current and historic periods of volcanism and tectonic activity.

4.1.3.1 Geology, Seismology, and Volcanism

LANL Region. Approximately 1.13 million to 1.5 million years ago, two major volcanic eruptions in the Jemez Mountains resulted in the formation of two large, deep ash-flow sheets. Collectively referred to as the Bandelier Tuff, these large ash-flow sheets include the Otowi and Tshirege members. The Otowi and Tshirege members erupted and were deposited sequentially. The tuff, ranging from more than 300 m (1,000 ft) thick in the western part of the plateau to about 80 m (260 ft) east above the Rio Grande, dates back to the Pleistocene epoch. Beneath the Bandelier Tuff, a sequence of intermixed strata of sedimentary and volcanic rocks of Miocene to Pleistocene age occurs. These interstratified sedimentary rock units include volcanic rocks of the Paliza Canyon Formation, Tschicoma Formation, and the Cerros del Rio volcanic field; and sedimentary deposits of the Puye Formation, the Totavi Formation, the Cochiti Formation and the Santa Fe Group (LANL 1992e).

The Pajarito Plateau and the Jemez Mountains are part of a massive volcanic field which includes the Valles Caldera, a large multi-stage, basin-shaped volcanic depression, and approximately 432 mi^3 of volcanic rocks. These materials erupted from numerous regional volcanic vents. The Jemez volcanic field is located at the intersection of the Jemez lineament (a northeast-trending alignment of volcanic fields) and the Rio Grande Rift (an extensive zone of north-trending tectonic features). A generalized cross-section showing the stratigraphy and structure of the Pajarito Plateau and Jemez Mountains is shown in Figure 4-5.

The latest eruption in the Jemez Mountains occurred about 130,000 years ago. Regional sulfur gas venting and hot spring activity, both within and outside of the Valles Caldera, provide evidence of residual volcanic activity. Recent studies have indicated the presence of partially molten rock beneath the caldera, suggesting the possibility of remnant magma still cooling within the Bandelier magma chamber.

The major faults of the Pajarito Plateau include the down-to-the-east Pajarito fault and the down-to-the-west Rendija Canyon and Guaje Mountain faults. The Pajarito fault extends some 47 km (29 mi) from approximately 28 km (17 mi) south of LANL to 17 km (12 mi) to the north. The Rendija Canyon fault is subparallel to and located approximately 3 km (1.8 mi) to the east of the Pajarito fault, extending from just south of the LANL area northward approximately 10 km (6.2 mi). The 14 km (8.7 mi) long Guaje Mountain fault is subparallel to and located approximately 4 to 5 km (2.5 to 3.1 mi) east of the Pajarito fault.

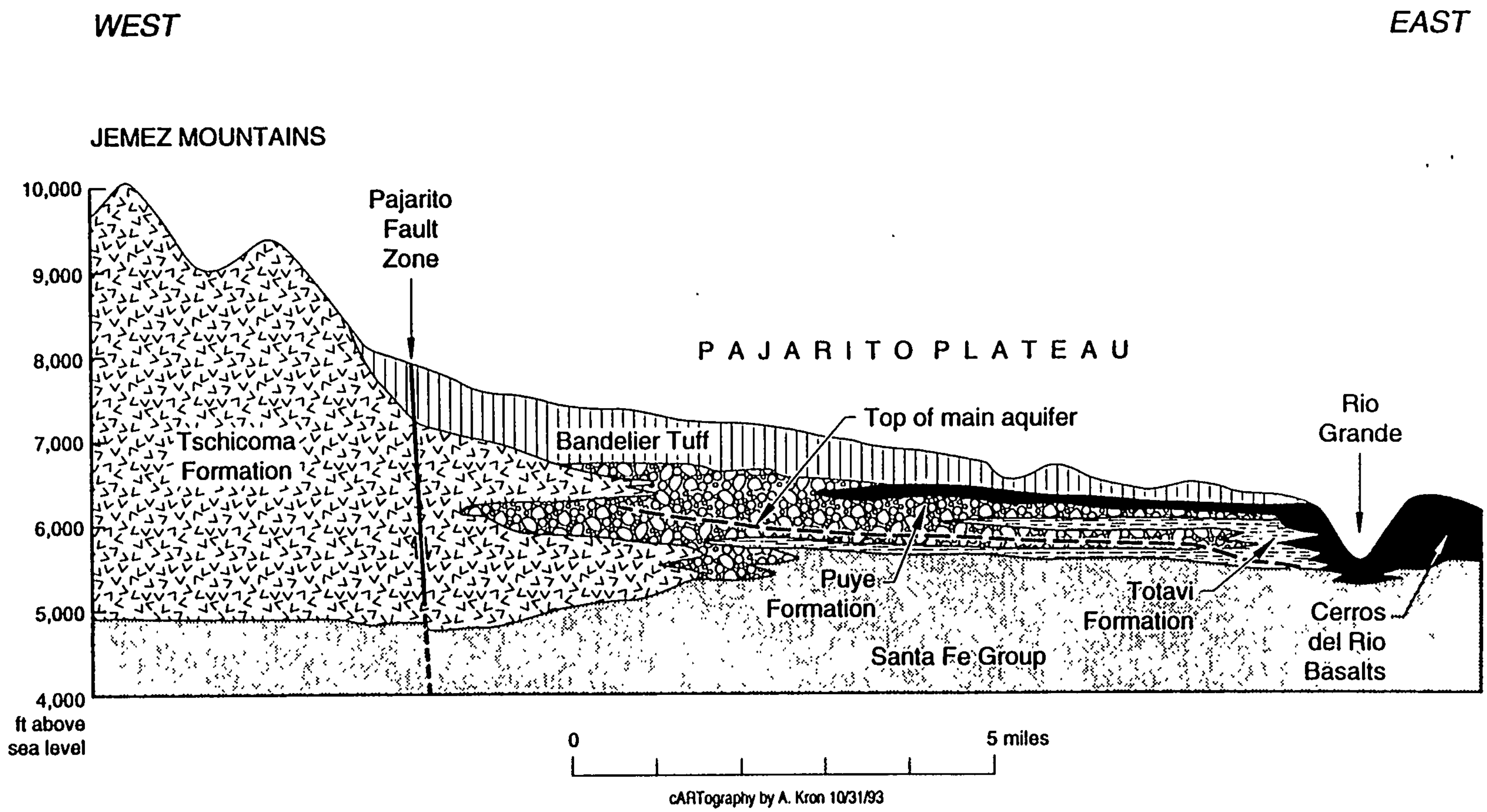


Figure 4-5
Generalized cross section showing stratigraphy and structure of the Pajarito Plateau from the Jemez Mountains to the Rio Grande (modified from Purtymun 1984, 0196)

A recent investigation into seismic activity in the LANL area indicates strong evidence of Pajarito fault movement sometime during the late Quaternary time period. The Rendija Canyon fault exhibits evidence of repeated late Quaternary activity, including a most-recent event about 8,000 to 9,000 years ago. The Guaje Mountain fault has evidence of repeated late Quaternary activity as well, with a most recent event at about 4,000 to 6,000 years ago (Woodward-Clyde 1993). The location of the fault zones is the LANL region is shown in Figure 4-6.

Proposed RLWTF Project Area. Of the three main faults in the LANL area, the Guaje Mountain fault is most relevant to the proposed RLWTF project area. As shown in Figure 4-6, the Guaje Mountain fault transects the center of the TA-50, TA-63, and TA-35 area. The north-trending, steeply dipping fault exhibits down-to-the-west displacement of the 1.1-million-year-old Bandelier Tuff of the Mortandad Mesa. The average post-1.1 million year slip rate along the Guaje Mountain fault (based on average displacement measurements along nine separate locations of the fault), is 0.01 mm/yr. It has been suggested that further paleoseismic data on the sense of slip of the Guaje Mountain fault are required to fully assess the role of the fault in the local geomorphology and site-specific seismic event probabilities (Woodward-Clyde 1993).

4.1.3.2 Soils and Sediments

LANL Region. The interactions of the regional climate with the soil surface slope and the underlying bedrock has resulted in the development of a large variety of soils and sediments on and around the Pajarito Plateau. The majority of the mineral components of plateau soils and sediments originate from the locally abundant Bandelier Tuff. Other constituents include materials from regional volcanic materials of the Tschicoma Formation, basalts of the Cerros del Rio volcanic field, and sedimentary rocks of the Puye Formation. The alluvium found in canyons and some mesa tops comes from the Pajarito Plateau material and from the east side of the Jemez Mountains. Layers of pumice derived from El Cajete in the Jemez Mountains and windblown sediments derived from other parts of New Mexico are also important in the composition of many soils and sediments of the Pajarito Plateau.

Soils formed on the tops of mesas on the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal series. On the plateau, soils are typically loam or sandy loam at the surface level, and clay or clay loam in the subsurface horizons. Of these soil series, there are two general categories: those that contain an abundance of pumice (Frijoles, Hackroy, and Seaby soils) and those that contain mostly wind-deposited sediments (Prieta soils). Soil depths on the mesas vary greatly in depth and are typically thinnest near the edges of the mesas, where bedrock is often exposed. Soils formed from generally loose and sandy alluvial and colluvial (loose composites of rocks and debris formed at the base of a cliff or steep slope) deposits include the Potrillo, Puye, and Totavi series (LANL 1992e).

Proposed RLWTF Project Area. The proposed RLWTF area is dominated by soils in the Hackroy and Nyjack series. Hackroy series soils are typically present around the TA-35 area, while the Nyjack series soils are more common throughout the grounds of TA-50 and TA-63. The slopes between the mesa top and canyon bottoms in the proposed project area often consist of steep rock outcrops and patches of shallow, undeveloped colluvial soils. South-facing canyon walls are steep and usually have little or no soil material or vegetation. In contrast, the north-facing walls generally have areas of very shallow, dark-colored soils containing higher amounts of organic matter and are more heavily vegetated.

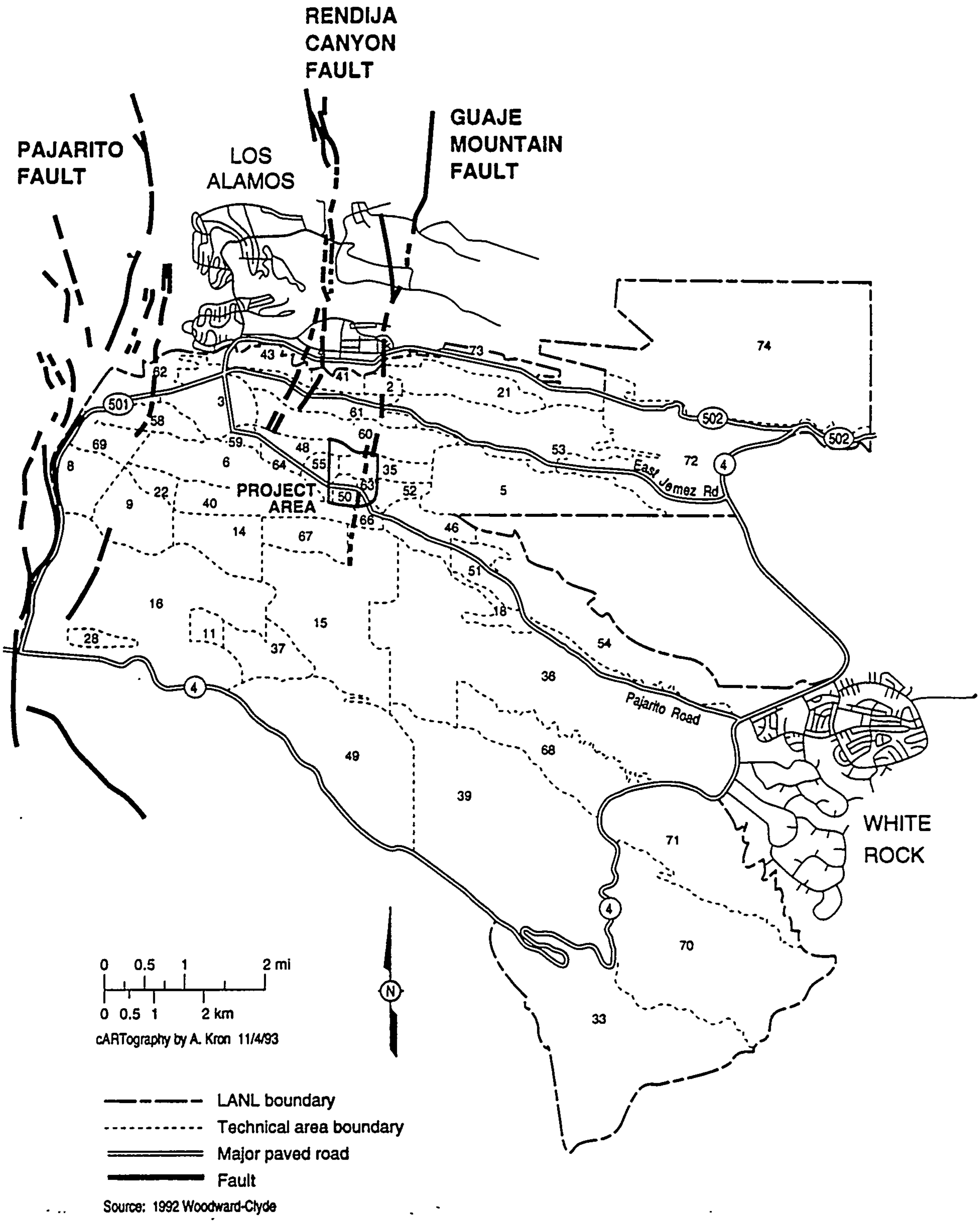


Figure 4-6
Location of fault zones in LANL region

Regional and site-specific sediments are formed and transported in the stream channels of the plateau area canyons. The majority of these sediments are composed of variable proportions of plateau soils and coarse-to-fine organic materials. Plateau sediments are formed and transported primarily by natural surface runoff from spring snow melt and summer thunderstorms. During the spring, snow melt typically moves small amounts of sediments short distances over long periods of time (days). In contrast, the summer thunderstorm runoffs move large amounts of sediments over short periods of time (hours). These factors are important to consider when identifying potential releases, location, and transportation of contaminants in plateau region runoff channels (LANL 1992c,d).

4.1.4 Water Resources

The following overview of regional hydrology is intended to describe the major surface water and groundwater features of LANL and the surrounding northern New Mexico region. It provides a basic description of the major surface water and groundwater locations and their distribution. For the purposes of this discussion, the northern New Mexico region includes the area encompassed within an 80 km (50 mi) radius of LANL. Most of the material in this section is compiled from information in LANL's Annual Environmental Surveillance Report for 1991 (LANL 1991b).

4.1.4.1 Surface Waters

Regional surface waters can be divided into two major categories: naturally occurring surface waters and industrial outfalls/sanitary wastewater treatment facility discharges. Naturally occurring surface waters originate directly from natural sources. Man-made lakes and reservoirs may not be "naturally occurring" but are comprised of naturally occurring waters. In contrast, industrial outfalls and wastewater discharges originate from industrial and municipal sources. For this discussion of the regional industrial outfall/wastewater effluents, the discussion will be limited to effluents out of the Pajarito Plateau that originate from past and present LANL operations.

Naturally Occurring Surface Waters–LANL Region. Regional surface waters from natural sources occur in five major modes: springs; intermittent streams and ponds; permanent streams and rivers; seasonal surface flows; and permanent ponds, lakes, and reservoirs. Figure 4-7 illustrates the general distribution of these surface water types at LANL and across the northern New Mexico region.

Most surface waters occur in the form of permanent streams, rivers, ponds, lakes, and reservoirs. The Rio Grande, the dominant surface water feature of the region, drains more than 37,000 km^2 (14,000 mi^2) in northern New Mexico and Colorado. The average discharge of the Rio Grande at the Otowi Bridge gauging station was about 1 km^3/year (0.82 x 10^6 acre-ft/year) for the 1955 to 1974 period (DOE 1979). Within about 100 km (60 mi) of Los Alamos, there are many permanent surface water tributaries to the Rio Grande. These tributaries include

- the Chama, Ojo Caliente, Santa Cruz, and Nambe rivers to the north and east;
- the Jemez Creek to the west; and
- the Santa Fe and Galisteo rivers to the south.

Flood control, irrigation, and water supply reservoirs include Heron, El Vado and Abiquiu reservoirs on the Chama River to the north; Santa Cruz Lake on the Santa Cruz River and Two-Mile, Nichols, and McClure reservoirs on the Santa Fe River to the east; and the Galisteo Reservoir on the Galisteo River, Jemez Reservoir on the Jemez River, and Cochiti Lake on the Rio Grande to the south. These major surface water features are illustrated in Figure 4-7.

In the Los Alamos area, there is intermittent stream flow in the canyons that cut into the Pajarito Plateau. The major surface water drainages in the LANL area are illustrated in Figure 4-8. Perennial flow from the plateau area to the Rio Grande occurs only in the Rio de los Frijoles to the south of LANL and Santa Clara Creek to the north. Base flow throughout the year to the upper reaches of Guaje, Los Alamos, Pajarito, and Water canyons, and Canyon del Valle is provided by springs located at an elevation of 2400 to 2700 m (7900 to 8900 ft) on the slopes of the Sierra de los Valles. These springs discharge water from perched water sources in the Bandelier Tuff and Tschicoma Formation at annual rates ranging from 7 l/min to 530 l/min (2 gal/min to 140 gal/min). Only the western third of these canyons receive flow from these springs before the surface volume is depleted by evaporation, transpiration, and infiltration into the underlying alluvium.

Passing through or originating within LANL boundaries are 16 drainage areas covering a total area of 212 km^2 (52,500 acres) . Stream flow in these canyons is intermittent. Seasonal surface flow runoff from heavy thunderstorms or unusually heavy snow melt reaches the Rio Grande. The four major drainage canyons of the plateau (Pueblo, Los Alamos, Pajarito, and Water) have areas greater than 20 km^2 (5,000 acres). Ancho Canyon has 17 km^2 (4,200 acres); all of the rest have areas less than 10 km^2 (2,500 acres). Theoretical flood frequency and maximum discharge in 10 of the well-defined channels of the 16 drainage areas range from 1.1 m^3/sec for a two-year frequency, to 21 m^3/sec for a 50-year flood frequency (LANL 1991b).

Proposed RLWTF Project Area. The major surface water drainages in the proposed project area include the intermittent streams in Mortandad and Ten Site canyons (Figure 4-8). Run-off from heavy thunderstorms and spring snowmelt is the sole source of surface water in the proposed project area. These sources of water are insufficient to maintain year-round surface flow.

Industrial Outfalls/Wastewater Effluents–LANL Region. The industrial outfalls and wastewater effluents of the Pajarito Plateau originate from past and present LANL operations. All industrial outfalls and wastewater effluents in the plateau area are strictly regulated by federal, state and local regulations. According to the Annual Environmental Surveillance Report for 1991 (1993), 112 industrial outfalls and 10 sanitary wastewater treatment facilities are included in the LANL federal National Pollution Elimination Discharge System (NPDES) application. The types and total number of discharges (industrial and wastewater) in the LANL area have been compiled in the surveillance report.

At LANL, discharge points are referred to as the NPDES outfalls, and are managed under strict quality and quantity standards defined by the NPDES permits. The NPDES was established by the Clean Water Act (CWA) in an attempt to restore and maintain the integrity of the nation's waters by establishing specific chemical, physical, and biological limits for industrial, municipal, and agricultural discharges. The DOE has two such permits for LANL: one covering a hot dry rock geothermal facility located 50 km (30 mi) west of Los Alamos at Fenton Hill; the other covering the remainder of wastewater discharges at LANL. The permit covering wastewater discharges expired on March 1, 1991, but will remain in effect until the new permit (submitted on September 4, 1990) is approved by the EPA. In anticipation of permit approval, LANL is conducting an extensive outfall monitoring program according to conditions set forth in the most recent permit application.

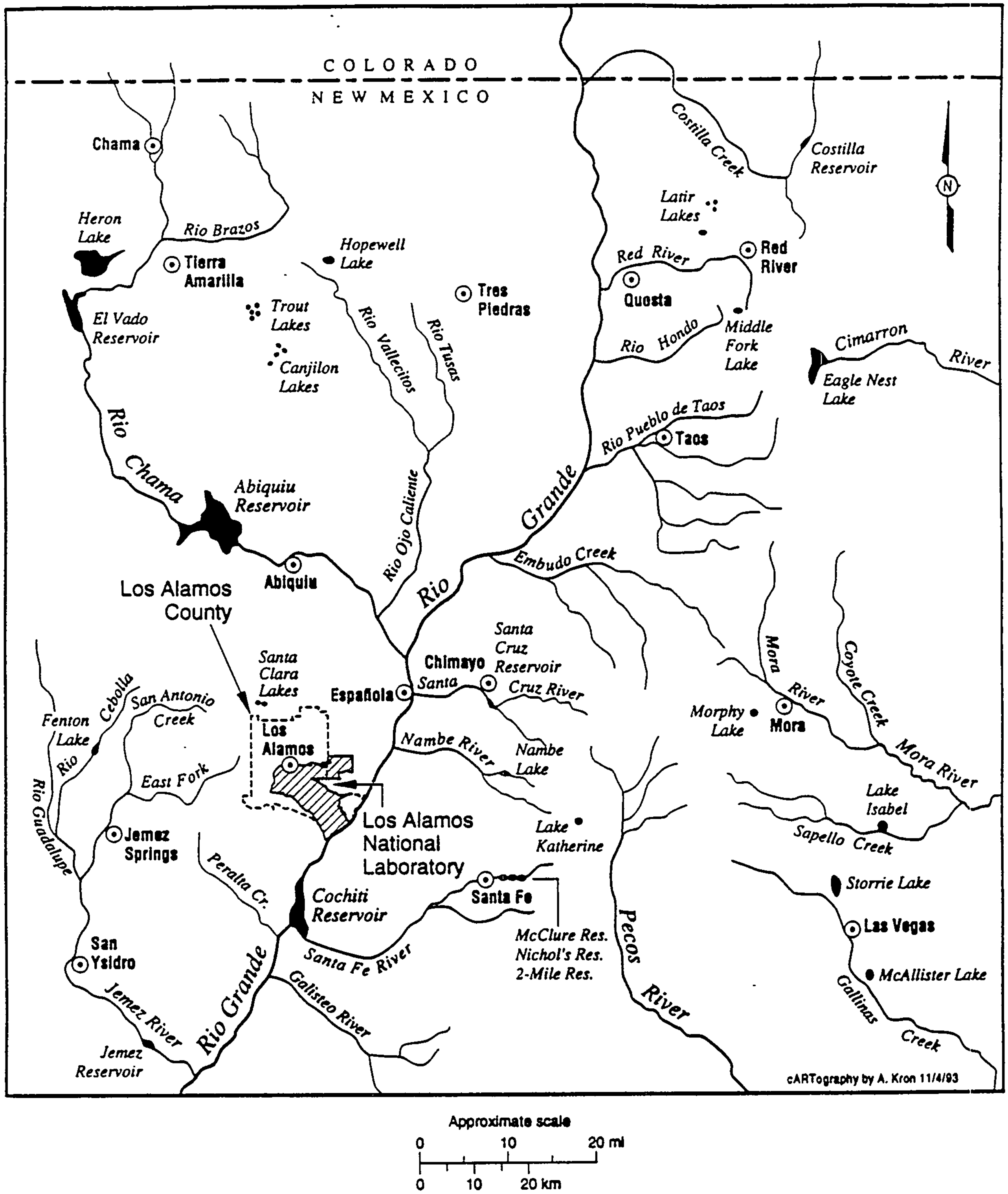


Figure 4-7
General distribution of surface waters in north-central New Mexico

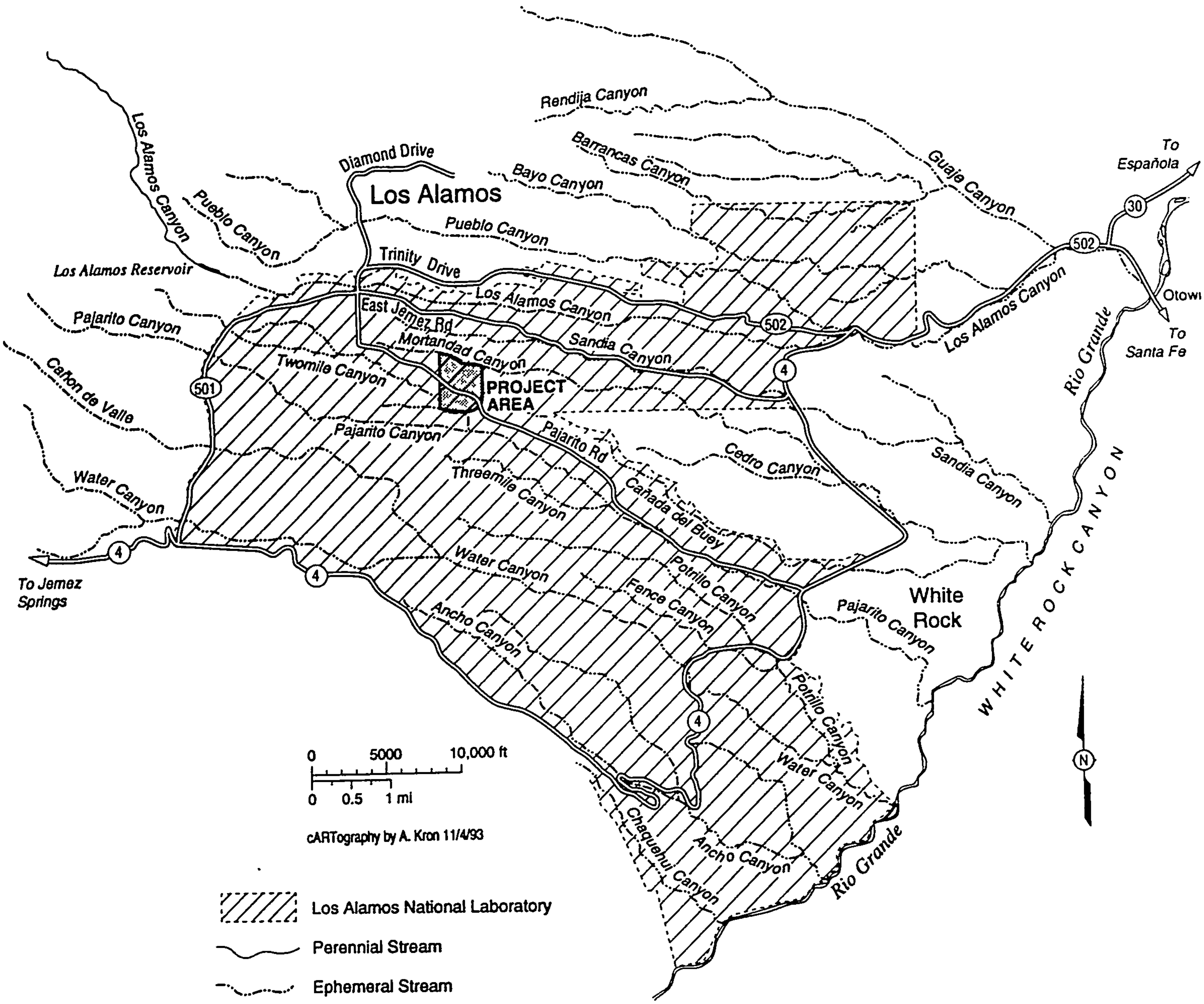


Figure 4-8
Location of major surface water drainages in the LANL area

Proposed RLWTF Project Area. Just north and west of the proposed project area, effluent from an the existing RLWTF and cooling-tower water are released to Mortandad Canyon, at rates sufficient to maintain flow for about 1.6 km (1 mi) downstream from the point of discharge. Most of this surface flow in Mortandad Canyon is lost to evapo-transpiration and infiltration into underlying alluvium.

4.1.4.2. Groundwaters

Regional groundwaters generally occur in three forms: waters in the shallow alluvium of area canyons; perched water reservoirs in alluvium and other subsurface geologic formations occurring above an impermeable strata; or waters in the zones of saturation in the region's main aquifers. The most significant volume of groundwater in the area occurs in the region's main aquifer (LANL 1991b).

LANL Region. The main aquifer in the LANL area is located beneath the entire Pajarito Plateau and the Rio Grande Valley within the Tesuque Formation. The depth of the main aquifer from the surface of the plateau mesa tops ranges from about 360 m (1200 ft) along the western margin of the plateau to about 180 m (600 ft) along the eastern part of the plateau. The potable water layer in the aquifer is estimated to be at least 1200 m (3900 ft) thick. Along the western edge of the plateau, the hydraulic gradient of the aquifer averages about 11 m/km (60 ft/mi) but increases to about 20 m/km (100 ft/mi) as the water enters less permeable sediments along the eastern edge of the plateau. The aquifer moves toward the Rio Grande at an average rate of about 0.3 m/day (1 ft/day) where portions are discharged into the river through multiple springs and seepages. The section of the Rio Grande from the Otowi Bridge through White Rock Canyon (18.4 km [11.5 mi]) receives an estimated 5.3 to 6.8 x 10^6 m^3 (4,300 to 5,500 acre-ft) of aquifer water annually. The majority of aquifer recharge comes from the Valles Caldera area, which is composed of highly permeably sediments and conglomerates (LANL 1991b).

Proposed RLWTF Project Area. The proposed RLWTF project area overlies approximately 290 m (950 ft) of hydrologically unsaturated volcanic tuff, sediments, and basalt of the Bandelier Tuff, the Puye Formation, and the Cerros del Rio basalt. Numerous investigations to characterize the hydrology of the upper 30.5 m (100 ft) of the Bandelier Tuff have been conducted in the LANL area since 1950. Investigations in the TA-50 area indicate that this tuff layer is unsaturated. An associated groundwater monitoring field (the Pajarito Well Field) has monitoring wells ranging in depth from about 701 m to 945 m (2,300 ft to 3,100 ft), with groundwater occurring from about 229 m (750 ft) to more than 366 m (1,200 ft) (LANL 1990b).

4.2 Biological Resources

The information in this section is a summary of a Biological Information Document prepared in support of the proposed RLWTF project (LANL 1993b).

4.2.1. Vegetation

4.2.1.1 LANL Region

New Mexico's semiarid environments support a diversity of plant communities ranging from Chihuahuan desert scrub to alpine tundra. The distribution of these communities in north-central New Mexico is in large part determined by elevation. Table E-1 in Appendix E lists the climatic zones and plant communities found in north-central New Mexico with typical plant species of each. Many of these plant communities are found on the Pajarito Plateau.

In addition to these communities, numerous wetland (riparian) plant communities occur in the uplands. The streams in most of the canyons in and adjacent to Los Alamos County are ephemeral (flowing for only part of the year) and are therefore not considered wetlands. However, permanent flow from springs and LANL facilities results in a small number of permanent or near-permanent streams along or within short stretches of certain canyons.

The lowest elevations near Los Alamos County along the Rio Grande flood plain (about 1524 m [5000 ft] above sea level) support Plains and Great Basin Riparian-Deciduous Forest. This vegetation type is characterized by cottonwood and willow stands and non-native species such as salt cedar and Russian olive.

Above the Rio Grande flood plain at elevations ranging from about 1700-1890 m (5600-6200 ft), juniper becomes the most common overstory species, often intermixed with lesser amounts of piñon pine. Piñon pine and juniper dominate in an open woodland at elevations of 1890-2100 m (6200-6900 ft). Most of the mesa tops are covered with a piñon-juniper woodland. Westward toward the Jemez Mountains, as the elevation increases, this woodland community eventually intergrades into plant communities where overstory species of the Rocky Mountain Montane Conifer Forest are dominant. Ponderosa pine is a common species at about 2103 -2286 m (6900 -7500 ft) on the higher mesa tops and along many of the north-facing canyon slopes. Several species of fir can be found along the north-facing slopes at intermediate elevations, where they intermix with ponderosa pine to form a mixed-conifer community. Species of the Rocky Mountain Subalpine Conifer Forest and Woodland occur along the extreme western edge of the county and are more prevalent at the higher elevations of the nearby Jemez Mountains.

4.2.1.2 Proposed RLWTF Project Area

The proposed RLWTF project area is characterized by two types of terrain, mesa top and canyon, each containing unique vegetative components. The alternative TA-35 site is located in Mortandad Canyon where the habitats are classified according to slope and canyon bottom. The proposed TA-63 site has a vegetation component different from the associated canyon bottoms.

Two primary vegetation communities are associated with the terrain features present in the proposed RLWTF project area: the Rocky Mountain Montane Conifer Forest and the Great Basin Conifer Woodland. This area includes influences of two riparian communities: the Rocky Mountain Riparian-Deciduous Forest and Rocky Mountain Montane Marshland. A breakdown of the general habitats is given below.

- Great Basin Conifer Woodland Community. This community consists mostly of piñon pine and juniper trees and can be further broken into a Piñon-Juniper series and Piñon/Wavyleaf Oak Habitat Type.

- Rocky Mountain Montane Conifer Forest Community. This community consists of species of a mixed conifer forest and can be broken down into a Douglas Fir Series, Ponderosa Pine Series, Douglas Fir/Gambel Oak Habitat Type, and a Ponderosa Pine/Gambel Oak Habitat Type.

- Rocky Mountain Riparian-Deciduous Forest Community with patches of a Rocky Mountain Montane Marshland Community.

Two series of the Rocky Mountain Montane Conifer Forest, ponderosa pine and Douglas fir were prevalent on north-facing slopes and canyon rims. A series refers to the principal plant and animal communities within each of the biotic communities and is based on distinctive climate dominant plants. Two habitat types were present within these series, the ponderosa pine-Gambel oak and the Douglas fir-Gambel oak. A habitat type is based on the occurrence of particular dominant species that are local or regional in distribution. Series and habitat types for the riparian vegetation are not well-defined, therefore no attempt is made here to classify these. These wetlands are present as a result of LANL outfalls.

The Great Basin Conifer Woodland community is found on the mesa top in the proposed RLWTF project area. It is represented by the piñon-juniper series, which is further broken down into the Colorado piñon-wavy leaf oak habitat type on the mesa tops and south-facing slopes.

The proposed TA-63 site is located on a mesa top devoid of overstory species because of disturbance. It is dominated by a mixture of grasses, forbs, scattered low-growing shrubs, and a large percentage of bare dirt and organic liter. Mesa top vegetation immediately adjacent to the site consists of a combination of piñon pine, juniper, and ponderosa pine.

The alternative TA-35 site includes portions of north-facing slopes, south-facing slopes, and canyon bottoms from Mortandad Canyon, Ten Site Canyon, and upper Cañada del Buey. Vegetation characteristics for the alternative site have similar habitat characteristics as the proposed site and surrounding area. Vegetation data are discussed below for all areas within the proposed alternative TA-35 site except the north-facing slopes of Mortandad Canyon and the south-facing slopes of Ten Site Canyon.

Canyon Bottoms. In the Mortandad Canyon bottom, the vegetation has been characterized below and above the industrial outfall associated with the existing TA-50 RLWTF (section 2.1.1.4). Below the outfall, ponderosa pine, limber pine, and Douglas fir are common overstory species. Shrubs include barberry, cliffbush, and oak, with common understory species of sedge, mountain muhly, and Virginia creeper. Above the outfall, Ponderosa pine and Douglas fir are common overstory species; mountain mahogany, Gambel oak, and cattail are common shrubs. Understory species include redtop, little bluestem, and mountain muhly.

Vegetation characteristics of the lower portions of the riparian area within Mortandad Canyon include an area dominated by large Ponderosa pine trees. Stream banks are dominated by box maple and box elder, but also include scattered oaks. The canopy cover within the canyon bottom ranges from 5% to 95%, with a greater density of canopy cover occurring in the upper portions of the canyon. Below the riparian area of Mortandad Canyon, piñon pine, one-seed juniper, and oak are the dominant species.

The canyon bottom of Ten Site Canyon is dominated by ponderosa pine with Russian olive occurring along the dry stream channel. Willow and Gambel oak are the most common shrub, with infrequent occurrences of mountain mahogany. Upper Cañada del Buey is dominated by ponderosa pine but includes an occasional juniper and Douglas fir. The dominant shrub in the area is choke cherry, with fewer occurrences of oak, skunkbush sumac, currant, and barberry. Mutton grass is the dominant undercover species in most areas of upper Cañada del Buey. Other common species include mountain muhly, western virgin's bower, horseweed, and redtop. Meadow rue and sedge are common in some locations.

North-facing Slopes. The north-facing slopes of Ten Site Canyon are dominated by Douglas fir and ponderosa pine. Common shrubs include gambel oak and mountain mahogany. ponderosa pine is the dominant overstory species along the north-facing slopes of Cañada del Buey; however, the area also includes one-seed juniper and piñon pine. The understory of the north-facing slopes of upper Cañada del Buey is dominated by mountain muhly and sedge.

South-facing Slopes. Ponderosa pine, Douglas fir, one-seed juniper, and piñon pine are common overstory species on the south-facing slopes of Mortandad Canyon. Low amounts of gambel oak, rose, and mountain mahogany are also present. The understory is generally considered sparse. One-seed juniper and piñon pine are dominant along the base of the south-facing cliff face of Cañada del Buey, with lesser occurrences of ponderosa pine. Ponderosa pine is the most common overstory species at the base of the south-facing slopes near the canyon bottom, and mountain mahogany is the dominant shrub. Although blue grama grass occurs in small amounts on the north-facing slopes, it is the dominant understory species on the south-facing slopes of Cañada del Buey.

4.2.2 Wildlife

The wide range of plant communities in the Los Alamos County area create a wide range of micro- and macro-habitats. This diversity results in a relatively wide range of wildlife species. Table 4-1 illustrates, in a general way, a theoretical food web that includes several layers of plant and animal species.

Information on wildlife communities has been collected at several locations within the previously discussed canyons and mesa tops. Site-specific studies on wildlife species are limited in the vicinity of the proposed project. However, extensive studies on birds, small mammals, and some large mammals, have been conducted in other portions of Mortandad Canyon and Cañada del Buey.

4.2.2.1 Invertebrates

Localized surveys for terrestrial and aquatic invertebrates have been conducted on DOE land and at Bandelier National Monument. In addition, the results of an extensive study conducted at Bandelier, directly south of DOE land, are included here. Few studies on aquatic invertebrates have been conducted in Los Alamos County. Currently, a study is under way to collect and identify aquatic insects within and adjacent to DOE property. To date, 33 families have been collected in the county.

Birds--LANL Region. Birds have been determined to be the most diverse group of wildlife in the LANL area. The diversity includes a variety of nesting and migrating raptors that occupy some of the less disturbed and less accessible areas of LANL. There are more than 200 bird species and at least 112 species of breeding birds in the county. Of the breeding birds, 39 are resident species and 59 are migratory summer residents (Travis 1992).

Proposed RLWTF Project Area. Several studies on birds have been conducted in and around Cañada del Buey as part of the biological surveys required for the Sanitary Waste System Consolidation facility project. In 1990, a bird transect was established along a section of Mortandad Canyon extending from the upper to the lower portions of the canyon. A total of 43 species of birds were identified throughout the area. Nineteen species were identified in the mixed conifer-habitat along the upper part of the transect, 29 in the piñon/juniper habitat within the lower canyon, and 31 in the Ponderosa pine habitat in mid-canyon. Table E-5 in Appendix E provides a listing of all bird species recorded in Cañada del Buey during this 1990 area survey. Because of the normal foraging and breeding ranges for the birds identified during this survey, the same species are expected to occur in Mortandad and Ten Site canyons. Additional species may occur in Mortandad Canyon due to the existing outfall water source.

Terrestrial Invertebrates--LANL Region. Four species of terrestrial mollusks have been identified on DOE property within canyons near the Rio Grande. To date, there have been at least 57 different families of terrestrial insects identified on DOE property.

Table 4-1
A Theoretical General Food Web of the Common Plants and Animals of the Los Alamos County Region

Group	Juniper-Grassland	Piñon-Juniper	Riparian Canyons	Ponderosa Pine	Mixed Conifer
Producers	Juniper Saltbush Ponderosa pine Prickly pear Feathergrass Dropseed Three-awn	Piñon pine Juniper Rabbitbrush Apache plume Mountain mahogany Blue grama	Cottonwood Currant Hoptree Box elder Sedge Bluegrass Bluestem	Ponderosa pine Gambel oak Skunkbush Mountain muhly	Douglas fir Ponderosa pine Aspen White fir
Primary Consumers	Deer mouse Piñon mouse Cottontail Woodrat	Deer mouse Piñon mouse Cottontail Woodrat Mule deer	Harvest mouse Meadow vole Cottontail Chipmunk Mule deer Elk	Deer mouse Chipmunk Squirrel Woodrat Mule deer Elk	Pocket gopher Montane vole Chipmunk Woodrat Mule deer Elk Bluebird Junco
Secondary Consumers	Coyote Gray fox Bobcat Scrub jay Piñon jay Rattlesnake	Coyote Gray fox Bobcat Steller's jay Piñon jay Spiny lizard	Coyote Racoon Bobcat Steller's jay Common raven Golden eagle Gopher snake	Mountain lion Black bear Bobcat Pygmy nuthatch Common flicker Pygmy nuthatch Common raven	Mountain lion Black bear Green-tailed towhee Clark's nutcracker Hairy wood-pecker Gopher snake

Source: DOE 1979

Proposed RLWTF Project Area. Several studies have been conducted on terrestrial invertebrates in the general project area and in locations adjacent to the area. Table E-2 in Appendix E provides information that has been compiled on groups of insects in the general project area.

4.2.2.2 Vertebrates

Fish. No fish have been found on DOE property. However, fish have been observed in Guaje Reservoir and below Guaje Reservoir, Los Alamos Canyon Reservoir, and at the confluence of

White Rock Canyon and the Rio Grande (below Ancho Springs). Fish are not expected to inhabit the water sources in the project area.

In 1988, 1991, and 1992, piñon-juniper mesa top habitats throughout LANL, including several around Cañada del Buey, were surveyed for birds found; Table E-4 in Appendix E lists bird species LANL biologists have assumed that these species would currently be present in mesa top habitat near Mortandad Canyon.

Reptiles and Amphibians--LANL Region. A variety of reptiles are common throughout much of Los Alamos County and include at least 14 species of skinks, lizards, and snakes. The presence of wetlands adds additional habitat for water-associated species. At least seven species of amphibians are found in the county.

Proposed RLWTF Project Area. Because of the presence of a stream channel and pools, amphibians are expected to occur in Mortandad Canyon. However, no recent surveys of amphibians or reptiles have been conducted.in that area.

Earlier trapping sessions conducted by Los Alamos Scientific Laboratory in 1978 and 1979 verified the presence in Mortandad Canyon of three reptile species and two amphibian species: the coachwhip snake, gopher snake, eastern fence lizard, Woodhouse toad, and southern spadefoot. During the same survey, the short-horned lizard, plateau striped whiptail, prairie rattlesnake, eastern fence lizard, and the Woodhouse toad were identified in Cañada del Buey.

Mammals--LANL Region. In this area, at least 29 species of small mammals occur, some of which are restricted to certain elevational ranges. Deer mice, woodrats, and least chipmunks are widely distributed throughout the region. Piñon mice are found primarily in piñon-juniper woodlands, the red-backed vole lives in higher elevations, and the western harvest mouse and long-tailed voles prefer moist canyon bottoms. Shrews are found in habitats associated with flowing.water. At least 13 species of bats are also present within the DOE boundaries.

Mule deer and elk are the best known of the larger mammals of the region, although their populations and distributions are constantly changing. These species generally winter in the lower elevations of the Pajarito Plateau, including many of the mesas and canyons along the central and eastern portions of the county and surrounding areas. Most of these species spend their summers at higher elevations in the Jemez Mountains. However, recent surveys in the Los Alamos County area indicate that growing numbers of large mammals are residing year-round at lower elevations.

Little is known about other large and medium-size mammals of the area. However, based on observations and current studies, at least 12 species of carnivores are present, including bear, mountain lion, bobcat, fox, and coyote.

Proposed RLWTF Project Area. Mammal surveys have been conducted in Mortandad Canyon and Cañada del Buey. Studies to determine use by large and medium-size mammals has also taken place in Cañada del Buey. Results of these studies are summarized below.

Small Mammals

- Brush mice and deer mice were the most commonly captured species during trapping sessions in Cañada del Buey. A density for brush mice was estimated between 13-36 animals per hectare and an estimated population size for all nocturnal rodents in the trapping session was 54 to 65 animals.

- In July 1991 and June 1992, several small mammal species were captured during LANL trapping sessions along an estimated 2.4 km (1.5 mi) transect in Cañada del Buey below the proposed Sanitary Waste System Consolidation facility. The following small mammal species were identified during the surveys: least chipmunk; Colorado chipmunk; white-throated woodrat; Mexican woodrat; brush mouse; harvester mouse; deer mouse; rock squirrel; and long-tailed vole.

- A 1986 survey conducted in Cañada del Buey and on Mesita del Buey indicated that a greater number of small mammals were captured in the canyon itself, with deer mice and chipmunks among the most common species identified. Although no specific habitat descriptions are available for this survey, it is likely that the chipmunks and deer, brush, and piñon mice were trapped in the rocky habitat along the canyon walls; the voles and harvest mice were trapped in the more mesic habitat in the canyon bottom. A greater number of piñon mice were also caught on the mesa top in the piñon-juniper woodland habitat, which is more characteristic of this species. The Northern pocket gopher was also present in the canyon bottom of Cañada del Buey. Table E-5 in Appendix E shows results of survey trapping conducted in Cañada del Buey and on Mesita del Buey in 1986.

- In 1990, a survey was conducted on Mesita del Buey in a habitat similar to the habitat identified on the mesa top at the proposed RLWTF site. Chipmunks were the only diurnal small mammals captured frequently enough to evaluate population size and density. However, the capture rate was not high enough to validate population dynamics through more detailed modeling.

- Surveys to obtain small mammal species diversity information were conducted in 1992 above and below the outfall in Mortandad Canyon. Table E-6 in Appendix E lists the species captured during these trapping sessions.

Two previous surveys in 1974 and 1986 also live-trapped small mammals along the mesa tops and between the canyons in the Mortandad Canyon/Ten Site Canyon area. In addition to most of the species listed above, the piñon mouse, harvest mouse, plains pocket mouse, rock pocket mouse, and a shrew species were identified.

Large Mammals

Most of the information collected for large mammals includes only deer and elk. Large mammal pellet/scat transects and circular plots have been established in Cañada del Buey to collect data on the large mammals using the canyon area. Data analysis from transect surveys revealed 141 deer pellet groups per hectare on circular plots, and 90 per hectare along transects. Six-hundred-five elk pellet groups per hectare were found on circular plots and 590 pellet groups on transects. Additional species recorded in this area based on scat counts and identification include bear, coyote, and fox.

4.2.3 Threatened, Endangered, and Sensitive Species

A total of 44 species of plants and animals listed by the state and/or federal government as threatened, endangered, or sensitive are known to occur in or could potentially occur in Los Alamos County. (A determination of potential occurrence is based on the presence of the species' preferred habitats within or near Los Alamos County or on confirmed observation of the species at locations adjacent to the county such as Bandelier National Monument.). A database developed by LANL's Biological Resource Evaluation Team was used to determine potentially occurring threatened, endangered, and sensitive species based on habitat evaluations. Table E-7 in Appendix E lists all federal- and state-listed species known to occur or potentially occur in the county along with their status and preferred habitat.

4.2.3.1 Plants

State Listed. Six endangered and 16 sensitive plant species are listed by the state of New Mexico as occurring or potentially occurring in Los Alamos County. Those known to occur in Los Alamos county include grama grass cactus, checker and wood lilies, and helleborine orchid. The following sensitive species, three of which are also listed as state threatened or endangered, could occur in habitats similar to that found in the proposed RLWTF project area.

Sessile-flowered false carrot (*Aletes sessiliflorus*)
Threadleaf horsebrush (*Tetradymia filifolia*)
Plank's catchfly (*Silene plankii*)
Santa Fe milkvetch (*Astragalus feensis*)
Mathew's wooly milkvetch (*Astragalus mollissimus*)
Taos milkvetch (*Astragalus puniceus*)
Cyanic milk-vetch (*Astragalus cyaneus*)
Tufted Sand Verbena (*Abronia bigelovii*)
Pagosa phlox (*Phlox caryophylla*)
Checker lily (*Fritillaria atropurpurea*)
Sandia alumroot (*Heuchera pulchella*)

Federally Listed. Two state-endangered species, the Santa Fe cholla and the grama grass cactus, are also listed by the federal government and may be considered for federal protection in the future. No federal endangered or threatened plant species were listed as potentially occurring in the project area. However, the following five federal candidate plant species meet the habitat search criteria for potential occurrence in the proposed RLWTF project area:

Wright fishhook cactus (*Mammillaria wrightii*)
Santa Fe cholla (*Opuntia viridiflora*)
Grama grass cactus (*Toumeya papyracantha*)
Wood lily (*Lilium philadelphicum var. andium*)
Helleborine orchid (*Epipactis gigantea*

4.2.3.2 Wildlife

State Listed. The state of New Mexico lists 22 animal species occurring or potentially occurring in Los Alamos County. Seven species are known to occur within the county, including the Jemez Mountains salamander, the bald eagle (along the Rio Grande), the peregrine falcon, the whooping crane (along the Rio Grande), the broad-billed hummingbird, and the meadow jumping mouse.

The following wildlife species, listed as endangered or threatened in the state of New Mexico, met the 1988 New Mexico Department of Game and Fish search criteria within and around the proposed project area.

Broad-Billed Hummingbird (*Cyanthus latirostris*)
Common Black Hawk (*Buteogallus anthracinus*)
Mississippi Kite (*Ictinia mississippiensis*)
Spotted Bat (*Euderma maculatum*)
Bald eagle (*Haliaeetus leucocephalus*)

Peregrine falcon (*Falco peregrinus*)
Willow flycatcher (*Empidonax trailii*)
Say's Pond Snail (*Lymnaea captera*)
Meadow Jumping Mouse (*Zapus hudsonius)*

The Migratory Bird Treaty Act (16 USC 703-711) provides federal protection for all wild birds except resident game birds, English sparrows, starlings, and feral pigeons. The Bald Eagle Protection Act provides additional protection to eagles, including the golden eagle. These species are protected from being collected and maimed and from having their nests disturbed.

Federally Listed. The bald eagle, peregrine falcon, and whooping crane are listed as endangered by the federal government. In addition, the following species are under review for listing or are candidates for listing. The northern goshawk has not been listed by the state but is being considered for listing by the federal government.

Willow flycatcher (*Empidonax trailii*)
Spotted bat (*Euderma maculatum*)
Meadow Jumping Mouse (*Zapus hudsonius*)
Northern goshawk (*Accipiter gentilis*)
Bald Eagle (*Haliaeetus leucocephalus*)
Peregrine falcon (*Falco peregrinus*)
Mexican spotted owl (*Strix occidentalis lucida*)

The results of a field habitat evaluation suggests that the habitat elements needed for sensitive and endangered species are not present in the proposed (and alternative) project site. Therefore, the species listed above, are not likely to appear in the project area.

Species Dismissed from Further Consideration. Based on the information gained from field surveys and previous data, LANL's Biological Resources Evaluation Team has concluded that the following plant and wildlife species are not expected to occur in the proposed or alternative RLWTF project sites. None of the following species has been previously recorded in the general project area, and because of the low potential for occurrence within this site, they are being dismissed from further consideration:

Plant species

Grama grass cactus
Mathew's woolly milkvetch
Pagosa phlox
Plank's catchfly
Santa Fe Cholla
Taos milkvetch
Cyanic milkvetch
Santa Fe milkvetch
Sessile-flowered false carrot
Threadleaf horsebrush
Tufted sand verbena

Wildlife species

Bald Eagle
Willow flycatcher
Common Black Hawk
Mississippi Kite
Meadow jumping mouse
Broad-billed Hummingbird
Say's pond snail
Mexican spotted owl
Northern goshawk
Wright fishhook cactus

Habitat requirements for the spotted bat and peregrine falcon were found to exist in the RLWTF project area, and a further evaluation of their possible presence was made. Based on subsequent study, the following conclusions were reached:

- The peregrine falcon (*Falco peregrinus*) has little probability of occurring in the project area. They do, however, migrate through New Mexico and winter statewide. Peregrines occupy steep cliffs in wooded or forested habitats; breeding territories center on cliffs. Peregrine falcons have been observed in and near Pueblo Canyon and have been recorded as nesting along the cliffs of this canyon. In 1992, several locations in Los Alamos County were examined by a peregrine falcon expert, who concluded that the peregrine will not use Mortandad or Ten Site canyons for nesting. Potential is modeerate to high for its re-occurrence in Pueblo Canyon, and from there, it may use the proposed RLWTF project area as feeding grounds.

- The spotted bat (*Euderma maculatum*) is a state-endangered species found in piñon-juniper, ponderosa, mixed-conifer, and riparian habitats. This species requires a source of water with standing pools and roost sites such as caves in cliffs or rock crevices. Suitable roosts sites are present along the cliff faces of the canyons. However, open water sources are somewhat limited and include a narrow flowing stream. Mist net surveys on LANL land were conducted for this species. No spotted bats were captured. In addition, surveys conducted in lower Pajarito Canyon in 1992 (more suitable habitat) resulted in no captures.

4.2.4 Unique/Sensitive Habitats

Large Mammal Travel Corridors—LANL Region. LANL is located within a transitional area for wintering elk and deer. Herds of these animals move down on to LANL property during the winter months as snow becomes deep at the higher elevations of the Jemez Mountains. Figure 4-9 indicates the wintering deer and elk patterns for the LANL region. These animals are probably widely distributed because of increasing populations, and additional travel corridors have probably been established throughout DOE property. In addition, small herds of these species are now residing year-round on LANL property. Fawning and calving grounds for deer and elk are also expected to be more widely distributed as population increases over time. Additional intensive studies will be necessary to identify these fawning and calving areas.

Breeding/Nesting Areas. A survey of breeding birds of Los Alamos County prepared in 1992 (Travis 1992) indicates that many of the less disturbed mesas and canyons support breeding birds. Breeding birds also utilize some disturbed areas. The combination of steep canyons and coniferous forests provides suitable nesting sites for a variety of bird species throughout the region.

Foraging/Hunting Areas. Those habitats supporting a relatively high diversity and density of prey species can be expected to support greater densities and diversities of predator species. Areas used heavily by elk and deer (Figure 4-9) may also have high densities of predators that feed on these animals. However, it should be kept in mind that there have been significant changes in distribution of elk and deer since studies of these populations were completed. High-use areas such as wetlands can be expected to support relatively greater densities and diversities of wildlife species than other areas. Additional intensive studies will be necessary to more accurately identify sensitive foraging and hunting areas for all groups of wildlife species in the area.

Water Sources. Frijoles Creek in Bandelier National Monument is the only perennial flowing stream in the LANL area. Ephemeral streams flow in many of the numerous canyons that dissect the Pajarito Plateau, including all of the major canyon systems at LANL. Parts of some of these canyons are fed by LANL facility outfalls or other artificial sources of water. These artificial sources receive relatively high amounts of use by a variety of wildlife species. Intermittent flows also provide water during certain times of the year for species such as amphibians and migratory animals.

Flood Plains and Wetlands. Water flows—either natural or artificial—surface for a short distance in Pajarito, Guaje, Los Alamos, and Water canyons. Other canyons (Bayo, Pueblo, Sandia, Mortandad,

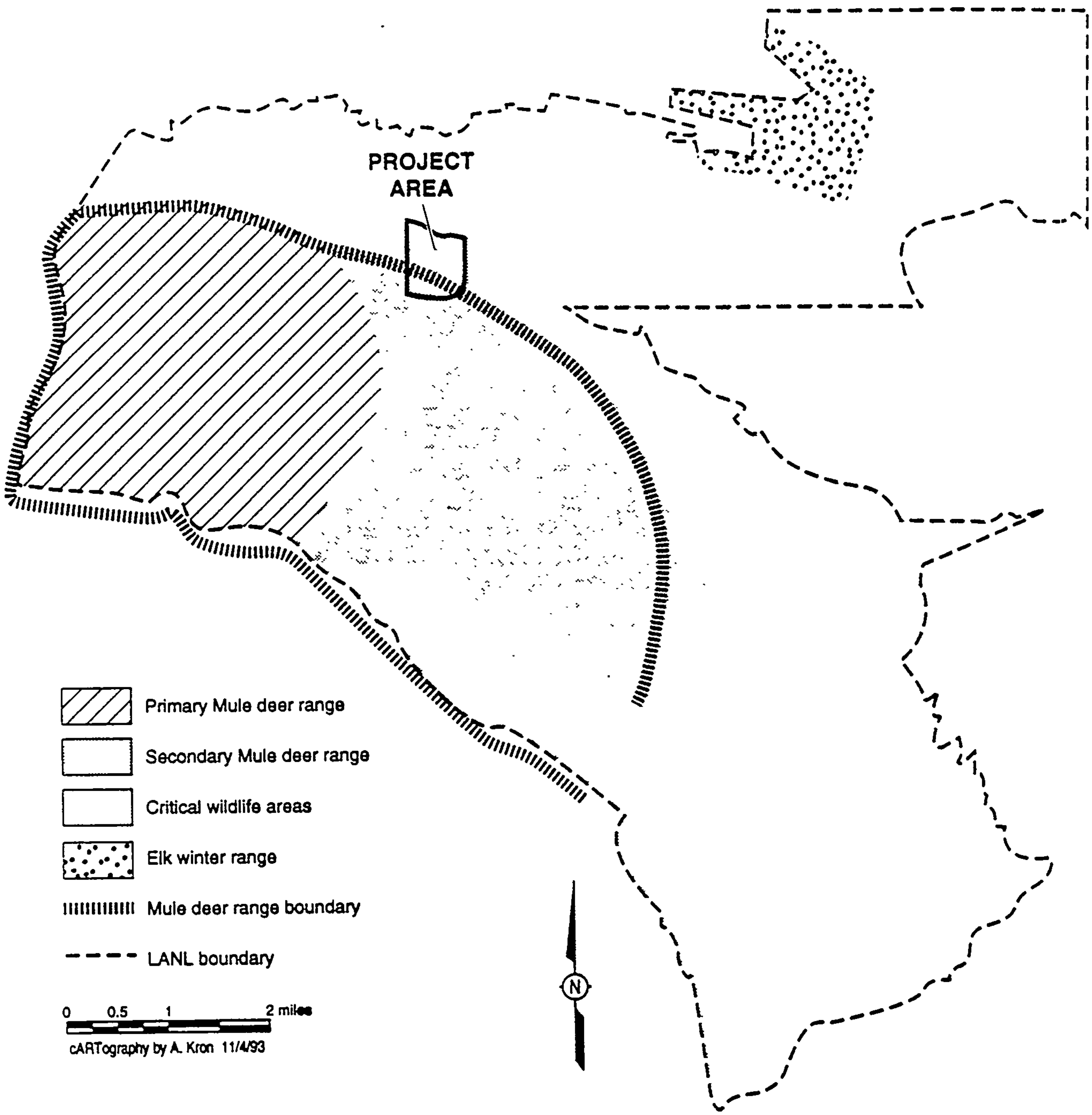


Figure 4-9
Wintering deer and elk patterns in LANL region

Cañada del Buey, Potrillo, Fence, Indio, Ancho, and Chaquehui) support ephemeral streams as a result of snowmelt or periods of heavy precipitation. Several springs are found in Guaje Canyon, upper Los Alamos Canyon, Pajarito Canyon, Water Canyon, and Canyon del Valle.

The National Wetlands Inventory maps identify two general types of wetlands within Los Alamos County. Riverine systems are contained within a channel. Palustrine systems include ponds, marshes, bogs and other non-tidal wetlands. The lower portion of Pajarito Canyon, near the intersection of Pajarito Canyon and State Road 4, is classified as a palustrine wetland. Frijoles Canyon, outside of the county, is considered to contain a riverine system. The major canyons within DOE property all contain flood plains within the canyon bottoms.

Proposed RLWTF Project Area. In the general project area, existence of all wetlands and flood plain have been verified. National Wetland Inventory maps were field checked, and wetlands, flood plain, and riparian area characteristics were noted using criteria outlined in the Federal Manual for Delineation for Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation 1989).

Both wetlands and flood plain exist in the project area. In addition to the outfall in Mortandad Canyon, sewage disposal ponds in Mortandad-Ten Site Canyon appear on the National Wetlands Inventory Maps as artificially and permanently flooded wetlands. The canyon bottom conveys both perennial and intermittent flows in Mortandad-Ten Site Canyon. Upper Mortandad Canyon is subject to perennial sewage effluent discharge.

The Biological Resource Evaluation Team at LANL did not delineate wetland boundaries during these surveys. These boundaries are valid for only two years and are best determined by teams just before sampling. This ensures that the work will not occur within areas meeting wetland criteria. Figure 4-10 indicates the location of wetlands in the vicinity and downstream of the project area as defined by the National Wetland Inventory. Table E-8 in Appendix E lists the wetland codes referenced in Figure 4-10.

4.3 Human Environment

4.3.1 LANL and Its Workers

4.3.1.1 Land Use and Population

LANL Area. All LANL activities take place within DOE-owned land, which comprises 111 km^2 (43 mi^2). LANL land comprises 40% of the Los Alamos County land. The land is managed primarily as a research and development (R&D) laboratory. A large number of buildings, outdoor experimental areas, waste disposal sites, and utility corridors occupy the mesa tops as well as canyon bottoms. Much of the DOE land is undeveloped, providing relative isolation and security for LANL facilities.

LANL is divided into 50 TAs, as shown in Figure 4-11. The DOE controls the area within the LANL boundaries and has the option to completely restrict access. The majority of the land within the borders of DOE property is used for LANL R&D and associated activities (i.e., waste management, environmental monitoring, and administration). A number of activities that take place at LANL involve hazardous and/or radioactive materials and explosives. Much of the land within DOE borders serves as a buffer for public safety and security. The on-site population at LANL is approximately 12,600 people. This includes direct LANL employees and contractors.

Proposed RLWTF Project Area. The proposed RLWTF project area includes TA-35, TA-50, and TA-63 (Figure 4-2). The proposed action and Alternatives 1 and 2 are associated with

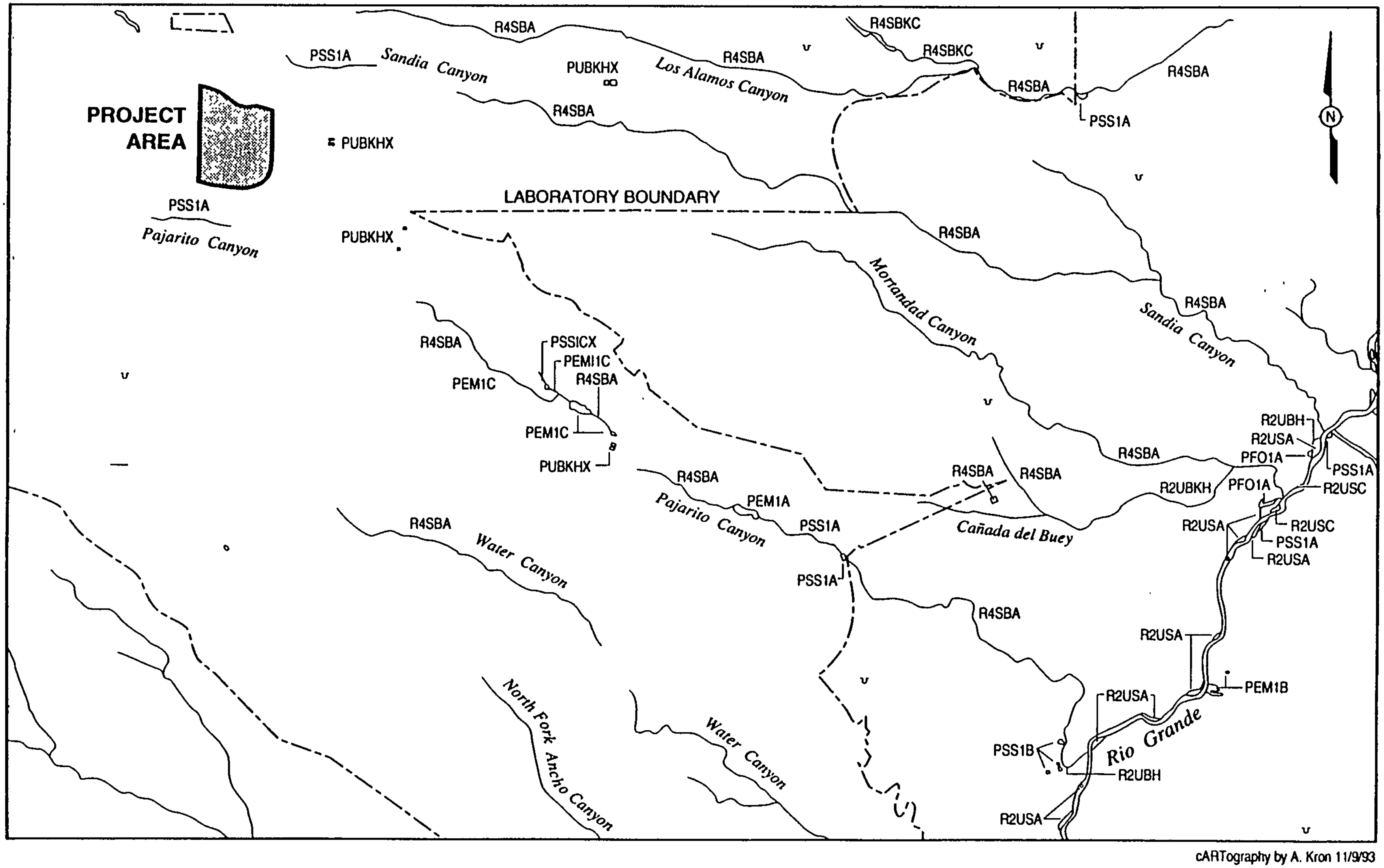


Figure 4-10
Locations of wetlands in the vicinity and downstream of the project area as defined by the National Wetland Inventory

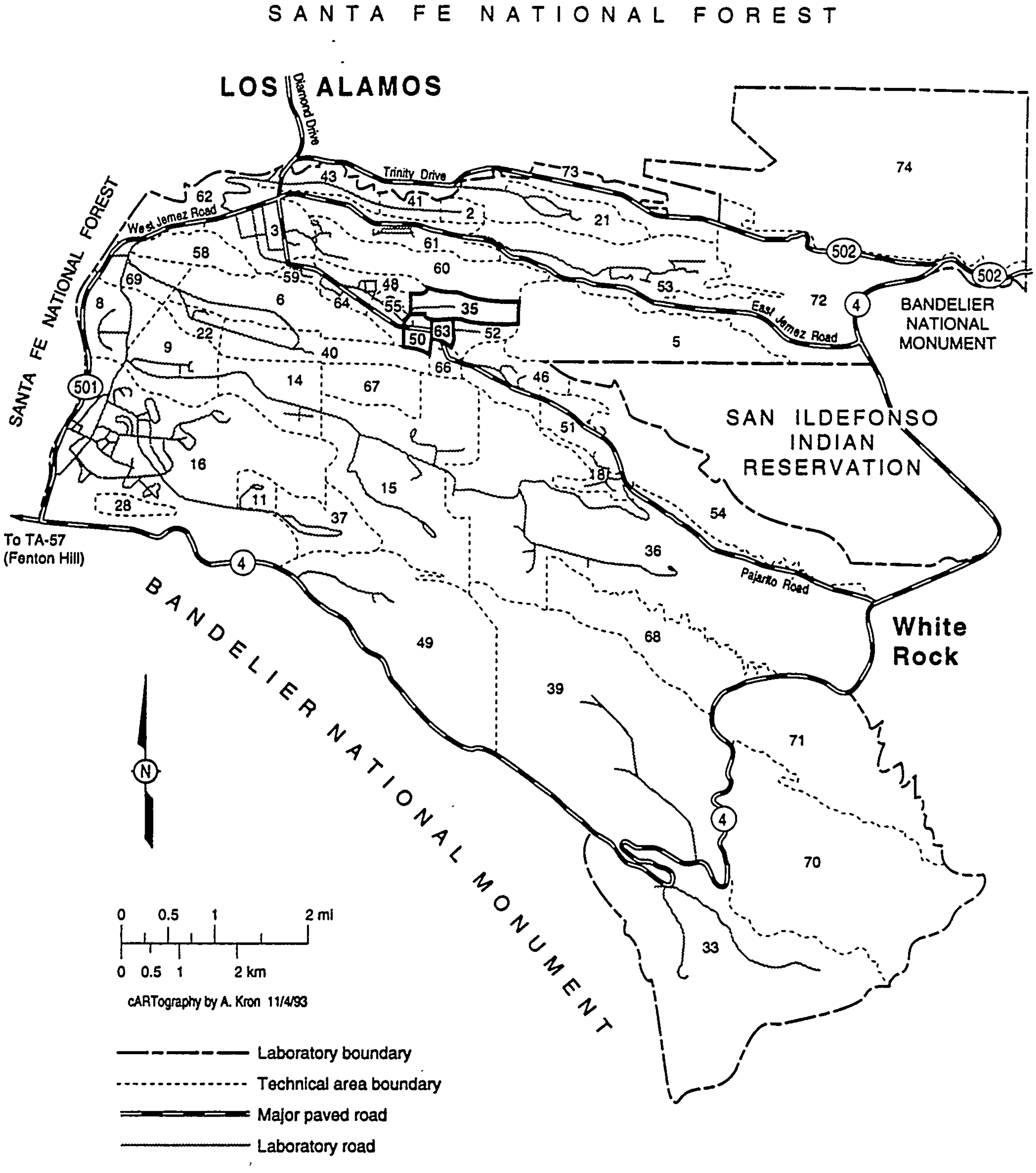


Figure 4-11
Map of Los Alamos National Laboratory showing technical areas and surrounding landholdings

Table 4-2
Summary of Land Use in Los Alamos County

Land Use Category	Area (km^2)	% Total Urbanized Area
Residential	7.0	45
Commercial	0.3	2
Industrial[a]	0.5	3
Government	5.1	33
Streets and Rights of Way	2.7	17
Developable Vacant Open Space and Undevelopable Vacant Land	14.8	--
TOTAL[b]	35.2	

a Includes transportation, communication, and utilities.
b Data covers land under Los Alamos County Government dominion and excludes most, but not all, federally owned land.

Source: DOE 1979

construction and/or activities within TA-50 and TA-63. TA-35 is included in the proposed project because it is the alternative site to TA-63, as discussed in Section 2.6. A brief discussion of each TA with respect to land use, population, and nearest receptors are given below. TA-35 and TA-50 are located on Mortandad Mesa between Mortandad Canyon and on the north and Ten Site Canyon on the south. Various nuclear safeguards R&D facilities have been constructed on the land at TA-35. The land at TA-50 is used to house the existing RLWTF. TA-63 is located on Mesita del Buey, bound on the north by Ten Site Canyon and on the south by Cañada del Buey. Several office buildings are currently located at TA-63.

The worker populations of the three TAs associated with the project area are given below.

Technical Area	Population
TA-35	525
TA-50	160
TA-63	109

The nearest receptors associated with the proposed RLWTF project area include receptors at the nearest TA and the nearest public access. These are discussed below.

- Receptor at Nearest Technical Area. The proposed action and Alternatives 1 and 2 discussed in Section 2.2 and 2.3 consist of construction and/or activities within TA-50 and TA-63. TA-35 is the technical area closest to both TA-50 and TA-63. Consequently, the nearest non-involved worker would be located at TA-35. TA-35 is located approximately 305 m (1000 ft) northeast of TA-50 and approximately 457 m (1500 ft) northeast of TA-50.

- Receptor at Nearest Public Access. TA-35, TA-50, and TA-63 are unrestricted areas that can be accessed directly from Pajarito Road, a public access road between Los Alamos and White Rock by any member of the public. Pajarito Road is located approximately 152 m (500 ft) south of TA-50, 152 m (500 ft) south of TA-63, and 457 m (1500 ft) south of TA-35.

4.3.2 The Community

4.3.2.1 Land Use and Population

LANL Region. Land use in Los Alamos County is summarized in Table 4-2. As the table indicates, vacant and open-space land dominates all categories of land use within the county. More than half of the land controlled by the county is urbanized area. Residential areas are the predominant land use within these urbanized areas, accounting for 45% of the land.

Proposed RLWTF Project Area. According to the 1990 U.S. Census, approximately 18,200 people reside in Los Alamos County. This population is distributed primarily in two residential/commercial centers: Los Alamos town site and White Rock. These two areas constitute the nearest residential receptors associated with the proposed RLWTF project area. The Los Alamos town site includes residential areas that have the following informal designations: Eastern Area, Western Area, Barranca Mesa, North Mesa, and the North Community. These areas have a total population of 11,830 residents. The White Rock area includes White Rock proper, La Senda and Pajarito Acres subdivisions. The area has a total of 6,800 residents.

Table 4-3 summarizes the approximate distribution of population within the LANL area as a function of direction and distance from TA-53. The proposed RLWTF project area is located approximately 3.2 km (2 miles) southwest of TA-53.

The nearest residential receptor associated with the proposed RLWTF project area would be located northwest of the project area:

- Nearest Residential Receptor. The nearest residential receptor associated with the proposed RLWTF project area would be located at the Royal Crest Trailer Court in Los Alamos. The trailer park is located approximately 1.6 km (1 m) northwest of the proposed RLWTF project area. White Rock is located approximately 8 km (5 m) southeast of the proposed RLWTF project area.

4.3.3 San Ildefonso Pueblo

The San Ildefonso Pueblo boundary borders DOE land as shown in Figure 4-12. The boundary extends to the west of State Road 4 and includes the eastern portions of Los Alamos, Sandia, and Mortandad canyons. As discussed in Section 4.1.1.2, the proposed RLWTF project area is bound by Mortandad Canyon to the north and Two Mile and Pajarito canyons to the south. Additionally, Mortandad Canyon is a major drainage associated with the proposed RLWTF project as shown in Figure 4-8.

4.4 Cultural Resources

4.4.1 LANL Region

The northern New Mexico region has a long and continuous history of human habitation and is widely known for its archaeological resources. The Pajarito Plateau is especially rich in evidence of prehistoric human occupation. Bandelier National Monument, located adjacent to LANL on the plateau, was established largely to protect a portion of these resources. The prehistoric cultural resources on DOE property rival in numbers those that have been identified within the boundaries of Bandelier.

Table 4-3
1991 Population within 80 km of Los Alamos[a]

Distance from TA-53	1-2 km	2-4 km	4-8 km	8-15 km	15-20 km	20-30 km	30-40 km	40-60 km	60-80 km
Direction									
N	1	0	0	0	0	0	1,152	0	373
NNE	0	0	0	524	0	550	1,756	1,824	224
NE	1	0	0	0	322	15,606	1,024	1,153	3,905
ENE	0	0	0	1,985	1,586	2,780	2,778	1,205	2,241
E	0	0	85	26	569	1,172	712	0	1,412
ESE	0	0	0	0	0	299	23,695	1,079	1,493
SE	0	0	6,776	0	0	0	54,778	2,500	8
SSE	0	0	0	0	0	0	436	4,449	97
S	0	0	0	50	0	333	642	7,069	0
SSW	0	0	0	20	0	854	210	8,609	34,996
SW	0	0	0	0	0	0	329	4,345	0
WSW	0	0	0	0	0	329	327	2,660	216
W	0	0	0	0	0	0	0	171	138
WNW	0	1,439	6,553	0	0	0	0	0	3,220
NW	0	525	1,726	0	0	0	0	1,459	0
NNW	0	580	581	0	0	0	0	65	63
1991 Population Total	2	2,544	15,721	2,655	2,477	21,923	87,839	36,588	48,386

[a] Total population within 80 km (50 mi) of Los Alamos is 218,135

Source: LANL 1991b

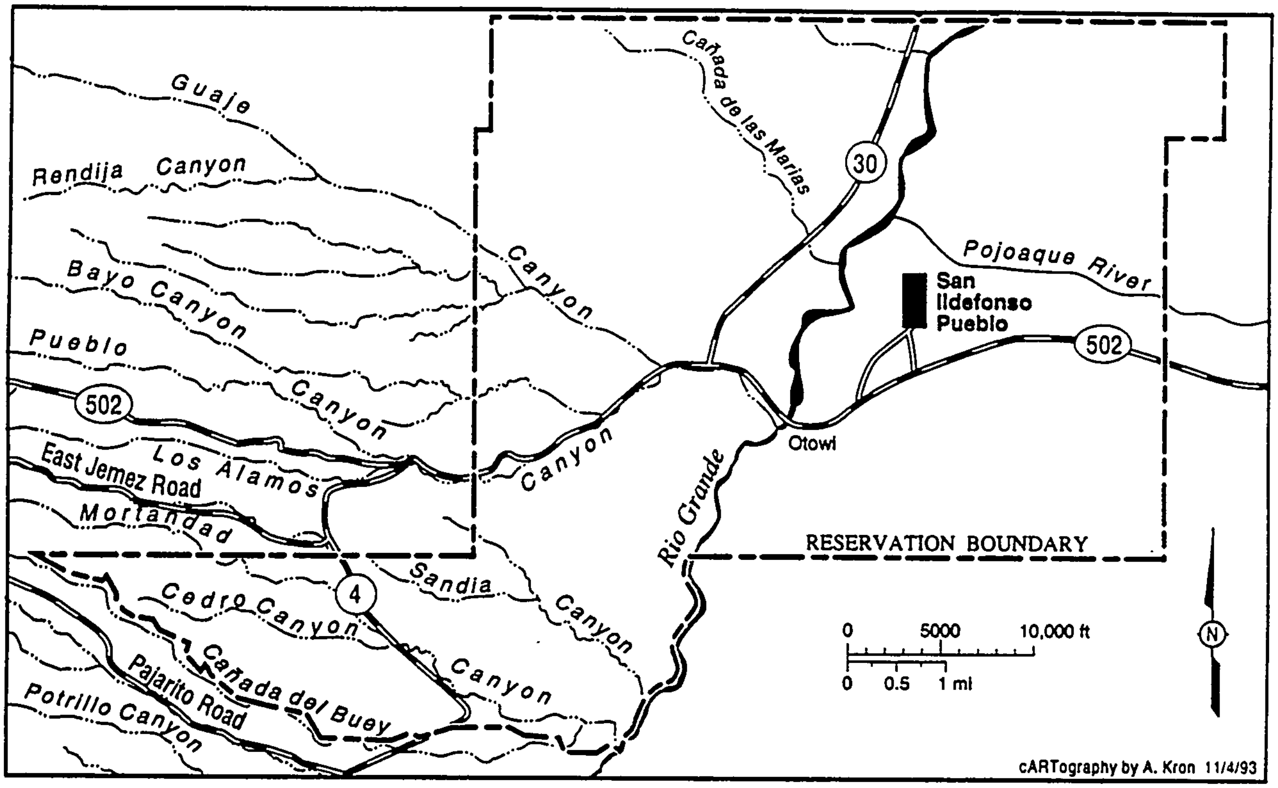


Figure 4-12
Location of San Ildefonso Pueblo and reservation boundary

A thorough and complete survey of all DOE lands managed by LANL has not been done, but a survey of approximately 60% of DOE land in Los Alamos County revealed close to 1,000 sites of archaeological significance. Most of these sites are located on mesa tops in piñon-juniper vegetation—a geographical setting that coincides closely with the area of most intensive development by DOE. Ongoing archaeological investigations by LANL personnel continue to identify prehistoric and historic sites and to excavate sites that could be disturbed by new LANL activities.

Interpretations of the archaeological record of the Pajarito Plateau are diverse and changing, and information from archaeological research on DOE lands could contribute greatly to furthering that understanding. For this reason alone, the archaeological sites at LANL are of great importance. The prehistoric sites of the Pajarito Plateau are also important to the Pueblo tribes of the northern Rio Grande region. Many sites are revered by the nearby Pueblo people as ancestral shrines and places of origin. The Pueblo of San Ildefonso is especially concerned about the welfare of prehistoric ruins and argues actively for their preservation. The oral history of the Tewa at San Ildefonso holds that specific sites on the Plateau were once the homes of their ancestors; modern archaeological interpretations in general do not dispute this claim.

In spite of wide gaps in understanding about the area's prehistory, a general sketch of prehistoric utilization and settlement of the Pajarito Plateau can be given based on current research. As a chronological frame for this information, a series of periods of human occupation of the area can be used.

Paleo-Indian Period (10,000 B.C. to 4000 B.C.). This period of prehistory is poorly represented in the archaeological record of the Pajarito Plateau—and indeed, in most of the northern New Mexico region. People who inhabited the area were large-game hunters who followed the herds in the Rio Grande Valley and visited the uplands of the Pajarito Plateau primarily to obtain obsidian (used for projectile points and tools) and other specialized materials. They did not build permanent structures. Projectile points characteristic of the period have occasionally been found on the ground surface on DOE lands.

Archaic Period (4000 B.C. to A.D. 600). The people who inhabited the northern New Mexico region during the Archaic Period were hunter-gatherers who concentrated on small game and supplemented their diet with wild plant foods. These people utilized resources on the Pajarito Plateau and left behind small campfire hearths, stone tools, projectile points, and debris from the manufacture of stone implements. There are scattered remnants of this period on DOE lands.

Early Developmental Period (A.D. 600 to A.D. 900). A more sedentary way of life emerged during this period of prehistory as the hunter-gatherer cultures of the Southwest began to build semi-subterranean dwellings known as pithouses. The first pottery to be used in the region also appeared in this period. Pithouses and associated ceramic and stone artifacts have not been positively identified on DOE property, although some sites may prove to be of this period.

Late Developmental Period (900 to 1100). The trend toward a settled lifestyle continued in this period. People living in the region started to cultivate corn extensively, although they still also relied on wild plant and game resources. The archaeological record of this period is found in small clusters of houses made of adobe or masonry. Most settlement was apparently at relatively low elevations near the Rio Grande, and little evidence of these structures has been found on DOE land.

Coalition Period (1100 to 1325). Continued development of corn cultivation and a gradual increase in settlement size occurred in the early Coalition Period. Late Coalition Period settlements consisted of large blocks of contiguous rooms, with more than 100 rooms per settlement in some cases. This apparently was the most widespread prehistoric settlement of the Pajarito Plateau; more than 700 sites from this period have been recorded on DOE lands.

Classic Period (1325 to 1600). The cultivation of corn intensified and expanded in this period, and the human population began to aggregate into very large settlements. There were three primary settlements on the Pajarito Plateau and a large number of outlying buildings that were utilized seasonally as field houses. The ruins of two of these settlements—Otowi and Tshirege—are located on DOE lands and are believed to be the ancestral ruins of the modern San Ildefonso Pueblo tribe.

Spanish Colonial, Mexican, and Territorial periods (1600 to 1890). The Pajarito Plateau was not widely settled during this period but was probably used for grazing, hunting, and gathering wild resources by Pueblo and non-Indian people living in the Rio Grande Valley. Little evidence of the human use of the area has been found on DOE land.

Homesteading Period (1890 to 1943). By the turn of the twentieth century, settlement encouraged by the Homestead Act brought Hispanic and Anglo people to the Pajarito Plateau. Cattle grazing, timber cutting and limited farming were the primary activities of the homesteaders, who built wooden houses, corrals, and other structures. Homesteading activities continued in the area until the U.S. Army took over 11.7 km^2 (2900 acres) of homestead land for the Manhattan Project in 1942. A number of homestead sites consisting of ruined structures and scatterings of domestic artifacts remain on DOE property.

The Los Alamos Ranch School, founded in 1918 on the Pajarito Plateau, served as a boys' school for almost 25 years. When the federal government acquired it in the 1940s,the school included 50 log buildings on 3.2 km^2 (790 acres) of land (DOE 1979).

Post-1943 Period (1943 to present). Since the establishment of what is now LANL, much of the area has been extensively used for DOE-sponsored R&D spread out over the 111 km^2 (43 mi^2) of DOE property. In addition, residential development has been established on approximately 30.4 km^2 (7500 acres) of land.

National Historic Sites. There are three prehistoric ruin complexes within the DOE boundary that are officially designated as Historic Sites: the Otowi and Little Otowi Ruins, east of Los Alamos; cavate ruins, including a cave kiva and game trap near Mortandad Canyon; and the Tshirege Ruins near White Rock. In addition, two pre-Columbian sites in the Pajarito Plateau/Rio Grande Valley area have been established as National Historic Sites.

Bandelier National Monument, located 16 km (10 mi) south of Los Alamos off State Highway 4, represents Pueblo civilization between 1300 and A.D. 1500. The area, which is managed by the National Park Service, was apparently abandoned around 1580. It encompasses several settlement sites, the best known of which are Tyuonyi and Tsankawi Ruins. The sites include ruins of a 400-room, three-story communal dwelling; excavated kivas; and volcanic cliff cave diggings. Many ruins in the monument have not been excavated.

Puye Cliffs Historical Ruins, 6 km (3.5 mi) north and 16.7 km (9 mi) west of Santa Clara Pueblo, was inhabited between the late 1200s and the mid-1500s. The ruins, which belong to Santa Clara Pueblo, consist of many caves honeycombed in volcanic cliffs and multistoried mesa-top structures.

4.4.2 Proposed RLWTF Project Area

Several archaeological surveys have been conducted within and near the proposed RLWTF project site. In 1984 and 1985, survey and excavation work was conducted in advance of road construction and facility upgrades at TA-55 (just to the east of the RLWTF site). The survey included part of the TA-50 field area situated to the west of the proposed project area. Two prehistoric artifact scatter sites were located and collected at TA-50 and TA-55. Portions of three historic homesteads were also excavated and collected at the site. Between 1986 and 1991, approximately 24.5 hectares were surveyed in the area of TA-63 in advance to several new LANL projects. An Archaic Period lithic scatter was identified and catalogued. In 1992, an additional survey was conducted in support of the Environmental Restoration program. During this survey, a historic site was identified in the TA-35-Mortandad Canyon area. (LANL 1992c,d).

Based on the archaeological surveys of the proposed RLWTF project, all identified sites except the historical site at TA-35 have been mitigated under LANL's archaeological program. If the proposed alternative site (TA-35) for the RLWTF is chosen, any project impacts to this site will have to be mitigated prior to the construction of the RLWTF (LANL 1992c).

4.5 Transportation

4.5.1 LANL Area

The majority of vehicular activity in the LANL area is commuter traffic, which is stopped when wastes are moved onsite or offsite. On Pajarito Road, a main public access road within LANL, the average daily traffic is 3,317 vehicles (LANL 1992b). The peak travel times at LANL are between 7:00 a.m. and 8:00 a.m. and 5:00 p.m. to 6:00 p.m. The intersection of East Jemez Road and Diamond Drive handles more than 5,000 vehicles between 3:45 p.m. and 6:30 p.m. On Pajarito Road, the existing traffic flow ranges from 300 to 337 vehicles per hour. During the morning rush hour, the traffic on Pajarito Road ranges from 720 to 750 vehicles per hour (LANL 1992b). Annually, Los Alamos County reports 280 accidents, representing a crash rate of 153, or 1.83 per 100 million vehicle miles, among the lowest in New Mexico (NMHTD 1992).

4.5.2 Proposed RLWTF Project Area

The proposed RLWTF project area can be accessed from Pajarito Road. TA-63 is located on Puye Road, which branches off Pajarito Road and provides access to TA-63 and TA-52. TA-35 and TA-50 are located on Pecos Drive, which branches off Pajarito Road and provides access to TA-55, TA-35, and TA-50. Both Puye Road and Pecos Drive have unrestricted access; therefore, any member of the public can enter these roadways.

As discussed in Section 2.2.1, a gravity pipeline collection system transfers waste from LANL waste generators to the TA-50 RLWTF (Alternative 1). This would also be the case for the proposed action and for Alternative 2. However, facilities not networked to the waste collection system would require its wastes to be transferred by truck to the RLWTF. The only main access road to the RLWTF project area is Pajarito Road. The distances from Pajarito Road to the TAs making up the proposed RLWTF project area are given in Section 4.3.1.1.

4.6 Recreational Resources

4.6.1 LANL Area

Most LANL and Los Alamos community developments are confined to mesa tops. The surrounding land is largely undeveloped, with large tracts of land north, west, and south of the LANL site being held by the U.S. Forest Service, the Bureau of Land Management, the U.S. Park Service, Bandelier National Monument, and Los Alamos County.

The Santa Fe National Forest, which makes up 40% of Los Alamos County, is a prime recreational destination for many Los Alamos area residents and people from adjoining counties and states. Santa Fe National Forest lands provide access to a wide variety of outdoor recreational activities, including permitted fishing and hunting. The Santa Fe National Forest land includes a widely used, privately owned downhill ski area. In addition to the numerous downhill ski runs, the area includes several trails for cross-country skiing. The Jemez Mountains Recreational Area, which sets aside 54,000 acres of land west of Los Alamos for recreational use, was signed into law by President Clinton on October 12, 1993. The Bureau of Land Management complements the National Forest lands with access to similar recreational resources.

Bandelier National Monument, established in 1916 by Presidential Proclamation, encompasses 32,000 acres of land, 23,000 of which are designated as wilderness. The monument, managed by the Park Service, borders the southwest side of DOE land, and all of the access routes to the monument pass through or along DOE property. More than 350,000 people from all over the world visit Bandelier each year, drawn primarily by the archaeological sites in Frijoles Canyon and at various other locations throughout the monument. Bandelier National Monument also includes many miles of backcountry hiking and nature trails. The monument also includes an outlying area of land surrounding the Tsankawi indian ruins, located east of DOE land.

Los Alamos County Parks provide numerous areas and facilities to the Los Alamos and White Rock communities for a wide variety of indoor and outdoor recreational uses.

The public is allowed limited access to certain areas on LANL property. An area north of Ancho Canyon between the Rio Grande and State Road 4 is open to hikers, boaters, and hunters; woodcutting and vehicles are prohibited. Portions of Mortandad and Pueblo canyons are also open to the public, primarily for hiking and sightseeing. An archaeological site (the Otowi tract) northwest of State Road 502 near the intersection of 502 and State Road 4, is open to the public, subject to restrictions imposed by state and federal regulations to protect cultural resources.

4.6.2 Proposed RLWTF Project Area

The proposed RLWTF project area is not expected to restrict public access. Areas throughout the LANL site with similar access status receive occasional use by associated LANL workers for walking, running, and biking but are rarely accessed by members of the public (non-LANL employees). The proposed RLWTF project area may be used by LANL employees and occasional members of the public, for limited outdoor exercising.

4.7 Aesthetic Quality

The proposed RLWTF project area is in a previously developed area. The area to be occupied by the proposed RLWTF is devoid of overstory vegetation and is widely recognized as one of the more disturbed areas of the LANL site. Several existing facilities in the TA-50, TA-63, and TA-35 mesa top area have been in operation for many years, and include established transportation and utility corridors. The proposed TA-63 project site is visible from Pajarito Road; however, the RLWTF is being scoped to feature a modern, aesthetically pleasing, architectural design.

The proposed alternative TA-35 site, located in Mortandad Canyon, has historically received minimal impact from facility construction and other LANL operations. Unlike the proposed site, this site is heavily vegetated with natural overstory and understory cover. Vegetation disturbance from construction of the RLWTF in the proposed alternative site would result in a significant change in thesite's visual appearance. The alternative site is situated below the proposed site on the mesa top. If constructed at the alternative site, the RLWTF would be less visible than the proposed site from Pajarito Road. The RLWTF will feature an architectural design as consistent as possible with the surrounding natural environment.

5.0 BIBLIOGRAPHY

Bowen 1990: B.M. Bowen, "Los Alamos Climatology," Los Alamos National Laboratory report LA-11735-MS, 1992.

DOE 1979: Los Alamos Scientific Laboratory Site," Final Environmental Impact Statement," US Department of Energy report DOE/EIS0018, 1979.

Fluor Daniel 1989: Fluor Daniel, "Addendum 11, Title 1 -Design Summary Report, Pretreatment Facility," June 30, 1989.

H&R TA 1993: H&R Technical Associates Inc., "Safety Analysis Report for the Radioactive Liquid Waste Treatment Facility and the Size Reduction Facility," Draft, January 1993.

ICF KE 1991: "Abbreviated Conceptual Design Report for the Design of Radioactive Liquid Waste Treatment Facility at the Los Alamos National Laboratory," February 1991.

ICF KE 1992: ICF Kaiser Engineers, "Feasibility Study for Radioactive Liquid Waste Treatment Facility Siting at the Los Alamos National Laboratory," November 1992.

ICF KE 1993: ICF Kaiser Engineers, "Feasibility Study for Radioactive Liquid Waste Treatment (RLWT) Plant Refurbishment at TA-50," September 17, 1993.

LANL 1990a: Los Alamos National Laboratory, "Industrial Waste System, TA-55 & TA-50, L.J. 9137," Memorandum, ENG-1/JMA/90-044, from J. Amezqita to Distribution, May 17, 1990.

LANL 1990b: Los Alamos National Laboratory Site, "Water Supply at Los Alamos During 1990, Progress Report," LA-12471-PR, 1990.

LANL 1991a: Los Alamos National Laboratory, "EM-7 Annual Analytical Report for the RLWTF, Calendar Year 1991," 1991.

LANL 1991b: Los Alamos National Laboratory, "Environmental Surveillance at Los Alamos during 1991," LA-12572-ENV, August 1993.

LANL 1992a: Los Alamos National Laboratory, "EM-7 Annual Analytical Report for the RLWTF, Calendar Year 1992, 1992.

LANL 1992b: Los Alamos National Laboratory, "Hourly Proportion of Traffic at LANL," September 1, 1992.

LANL 1992c: Los Alamos National Laboratory, "RFI Work Plan for Operable Unit 1129, Environmental Restoration Program," LA-UR-92-800, 1992.

LANL 1992d: Los Alamos National Laboratory, "RFI Work Plan for Operable Unit 1147, Environmental Restoration Program," LA-UR-92-969, 1992.

LANL 1992e: Los Alamos National Laboratory, "Installation Work Plan for Environmental Restoration," LA-UR-92-3795, Revision (2), 1992.

LANL 1992f: Los Alamos National Laboratory, "Value Engineering Study for the RLWTF Project," April 1992.

LANL 1993a: Los Alamos National Laboratory, "Fact Sheet for the Radioactive Liquid Waste Treatment Facility Project at Los Alamos National Laboratory," fifth draft, August 19, 1993.

LANL 1993b: Los Alamos National Laboratory, "Biological Information Document (BID) for the Radioactive Liquid Waste Treatment Facility," LA-XX-XXX, draft, 1993.

LANL 1993c: Los Alamos National Laboratory, "Disposition of TA-50-1," Memorandum, ENG-DO/MPO-93-CRLW-074, from Anthony Drypolcher to Carey Bare, August 5, 1993.

LANL and DOE 1993: Los Alamos National Laboratory and US Department of Energy, "Office of Environmental Restoration and Waste Management, Mission Need Statement," March 15, 1993.

NMHTD 1992: New Mexico Highway & Transportation Department, "New Mexico Traffic Crash Data, 1992," Calendar Year 1992.

Parsons 1993a: Ralph M. Parsons Co., "Los Alamos National Laboratory Radioactive Liquid Waste Treatment Facility Best Demonstrated Available Technology Study," Draft, April 16, 1993.

Parsons 1993b: Ralph M. Parsons Co., "Preconceptual Functional Design Criteria Document for Radioactive Liquid Waste Treatment Facility Volume I and Volume II," Draft, January 22, 1993.

Purtymun 1984: W. Purtymun, "Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies," Los Alamos National Laboratory report LA-9957-MS, January 1984.

Travis 1992: J.R. Travis, "Atlas of the Breeding Birds of Los Alamos County, New Mexico, Pajarito Ornithological Survey," Los Alamos National Laboratory report LA-12206, 1992.

Woodward-Clyde 1993: "Seismic Hazards Evaluation of the Los Alamos National Laboratory," Woodward-Clyde Federal Services, Oakland California, Draft Volume I, 1993.

GLOSSARY

absorption	movement of ions and water as a result of diffusion along an activity gradient.
acre-foot (acre-ft)	the volume (as of irrigation water) that would cover one acre to the depth of one foot.
actinide	any of the set of radionuclides found on the last row of the periodic table, ranging from actinium (Ac) to lawrencium (Lr).
adiabatic	occurring without loss or gain of heat.
adsorption	the adhesion in an extremely thin layer of molecules to the surfaces of solid bodies or liquids with which they are in contact.
alluvium	clay, silt, sand, gravel or similar detrital material deposited by running water.
alpha-emitting	discharging a high-speed stream of alpha particles.
anthracite	a hard natural coal of high luster differing from bituminous coal in containing little volatile matter.
aquifer	rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit significant quantities of water to wells and springs.
ash flow	mixture of volcanic ash, hot gases, and fragments of rock and glass that flows rapidly down the flank of a volcano.
cementation	the process of surrounding a solid with a powder and heating the whole so that the solid is changed by chemical combination with the powder.
chelate	a ring compound in which a metal is held between two or more atoms.
chemical fixation	to change into a stable compound or available form.
chemical precipitation	to separate a substance from a solution or suspension by chemical or physical change, usually as an insoluble amorphous or crystalline solid.

chemical reduction	process subjecting a substance to the action of hydrogen, changing it to a lower oxidation state.
chloride	a compound of chlorine with another element or radical.
clarification	freeing suspended matter from a liquid.
coagulation	process causing a substance to become viscous or thickened into a coherent mass.
condensate	a liquid obtained by condensation of a gas or vapor.
connected action	project associated with a proposed action.
decanting	drawing off liquid without disturbing the sediment or lower liquid layers.
ductile	capable of being fashioned into a new form.
ductile shear wall	wall in which the principal resisting vertical elements, when stressed beyond the elastic limit, will provide non-elastic energy absorption without collapse hazard. (Eagling, Donald G.., *Seismic Safety Guide.* LBL-9143. UC-11. 1983)
effluent	waste material that flows out.
entrained	to draw in and transport (as solid particles or gas) by the flow of a liquid.
evapotranspiration	loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.
fifty year flood (50 year flood)	the average worst flood expected when flood predictors seek to estimate the probable discharge that, on average, will be exceeded only once in fifty years.
filtration	passing a liquid or gas through a porous article or mass to separate out matter in suspension.
floc	a flocculant mass formed by the aggregation of a number of fine suspended particles.
flocculation	process which causes a suspended substance or precipitate to collect in small, loosely aggregated masses or floccules.
flocculator	a device for aggregating fine particles.
fractionator	equipment used to separate a mixture into different fractions or portions, usually by distillation.

gamma radiation	a continuous stream of high-energy photons.
gravity flow	describes any hydraulic system whereby fluid is transported from a higher to a lower elevation by the action of gravity.
Greenfield D&D	a standard for environmental restoration which requires that a site be decontaminated, decommissioned and returned to its initial pristine state.
gross alpha activity	intensity of alpha radiation (emission of alpha particles), measured in disintegrations/minute/liter.
gross square feet	the total area contained inside a structure.
halon system	a fire protection system which uses smoke detectors, thermal detectors and/or photoelectric cells to trigger a device containing a small charge (squib) which allows a material (usually bromotrifluoromethane [$BrCCl_3$] to be released into the fire area.
Important or Low Hazard	Department of Energy usage category for facilities that have mission-dependent use (e.g., laboratories, production facilities, and computer centers) and emergency handling or hazard recovery facilities (e.g., hospitals, fire stations).
influent	stream flowing in.
ion exchange	a reversible interchange of one kind of ion present in a solution surrounding the solid with another of like charge present in a solution surrounding the solid with the reaction being used, usually for the purpose of purification or separation.
kilo- (k)	one thousand (10^3)
lamella plate clarifier	a sedimentation unit which uses an arrangement of plates to collect and deposit suspended solids.
magnehelic differential pressure gauge	a particular design for a pressure gauge used to measure the pressure differential (delta P) across a boundary.
mesa	an unusually isolated hill having steeply sloping sides and a level top.
net square feet	the total usable area inside a structure.
neutralization	any process used to make a substance chemically neutral.

nitrate	a salt or ester of nitric acid ($HCNO_3$).
off gas	vapor which is a product of a waste treatment process.
outfall	the mouth of a drain or sewer.
oxidant	an oxidizing agent.
oxidation	the process of changing a compound by increasing the proportion of the electronegative part.
ozonization	the process of treating, impregnating, or combining with ozone.
penthouse	a smaller structure joined to a building.
perched water source	An unconfined groundwater body supported by a small impermeable or slowly permeable unit.
pH	the negative logarithm of the hydrogen ion ($H+$), used as a measure of the acidity or alkalinity of a solution on a scale of 0 to 14, 0 being the most acidic, 7 being neutral, and 14 most alkaline.
precipitation	process which causes a substance to separate from a solution or suspension by chemical or physical change, usually as an insoluble amorphous or crystalline solid.
Quaternary	geologic time period which begins approximately two million years ago.
redundant	serving as a duplicate for preventing failure of an entire system (as a spacecraft) upon failure of a single component.
retrofit	to furnish with new parts or equipment not available at the time of manufacture.
riparian	relating to, living or located on the bank of a natural watercourse.
scarp	a line of cliffs produced by faulting or erosion.
scrubber	a piece of equipment used to control acid gas emissions.
sedimentation	the process of sediment depostion.
sludge contactor	a biological treatment process in which a suspended aerobic microbial culture (activated sludge) is used to treat waste by nitrification.
snowmelt	runoff produced by the melting of snow.
tectonic	of or relating to the deformation of the earth's crust.

transpiration	the process of passing off or giving passage to a fluid through pores or interstices, especially as in excreting water vapor through a living membrane.
treatment train	a series of parts or elements that together constitute a system designed to change the physical, chemical or biological character or composition of any hazardous waste so as to neutralize it, render it non-hazardous or less hazardous, or recover it.
tritiated	containing tritium (^3H), a radioactive isotope of hydrogen (H).
tuff	volcanic ash that is compacted, cemented, or welded together.
ultraviolet radiation	radiation having a wavelength shorter than wavelengths of visible light and larger that those of x-rays.
value engineering study	systematic application of recognized techniques in order to identify the function of a product or service and provide the necessary function reliably at lowest overall cost.
volcanism	power or action produced by a volcano.
volt (V)	unit of electromotive force
volt-ampere (VA)	a unit of electric measurement equal to the product of a volt and an ampere.
waste acceptance criteria (WAC)	specified limits (DOE Order 5820.2a) placed on waste characteristics for waste to be accepted by a storage or treatment facility.
wastestream	the waste material output of a community, region or facility.

7.0 APPENDICES

APPENDIX A	Accident Events
APPENDIX B	EID Impact Assessment Matrices
APPENDIX C	Existing Building TA-50-1 (RLWTF at TA-50) Non-Conformance with DOE Order 6430.1A, General Design Criteria
APPENDIX D	Alternative Treatment Processes
APPENDIX E	Biological Resource Tables

APPENDIX A
Accident Events

This appendix provides a qualitative discussion regarding the potential accident events associated with the proposed action and Alternative 1 through 3. The accident events associated with Alternative 3 are identical to those for the proposed action. The potential accident events identified in this appendix are consistent with those identified in the Safety Information Document (SID) for the proposed RLWTF project. The SID addresses the proposed action and Alternative 1 and 2. This appendix does not address the accident scenario development for the accident events and subsequent risk assessment for the accident scenarios. This detailed quantitative analysis is performed in the SID for the proposed action and Alternatives 1 and 2.

A.1 Selection of Accident Events

The selection of potential accident events for the proposed action and Alternatives 1 through 3 was based on the following sources:

- Previous experience at the existing RLWTF
- Safety Analysis Reports for similar DOE radioactive liquid waste treatment facilities
- Preconceptual and conceptual design documents for the proposed Radioactive Liquid Waste Treatment Facility
- Interviews with design and safety professionals familiar with this type of treatment processes

The spectrum of potential accident events encompasses the following three types of events:

- Natural phenomena, such as earthquakes, tornadoes, and floods, that are site-specific events
- Operational accidents, such as leaks in tanks and pipes, that are process- or operational-specific accidents
- External manmade events, such as an airplane crashing into the facility

The potential accident events are categorized as either within design basis or beyond design basis. The latter is defined as an event having a probability less than 10^{-7} per year. Events within design basis are defined as having a probability greater than 10^{-6} per year. The accident events identified in this appendix include both within-design-basis and beyond-design-basis events. Accident events categorized as beyond design basis (i.e., plane crash) are included to satisfy NEPA requirements.

A.2 Accidents Associated with the Proposed Action

Natural Phenomena Events

Natural phenomena events of a magnitude beyond the design basis could potentially cause a breach of building containment. These events include earthquakes, extreme winds and tornadoes, flooding (including landslides), and lightning.

The proposed TA-63 RLWTF and the TA-50 PTF would be designed in accordance with DOE Order 6430.1A, General Design Criteria, and UCRL-15910, Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards. UCRL-15910 provides data for earthquake ground acceleration; wind speed, tornado wind speed, and other effects; and flood level corresponding to the design basis earthquake (DBE), design basis wind (DBW), design basis tornado

(DBT), and design basis flood (DBF) as described in DOE Order 6430.1A. Integrated with these natural phenomena loadings, UCRL-15910 provides recommended response evaluation methods and acceptance criteria to achieve acceptable low probabilities of facility damage due to natural phenomena.

- Earthquake. The Design Basis Earthquake (DBE) is a seismic event with a peak ground acceleration of 0.22 g for the RLWTF and 0.22 g for the PTF. Earthquakes of this magnitude and lower would result in little or no damage to the facilities with no release of hazardous or radioactive materials. A seismic event of a magnitude beyond the design base could cause damage to the TA-63 RLWTF and the TA-50 PTF. Breaching of containment systems at these facilities could release untreated radioactive liquid waste, radioactive sludge, and hazardous materials into the environment.

- Extreme Winds and Tornadoes. The Design Basis Wind (DBW) is a fastest-mile wind speed at a 10 m height. The DBW for the RLWTF is 77 miles per hour. The DBW for the PTF is 93 miles per hour. UCRL-15910 provides no tornado wind design criteria for LANL, and tornado winds need not be included in the design of LANL facilities. Extreme winds of DBW magnitude and lower would result in little or no damage to the facilities, with no release of hazardous or radioactive materials.

  Extreme winds above DBW magnitude would cause little damage to the facilities. The damage would be more localized and could include damage to cladding (siding and roofing) and pressure surges in the HVAC intake and exhaust systems. Damage to the cladding could breach the secondary building containment, but the primary containment would be functional.

- Flooding. The TA-63 RLWTF and TA-50 PTF are located on top of a rocky mesa with deep canyons on both sides. There are no large bodies of water nearby to pose a hazard to the facilities. Primary hazards that must be considered in the Design Basis Flood (DBF) events include river flooding; dam, levee, or dike failure; tsunami, storm surge; and local precipitation. The only primary hazard applicable to this site is local precipitation. DBF events associated with local precipitation are roof drain clogging and storm sewers blocking. Neither of these events would result in release of hazardous or radioactive material from the facilities.

- Lightning. The TA-63 RLWTF and TA-50 PTF will be equipped with a lightning protection system that safely discharges to ground without damage to structures or its equipment. The lightning protection system will be designed in accordance with DOE Order 6430.1A and the National Fire Protection Association (NFPA) codes. If the lightning protection system is adequately maintained, the breaching of the facilities' structures is highly unlikely.

External Man-Made Events

This category considers two accident events: an aircraft on approach to Los Alamos Airport crashing into the RLWTF or PTF; and a motor vehicle crashing into the facility.

- Aircraft Crash. The TA-63 RLWTF and TA-50 PTF are relatively close to the Los Alamos Airport, and the possibility of an aircraft crashing into the facilities should be considered. An aircraft crash into the facility could cause a release of hazardous and radioactive materials into the environment.

- Vehicle Crash. The TA-63 RLWTF and TA-50 PTF would be located adjacent to roadways with a service entrance into the buildings. A vehicle could crash through the protective building barrier and hit process equipment, causing a release of hazardous and radioactive materials into the environment.

Operational Events

Accident events resulting from operation of the facilities involve accumulation of fissile materials, the release of radioactive or toxic materials from tanks and piping, or the release of particulate radioactive materials.

- Accumulation of Fissile Materials. Plutonium could collect in the caustic holding tank in the TA-50 PTF. The holding tank would be designed with a cone-shaped bottom, equipped with a mixer, and a recirculation loop. Failure to mix and recirculate the waste prior to treatment could result in the plutonium reaching a minimum critical mass, which would create a source of high radiation with exposure to the outside environment.

- Release of Radioactive Materials from Tanks and Piping. Failure to neutralize the nitric acid waste in the PTF could result in a release of the nitric acid waste tank contents. The nitric acid would react with the iron piping, which would result in its rupture. The building containment should contain the spill; thus, the accident would have minimal effects on the environment.

- Release of Toxic Materials from Tanks and Piping. The TA-50 RLWTF contains nitric acid and sodium hydroxide inventories stored in tanks. A minor spill during tank refueling could release a small amount within the facility. This would have very little or no effect on the environment.

- Release of Particulate Radioactive Materials. Failure of the HEPA filters could result in a stack release of radioactive materials. A large fire in the building could ignite a HEPA filter loaded with radioactive materials, resulting in a release of radioactive particles to the environment.

During vitrification, if one liquid is brought in contact with a second liquid that is hot enough to cause film boiling, a steam explosion could occur. The explosion would most likely not breach the secondary building containment and thus, would have little or no effect on the environment.

A runaway chemical reaction in the ion exchange columns could cause an explosion resulting from concentrated nitric acid contacting the ion exchange resin. The explosion could breach the building confinement and release radioactive particles.

A flammable gas explosion in the PTF could occur in rooms serviced by natural gas. The explosion could breach both process equipment and the building confinement, resulting in a release of radioactive particles.

A.3 Accident Events Associated with Alternatives 1 through 3

Natural Phenomena Events

- No Action Alternative . The existing Building TA-50-1 does not meet the seismic requirements of UCRL-15910 for a Low Hazard category facility. The building is postulated to collapse because of an earthquake with a peak ground acceleration of 0.22 g (H&R TA 1993). This would result in releases of hazardous and radioactive material into the environment.

- Retrofit Existing RLWTF at TA-50 and Construction of TA-50 PTF. The natural phenomena events associated with the retrofitting of the existing RLWTF would be the same as for the proposed action discussed in Section 1.2.1

- Privatization of RLWTF and PTF. The natural phenomena events associated with the privatization of the RLWTF would be the same as for the proposed action discussed in Section 1.2.1

External Manmade Events

- No-Action Alternative. The external manmade events associated with the no-action alternative would be the same as for the proposed action discussed in Section 1.2.2.

- Retrofit Existing RLWTF at TA-50 and Construction of TA-50 PTF. The external manmade events associated with the retrofit alternative would be the same as for the proposed action discussed in Section 1.2.2.

- Privatization of the RLWTF and PTF. The external man-made events associated with the privatization alternative would be the same as for the proposed action discussed in Section 1.2.2.

Operational Events

- No-Action Alternative. The no-action alternative operational events would be the same as in Section 1.2.1 for the proposed action except for the steam explosion during vitrification event, which does not apply to the no-action alternative. In addition to the events discussed in Section 1.2.1, the following events apply to the no-action alternative.

  Energetic Vessel Rupture. The pressure relief valve and refrigeration system fail to operate, causing the Dewar flask containing carbon dioxide to explode. This would release the stored carbon dioxide to the environment.

  Hydrogen Leak. Room 124 in the existing RLWTF has hydrogen gas piped in from an outdoor supply. A hydrogen gas leak in this room could result in an explosion.

  Natural Gas Burner Upset. The existing RLWTF has natural-gas-fired boilers located in the waste treatment building. One of these boilers, in Room 14, is not equipped with a flame safeguard system; the flame safeguard system on the other boiler could also fail. A large natural gas explosion in this area could destroy the wall separating the equipment room from the mechanical room and cause releases of toxic and radioactive materials into the environment.

- Retrofit of Existing RLWTF at TA-50 and Construction of TA-50 PTF. The operational events associated with the retrofit of the existing RLWTF at TA-50 would be the same as for the proposed action discussed in Section 1.2.2.

- Privatization of RLWTF and PTF. The operational events associated with the privatization of the existing RLWTF at TA-50 would be the same events as for the proposed action discussed in Section 1.2.2.

A.4 Summary of Accident Events

A summary of the accident events associated with the proposed action and Alternatives 1 through are given in Table A-1.

Table A-1
Summary of Accident Events for the Proposed Action and Alternatives 1 –3

Accident Events	Proposed Action	Alternative 1 No-Action Alternative	Alternative 2 Retrofit Existing RLWTF	Alternative 3 Privatization
Natural Phenomena				
Earthquake: [1] Design Basis [2] Beyond Design Basis	[1] little or no damage [2] possible release	[1] and [2] possible release	[1] little or no damage [2] possible release	[1] little or no damage [2] possible release
Extreme Winds and Tornadoes	little or no damage	little or no damage	little or no damage	little or no damage
Flooding	little or no damage	little or no damage	little or no damage	little or no damage
Lightning	little or no damage	little or no damage	little or no damage	little or no damage
Man-Made Events				
Airplane Crash	possible release	possible release	possible release	possible release
Vehicular Crash	possible release	possible release	possible release	possible release
Operational Events				
Accumulation of Fissile Materials	possible release	possible release	possible release	possible release
Release of Radioactive Material from Tanks and Piping	little or no effect on environment	little or no effect on environment	little or no effect on environment	little or no effect on environment
Release of Particulate Radioactive Materials	possible release	possible release	possible release	possible release
Release of Toxic Materials from Tanks and Piping	little or no effect on environment	little or no effect on environment	little or no effect on environment	little or not effect on environment
Energetic Vessel Rupture	n/a*	possible release	n/a	n/a
Hydrogen Leak	n/a	possible release	n/a	n/a
Natural Gas Burner Upset	n/a	possible release	n/a	n/a

APPENDIX B
EID Impact Assessment Information Matrices

This appendix was prepared to provide the EIS preparer with a cross reference of information sources in the EID. Three summary matrices were prepared for the proposed action and Alternative 1 and Alternative 2. The summary matrix for the proposed action is also applicable to Alternative 3. The summary matrices are designed to provide quick reference to pertinent sections in the EID where environmental impacts are assessed. The environmental impacts are a function of the vertical and horizontal axis elements of the matrix. The impacts are a function of the affects referenced in the horizontal axis on the environmental areas listed on the vertical axis.

For credible accident information, the EIS preparer will need to refer to the SID for the accident scenarios developed for the accident events in Appendix A (referred to in matrix as Section A-1.0, etc). The SID will provide a description of the credible accident scenarios, associated source terms, and the dose assessment associated with these accident scenarios.

Table B-1 EID Impact Assessment Information Matrix Proposed Action				
Affected Environment	**Construction**	**Operations**	**D&D**	**Accidents**
Air Quality	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2 and 4.1.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3 through 2.1.2.6, and 4.1.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.1.2	Sections A-1.2 and 4.1.2
Geology and Soils	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, 4.1.3.1, and 4.1.3.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.1.3.1, 4.1.3.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, 4.1.3.1, and 4.1.3.2	Sections A-1.2 4.1.3.1, and 4.1.3.2
Water Resources	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, 4.1.4.1, and 4.1.4.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, 4.1.4.1, and 4.1.4.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, 4.1.4.1, and 4.1.4.2	Sections A-1.2 4.1.4.1, and 4.1.4.2
Vegetation	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.2.1.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.2.1.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.2.1.2	Sections A-1.2 and 4.2.1.2
Wildlife	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.2.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.2.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.2.2	Sections A-1.2 and 4.2.2
Threatened and Endangered Species	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.2.3	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.2.3	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.2.3	Sections A-1.2 and 4.2.3
Unique/Sensitive Habitat	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.2.4	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.2.4	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.2.4	Sections A-1.2 and 4.2.4
LANL and Its Workers	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, 4.3.1	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.3.1	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.3.1	Sections A-1.2 and 4.3.1
Community and Population	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, 4.3.2.1, and 4.3.3	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, 4.3.2.1, and 4.3.3	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, 4.3.2.1, and 4.3.3	Sections A-1.2, 4.3.2.1, and 4.3.3
Cultural Resources	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.4.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.4.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.4.2	Sections A-1.2 and 4.4.2
Transportation	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.5.2	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.5.2	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.5.2	Sections A-1.2 and 4.5.2
Recreational Resources	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.6.1	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.6.1	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.6.1	Sections A-1.2 and 4.5.2
Aesthetic Quality	Sections 2.1.1.2, 2.1.1.3, 2.1.2.1, 2.1.2.2, and 4.7	Sections 2.1.1.4 through 2.1.1.7, 2.1.2.3, through 2.1.2.6, and 4.7	Sections 2.1.1.8, 2.1.1.9, 2.1.2.7, and 4.7	Sections A1.2 and 4.7

Table B-2 EID Impact Assessment Information Matrix Alternative 1 -No Action Alternative				
Affected Environment	**Construction**	**Operations**	**D&D**	**Accidents**
Air Quality	n/a	Sections 2.2.1 through 2.2.5, and 4.1.2	Sections 2.2.6 and 4.1.2	Sections A-1.3 and 4.1.2
Geology and Soils	n/a	Sections 2.2.1 through 2.2.5, 4.1.3.1, and 4.1.3.2	Sections 2.2.6, 4.1.3.1, and 4.1.3.2	Sections A-1.3, 4.1.3.1, and 4.1.3.2
Water Resources	n/a	Sections 2.2.1 through 2.2.5, 4.1.4.1, and 4.1.4.2	Sections 2.2.6, 4.1.4.1, and 4.1.4.2	Sections A-1.3, 4.1.4.1, and 4.1.4.2
Vegetation	n/a	Sections 2.2.1 through 2.2.5, and 4.2.1.2	Sections 2.2.6 and 4.2.1.2	Sections A-1.3 and 4.2.1.2
Wildlife	n/a	Sections 2.2.1 through 2.2.5, and 4.2.2	Sections 2.2.6 and 4.2.2	Sections A-1.3 and 4.2.2
Threatened and Endangered Species	n/a	Sections 2.2.1 through 2.2.5, and 4.2.3	Sections 2.2.6 and 4.2.3	Sections A-1.3 and 4.2.3
Unique/Sensitive Habitat	n/a	Sections 2.2.1 through 2.2.5, and 4.2.4	Sections 2.2.6 and 4.2.4	Sections A-1.3 and 4.2.4
LANL and Its Workers	n/a	Sections 2.2.1 through 2.2.5, and 4.3.1	Sections 2.2.6 and 4.3.1	Sections A-1.3 and 4.3.1
Community and Population	n/a	Sections 2.2.1 through 2.2.5, 4.3.2.1, and 4.3.3	Sections 2.2.6, 4.3.2.1, and 4.3.3	Sections A-1.3, 4.3.2.1 and 4.3.3
Cultural Resources	n/a	Sections 2.2.1 through 2.2.5, and 4.4.2	Sections 2.2.6 and 4.4.2	Sections A-1.3 and 4.4.2
Transportation	n/a	Sections 2.2.1 through 2.2.5, and 4.5.2	Sections 2.2.6 and 4.5.2	Sections A-1.3 and 4.5.2
Recreational Resources	n/a	Sections 2.2.1 through 2.2.5, and 4.6.1	Sections 2.2.6 and 4.6.1	Sections A-1.3 and 4.6.1
Aesthetic Quality	n/a	Sections 2.2.1 through 2.2.5, and 4.7	Sections 2.2.6 and 4.7	Sections A-1.3 and 4.7

Table B-3 EID Impact Assessment Information Matrix Alternative 2 - Retrofit				
Affected Environment	**Construction**	**Operations**	**D&D**	**Accidents**
Air Quality	n/a	Sections 2.3.2 through 2.3.6, and 4.1.2	Sections 2.3.7 and 4.1.2	Sections A-1.3 and 4.1.2
Geology and Soils	n/a	Sections 2.3.2 through 2.3.6, 4.1.3.1, and 4.1.3.2	Sections 2.3.7, 4.1.3.1, and 4.1.3.2	Sections A-1.3, 4.1.3.1, and 4.1.3.2
Water Resources	n/a	Sections 2.3.2 through 2.3.6, 4.1.4.1, and 4.1.4.2	Sections 2.3.7, 4.1.4.1, and 4.1.4.2	Sections A-1.3, 4.1.4.1, and 4.1.4.2
Vegetation	n/a	Sections 2.3.2 through 2.3.6, and 4.2.1.2	Sections 2.3.7 and 4.2.1.2	Sections A-1.3 and 4.2.1.2
Wildlife	n/a	Sections 2.3.2 through 2.3.6, and 4.2.2	Sections 2.3.7 and 4.2.2	Sections A-1.3 and 4.2.2
Threatened and Endangered Species	n/a	Sections 2.3.2 through 2.3.6, and 4.2.3	Sections 2.3.7 and 4.2.3	Sections A-1.3 and 4.2.3
Unique/Sensitive Habitat	n/a	Sections 2.3.2 through 2.3.6, and 4.2.4	Sections 2.3.7 and 4.2.4	Sections A-1.3 and 4.2.4
LANL and Its Workers	n/a	Sections 2.3.2 through 2.3.6, and 4.3.1	Sections 2.3.7 and 4.3.1	Sections A-1.3 and 4.3.1
Community and Population	n/a	Sections 2.3.2 through 2.3.6, 4.3.2.1, and 4.3.3	Sections 2.3.7, 4.3.2.1, and 4.3.3	Sections A-1.3, 4.3.2.1, and 4.3.3
Cultural Resources	n/a	Sections 2.3.2 through 2.3.6, and 4.6.1	Sections 2.3.7 and 4.6.1	Sections A-1.3 and 4.6.1
Transportation	n/a	Sections 2.3.2 through 2.3.6, and 4.5.2	Sections 2.3.7 and 4.5.2	Sections A-1.3 and 4.5.2
Recreational Resources	n/a	Sections 2.3.2 through 2.3.6, and 4.6.1	Sections 2.3.7 and 4.6.1	Sections A-1.3 and 4.6.1
Aesthetic Quality	n/a	Sections 2.3.2 through 2.3.6, and 4.7	Sections 2.3.7 and 4.7	Sections A-1.3 and 4.7

APPENDIX C

Existing Building TA-50-1 (RLWTF at TA-50) Non-Conformance with DOE Order 6430.1A, General Design Criteria

DOE Order 6430.1A provides general design criteria for DOE facilities. The criteria serve as a guideline for evaluating the existing RLWTF at TA-50 against current design practice.

Effluent Control and Monitoring (Section 1300-9)

- The concentration of radionuclides in the plant's liquid effluents routinely exceed the Derived Concentration Guides in DOE Order 5400.5, Appendix C.

Decontamination and Decommissioning (Section 1300-11.1)

- The walls, ceilings, and floors of the existing plant are not finished with washable or finishable coverings.

Nuclear Criticality Safety (Section 1323-3)

- The existing plant contains floor drains and other enclosures that could allow an un-monitored accumulation of fissile material capable of undergoing a chain reaction.

Collection Systems (Section 1323-4.2)

- Incoming wastestreams are not segregated to prevent chemical reactions and to prevent the introduction of chemical agents that could interfere with waste treatment.

Treatment Systems (Section 1323-4.4)

- The treatment system does not meet requirements for inherent volume reduction and waste minimization requirements.

Confinement Systems (Section 1323-5)

- The process system and the primary storage tanks are not designed to ensure structural integrity during an earthquake.

Non-Reactor Nuclear Facilities - General (Section 1530-99)

Fire protection systems and natural gas storage in the facility do not meet safety class equipment requirements.

The building structural shell and its associated ventilation system do not meet the retaining requirements for withstanding a fire.

The system lacks an emergency power source.

Limiting Public Exposure (Section 1300-1.4)

- Risk of public exposure from routine and accidental releases of airborne contaminants is excessive because of inadequate confinement systems.

- Open tanks are used in the treatment process, exposing contaminated waste to the atmosphere.

- Unsecured windows in the process area allow unfiltered air to be discharged to the environment.
- Building ventilation is not properly controlled and filtered between various control areas.
- Holding tanks are not equipped with filters and can release airborne contaminants to the environment.

Radiation Protection - Change Rooms (Section 1300-6.8)

- Change rooms in the existing plant do not provide proper segregation of personnel wearing protective clothing from those not wearing such clothing.
- Air exhausted from the change areas does not meet filtration requirements.

Confinement Systems - Transfer Pipes and Encasement (Section 1300-7.4)

- The plant is not equipped with double-walled pipes for leak protection. Existing pipes are not accessible for inspection.

APPENDIX D
Alternative Treatment Processes

Twelve process flow schemes were simulated representing process treatment train alternatives for the proposed RLWTF (Parsons 1992). These flow schemes were derived from an analysis of existing radioactive liquid waste treatment systems, interviews with experienced professionals, and a literature review. Screening criteria were used to eliminate treatment technologies not suitable for LANL radioactive liquid wastestreams. The treatment processes evaluated are given in Table D-1. The most suitable treatment technologies were then configured in process flow schemes most effective in treating LANL radioactive liquid wastestreams. At the present time, the preferred process flow scheme is the scheme addressed in the proposed action (Section 2.1.1.2).

Based on discussions with the Waste Management Group, alternative treatment technologies will be evaluated based on a wastestream characterization study currently being performed (Merrick & Company, in process). The study will evaluate the radioactive waste water collection system and the composition and quantity of radioactive liquid waste both currently generated and anticipated to be generated in the future. Based on the results of this study, treatment technologies will be evaluated further during the Conceptual Design Report phase for the proposed RLWTF project. Bench-scale and pilot-scale tests for the selected alternative treatment technologies will be performed.

Table D-1
Waste Treatment Processes Evaluated for Applicability to LANL Wastestreams

THERMAL TREATMENTS

- Incinerations
- Molten Salt Oxidation
- Pyrolysis
- Wet Air Oxidation
- Calcination
- Microwave Discharge
- Cement Kiln
- Lime Kiln

CHEMICAL TREATMENTS

- Absorption Mound/Field Aerobic Lagoon
- Absorption Bed/Columns
- Chemical Fixation*
- Chlorinolysis
- Chemical Oxidation
- Chemical Precipitation*
- Chemical Reduction*
- Chlorination
- Cyanide Destruction
- Ion Exchange*
- Neutralization*
- Ozonation*
- Photolysis
- Ultraviolet Radiation*

PHYSICAL SEPARATION OF COMPONENTS

Centrifugation	Flocculation*
Coagulation*	Sedimentation*
Clarification*	– Thickening*
Decanting*	– Ultrafiltration
Encapsulation	
Filtration*	
Flotation	
Foaming	

SANITARY WASTE/BIOLOGICAL TREATMENTS

Activated Sludge	Spray Irrigation
Thickening Filter	
Composting	Trickling Filter
Septic Tank	

PHYSICAL REMOVAL OF COMPONENTS

Activated Carbon	Sand Filter
Blending	Stripping
Catalysis	Solvent Recovery
Crystallization	
Distillation	
Electrodialysis	
Evaporation*	
High Gradient Magnetic Separation	
Leaching	
Liquid-Liquid Extraction	
Molecular Sieve Adsorption	
Reverse Osmosis	

* Process considered suitable for LANL wastes.

APPENDIX E
Biological Resource Tables

Table E-1
Climatic Zones and Plant Communities of North-Central New Mexico

Climatic Zone	Community	Typical Plant Species[1]
Upland		
Boreal Forests and Woodlands	Rocky Mountain Subalpine Conifer Forest and Woodland	Englemann spruce Corkbark fir
Cold Temperate Forest and Woodlands	Rocky Mountain Montane Conifer-Forest	Colorado spruce White fir Douglas fir Gambel oak Ponderosa pine
Great Basin	Conifer-Woodland	Piñon pine One-seed juniper Gambel oak
Arctic-Boreal Grassland	Rocky Mountain Alpine and Subalpine Grassland	Sedge-Forb mixture
Cold Temperate Grassland	Plains Grassland Community	Blue grama Western wheatgrass Galleta
	Great Basin Shrub Grassland	Wheatgrass Galleta Sagebrush Saltbush
	Rocky Mountain Montane Grassland	Thurber fescue Arizona fescue Mountain muhly Sedge

[1] Plant species listed are intended for general interpretation only and may not be present in all locations where these communities occur.

Table E-1 (cont.)

Climatic Zone	Community	Typical Plant Species[1]
Wetland		
Cold Temperate Swamp and Riparian Forest	Plains and Great Basin Riparian-Deciduous Forest	Fremont cottonwood Willow
	Rocky Mountain Riparian-Deciduous Forest	Narrowleaf cottonwood Willow Box elder
Arctic-Boreal Swamp-Scrub	Rocky Mountain Alpine Subalpine Swamp and Riparian-Scrub	Narrowleaf alder Sand bar willow Scouler willow
	Plains and Great Basin Riparian-Scrub	Willow Salt cedar
Arctic-Boreal Marshland	Rocky Mountain Alpine Sub-alpine Marshland	Rush
	Plains Interior Marshland	Cattail Bulrush
	Rocky Mountain Montane Marshland	Rush
Arctic-Boreal Strand	Rocky Mountain Alpine Subalpine Stream and Lake Strand	
Cold Temperate Strand	Rocky Mountain Alpine and Subalpine Stream and Lake Strand	

Source: LANL 1993b

[1] Plant species listed are intended for general interpretation only and may not be present in all locations where these communities occur.

Table E-2
Terrestrial Insects Potentially Occurring in the General Project Area

Order	Family	Common Name
Odonata	*Aeshnidae*	Darner
	Libellulidae	Common skimmer
	Coenagrionidae	Narrow-winged damselfly
Orthoptera	*Acrididae*	Short-homed grasshopper
	Gryllacrididae	Camel cricket
	Gryllidae	True cricket
Plecoptera	*Perlidae*	Common stonefliy
Dermoptera	*Forficulidae*	Common earwig
Hemiptera	*Belostomatidae*	Giant water bug
	Miridae	Plant bug
	Reduviidae	Assasin bug
	Phymatidae	Ambush bug
	Lygaeidae	Seed bug
	Cydnidae	Burrower bug
	Scutelleridae	Shield-backed bug
	Pentatomidae	Stink bug
Homoptera	*Cicadidae*	Cicadas
Neuroptera	*Myrmeleontidae*	Ant lions
Coleoptera	*Cicindelidae*	Tiger beetle
	Carabidae	Ground beetle
	Silphidae	Carrion beetle
	Elateridae	Click beetle
	Staphylinidae	Rove beetle
	Anthicidae	Antlike flower beetle
	Lampyridae	Firefly
	Cantharidae	Soldier beetle
	Lycidae	Net-winged beetle
	Buprestidae	Metallic wood-boring beetle
	Erotylidae	Pleasing fungus beetle
	Coccinellidae	Ladybird beetle
	Tenebrionidae	Darkling beetle

Table E-2 (cont.)

Order	Family	Common Name
Coleoptera	*Meloidae*	Blister beetle
	Cerambycidae	Long-horned beetle
	Lucanidae	Stag beetle
	Scarabaeidae	Scarab beetle
	Chrysomelidae	Leaf beetle
	Curculiouidae	Weevils
Lepidoptera	*Papilionidae*	Swallowtail butterfly
	Pieridae	Whites, sulphurs, and orange butterfly
	Nymphalidae	Brush-footed butterfly
	Satyridae	Satyr, nymph, and arctic butterfly
	Saturniidae	Giant silkworm moth
	Pterophoridae	Plume moth
Diptera	*Tabanidae*	Horsefly and deer fly
	Therevidae	Stiletto fly
	Asilidae	Robber fly
	Bombyliidae	Bee fly
	Syrphidae	Hover fly
	Tachinidae	Tachinid fly
Hymenoptera	*Ichneumonidae*	Ichneumonid wasp
	Cynipidae	Gall wasp
	Mutillidae	Velvet ant
	Scoliidae	Scoliid wasps
	Formicidae	Ant
	Pompilidae	Spider wasp
	Vespidae	Vespid wasp
	Apidae	Honey bee
	Sphecidae	Sphecid wasp
	Halictidae	Metallic bee
	Tiphiidae	Tiphiid wasp
	Megachilidae	Leaf-cutting bee

Source: LANL 1993b

Table E-3
Bird Species Recorded and Associated Habitat in Cañada del Buey 1990

Species	Habitat		
	*Mixed Conifer	*Piñon/ Juniper	*Ponderosa Pine
American Robin	X		X
Ash-throated flycatcher		X	X
Bewick's wren		X	X
Black-headed grosbeak	X	X	X
Blue-gray gnatcatcher		X	X
Broad-tailed hummingbird	X	X	X
Brown-headed cowbird	X	X	X
Canyon wren		X	X
Chipping sparrow		X	X
Common nighthawk	X		
Common raven			X
Grace's warbler	X		
Gray flycatcher		X	
Hairy woodpecker		X	X
Hammond's flycatcher	X		X
Hermit thrush	X		
House finch		X	
House wren	X		X
Lesser goldfinch		X	X
Mountain chickadee	X		X
Mourning dove		X	
Northern flicker	X	X	
Plain titmouse		X	X
Pygmy nuthatch		X	X
Red crossbill	X		
Red-tailed hawk		X	
Rock wren			X
Rufous-sided towhee	X	X	X

Table E-3 (cont.)

Species	Habitat		
	*Mixed Conifer	*Piñon/ Juniper	*Ponderosa Pine
Solitary vireo		X	X
Stellar's Jay		X	
Turkey vulture		X	
Violet-green swallow	X	X	X
Western bluebird		X	X
Western tanager	X		X
Western wood peewee	X	X	X
White-breasted nuthatch	X	X	X
Yellow-bellied sapsucker			X

Source: LANL 1993b

Table E-4
Pinon-Juniper Mesa-Top Habitat Bird Species Identifed in 1988 and1991—1992

Species identified during 1988

American robin
Ash-throated flycatcher
Broad-tailed hummingbird
Brown-headed cowbird
Chipping sparrow
Clark's nutcracker
Common bushtit
Gray flycatcher
House finch
Lesser goldfinch
Mountain chickadee
Northern flicker
Plain titmouse
Pygmy nuthatch
Rufous-sided towhee
Scrub jay
Violet-green swallow
Virginia warbler
Western bluebird
Western wood peewee
White-breasted nuthatch
White-tailed swallow
Yellow-rumped warbler
nuthatch

Species identifed during 1991 and 1992

Acorn woodpecker
American kestrel
American robin
Ash-throated flycatcher
Bewick's wren
Blue-gray gnatcatcher
Black-headed grosbeak
Brown-headed cowbird
Brown creeper
Broad-tailed hummingbird
Bushtit
Canyon towhee
Canyon wren
Chipping sparrow
Clark's nutcracker
Cooper's hawk
Common raven
Dark-eyed junco
Dusky flycatcher
Gray flycatcher
Grace's warbler
Green-tailed towhee
Hammond's flycatcher
Hairy woodpecker
Hepatic tanager
Hermit thrush
House finch
House wren
Hummingbird
Lark sparrow
Lesser goldfinch
Mountain chickadee
Mourning dove
Northern flicker
Piñon jay
Pine siskin
Plain titmouse
Pygmy nuthatch
Ruby-crowned kinglet
Red crossbill
Rock wren
Rufous-sided towhee
Red-tailed hawk
Say's phoebe
Scrub jay
Solitary vireo
Steller's jay
Townsend's solitaire
Turkey vulture
Violet-green swallow
Virginia's warbler
Warbling vireo
White-breasted
Western bluebird
Western tanager
Williamson's sapsucker
Wilson's warbler
Western wood-pewee
Yellow-rumped warbler

Source: LANL 1993b

Table E-5
Small Mammal Survey Result from Cañada del Buey and Mesita del Buey

Small Mammal Species	Cañada del Buey	Mesita del Buey
Deer mouse	23.0	8.0
Piñon mouse	0.3	0.4
Brush mouse	0.1	0
Peromyscus s pp.	0.1	0
Chipmunk	0.9	2.0
Long-tailed vole	0.2	0
Western harvest mouse	0.2	1.0

Source: LANL 1993b

Table E-6
Small Mammal Species Captured Around the Outfall in Mortandad Canyon in 1992

Common Name	Scientific Name
Least chipmunk	*Eutamias minimus*
Colorado chipmunk	*Eutamias quadrivatattus*
Long-tail vole	*Microtus longicaudus*
White-throated woodrat	*Neotoma albigula*
Mexican woodrat	*Neotoma mexicana*
Brush mouse	*Peromyscus boylii*
Deer mouse	*Peromyscus maniculatus*

Source: LANL 1993b

Table E-7
Regulated Plant and Wildlife Species within Los Alamos County

Species	Status[1]	General Habitat	Confirmed in county?
Plant			
Wright fishhook cactus (*Mammillaria wrightii*)	SE	Piñon-Juniper; 3000-7000	No
Dagger-thorn cholla (*Opuntia clavata*)	SS	Juniper-Grassland; 6000-8000 ft	No
Santa Fe cholla (*Opuntia viridiflora*)	SE, Federal C2	Piñon-Juniper; 7200-8000 ft	No
Grama grass cactus (*Toumeya papyracantha*)	SE Federal C2	Piñon-Juniper; 5000-7300 ft	Yes
Sessile-flowered false carrot (*Aletes sessiliflorus*)	SS	Piñon-Juniper; 6500-8100 ft	No
Plain thistle (*Cirsium inornatum*)	SS	Mountain slopes; 7500-9000 ft	No
Threadleaf horsebrush (*Tetradymia filifolia*)	SS	Piñon-Juniper; 6000-7000 ft	No
Alpine bluebell (*Mertensia viridis*)	SS	Mountain slopes; 12000-13000 ft	No
Plank's catchfly (*Silene plankii*)	SS	Piñon-Juniper; 5000-6000 ft	No
Cyanic milk-vetch (*Astragalus cyaneus*)	SS	Piñon-Juniper; 5500-6500 ft	No
Santa Fe milk-vetch (*Astragalus feensis*)	SS	Piñon-Juniper; 5000-6500 ft	No
Spiny-leaf milk-vetch (*Astragalus kentrophyta*)	SS	Juniper-Grassland ; 5300-6900 ft	No
Matthew's woolly milk-vetch (*Astragalus mollissimus*)	SS	Piñon-Juniper; 5000-6000 ft	No
Taos milk-vetch (*Astragalus puniceus*)	SS	Piñon-Juniper; 7000-? ft	No
La Jolla prairie clover (*Dalea scariosa*)	SS	Juniper-Grassland 4900-5300 ft	No
Checker lily (*Fritillaria atropurpurea*)	SS	Mixed-conifer	Yes
Wood lily (*Lilium philadelphicum* var. *andium*)	SE	Mixed-conifer 6000-10,000 ft	Yes

TABLE E-7 (cont.)

Species	Status[1]	General Habitat	Confirmed in county?
Plant			
Wild hollyhock (*Iliamna grandiflora*)	SE	Mountain slopes 7000-11000 ft	No
Tufted sand verbena (*Abronia bigelovii*)	SS	Piñon-Juniper 6000-? ft	No
Helleborine orchid (*Epipactis gigantea*)	SE	Riparian zones	Yes
Pagosa phlox (*Phlox caryophylla*)	SS	Ponderosa-Piñon 6500-7500 ft	No
Sandia alumroot (*Heuchera pulchella*)	SS	Mixed-conifer 8000-12000 ft	No
Wildlife			
Western toad (*Bufo boreas*)	SE Group 2	Lakes; ponds	No
Jemez Mountains salamander (*Plethodon neomexicanus*)	SE Group 2	Spruce-fir 7225-9250 ft	Yes
Northern goshawk (*Accipiter gentilis*)	Candidate	Ponderosa pine	Yes
Common black hawk (*Buteogallus anthracinus*)	SE Group 2	Riparian zones; lower elevations	No
Bald eagle (*Haliaeetus leucocephalus*)	SE Group 2, FE	Riparian zones	Yes
Baird's sparrow (*Ammodramus bairdii*)	SE Group 2, FE	Juniper-Grassland	No
Mississippi kite (*Ictinia mississippiensis*)	SE Group 2	Riparian zones, shelter belt, manicured areas	No
Peregrine falcon (*Falco peregrinus* var. *anatum*)	SE Group 1, FE	Ponderosa-Piñon	Yes
Whooping crane (*Grus americana*)	SE Group 2, FE	Rivers-streams	Yes
Least tern (*Sterna antillarum*)	SE Group 1, FE	Rivers-streams	No
White-tailed ptarmigan (*Lagopus leucurus*)	SE Group 1	Tundra	No
Mexican spotted owl (*Strix occidentalis lucida*)	Candidate	Mixed-conifer	No
Broad-billed hummingbird (*Cynanthus latirostris*)	SE Group 2	Riparian zones	Yes

TABLE E-7 (cont.)

Species	Status[1]	General Habitat	Confirmed in county?
Wildlife			
Willow flycatcher (*Empidonax traillii*)	SE Group 2 Candidate	Riparian zones 3700-8900 ft	No
Gray vireo (*Vireo vicinior*)	SE Group 2	Juniper-Grassland	No
Rio Grande silvery minnow (*Hybognathus amarus*)	SE Group 2	Rivers; streams	No
Bluntnose shiner (*Notropis simus*)	SE Group 1	Rivers; streams	No
Pine marten (*Martes americana*)	SE Group 2	Spruce-fir	No
Spotted bat (*Euderma maculatum*)	SE Group 2, FNR	Varies; usually near water	No
Meadow jumping mouse (*Zapus hudsonius*)	SE Group 2, FNR	Wetland	Yes
Say's pond snail (*Lymnaea caperata*)	SE Group 1	Wetland; 3700-8600 ft	No
Lilljeborg's pea-clam (*Pisidium lilljeborgi*)	SE Group 2	Lakes, ponds	No

Source: BRET team database for threatened, endangered, and sensitive species.

[1]**Codes for Legal Status**

SS = State Sensitive: New Mexico listed species which are considered rare becuse of restricted distribution or low numerical density; they are sensitive to long-term or cumulative land use impact and are vulnerable to biological or climatic event.
SE = State Endangered: "...any species or subspecies whose prospect of survival or recruitment in New Mexico are (or)...are likely to be (within the foreseeable future) in jeopardy" (NMDGF, State Commission, Reg. No. 682, 1990). **Group 1:** state protected endangered species, **Group 2:** state protected threatened species.
FC = Federal Candidate: "...[any species] for which the USFWs has on file enough substantial information on biological vulnerability and threat, (or) for which other information now in the possession for the USFWS indicates that proposing to list them as threatened or endangered is possibly appropriate..."(Federal Register Vol. 56, No. 255).
FE = Federal Endangered: "Any species that is in danger of extinction throughout all or a significant portion of it range..." (Federal Register Vol. 56, No. 255).
FNR = Federal Notice of Review

Table E-8
National Wetland Inventory Characterizaton Codes

Wetland Code	Wetland Characteristic
PEM1B	Palustrine Emergent, Persistent, Saturated
PEM1C	Palustrine Emergent, Persistent, Seasonally Flooded
PFC1A	Palustrine, Temporarily Flooded
PFO1A	Palustrine, Forested, Temporarily Flooded
PSS1A	Palustrine, Shrub-Shrub, Broad-Leaved Deciduous, Temporarily Flooded
PSS1B	Palustrine, Shrub-Shrub; Broad-Leaved Deciduous, Saturated
PSS1CX	Palustrine, Shrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded
PUBKHX	Palustrine, Unconsolidated Bottom, Permanently Flooded
R2UBH	Riverine, Lower Perennial, Unconsolidated Bottom, Mud, Permanently Flooded
R2UB4H	Riverine, Lower Perennial, Unconsolidated Bottom, Organic, Permanently Flooded
R2USA	Riverine, Lower Perennial, Unconsolidated Shore, Temporarily Flooded
R2USC	Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded
R4SBA	Riverine, Intermittent, Streambed, Temporarily Flooded
R4SBKC	Riverine, Intermittent, Streambed, Saturated, Artificially/Seasonally Flooded

Source: Regional Director (ARDE) Region II, U.S. Fish and Wildlife Service