# 3.0 OVERVIEW OF THE AFFECTED ENVIRONMENT

*This chapter discusses the regional and local setting associated with the land tracts being considered for conveyance or transfer. Each aspect of the environment or resource area (for example, air quality, water resources) is discussed in Section 3.2 of this chapter.*

## 3.1 Introduction

Because most of the subject tracts are currently part of LANL, the discussion of the regional and local settings for the tracts is tiered to the discussions contained in the LANL SWEIS (DOE 1999c). The exceptions are the Rendija Canyon and the Miscellaneous Manhattan Monument Tracts, which, while administered by the DOE, are not part of LANL, and therefore, were not discussed in the LANL SWEIS. Each resource area summarizes and references the LANL SWEIS where additional data and references can be found. The discussion of each resource area concentrates on those elements that are relevant to the tracts. Additional LANL information is available in annual Environmental Surveillance Reports, which are posted on the LANL web site (http://lib-www.lanl.gov/pubs/Environment.htm).

## 3.2 Regional and Local Setting

### *3.2.1 Land Use*

Los Alamos is located in a region of north-central New Mexico where the very old and very new adjoin. The active Pueblos of Native Americans, the ruins of prehistoric Indian cultures, and old high-mountain Hispanic villages highlight the natural setting and features of the land. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east and contains Santa Fe, the oldest capital city in the nation (see Figure 3.2.1-1). This predominantly undeveloped area supports land uses that range from the protected wilderness areas of Bandelier National Monument (BNM) and Santa Fe National Forest, to the research and development activities carried out at LANL. The LANL facility, located in Los Alamos and Santa Fe Counties, rests on the Pajarito Plateau on the eastern slope of the Jemez Mountains.

Los Alamos County (the County) encompasses approximately 70,400 acres (28,500 hectares). LANL occupies an area of approximately 27,832 acres (11,272 hectares), or 43 square miles (111 square kilometers) of which 86 percent (23,951 acres or 9,700 hectares) lies within Los Alamos County. The remaining 14 percent of LANL lies within Santa Fe County. Los Alamos County, the DOE, U.S. Forest Service (USFS), and National Park Service (NPS) represent the four major governmental bodies that determine land use and provide stewardship of the land within Los Alamos County. In addition, the State of New Mexico, the Bureau of Land Management, and several Native American Pueblos also provide stewardship of additional lands located near Los Alamos.

Land uses on these properties include the following:

- **Los Alamos County.** 29 percent of County land is dedicated to land use associated with the Los Alamos townsite; another 26 percent lies within the community of White Rock where uses range from residential to commercial and retail development; the remaining 45 percent of county

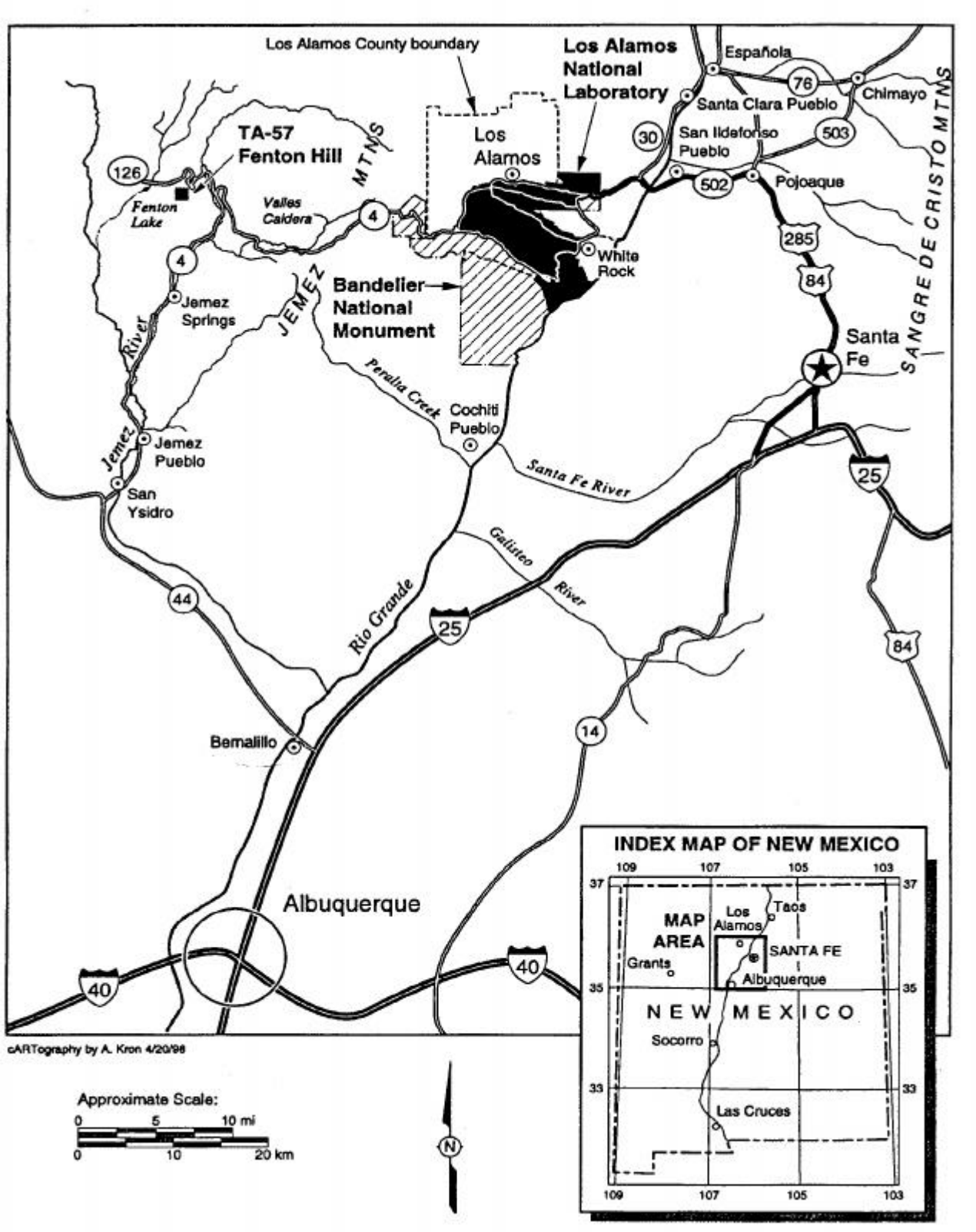


**Figure 3.2.1-1. Location of the Los Alamos National Laboratory.**

land is undeveloped and dedicated to recreational uses and open space (DOE 1999c).

- **U.S. Department of Energy.** Land use is based primarily on the support, research and development (R&D), R&D waste disposal, explosives waste disposal, and buffer land activities associated with LANL (DOE 1999c).
- **U.S. Forest Service.** Management of the Santa Fe National Forest is directed toward the wise use of land and resources in order to provide optimum long-term public benefits. Guided by the principles of multiple use and sustained yield, the Santa Fe National Forest strives to meet the needs and desires of present and future generations. Existing uses of the Santa Fe National Forest lands in the vicinity of the 10 subject land tracts include tourism; mining; recreational activities, including hiking, hunting, fishing, camping, climbing, and skiing; and other traditional uses such as firewood gathering and tree cutting for vigas and latillas.
- **National Park Service.** Land use activities at BNM in the vicinity of the 10 subject land tracts are dominated by resource management and tourism. BNM consists of two units under the responsibility of the NPS. The larger unit, which is located south of the Los Alamos townsite, is the primary destination for the park's 440,000 annual visitors and includes park headquarters, campgrounds, employee residences, and a visitor center. Seventy percent of this unit is legislated wilderness. The second unit, Tsankawi, is located to the east of Los Alamos, across State Road (SR) 4 from Technical Area (TA) 74 and White Rock Y Tracts. Tsankawi is essentially undeveloped and is visited for its solitude and the opportunity for visitors to explore the archeological resources. Both units contain the cultural remains of present day Pueblo people whose ancestors had occupied the area for centuries. BNM has a legislated mandate to protect the natural and cultural resources of these lands, and to provide for visitor enjoyment and education.
- **State of New Mexico.** Land use on State lands is recreational, based primarily on open space (DOE 1999c).
- **Native American Pueblos.** Lands of the Pueblo of San Ildefonso are located adjacent to the communities of Los Alamos and White Rock, and share the eastern border of LANL in Santa Fe and Sandoval Counties. Land use is based on a mixture of residential use, gardening and farming, cattle grazing, hunting, fishing, food and medicinal plant gathering, firewood production, and general cultural and resource protection. Other Native American lands are located in Sandoval, Santa Fe, and Rio Arriba Counties and have similar uses, together with some commercial and light industrial land use (DOE 1999c).

Land use in Los Alamos County and in the overall region is linked to the economy of northern New Mexico and depends heavily on tourism, recreation, and the State and Federal Governments for its economic base. Area communities are generally small, such as the Los Alamos townsite with approximately 12,000 residents. These communities primarily support residential, commercial, and light industrial land uses. Recreational resources such as hiking trails, cliff faces, parks, and athletic facilities are abundant in the County and highly valued by the residents of local communities (Figure 3.2.1-2).

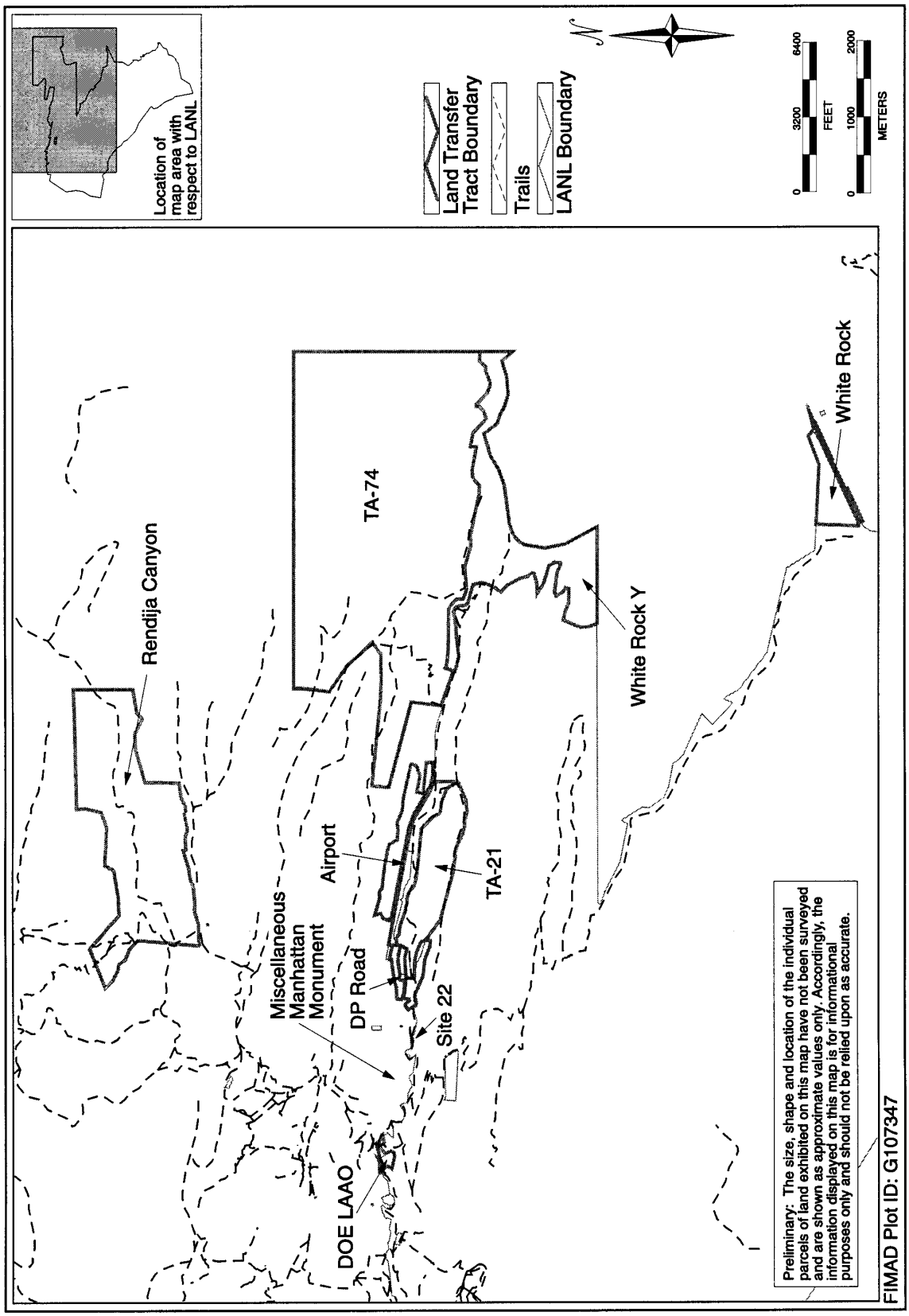


**Figure 3.2.1-2. Recreational Trails in the Los Alamos Area.**

#### 3.2.1.1 Environmental Restoration

The Environmental Restoration (ER) Project at LANL was established by the DOE in 1989 to assess and remediate sites that were known or suspected to be contaminated because of historical operations and that either were or still are under DOE control. By 1992, the ER Project had reviewed existing historical records and interviewed long-time employees, which resulted in the identification of approximately 2,120 of such sites, called "potential release sites" (PRSs). LANL's PRSs are diverse and include historically used material disposal areas (MDAs), canyons, outfalls, drain lines, firing sites, industrial sites, and miscellaneous other sites, such as locations of historic spills. By 1994, detailed work plans were being implemented to characterize LANL's PRSs in accordance with the requirements of the U.S. Environmental Protection Agency's (EPA) *Resource Conservation and Recovery Act* (RCRA) and Hazardous and Solid Waste Amendments (HSWA) regulations governing the cleanup of hazardous wastes.

In 1996, the DOE Office of Environmental Management initiated a complex-wide strategy to accelerate site cleanup and enhance performance of the cleanup program. In particular, the strategy focuses on completing work at as many sites as possible by the end of fiscal year 2006. Known as *Accelerating Cleanup: Paths to Closure* (DOE 1998c), the plan includes input from all major field sites, including LANL, to support the Office of Environmental Management's program planning process.

As of September 1998, the LANL ER Project was in some phase of characterization for more than 1,100 PRSs and had reported results on 774 of these PRSs. In addition, the ER Project had conducted cleanups at 120 sites and had recommended 822 sites for no further action (NFA) to the DOE and an additional 586 such sites to New Mexico Environment Department (NMED). The DOE has concurred with 425 such recommendations at the sites over which it has oversight authority, and the NMED has concurred with 102 recommendations and removed 99 sites from Module VIII of LANL's RCRA permit. The DOE currently estimates that most environmental restoration activities at LANL will be completed by 2008.

In addition to remediating LANL's PRSs, the ER Project encompasses another important component: decontamination and decommissioning (D&D) of DOE facilities that are contaminated as a result of historical operations and are considered to be surplus. Since 1990, more than 40 such structures have been decommissioned. Approximately 100 additional structures have been slated for D&D in the future, on a schedule determined annually on the basis of budget allocations. Unlike the component of the ER Project related to PRSs, which has a projected year of completion, D&D activities are expected to be ongoing throughout the life of LANL.

**Environmental Restoration Activities Associated with the Land Transfer Parcels**

There are about 200 PRSs and about 150 DOE structures located within the 10 parcels tentatively identified by the DOE for conveyance and transfer[1]. One of the parcels, the Miscellaneous Manhattan Monument Tract, has no PRSs associated with it and, consequently, the environmental restoration issues associated with it are minimal. At the other end of the spectrum, the TA 21 Tract contains 154 of the 200 PRSs and 125 of the 152 structures. The environmental restoration issues associated with this parcel are the most complex and will be the most costly of all of the tentatively proposed land transfer parcels. Certain of the other parcels, including the

[1] Additional structures may be present onsite that do not belong to the DOE. The total number of PRSs, buildings, and structures on each tract may change when the tract boundaries are surveyed.

Rendija Canyon Tract, the White Rock Y Tract, the White Rock Tract, and the TA 74 Tract, are situated within one or more canyon drainage systems and could, potentially, have been the recipients of contaminant migration in the past from mesa top or up-canyon locations.

Table 3.2.1.1-1 summarizes the number of PRSs and structures located in each parcel, and identifies other important issues related to LANL ER Project activities.

The issues associated with each of the 10 parcels are presented in detail in Appendix B of this CT EIS, as are the DOE's estimates of total remediation and decommissioning durations.

**Environmental Restoration Worker Health and Safety**

Environmental restoration activities, which include D&D activities, are undertaken with the intent of reducing the long-term public and worker health and safety risks associated with contaminated sites or with surplus facilities and to reduce risk posed to ecosystems.

Environmental restoration cleanup workers are often the most vulnerable to hazardous exposure and risk. Such workers are frequently engaged in activities that involve radioactive and toxic wastes and under conditions that are conducive to industrial accidents. Protection of worker health and safety is built into the planning of each cleanup project. Decisions regarding whether and how to undertake an environmental restoration action are made after a detailed assessment of the short-term and long-term risks and benefits for options specific to the site in question, and, at LANL, they are made primarily within the framework of the RCRA.

Environmental restoration activities can involve heavy equipment, trenches and other excavations, solvents and other chemicals, and other hazards. Worker health and safety risks are mitigated with work plans, safety

**Table 3.2.1.1-1. Summary of Environmental Restoration Sites and Issues Tentatively Identified for Land Transfer Tracts**

| TRACT | NUMBER OF POTENTIAL RELEASE SITES | NUMBER OF DOE BUILDINGS AND STRUCTURES[a] | OTHER ENVIRONMENTAL RESTORATION ISSUES |
|---|---|---|---|
| Rendija Canyon | 4 | 0 | None |
| DOE LAAO | 3 | 2 | None |
| Miscellaneous Site 22 | 0 | 1 | Construction debris |
| Miscellaneous Manhattan Monument | 0 | 1 | None |
| DP Road | 10 | 9 | Canyon contamination |
| TA 21 | 154 | 125 | Canyon contamination |
| Airport | 25 | 4 | Canyon contamination |
| White Rock Y | 0 | 6 | Canyon contamination |
| TA 74 | 4 | 3 | Canyon contamination |
| White Rock | 0 | 1 | Canyon contamination |

[a] The number of buildings and structures presented in the Environmental Restoration Report (DOE 1999b) has been slightly modified where possible to exclude structures that are temporary in nature or that do not belong to the DOE.

programs, protective equipment, and similar administrative, education, and physical protection measures.

Because there are no individual or specific environmental restoration actions that have reached a stage where specific remediation work plans, methodologies, tasks, or labor-hour estimates have been developed, any impact analyses of these actions can only be presented in general terms at this time. The short-term risks and controls associated with the environmental restoration activities include the following:

- **Fugitive Dust.** The amount of material suspended in air and the associated risk to human health and the environment is controlled by frequently wetting the ground at the cleanup site.
- **Surface Runoff.** The potential for contaminant transport by surface water flow off of a cleanup site is controlled by collection, flow barriers, or contouring the ground.
- **Soil and Sediment Erosion.** This potential risk is minimized by covering cleanup sites with tarps during storm events.

The environmental restoration activities associated with these tracts are part of the totality of future environmental restoration activities discussed in the LANL SWEIS (DOE 1999c). The risks associated with the transport, treatment, storage and disposal of this waste are included in the LANL SWEIS analyses (in particular, refer to Sections 3.1.14, 3.1.15, 3.2.14, 3.2.15, 3.3.14, 3.3.15, 3.4.14, 3.4.15, 3.6.3.1, 5.2.9, 5.3.9, 5.4.9, and 5.5.9 of the LANL SWEIS).

### *3.2.2 Transportation*

Two state roads, SR 501 and SR 502, serve the County and the immediate LANL area. SR 501, also known as West Jemez Road, enters the region from the south. SR 502 enters the region from the east. SR 4 is a state road that loops around the region to the south and east (see Figure 3.2.1-1).

SR 501 branches north from SR 4 about 5 miles (8 kilometers) southwest of Los Alamos, while SR 4 intersects with SR 502 approximately the same distance east of Los Alamos. South from Española, SR 30 also joins SR 502 approximately 2 miles (3 kilometers) east of the SR 502 and SR 4 intersection and approximately 8 miles (13 kilometers) west of the U.S. 84 and U.S. 285 interchange. Two other roads enter from the east and also provide access to SR 4: East Jemez Road, the designated truck route for entering Los Alamos, and Pajarito Road (Figure 3.2.1-1).

Due to the relative remoteness of LANL and its location on the top of the Pajarito Plateau, the roads into the region have some sharp curves. Although improved in recent years, SR 502 is a winding, rather steep, two- to five-lane highway as it rises up from the canyon floor. Prior to the ascent up the canyon to the mesa, SR 502 is a four- and five-lane road. The other roads into the area, SR 501, East Jemez Road, and Pajarito Road are all two-lane roads.

In general, the traffic into the region is light, although there are substantial peaks in traffic flows due to employment at LANL. A significant number of LANL employees living in White Rock, Española, Jemez Springs, and elsewhere contribute to the traffic levels entering the region during the peak hours of the morning and evenings. Traffic during the noon hour also is dense. Although this causes heavy localized congestion, this congestion is generally experienced for only a limited duration (less than 30 minutes). This localized congestion is inconvenient and frustrating to motorists; however, it would be difficult to justify significant system-wide improvements when the transportation system operates satisfactorily the vast majority of the time.

The SR 4 and SR 502 intersection was reconstructed recently as a grade-separated interchange to accommodate the volume of traffic entering and exiting the region via this intersection.

Although the transportation network near each of the subject tracts may have additional lanes in some areas, the carrying capacity of the roadway is limited to the number of cars that can be accommodated on the narrowest section of road. For instance, SR 502 is a five-lane highway in one section prior to the interchange with SR 4; however, as SR 502 climbs the mesa into Los Alamos it is only a two-lane road. The capacity of SR 502 is therefore limited to the available capacity of the two-lane section even though it could carry significantly more traffic near the interchange.

### *3.2.3 Infrastructure*

Utility systems at LANL and Los Alamos County include electricity service, natural gas, water, sanitary wastewater, and solid waste. Ownership and distribution of these services are split between the DOE and the County and are summarized below for each utility system.

Electricity service comes from the Los Alamos power resource pool and is delivered to LANL and the communities of White Rock and Los Alamos via two regional 115-kilovolt transmission lines. The installation of an additional transmission line is under consideration currently by DOE (see Chapter 1, Section 1.5.4). This third line would split the existing power between three lines instead of two to increase reliability and could be adapted to provide additional delivery capacity when new power sources become available. A steam/power plant at LANL's TA 3 can generate additional power on an as-needed basis. There also are hydroelectric facilities at Abiquiu and El Vado Reservoirs.

The natural gas system includes a DOE-owned high-pressure main, a distribution system, and pressure reducing stations to LANL facilities. The County owns the gas distribution systems to the Los Alamos townsite and White Rock.

The water system includes supply wells, water chlorination and pumping stations, storage tanks, and distribution piping. The DOE is currently in the process of transferring ownership of water rights, wells, rights-of-way, and distribution equipment to the County. Following transfer, the County would generally own all water production and distribution facilities except distribution systems within LANL technical areas. For a detailed discussion of the transfer of water rights to the County, see Section 3.2.3.1.

The Sanitary Wastewater Systems Consolidation (SWSC) Plant handles wastewater from most LANL buildings. The County-owned Bayo Wastewater Treatment Plant and White Rock Wastewater Treatment Facility handle sewage for the Los Alamos townsite and White Rock, respectively. Solid waste from LANL and the County is disposed at the DOE-owned, County-operated landfill. The landfill also receives waste from the City of Española. Santa Clara Pueblo has petitioned to send their solid waste to the DOE landfill and is awaiting approval from the DOE. The County has decided to close the current landfill and is planning the development of a new regional solid waste facility (PC 1999c).

Table 3.2.3-1 shows the current annual usage of utilities by LANL and the County and the existing system capacity. For more detailed information on LANL utilities and infrastructure, please refer to the LANL SWEIS, Section 4.9.2 (DOE 1999c).

#### 3.2.3.1 LANL and Los Alamos County Water Rights

Until September 8, 1998, the DOE supplied all potable water for LANL, BNM,

## Table 3.2.3-1. Annual Usage and Capacity of Utilities

| | PEAK POWER mw | ELEC. gwh/yr | GAS mcf (mly) | WATER mgy (mly) | | SEWAGE mgy (mly) | | | SOLID WASTE tpy (mty) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | COUNTY | LANL | SWSC | BAYO | WHITE ROCK | |
| System Limits[a] | 107 | 937 | 8,100 (229,400) | 1,260[b] (4,770) | 540 (2,044) | 220 (833) | 500 (1,893) | 300 (1,136) | None |
| Baseline Usage | | | | | | | | | |
| LANL[c] | 95 | 628 | 2,020 (57,200) | --- | 693[d] (2,624) | 187 (708) | --- | --- | 2,860 (2,600) |
| County + BNM | 14 | 94 | 1,040 (29,500) | 963 (3,645) | --- | --- | 365 (1,382) | 146 (553) | 15,990 (14,500) |
| Total | 109 | 722 | 3,060 (86,700) | 963 (3,645) | 693 (2,624) | 187 (708) | 365 (1,382) | 146 (553) | 18,850 (17,100) |
| Remaining Capacity | -2 | 215 | 5,040 (142,700) | 297 (1,125) | -153(-579) | 33 (125) | 135 (511) | 154 (583) | 7 years[e] |

**Notes:** mw = megawatts, gwh = gigawatt-hours, mcf = million cubic feet, mgy = million gallons per year, mly = million liters per year, tpy = tons per year, mty = metric tons per year

[a] For electricity, this is the sum of the contractual import limits and onsite generation; for gas, this is the contract limit; for sewage, this is the design limit of the system; for water, this is the legal water rights.

[b] Does not include Los Alamos County's rights to 391 mgy (1,400 mly)of San Juan-Chama River water, for which there is currently no mechanism for delivery.

[c] Projected usage from the LANL SWEIS No Action Alternative. Figures reflect a decrease in the anticipated peak power usage of the Low Energy Demonstration Accelerator (LEDA) Project.

[d] Includes 20 mgy (75 mly) of water use for Strategic Computing Complex (SCC). The SWEIS assumes 100% of SCC water needs will be met with treated wastewater. Here, it is assumed that only 2/3 of the water needs will be met with wastewater, and the other 1/3 will come from fresh water.

[e] Expected life of the landfill at current solid waste generation rates.

and Los Alamos County, including the towns of Los Alamos and White Rock. On that date, the DOE leased or conveyed portions of its water production and distribution system to the County of Los Alamos. The delineation between County and the DOE's water rights, production, and distribution system under this agreement is essentially as follows: the lease of the Los Alamos Water Production System, including all water distribution lines up to the main distribution point at the boundary of each TA; the lease of surface and groundwater rights amounting to 5,541.3 acre feet (1,805 million gallons [or 6,833 million liters]) of water per year (DOE 1999c, Section 4.9.2.1); and the conveyance of DOE's contracted annual right obtained in 1976 to 1,200 acre feet (391 million gallons [or 1,480 million liters]) of San Juan-Chama Transmountain Diversion Project water (DOE/LAC 1998a). Neither the DOE nor the County has constructed a delivery system for the San Juan-Chama River waters from El Vado Lake and Abiquiu reservoirs to the County or LANL. The lease agreement "shall terminate on the earlier of the 7th day of September, 2001 or upon delivery by the Government of a quitclaim deed conveying the Leased Premises to the Lessee." The ultimate intent, pending indemnification, is for the DOE to convey to Los Alamos County 70 percent of the DOE water right and lease to Los Alamos County the remaining 30 percent. Per the lease agreement, the DOE would have purchase rights from the County for the 30 percent of the water right.

On several occasions since 1986 through 1998, LANL operations have exceeded 30 percent of the total DOE annual water right (not including San Juan-Chama Transmountain Diversion Project water). The agreement between the DOE and the County does not preclude provision of additional waters in excess of the 30 percent agreement, if available. However, the agreement states that should the County be unable to provide water to its customers, then the County shall be entitled to reduce water services to the DOE in an amount equal to the water rights deficit (DOE/LAC 1998b).

### 3.2.4 Noise

Noise is traditionally defined as unwanted sound. Vibrations include air blasts (also known as air pressure waves) and ground vibrations. Higher frequency air blast vibrations are audible, while lower frequency air blast and ground vibrations may cause a secondary and audible noise within structures. The characteristics of sound include parameters such as amplitude (loudness), frequency (pitch), and duration. The decibel (dB), a logarithmic unit that accounts for large variations in amplitude, is the accepted standard measurement for sound. The threshold for human hearing is between 1 and 5 dB. The threshold of pain, at the other end of the audible scale, occurs at approximately 140 dB (GSA 1997).

Humans are capable of hearing only a limited range of frequencies, from 20 to 20,000 hertz. In addition, the human ear is not equally sensitive to all frequencies over this range. In order to take this characteristic into account when measuring noise, a frequency-weighting known as A-weighting is commonly applied to sound levels. Because the A-weighted scale closely describes the response of the human ear, it is most commonly used in noise measurements. A-weighted sound levels are expressed as dBA. Examples of typical A-weighted sound levels are shown in Table 3.2.4-1.

Sounds also can be measured in C-weighted decibels (dBC), a measurement that reflects a nearly uniform response to frequencies from 30 to 10,000 hertz. C-weighted sound measurements tend to be larger than their A-scale equivalents. In addition, while the A-weighted scale is best for human noise response, the C-weighted scale is more representative of sounds heard by animals.

**Table 3.2.4-1. Comparative A-Weighted Sound Levels**

| COMMON OUTDOOR SOUNDS | SOUND LEVEL (dBA) | COMMON INDOOR SOUNDS |
|---|---|---|
| Jet flyover at 1,000 feet (300 meters) | 110 | Rock band |
| Gas lawn mower at 3 feet (0.9 meter) | 100 | Subway train |
| Diesel truck at 50 feet (15 meters) | 90 | Food blender or garbage disposal at 3 feet (0.9 meter) |
| Major urban center, daytime | 80 | Shouting at 3 feet (0.9 meter) |
| Gas lawn mower at 100 feet (30 meters) | 70 | Vacuum cleaner at 10 feet (3 meters) |
| Heavy traffic at 300 feet (90 meters) | 60 | Large business office; dishwasher in the next room |
| Urban center, daytime | 50 | Background noise in large conference room |
| Urban center, nighttime | 40 | Background noise in a library |
| Suburban area, nighttime | 30 | Bedroom at night |
| Rural area, nighttime | 20 | Background at a recording studio; average whisper |
| Rustle of leaves in the wind | 10 | Threshold of hearing |

**Source:** DOE 1996b

Regulatory noise and vibration limits in the Los Alamos region are outlined in depth in the LANL SWEIS (DOE 1999c, Section 4.1.3.1).

### 3.2.4.1 Existing Noise Levels

Common sources of noise in the region include traffic, sirens, construction, lawnmowers, ventilation fans, refrigeration units, and other commercial noises. Less frequently encountered sounds include those from firearms practice, thunder, and LANL explosives testing. Noise and air and ground vibrations, even noise created by traffic, are intermittent aspects of the Los Alamos area. Although the receptor most often considered for these environmental conditions is human, noise and vibration also are perceived by animals and may be perceived by plants. Vibration also may contribute to physical damage of property.

Some studies of ambient noise levels in the Los Alamos region have been performed. Readings ranged from 31 to 35 dBA at the entrance to BNM on SR 4, and from 38 to 51 dBA in White Rock (DOE 1995, page 4-16). The White Rock readings of 40 to 50 dBA are within expected sound levels for residential areas.

Traffic noise from trucks and automobiles within the County contributes heavily to background noise in the region. Although some measurements have been made, these sound levels are found to be highly dependent upon the measurement location, time of day, and meteorological conditions such as wind direction and strength. Therefore, there is no single representative measurement for ambient traffic noise.

Intermittent noise and vibrations are experienced in the Los Alamos area due to explosives testing and summer thunderstorms. Studies conducted to assess the noise and vibration impact of explosives testing conclude that local noise limits are not being exceeded by these tests. The air blasts and ground vibrations generated by explosives testing would not be expected to damage either sensitive historic or prehistoric structures or other buildings in the region (DOE 1999c, page 4-21).

### *3.2.5 Visual Resources*

The area that includes the Los Alamos townsite and the subject tracts for this CT EIS are located within a region of great visual diversity and resources. Visual resources include scenery in the near, middle, and distant landscape. Views throughout the region include mountains, mesas, mesa side slopes, rolling hills, flat areas, and canyons. Vegetation ranges from fairly dense forest to rugged, rocky, less vegetated areas. This creates another level of visual interest with color and texture. The visual character of the region also includes residential communities and highly developed building complexes and associated facilities. A large variety of views may be seen at almost any location in the region.

#### 3.2.5.1 Physical Characteristics of the Visual Environment

The topography of this part of northern New Mexico is rugged, especially in the vicinity of Los Alamos. Mesa tops are cut by deep canyons, creating sharp angles in the landforms. In some cases, slopes are nearly vertical with exposed geology in striking, contrasting horizontal planes of color varying from bright orange-red to almost white. Terrain alteration has been relatively limited in the region, and disturbance has occurred for the most part on the level plateau areas. The most obvious terrain alterations in this area are the side-hill cuts needed for roadways. However, these steep cuts are not as out of character with the surrounding sharply angled terrain as they would be in more gentle topography.

A variety of vegetation occurs in the region, adding to the visual interest. The range of vegetation communities include low-lying meadows (grasslands and recent burn areas), mixed grass, shrub and savannah lands, and dense conifer evergreen forests. The height and density of trees may obscure many views and partially screen others. Portions of LANL located along mesa tops at the lower elevations of the facility toward the eastern site boundary are covered with grasslands, mixed shrubs, or short trees with sparsely distributed taller trees, allowing greater visibility from within the viewshed. In contrast, portions of LANL located at the upper elevations toward the western boundary are more densely covered by tall mixed conifer forests that lessen the visibility of these areas.

The most obvious modern alteration of the natural environment is development. Within LANL and the Los Alamos townsite, much of this development is austere and utilitarian in appearance, contrasting greatly with nature (DOE 1999c). Because both LANL and the townsite were established in response to a national emergency, many buildings were built as temporary structures. Overcrowded conditions, due to the limited amount of land, often have resulted in an unplanned, visually discordant assembly of structures and functions, equipment, parking, and outside storage. More recent development, however, includes many facilities with designs and materials that are more visually appropriate and compatible with the natural environment.

Visibility related to air quality is an important facet of the visual environment within the Los Alamos viewshed. Smoke is produced in the viewshed by residential burning, controlled forest management burns,

and the periodic burning of high explosives waste material at LANL. Similarly, light pollution from various sources within the Los Alamos viewshed is an important facet of the nighttime visual environment with regard to the visibility of LANL and the visibility of celestial features.

The visual assets of the 10 subject tracts reflect the variety of the Los Alamos region. While some of the tracts include the visually discordant elements of developed industrial sites, others include large expanses of natural and undeveloped canyon areas. For more detailed information on the visual resources of the Los Alamos region, please refer to the LANL SWEIS, Section 4.1.2 (DOE 1999c).

## *3.2.6 Socioeconomics*

This section presents an overview of current socioeconomic conditions within the region of influence (ROI). The ROI for this analysis is a three-county area that includes Los Alamos, Santa Fe, and Rio Arriba Counties.

### 3.2.6.1 Los Alamos County Self-Sufficiency

Los Alamos County is a unique municipality. The vast majority of the property and economic activity (LANL) in the County is exempt from taxation but generates significant demands for public services. In light of this serious constraint to revenue generation, the County faces the dilemma of how to continue to provide services while dealing simultaneously with declining revenues resulting from the loss of Federal assistance payments and increasing costs arising from accepting and operating DOE facilities.

Los Alamos County has long been economically dependent on assistance payments from the DOE. As a result of budget constraints, these assistance payments have ended. The County has been, and continues to be, greatly restricted in efforts toward diversification of its economy to reduce dependence upon LANL. Any discussion of self-sufficiency for Los Alamos needs to recognize the factors that have significantly hindered economic development to date, such as rugged topography, a location remote from materials or markets, a high cost of living, revenue generation restrictions, and a limited workforce.

### 3.2.6.2 Employment and Income

The ROI has historically depended in a large part on government employment. Because the ROI includes the cities of Los Alamos and Santa Fe, both the Federal and State Governments generate many jobs within this area. However, as shown in Table 3.2.6.2-1, the private sector has been gaining in importance. In 1996, government employment was second to the service sector in terms of the percentage of jobs provided in the ROI. The service sector is the largest employer in the ROI, providing 34.9 percent of the jobs in the ROI, while government provides 25.8 percent of the jobs in the ROI, and the wholesale and retail trade sector provide 19 percent. Historically, these three sectors have been the dominant employers (BEA 1998).

Traditionally, the unemployment rate in the ROI has been lower than the unemployment rate in New Mexico and has remained steady, as shown in Table 3.2.6.2-2. The 1997 unemployment rate in the ROI ranged from 1.7 percent in Los Alamos County to 10.7 percent in Rio Arriba County, averaging 5.2 percent. The unemployment rate in New Mexico averaged 6.2 percent in 1997 (BLS 1998).

The average per capita income in the ROI was $22,861 in 1996, a 31 percent increase over the 1990 level of $17,398. Average per capita income levels in the ROI ranged from a low of $12,243 in Rio Arriba County to a high of $32,257 in Los Alamos County. The

**Table 3.2.6.2-1. Employment by Sector in the Region of Influence**

| SECTOR | PERCENTAGE | | |
|---|---|---|---|
| | 1980 | 1990 | 1996 |
| Services | 26.7 | 32.3 | 34.9 |
| Government and Government Enterprises | 37.2 | 29.4 | 25.8 |
| Wholesale and Retail Trade | 16.1 | 18.1 | 19.0 |
| Finance Insurance and Real Estate | 5.7 | 5.9 | 6.4 |
| Construction | 5.4 | 5.9 | 5.9 |
| Manufacturing | 3.1 | 3.6 | 3.4 |
| Transportation and Public Utilities | 2.4 | 2.0 | 1.9 |
| Farm Employment | 2.1 | 1.5 | 1.3 |
| Other | 1.3 | 1.3 | 1.4 |

**Source**: BEA 1998

**Table 3.2.6.2-2. Unemployment in the Region of Influence and New Mexico**

| AREA | 1990 | 1995 | 1997 |
|---|---|---|---|
| Los Alamos County | 1.5% | 2.0% | 1.7% |
| Rio Arriba County | 13.5% | 11.9% | 10.7% |
| Santa Fe County | 3.3% | 4.3% | 4.1% |
| ROI | 5.0% | 5.4% | 5.2% |
| New Mexico | 6.5% | 6.3% | 6.2% |

**Source:** BLS 1998

1996 average per capita income in New Mexico was $18,814 (BEA 1998).

### 3.2.6.3 Population and Housing

**Population**

The ROI population grew steadily from 1980 to 1994, with annual growth rates ranging between 2.1 and 3.1 percent. The rate of growth has slowed since 1994 and averaged just 0.1 percent between 1996 and 1997. Population growth is expected to remain slow. Population projections for the ROI through 2025 are shown in Table 3.2.6.3-1 (Census 1994 and Census 1998).

**Table 3.2.6.3-1. Population Estimates for the Region of Influence**

| COUNTY | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2025 |
|---|---|---|---|---|---|---|---|
| Los Alamos | 18,134 | 18,605 | 21,121 | 22,852 | 24,482 | 26,098 | 29,113 |
| Rio Arriba | 34,507 | 36,853 | 40,897 | 44,250 | 47,406 | 50,535 | 56,374 |
| Santa Fe | 99,498 | 112,807 | 125,848 | 136,163 | 145,877 | 155,504 | 173,470 |
| ROI | 152,139 | 168,265 | 187,866 | 203,265 | 217,765 | 232,137 | 258,957 |

**Sources:** Census 1998 and BEA 1998

**Housing**

In 1990, there were a total of 21,125 housing units in the ROI, 17,216 of which were occupied. The majority of these were single-family, detached houses. Rental vacancy rates ranged from 12.3 percent in Los Alamos County to 21.8 percent in Santa Fe County, while owner-occupied vacancy rates ranged from 2.2 percent in Los Alamos County to 5.6 percent in Santa Fe County (Census 1992). ROI housing characteristics are shown in Table 3.2.6.3-2.

### 3.2.6.4 Community Services

This section discusses the following community services in the ROI: medical services, education, law enforcement, and fire protection.

**Medical Services**

The ROI contains five hospitals with a total capacity of 428 beds. Three of these hospitals are located in Santa Fe County. All of the hospitals operate at well below capacity (AHA 1995). There are 427 doctors serving the ROI, the majority of whom are located in Santa Fe County (AMA 1996).

**Education**

The ROI encompasses four school districts with over 23,700 students and about 1,377 teachers (see Table 3.2.6.4-1). Student enrollment in the Los Alamos School District increased 6.5 percent during the period from 1990 to 1995, although enrollment decreased during the 1996-1997 school year. Student enrollments at the other ROI school districts have remained stable with increases of about 4 percent during the period from 1990 to 1995. None of the school districts in the ROI is at full capacity. The Los Alamos School District owns four facilities that are currently leased to other parties, while the Pojoaque School District actively recruits students from other districts.

There are several private, post-secondary educational institutions located in the ROI and one public institution, the University of New Mexico, Los Alamos.

**Law Enforcement**

Police protection within the vicinity of LANL is provided by the Los Alamos County Police Department, which is staffed with 39 officers and 4 detention personnel. The department, with a budget of about $3.7 million, responds to over 1,700 service calls per month and is involved in various community programs. Both Santa Fe and Rio Arriba Counties have a Sheriff's Office with a staff of 87 and 42, respectively (DOE 1999c). In addition, the Santa Fe Police Department supports a staff of 192, while the Chama Police Department in Rio Arriba County has a staff of 5 employees (HPI 1998).

**Table 3.2.6.3-2. Region of Influence Housing Characteristics (1990)**

| COUNTY | TOTAL NUMBER OF HOUSING UNITS[a] | NUMBER OF OWNER-OCCUPIED UNITS | OWNER-OCCUPIED VACANCY RATES | MEDIAN VALUE | NUMBER OF OCCUPIED RENTAL UNITS | RENTAL VACANCY RATES | MEDIAN MONTHLY CONTRACT RENT |
|---|---|---|---|---|---|---|---|
| Los Alamos | 7,766 | 4,836 | 2.2 | $126,100 | 1,961 | 12.3 | $403 |
| Rio Arriba | 6,902 | 3,856 | 3.0 | $58,800 | 2,135 | 11.6 | $191 |
| Santa Fe | 6,457 | 3,247 | 5.6 | $103,300 | 1,181 | 21.8 | $425 |
| ROI | 21,125 | 11,939 | — | — | 5,277 | — | — |

[a] This number includes housing units that are only used for seasonal, recreational, and other uses.

**Source:** Census 1992

**Table 3.2.6.4-1. Public School Statistics in the LANL Region of Influence (1995-1996 School Year)**

| SCHOOL DISTRICT | STUDENT ENROLLMENT[a] | TEACHERS[a] | TEACHER/ STUDENT RATIO | OPERATIONAL EXPENDITURES PER STUDENT |
|---|---|---|---|---|
| Los Alamos | 3,606 | 253.8 | 1:14.2 | $6,640 |
| Santa Fe | 12,789.5 | 706.1 | 1:18.1 | $3,665 |
| Española | 5,130 | 283.5 | 1:18.1 | $3,986 |
| Pojoaque | 1,852.5 | 103.5 | 1:17.9 | $4,011 |
| State Average | — | — | 1:17.0 | $4,009 |

[a] These are full-equivalent figures.

**Source:** DOE 1999c

**Fire Protection**

The Los Alamos County Fire Department facilities and equipment are owned partially by the DOE, operated by Los Alamos County, and staffed by County employees. Recent disposition of several fire department facilities from the DOE to the County have occurred. The fire department provides medical and rescue emergency response, and fire suppression and prevention services to both LANL and the Los Alamos County communities. The department operates (on a full-time basis) five fire stations, including two at LANL, and a training facility at the fire department headquarters (DOE 1999c).

### *3.2.7 Ecological Resources*

The following ecological resource description and discussion is intended to provide the reader with a general ecological overview of the organisms present in the LANL region and their relationship with their environment. Specific tract information is addressed in Chapters 5 through 14. This information was primarily extracted and condensed from the LANL SWEIS (DOE 1999c).

The biodiversity of the LANL region is shaped by the variety and dynamic interactions of elevation, climate, topography, soils, water, vegetation, and animal life, along with historic and current land use practices. Variation in precipitation and temperature and differences in the amount of sunlight that reach the north-facing and south-facing canyon slopes have resulted in a diversity of plant life, wildlife, and soils. The mosaic of mesa tops, mountains, canyon bottoms, cliffs, and steep slopes within this region support the habitats of numerous Federal-and State-protected species.

The LANL SWEIS used two organizational themes to address ecological resources within the LANL region: watershed units and major vegetation zones. As mapped, the LANL region includes 14 regional watersheds bounded by Guaje Canyon on the north, Frijoles Canyon on the south, the crest of the Jemez Mountains on the west, and the Rio Grande on the east (see Figure 3.2.7-1, Watersheds and Vegetation Zones in the Los Alamos Area). The watersheds potentially affected from the Proposed Action Alternative are Barrancas, Bayo, Cañada del Buey, Guaje, Los Alamos, and Pueblo watersheds.

While watersheds traverse all or part of the elevational gradient, major vegetation zones are organized into elevation- and aspect-defined bands across this gradient. Increasing temperature and decreasing moisture along the approximately 12-mile (19-kilometer) wide, 5,000-foot (1,500-meter) elevational gradient from the peaks of the Jemez Mountains to the Rio Grande are primarily responsible for the formation of five broad bands, containing six major vegetation zones. These vegetation zones consist of montane grasslands, spruce-fir forest, mixed-conifer forest (with aspen forest), ponderosa pine forest, pinyon-juniper woodland, and juniper savannah. The vegetation zones and associated ecotones provide habitat, including seasonal and year-round breeding, foraging, calving, fawning, and denning habitat, and migration routes for a diversity of resident and migratory wildlife species. This diversity is illustrated by the presence of over 900 species of vascular plants; 57 species of mammals; 200 species of birds, including 112 species known to breed in Los Alamos County; 28 species of reptiles; 9 species of amphibians; and over 1,200 species of arthropods. No fish species have been found within LANL boundaries. Land tracts proposed for conveyance or transfer primarily support ponderosa pine forest, pinyon-juniper woodland, or juniper savannah vegetation.

In some of these land tracts, long-term fire suppression coupled with a lack of forest management has resulted in the unnatural heavy accumulation of live and dead vegetation. High fuel loads (vegetation) pose a severe wildfire hazard to natural resources, cultural resources, and structures. The County is a member of the Los Alamos Wildfire Cooperators and Interim Fire Management Team. The goals of these organizations are to develop a cooperative urban interface plan and to develop wildfire protection requirements. The Pueblo of San Ildefonso is not a member of either organization.

The primary large-scale components of the watersheds are the mesa tops and canyons. Mesa tops provide important foraging habitat, wildlife corridors that are especially important for canyon-to-canyon travel, and provide differing seasonal climatic conditions (such as temperature) compared to other habitats.

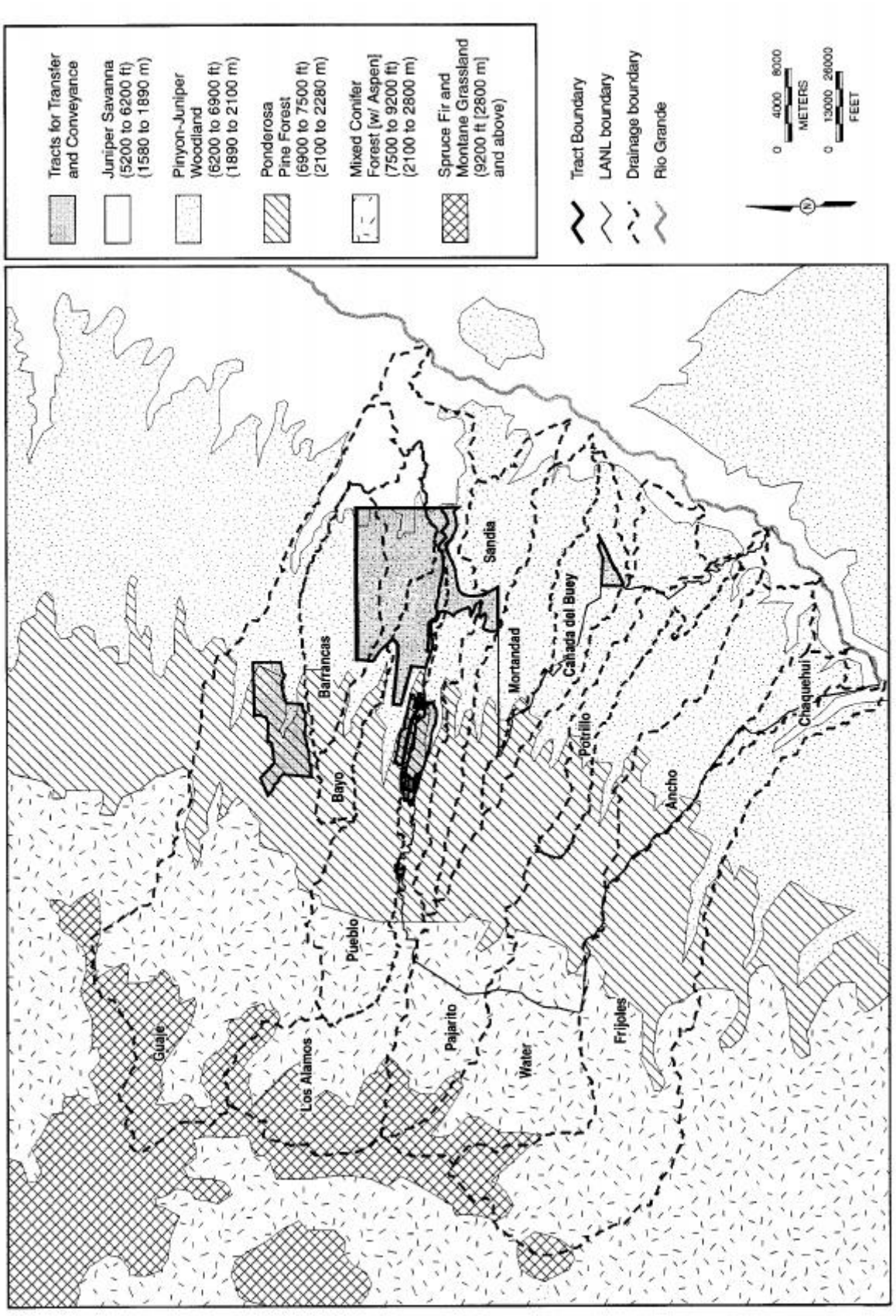


**Figure 3.2.7-1. Watersheds and Vegetation Zones in the Los Alamos Area.**

The canyons within each of these watersheds contain an abundant and diverse array of wildlife. The canyons contain a more complex mix of habitats than the adjacent mesa tops and provide nest and den sites, food, water, and travel corridors. Mammals and birds are especially evident in these environments. Large and medium mammals, such as black bears (*Ursus americanus*), mountain lions (*Felis concolor*), bobcats (*Lynx rufus*), coyotes (*Canis latrans*), raccoons (*Procyon lotor*), elk (*Cervus elaphuis nelsoni*), and mule deer (*Odocoileus hemionus*) are known to use some portion of nearly all regional canyons. Regional canyon systems also are essential to a variety of Federal-and State-protected species. The north-facing slopes of these canyons provide habitat for rare species, like the State-endangered yellow lady slipper orchid (*Cypripedium calceolus L.* var. *pubescens* [*Willd.*] *Correll*), as well as the Jemez Mountain salamander (*Plethodon neomexicanus*), a Federal species of concern and State-threatened species. Mexican spotted owls (*Strix occidentalis lucida*), which are Federal-listed as threatened, and American peregrine falcons (*Falco pereginus anatum*), which are Federal-listed as endangered, are known to nest in the regional canyons. Wetlands are found in each of these vegetation zones, and the majority of wetlands on LANL are associated with canyon stream channels or are present on mountains or mesas as isolated meadows containing ponds or marshes, often in association with springs or seeps. Wetlands provide habitat, food, and water for a wide variety of fauna including Federal- and State-protected species. Of the tracts proposed for conveyance or transfer, the Airport, Rendija Canyon, White Rock, White Rock Y, TA 21, and TA 74 Tracts contain wetlands (LANL 1998d). See Appendix D of this CT EIS for further description of the wetlands.

A number of regionally protected and sensitive (rare or declining) species potentially are present in the LANL region (see Table 3.2.7-1, Protected and Sensitive Species). These consist of 5 Federal endangered species, 2 Federal threatened species (USFW 1998), 1 candidate species, and 20 species of concern[2] (USFWS 1998). The black-footed ferret (*Mustela nigripes*), Federal-listed as endangered, was once widely distributed between Saskatchewan, Canada, and Arizona, New Mexico, and Texas where it lived in close association with prairie dog colonies. It has not been sighted in New Mexico since 1934. The Arctic peregrine falcon (*Falco peregrinus tundrius*), Federal-listed as endangered, breeds in the Arctic tundra and inhabits coastlines and mountains from Florida to South America in winter. In New Mexico it is considered a rare migrant, having been verified only in the Roswell area. An experimental population of endangered whooping cranes (*Grus americana*), consisting of four individuals, migrates along with sandhill cranes (*Grus canadensis*) in October through mid November and from March through April following the Rio Grande through northern and central New Mexico to overwinter in southern New Mexico. The whooping cranes roost on sandbars along the way, including those in White Rock Canyon and the upper sections of Cochiti Reservoir. This is the only known period when whooping cranes might occur on or near LANL (LANL 1998a).

[2] Federal-listed endangered and threatened species and their critical habitat are provided legal protection under the *Endangered Species Act*. Candidate species are taxa for which the U.S. Fish and Wildlife Service (USFWS) has sufficient information to propose that they be added to the list of endangered and threatened species, but the listing action has been precluded by other higher priority listing activities. Species of concern are those that may be of concern to the USFWS but do not receive recognition under the *Endangered Species Act* and that USFWS encourages agencies to include in NEPA studies.

### Table 3.2.7-1. Protected and Sensitive Species

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS |
|---|---|---|---|---|
| **Animal Species** | | | | |
| American Peregrine Falcon *(Falco peregrinus anatum)* | Endangered | Threatened | • Uses the juniper savannah, pinyon-juniper woodland, ponderosa pine forest, and mixed-conifer forest biotic zones<br>• Requires cliffs for nesting | • Observed breeding and foraging on LANL and adjacent lands |
| Arctic Peregrine Falcon *(Falco peregrinus tundrius)* | Endangered due to similarity of appearance to the American Peregrine Falcon | Unlisted | • Rare migrant | • Verified only in the Roswell, New Mexico area |
| Whooping Crane *(Grus americana)* | Endangered | Endangered | • Requires rivers and marshes<br>• Roosts on sand bars | • Migratory visitor along the Rio Grande and Cochiti Lake |
| Southwestern Willow Flycatcher *(Empidonax traillii extimus)* | Endangered | Threatened | • Requires riparian areas<br>• Requires willows and cottonwoods | • Observed in Jemez Mountains<br>• Potential breeding areas on LANL lands<br>• Observed in Rio Grande Valley near Española |
| Black-Footed Ferret *(Mustela nigripes)* | Endangered | Unlisted | • Requires grasslands in association with prairie dogs | • Regional habitat could support the species<br>• Last confirmed sighting in New Mexico occurred in 1934 |
| Mountain Plover (*Charadrius montanus)* | Candidate Species | Unlisted | • Moderate elevation, open plains especially short grass prairie and sage brush | • Two potential sightings of flocks of mountain plovers during 1995 and 1996 fall migrations (PC 1999a) |

### Table 3.2.7-1. Protected and Sensitive Species (Continued)

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS |
|---|---|---|---|---|
| **Animal Species** | | | | |
| Bald Eagle *(Haliaeetus leucocephalus)* | Threatened | Threatened | • Riparian areas | • Observed as a migratory and winter resident along the Rio Grande and on adjacent LANL lands |
| Mexican Spotted Owl *(Strix occidentalis lucida)* | Threatened | Unlisted | • Uses the pinyon-juniper woodland, ponderosa pine forest, and spruce-fir forest biotic zones<br>• Prefers mature and old-growth forests | • Breeding resident on LANL, County, BNM, and Santa Fe National Forest lands |
| Jemez Mountain Salamander *(Plethodon neomexicanus)* | Species of Concern | Threatened | • Uses the mixed-conifer forest biotic zone<br>• Requires north-facing, moist slopes | • Permanent resident on LANL, County, BNM, and Santa Fe National Forest lands |
| Bairds Sparrow *(Ammodramus bairdii)* | Species of Concern | Threatened | • Uses the pinyon-juniper woodland, ponderosa pine forest and mixed-conifer forest biotic zones | • Observed on Santa Fe National Forest lands |
| Spotted Bat *(Euderma maculatum)* | Species of Concern | Threatened | • Uses the pinyon-juniper woodland, ponderosa pine forest, and spruce-fir forest biotic zones<br>• Requires riparian areas<br>• Roosts in cliffs near water | • Permanent resident on BNM and Santa Fe National Forest lands<br>• Unconfirmed reports on LANL lands |
| New Mexico Jumping Mouse *(Zapus hudsonius luteus)* | Species of Concern | Threatened | • Uses the mixed-conifer and spruce-fir forest biotic zones<br>• Requires riparian areas<br>• Requires water nearby | • Permanent resident on County and Santa Fe National Forest lands<br>• Overwinters by hibernating |
| Flathead Chub *(Platygobio gracilis)* | Species of Concern | Sensitive | • Requires access to perennial rivers | • Permanent resident of the Rio Grande between Española and the Cochiti Reservoir |

### Table 3.2.7-1. Protected and Sensitive Species (Continued)

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS |
|---|---|---|---|---|
| **Animal Species** | | | | |
| Ferruginous Hawk *(Buteo regalis)* | Species of Concern | Sensitive | • Uses the juniper savannah and pinyon-juniper woodlands biotic zones | • Observed as a breeding resident on County, LANL, BNM, and Santa Fe National Forest lands |
| Northern Goshawk *(Accipiter gentilis)* | Species of Concern | Sensitive | • Uses the mixed-conifer, ponderosa pine, spruce-fir forest biotic zones | • Observed as a breeding resident on County, LANL, BNM, and Santa Fe National Forest lands |
| White-Faced Ibis *(Plegadis chihi)* | Species of Concern | Sensitive | • Requires perennial rivers and marshes | • Summer resident and migratory visitor on the Rio Grande and Santa Fe National Forest lands |
| Loggerhead Shrike *(Lanius ludovicianus)* | Species of Concern | Unlisted | • Uses the juniper savannah, pinyon-juniper woodland, Ponderosa pine forest, and mixed-conifer forest biotic zones | • Observed on County, BNM, and Santa Fe National Forest lands |
| Big Free-Tailed Bat *(Nyctinomops macrotis)* | Species of Concern | Sensitive | • Uses the juniper savannah, pinyon-juniper woodland, and ponderosa pine forest, and mixed-conifer forest biotic zones<br>• Roosts on cliffs | • Migratory visitor on County, BNM, and Santa Fe National Forest lands |
| Fringed Myotis *(Myotis thysanodes)* | Species of Concern | Unlisted | • Uses the juniper savannah, pinyon juniper woodland, ponderosa pine forest biotic zones<br>• Roosts in caves and buildings | • Observed on LANL, BNM, and Santa Fe National Forest lands |
| Long-Eared Myotis *(Myotis evotis)* | Species of Concern | Sensitive | • Uses the ponderosa pine forest, mixed-conifer, and spruce-fir forests biotic zones<br>• Roosts in dead ponderosa pine trees | • Summer resident on LANL, BNM, and Santa Fe National Forest lands |

### Table 3.2.7-1. Protected and Sensitive Species (Continued)

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS |
|---|---|---|---|---|
| **Animal Species** | | | | |
| Long-Legged Myotis *(Myotis volans)* | Species of Concern | Sensitive | • Uses the pinyon-juniper woodland, ponderosa pine forest, and mixed-conifer forest biotic zones<br>• Roosts in dead conifer trees | • Summer resident on LANL, County, BNM, and Santa Fe National Forest lands |
| Small-Footed Myotis *(Myotis ciliolabrum)* | Species of Concern | Sensitive | • Uses the juniper savannah, pinyon-juniper woodland, ponderosa pine forest, and mixed-conifer forest biotic zones<br>• Roosts in cliffs and caves | • Observed on LANL, BNM, and Santa Fe National Forest lands<br>• Overwinters by hibernating |
| Yuma Myotis *(Myotis yumanensis)* | Species of Concern | Unlisted | • Uses the juniper savannah and pinyon-juniper woodland forest biotic zones<br>• Roosts in cliffs and caves near water | • Summer resident on LANL, County, and Santa Fe National Forest lands |
| Occult Little Brown Bat *(Myotis lucifungus occultus)* | Species of Concern | Unlisted | • Uses the pinyon-juniper woodland and ponderosa pine forest biotic zones<br>• Requires riparian areas<br>• Forages over water | • Observed on Santa Fe National Forest lands |
| Pale Townsends Big-Eared Bat *(Plecotus townsendii pallescens)* | Species of Concern | Sensitive | • Uses the pinyon-juniper woodland, ponderosa pine forest, and mixed-conifer forest biotic zones<br>• Roosts in caves | • Observed on LANL and BNM lands<br>• Overwinters by hibernating |
| Goat Peak Pika *(Ochotona princeps nigrescens)* | Species of Concern | Sensitive | • Uses the mixed-conifer and spruce-fir forests biotic zones<br>• Requires boulder piles and rockslides | • Observed on County and BNM lands |
| Common Blackhawk *(Buteogallus anthracinus anthracinus)* | Unlisted | Threatened | • Uses the juniper savannah, and pinyon-juniper woodland forests biotic zones | • Observed on BNM lands |

### Table 3.2.7-1. Protected and Sensitive Species (Continued)

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS |
|---|---|---|---|---|
| **Animal Species** | | | | |
| Gray Vireo *(Vireo vicinior)* | Unlisted | Threatened | • Uses riparian areas in the juniper savannah and pinyon-juniper forests biotic zones | • Observed on County, BNM, and Santa Fe National Forest lands |
| New Mexico Silverspot Butterfly (*Speyeria nokomis nitocris*) | Species of Concern | Unlisted | • Requires mountain meadows with violets or other riparian areas with associated meadows | • Confirmed sightings in the Taos area and east of Santa Fe<br>• No confirmed sighting in Los Alamos County or on DOE/LANL lands, however, appropriate habitat is present (PC 1999b) |
| **Plant Species** | | | | |
| Grama grass cactus *(Pediocactus papyracanthus)* | Species of Concern | Unlisted | • Grows in the juniper savannah and pinyon-juniper forests biotic zones<br>• Prefers sandy soils in basalt areas | • Observed on County, BNM, and Santa Fe National Forest lands |
| Wood lily *(Lilium philadelphicum* var. *andinum)* | Unlisted | Endangered | • Grows in the ponderosa pine forest, mixed-conifer, and spruce-fir forests biotic zones<br>• Requires riparian areas | • Observed on County, BNM, and Santa Fe National Forest lands |
| Yellow lady's slipper orchid *(Cyprepedium calceolus* var. *pubescens)* | Unlisted | Endangered | • Requires riparian areas<br>• Grows in the mixed-conifer forest biotic zones<br>• Requires moist soil | • Observed on BNM lands |
| Helleborine orchid *(Epipactis gigantea)* | Unlisted | Rare and sensitive | • Requires riparian areas<br>• Grows in the juniper savannah and pinyon-juniper woodland forests biotic zones<br>• Requires springs, seeps, or other wet areas | • Observed on County lands |

**Table 3.2.7-1. Federal- and State-Listed Species (Continued)**

| SPECIES | FEDERAL STATUS | STATE STATUS | HABITAT NEEDS | COMMENTS[a] |
|---|---|---|---|---|
| **Plant Species** | | | | |
| Great plains ladiestresses (*Spiranthes magnicamporium)* | Unlisted | Endangered | • Grows in riparian areas in Plains and Great Basin grassland<br>• This grassland type is widespread in New Mexico valley elevations below 7,500 feet (2285 meters) | • Observed in Española<br>• Unconfirmed reports from White Rock Canyon |

**Note:** This listing was developed with information and guidance provided by biologists from LANL; the U.S. Fish and Wildlife Service; the USFS; the NPS; the National Biological Service; the New Mexico Department of Game and Fish; the New Mexico Energy, Minerals, and Natural Resources Department; and the New Mexico Natural Heritage Program, as well as consultations with independent consultants and reviews of the technical literature.

These species are not addressed further in this CT EIS due to the extremely remote possibility of their presence at or near the subject tract locations. The remaining Federal-protected species—American peregrine falcon (*Falco peregrinus anatum*) (endangered), bald eagle (*Haliaeetus leucocephalus*) (threatened), Mexican spotted owl (*Strix occidentalis lucida*) (threatened), and southwestern willow flycatcher (*Empidonax trailii extimus*) (endangered)—are all known to occur at the LANL area and are considered fully in the CT EIS analysis.

Each species habitat, as part of the development process for the LANL Threatened and Endangered Species Habitat Management Plan, has been identified and areas of environmental interest (AEI) have been designated. There are two components to each AEI: core zone and buffer zone. AEI core zones contain important breeding or wintering habitat for a species, while AEI buffer zones are areas designated to protect the core zone from disturbances that would degrade the value of the area to a protected species (LANL 1998a).

The breeding territories of American peregrine falcons center on cliffs that are in wooded or forested regions. All of Los Alamos County is within the foraging range of identified suitable nesting habitat. Several American peregrine falcon nesting areas are located in the LANL region. Reproduction at these nesting sites has been similar to the State as a whole. One nesting area has been occupied each year since 1994, and at least four young were fledged during this period. There are four American peregrine falcon AEIs on LANL. In general, the AEI core zones are centered on deep canyons on the eastern side of LANL or lands adjacent to LANL. The canyons with AEIs are Pueblo, White Rock, Frijoles, and Los Alamos Canyons (LANL 1998a). Two of the AEIs in Frijoles and White Rock Canyons are not affected by the Proposed Action Alternative; no occupied nesting sites for the American peregrine falcon are present on the subject tracts.

In New Mexico, the bald eagle is primarily a winter inhabitant in the San Juan, upper Rio Grande, Pecos, Canadian, San Francisco, Chama, Gila, and Estancia

Valleys. Bald eagles also occur sporadically in New Mexico during the summer months. In the LANL region, bald eagles roost throughout much of White Rock Canyon from November until late March or mid April. Since 1979, these wintering populations have doubled in size and have extended their occupancy from the Cochiti Lake area upriver to include the Rio Grande in White Rock Canyon. They have been commonly observed at roost sites near Water Canyon. While most often they forage in the vicinity of Cochiti Lake, they use all of White Rock Canyon regularly and the entire Pajarito Plateau occasionally (LANL 1998a). There is one bald eagle AEI, located along the eastern boundary of LANL in conjunction with the Rio Grande, and this AEI would not be affected by the Proposed Action Alternative.

The Mexican spotted owl is found in most of the mountain ranges of New Mexico, Arizona, and in portions of Colorado, Utah, Texas, and northern Mexico. Spotted owls occupy mixed conifer forests or ponderosa pine forests that are intermixed with firs and oaks. In the LANL region, the Mexican spotted owl is a year-round resident of forested areas. The owls nest in canyons vegetated by mixed conifer forest. Nesting usually begins in late March or early April. The owls forage in adjacent areas that are vegetated by a variety of community types, including open grasslands, ponderosa pine forest, and pinyon-juniper woodland. Most individual owls and pairs of owls remain in their summer territory throughout the year; however, some individual owls move to lower elevations during winter months, and about 10 percent travel as far as 35 miles (56 kilometers) from the nesting area. The reproductive success of Mexican spotted owls that nest in the LANL region has been good to excellent. One pair of owls on LANL property has fledged two chicks per year for the last 4 years. Successful nests also have been maintained in Los Alamos County, at BNM, and elsewhere in the Jemez Mountains. There are six Mexican spotted owl AEIs at LANL. In general, the AEI core zones are centered in canyons on the western side of LANL. The canyons with AEIs are Cañon de Valle, Pajarito, Los Alamos, Pueblo, Sandia-Mortandad, and Threemile Canyon (LANL 1998a). While some of the subject tracts contain or are near Mexican spotted owl AEIs, no occupied nesting sites are present within the tracts currently.

The southwestern willow flycatcher breeds in riparian habitats from southern California to Arizona and New Mexico, extending northward to southern Utah and Nevada. It winters in southern Mexico, Central America, and northern South America from September to May. Breeding habitat is characterized by dense stands of willows (*Salix* spp.), tamarisk (*Tamarix pentandra*), buttonbush (*Cephalanthus occidentalis* var. *pubescens*), and other riparian shrubs with open canopies of cottonwoods (*Populus* spp.). In the Los Alamos region, southwestern willow flycatchers have been observed in BNM; but there has been no indication that they have successfully nested there. The nearest known nest site is along the Rio Grande near Española, upstream from LANL. Willow flycatchers occasionally have been observed in White Rock Canyon, and one sighting of a migrating individual occurred on LANL property in the wetlands of Pajarito Canyon. LANL has one AEI for the southwestern willow flycatcher. It is composed of two core zones with associated buffer zones. The AEI core zones are located in the bottom of Pajarito Canyon (LANL 1998a). No occupied southwestern willow flycatcher nesting sites are known to be present within the subject tracts.

Species listed as endangered, threatened, or rare or sensitive by the State of New Mexico are also included in Table 3.2.7-1. The New Mexico “sensitive” taxa are those taxa that, in the opinion of the New Mexico Department of Game and Fish, deserve special consideration in management and

planning, and these are not listed as threatened or endangered by the State of New Mexico.

The County does not have a natural resource management plan that would be in effect for conveyed or transferred lands (PC 1998a). Similarly, the Pueblo of San Ildefonso has no resource management plan; however, the Pueblo is beginning development of a plan, which could take about 2 years to complete (PC 1998b).

### *3.2.8 Cultural Resources*

Cultural resources are those aspects of the physical environment that relate to human culture and society, and those cultural institutions that hold communities together and link them to their surroundings. Cultural resources include expressions of human culture and history in the physical environment (such as prehistoric or historic sites, buildings, structures, objects, districts, or other places, including natural features and biota) that are considered to be important to a culture, subculture, or community. Cultural resources also include traditional lifeways and practices, community values, and institutions. The cultural resources present within the LANL region are complex because of the long and intensive prehistoric use of the area, the continuity of traditional cultural practices among Hispanic and Native American groups, the diversity of cultural groups in the area, and the unique importance of the historic events that have occurred at LANL. Information presented in this section on the cultural resources of the LANL region is based on extensive discussions found in the LANL SWEIS (DOE 1999c).

#### 3.2.8.1 Culture History

Human occupation of the Upper Rio Grande, Jemez Mountains, and Pajarito Plateau region is believed to date back to the Late Pleistocene, approximately 10,000 years ago. Most archaeologists believe that bands of early, mobile hunter-gatherers hunted the large game of that era and collected wild plant foods. Later, in response to warmer and drier climatic conditions and the subsequent loss of large game, hunter-gatherers practiced a more diverse subsistence strategy by targeting smaller game and increasing their plant gathering activities. More sedentary adaptations and labor specialization occurred with the development and refinement of agriculture and the use of bow and arrow technologies. As larger communities evolved, a succession of settlement changes occurred in response to more climatic shifts and population pressures. Prior to the arrival of the Spanish, principal settlements had moved from the mesa tops and cliffs to the Rio Grande floodplain where Pueblo groups still reside. As a greater number of Spanish moved into the region, the puebloan populations suffered from the incursions of settlers, epidemics of disease, and attacks by Apaches. During this period, puebloan populations declined dramatically and Hispanic villages were established that continue today. After an interval of Mexican rule, the United States took control of New Mexico in 1849. Ranching, homestead, agricultural, and recreational uses of the land in the LANL area continued until 1943 when the U.S. Government's program to develop nuclear weapons for the war effort was established at Los Alamos. New facilities were constructed and new missions continued at LANL through the Cold War to the present. Further discussion of regional cultural prehistory and history is presented in Appendix E of the LANL SWEIS (DOE 1999c).

The cultural resources identified within LANL boundaries reflect the patterns of human use over the last 10,000 years (see Table 3.2.8.1-1). No Paleo-Indian materials have been reported at LANL; but these sites are rare in the region in general. Archaic period hunter-gatherer adaptations are represented by scatters of stone tools and flakes, grinding implements, and burned rock

**Table 3.2.8.1-1. Timetable for Cultures in the LANL Region**

| TIME PERIOD | DATES |
|---|---|
| Paleo-Indian | 10,000 to 4,000 B.C. |
| Archaic | 4,000 B.C. to A.D. 600 |
| Developmental | A.D. 600 to 1100 |
| Coalition | A.D. 1100 to 1325 |
| Classic | A.D. 1325 to 1600 |
| Spanish Colonial | A.D. 1600 to 1849 |
| Early U.S. Territorial/Statehood | A.D. 1849 to 1942 |
| Nuclear Energy | A.D. 1942 to present |

**Source:** DOE 1999c

features. Sites dating to the Developmental period on LANL are scarce but include some pithouse, adobe, and crude masonry structures near the Rio Grande in the vicinity of Chaquihui Mesa and lower Water Canyon. Most Pueblo ruins recorded at LANL date to the Coalition period. During that time, habitation typically was in fairly small Pueblos, distributed widely on the mesa tops. The settlement pattern shifted during the Classic period when the smaller mesa top Pueblos were abandoned and populations concentrated at major Pueblos, such as Tsirege and Otowi on land currently held by LANL. By 1600, however, these communities were also largely abandoned and local puebloan populations had moved to the Rio Grande Valley. Few sites reflecting the use of LANL property during the Spanish Colonial period are documented, possibly indicating seasonal and nonintensive utilization. Structural remains and ranching and agricultural features have been recorded from the U.S. Territorial and Statehood periods. Cultural resources from the Nuclear Energy period include a large number of buildings, structures, and objects that are or may be considered important historic cultural resources because of their association with the Manhattan Project, World War II, or the Cold War. Consultations with Native American groups and traditional Hispanic communities during the preparation of the LANL SWEIS (DOE 1999c) indicate continuing cultural use and the presence of all general categories of traditional cultural properties (TCPs) within the lands controlled by LANL.

### 3.2.8.2 Cultural Resource Types

For this CT EIS, cultural resources information has been organized into the categories of: prehistoric and historic resources, and TCPs. A cultural resource can fall into more than one of these types due to use through a long period of time or multiple functions. Prehistoric cultural resources refer to any material remains, structures, and items used or modified by people before the establishment of a European presence in the upper Rio Grande Valley in the early 17th Century. Examples of prehistoric resources in the LANL region include Pueblo ruins, rock shelters, cavates, rock art, water control features, game traps, aboriginal trails and steps, campsites, and scatters of prehistoric artifacts (such as pottery sherds or stone tool-making debris).

Historic resources include the material remains and landscape alterations that have occurred since the arrival of Europeans in the region. Examples of historic resources in the LANL area include homestead, ranching, and agricultural features; scatters of historic artifacts; historic trails; Native American resources; and buildings and features associated with Manhattan Project, World War II, and the Cold War.

TCPs are places associated with the cultural practices or beliefs of a living community. These sites are rooted in the community's history or are important in

maintaining cultural identity. Examples of TCPs for Native American and Hispanic communities can include natural landscape features; places used for ceremonies and worship; places where plants are gathered that are used in traditional medicines and ceremonies; places where artisan materials are found; or places and features of traditional subsistence systems such as community-maintained irrigation systems and traditionally used fields, grazing areas, and firewood-gathering sites. TCPs also include sacred areas and places required for the practice of religion. A detailed discussion of cultural resource types is presented in Appendix E of this CT EIS.

The 10 parcels considered for conveyance or transfer vary in size, topography, natural resources, and past development. These differences are reflected in the types of cultural resources present or expected on each tract and in trends of land use through time. For example, several of the tracts are located on mesa tops that coincide with prehistoric settlement patterns during the Coalition period. Some of these tracts also are partially developed, and though prehistoric resources are not present, potentially eligible historic buildings are. Both mesa tops and canyon bottoms are areas likely to contain TCPs.

#### 3.2.8.3 National Register of Historic Places Eligibility

The identification of cultural resources and DOE responsibilities with regard to cultural resources are addressed by a number of laws, regulations, executive orders, Pueblo Accords and other requirements, as discussed in Chapter 17 of this CT EIS. One of these laws relevant to the discussion of the cultural resources of the 10 land tracts is the *National Historic Preservation Act* (NHPA) of 1966, as amended (16 United States Code [U.S.C.] Section 470), and its implementing regulations (36 Code of Federal Regulations [CFR] 800) that describe the process for identification and evaluation of historic properties; assessment of the effects of Federal actions on historic properties; and consultation to avoid, reduce, or minimize adverse effects. The term "historic properties" refers to cultural resources that meet specific criteria for eligibility for listing on the National Register of Historic Places (NRHP). The NHPA process does not require preservation of historic properties but does ensure that the DOE's decisions (as a Federal agency) concerning the treatment of these properties result from meaningful considerations of cultural and historic values and of the options available to protect the properties.

Under NHPA, cultural resources undergo an evaluation process that determines if the resource is eligible for listing on the NRHP. Resources that are already listed, determined eligible for listing, or are undetermined are afforded a level of consideration under the NHPA Section 106 process. Undetermined resources are those for which eligibility cannot be determined based on current knowledge of the resource and where further work is needed to make an evaluation; meanwhile, resources are treated as though eligible until a formal evaluation is completed. Resources that are not yet identified are considered to have undetermined eligibility; these resources include subsurface archaeological deposits, unrecorded burials, and unidentified TCPs.

In order to be determined eligible for listing on the NRHP, a resource must meet one or more of the following criteria (36 CFR Part 60):

- **Criterion A:** associated with events that have made a significant contribution to the broad patterns of our history
- **Criterion B:** associated with the lives of people significant in our past
- **Criterion C:** embodies the distinctive characteristics of a type, period, or method of construction

- **Criterion D:** yielded or may be likely to yield information important in prehistory or history

The resource also must retain most, if not all, of seven aspects of integrity: location, design, setting, workmanship, material, feeling, and association.

A resource also is eligible for listing on the NRHP if it is determined to have traditional cultural significance. This significance derives from the role the resource plays in a community's historically rooted beliefs, customs, and practices. To have this significance, the resource must be associated with cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing identity of the community (Parker and King 1990). To be eligible for the NRHP, the resource also must retain integrity as a cultural resource and be at least 50 years of age.

#### 3.2.8.4 Religious Resources

Religious resources such as sacred areas or places needed for the practice of religion are a subset of TCPs. The LANL area has been occupied or utilized for 10,000 years by Native American, Spanish, Mexican, and American cultures. The relationships between these cultures and the land were and are as varied as the cultures themselves. These continued relationships have often resulted in the attachment of spiritual or religious aspects to the land. These resources have attained a position in the religious or spiritual history and activities of the community and are a part of that particular culture's spiritual survival.

There are a number of pieces of legislation that consider or protect religious resources. Under the *American Indian Religious Freedom Act* (42 U.S.C. 1996), Federal agencies must evaluate their policies and procedures to determine changes necessary to preserve Native American religious rights and practices, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. The *Religious Freedom Restoration Act* (42 U.S.C. 2000bb) stipulates that the government cannot burden a person's exercise of religion without first showing that the action is in furtherance of a compelling governmental interest and that the action is the least restrictive means of furthering that compelling interest. Finally, Executive Order 13007, "Indian Sacred Sites," protects religious resources by directing Federal agencies to protect the physical integrity of sacred sites and accommodate access to and use of these sites by Native American religious practitioners. This order applies to federally owned land, but not to Native American trust lands.

#### 3.2.8.5 Identification of Cultural Resources

The 10 land tracts proposed for possible conveyance or transfer have been completely inventoried for historic and prehistoric cultural resources, but identification of TCPs has not been completed. Methods used to identify the presence of cultural resources and to determine eligibility vary among the resource types.

Prehistoric and historic cultural resources have been identified in all but one of the 10 tracts (Miscellaneous Site 22) (DOE 1998d). A total of 254 cultural sites have been recorded. The number of sites by tract and their NRHP eligibility status is presented in Table 3.2.8.5-1. Prehistoric resource types recorded at these sites include Pueblo ruins, masonry features, rock shelters and cavates, rock art, water control features and game traps, garden plots, aboriginal trails and steps, and scatters of prehistoric artifacts. Historic resource types recorded at these sites include homestead, ranching, and agricultural features; historic trails, historic artifact scatters, and Native American resources; and

**Table 3.2.8.5-1. Known Cultural Sites by Tract and Eligibility**

| TRACT | PREHISTORIC SITES | | | HISTORIC SITES | | | TOTAL SITES IN TRACT |
|---|---|---|---|---|---|---|---|
| | Eligible | Potentially Eligible | Not Eligible | Eligible | Potentially Eligible | Not Eligible | |
| Rendija Canyon | 38 | 3 | 7 | 3 | 2 | -- | 53 |
| DOE LAAO | -- | -- | -- | -- | 2 | -- | 2 |
| Miscellaneous Site 22 | -- | -- | -- | -- | -- | -- | 0 |
| Miscellaneous Manhattan Monument | -- | -- | -- | 1 | -- | -- | 1 |
| DP Road | 1 | -- | -- | -- | 2 | -- | 3 |
| TA 21 | 1 | -- | 1 | 1 | 41 | -- | 44 |
| Airport | 2 | -- | -- | -- | 2 | 1 | 5 |
| White Rock Y | 19 | 7 | 10 | -- | 4 | 1 | 41 |
| TA 74 | 76 | 21 | -- | -- | 2 | 1 | 100 |
| White Rock | 3 | 1 | -- | -- | -- | 1 | 5 |
| **Total by Eligibility** | 140 | 32 | 18 | 5 | 55 | 4 | 254 |
| | **Prehistoric Sites = 190** | | | **Historic Sites = 64** | | | |

Cold War era LANL properties. Preliminary evaluation of these cultural sites for NRHP eligibility is complete; however, final DOE evaluation recommendations are not expected until after completion of this CT EIS. All but two of the tracts (Miscellaneous Site 22 and Rendija Canyon Tracts) include LANL buildings, structures, or objects that may have historic significance. A total of 51 of these resources have been identified (included in the 254 sites). Forty of these are located in TA 21. Formal evaluation of these sites for NRHP eligibility requires archival research to identify the role that the building may have played in historic events and field documentation to assess its current historical integrity. The NRHP has an additional eligibility requirement of "exceptional importance" that applies to properties less than 50 years old.

More detail regarding the identified cultural sites can be found in Appendix E of this CT EIS.

For the subject land tracts, which all have been inventoried, data collected on resource locations could be incomplete due to human error or conditions such as heavy vegetation cover, which can seriously affect the ability to see resources on the ground. In addition, archaeological resources may be located completely below the surface. There also is

the possibility for human burials, especially in areas near major habitation sites. Patterns in the locations and densities of cultural resources in an area can be used to predict if additional resources are likely to be located in an area already inventoried.

The LANL SWEIS process included a review of literature and consultation with Native American and Hispanic groups to determine the presence of TCPs or religious resources (DOE 1999c, Appendix E). This research determined the presence of ceremonial and archaeological sites, natural landscape features, ethnobotanical gathering sites, artisan material gathering sites, and subsistence features generally located within the LANL area. Seven TCPs have been identified within the subject land tracts so far (DOE 1998d). The Pueblo of San Ildefonso has indicated, in general terms, that TCPs are present on the Rendija Canyon, White Rock Y, TA 74, and White Rock Tracts. Additional TCPs may be identified during further consultations with Native American and Hispanic groups. TCPs can undergo the same evaluation of NRHP eligibility as other cultural resources for consideration under NHPA.

## *3.2.9 Geology and Soils*

This section describes the geology, geologic conditions, soils, and mineral and geothermal resources present at LANL and the areas surrounding LANL that are relevant to the subject land tracts. More detailed information is contained in the LANL SWEIS (DOE 1999c). The geologic area includes LANL, extends to the northern-most point of the Jemez Mountains and Española Valley in the north, to the Cerros del Rio Volcanic Field in the east, to Cochiti Lake in the south, and to the Valles Caldera in the west.

### 3.2.9.1 Geology

LANL (including the subject land tracts) and the communities of Los Alamos and White Rock are located on the Pajarito Plateau (see Figure 3.2.9-1). The Pajarito Plateau is 8 to 16 miles (13 to 26 kilometers) wide and 30 to 40 miles (48 to 64 kilometers) long, lying between the Jemez Mountains to the west and the Rio Grande to the east (DOE 1999c). The surface of the Pajarito Plateau is divided into numerous narrow, finger-like mesas separated by deep east-to-west oriented canyons that drain toward the Rio Grande. The land tracts themselves consist of parts of the mesa tops and the canyons in between the mesas.

A primary geologic feature in the region is the Rio Grande Rift, which begins in northern Mexico, trends northward across central New Mexico, and ends in central Colorado. The north-trending Pajarito Fault system is part of the Rio Grande Rift and consists of a group of interconnecting faults that are nearly parallel (see Figure 3.2.9.1-1).

Rocks in the LANL region were predominantly produced by volcanic and sedimentary processes.

### 3.2.9.2 Geologic Conditions

This subsection describes the geologic conditions that could affect the stability of the ground and infrastructure in the subject land tracts and includes volcanic activity, seismic activity (earthquakes), slope stability, surface subsidence, and soil liquefaction.

**Volcanism**

Volcanism in the Jemez Mountains' volcanic field, west of LANL, has a 13-million-year history. The Jemez Mountains currently show an unusually low amount of seismic activity, which suggests that no magma migration is occurring. Seismic signals may be partially absorbed deep in the subsurface due to elevated temperatures and high heat flow. Such masking of seismic signals would add difficulty in predicting volcanism in the

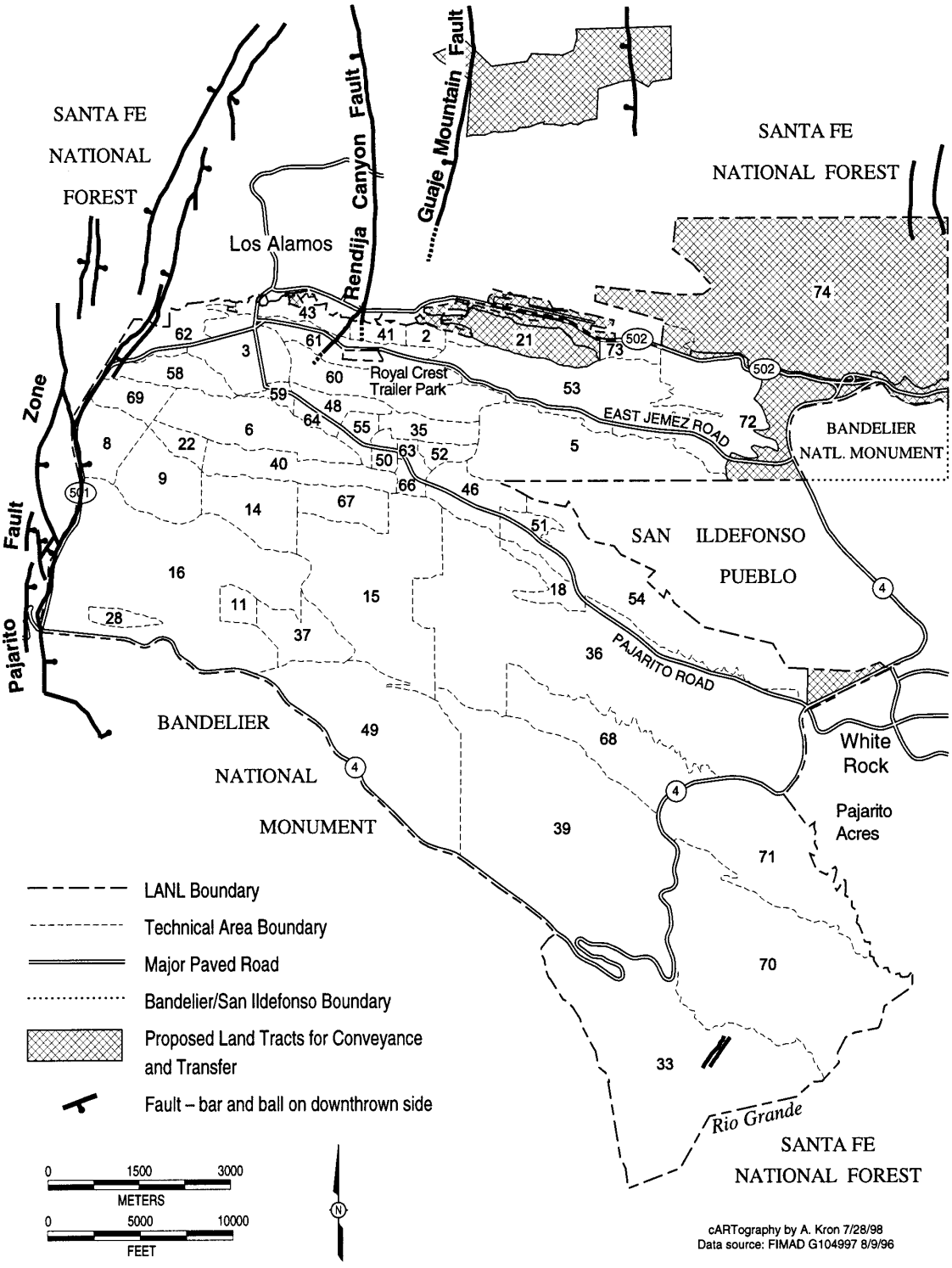


**Figure 3.2.9.1-1. Major Surface Faults in the Los Alamos Region.**

LANL area. There are plans to install additional seismograph stations in the vicinity of the Valles Caldera to improve predictive capabilities (DOE 1999c).

**Seismic Activity**

A comprehensive seismic hazards study was completed in 1995 at LANL (DOE 1999c). This study provided estimates of the ground shaking hazards and the resulting ground motions that may be caused by these earthquake sources.

The major faults in Los Alamos County are the Pajarito, Rendija Canyon, and Guaje Mountain Faults, and their characteristics are summarized in Table 3.2.9.2-1. Fault locations are shown on Figure 3.2.9-1.

The seismic hazards results indicate that the Pajarito Fault system represents the greatest potential seismic risk to LANL, with an estimated maximum earthquake Richter magnitude of about 7. Although large uncertainties exist, an earthquake with a Richter magnitude greater than or equal to 6 is estimated to occur once every 4,000 years; an earthquake with a magnitude greater than or equal to 7 is estimated to occur once every 100,000 years along the Pajarito Fault system. Earthquakes of this magnitude may cause considerable damage to structures and underground pipes.

**Slope Stability, Subsidence, and Soil Liquefaction**

Rockfalls and landslides are two geologic processes related to slope stability in the area. The primary risk factors most likely to affect slope stability are wall steepness, canyon depth, and stratigraphy. Because of this, land near a cliff edge (for example, TA 21) or in a canyon bottom (for example, the White Rock Tract) is potentially susceptible to slope instability. The largest slope instability may be triggered by any process that might destabilize supporting rocks. These processes include, but are not limited to, excessive rainfalls, erosion, and seismic activity.

Subsidence (lowering of the ground surface) and soil liquefaction are two geologic processes that are less likely to affect LANL than rockfalls or landslides. The potential for subsidence is minimal due to the firm rock beneath LANL. Bedrock, soils, and unconsolidated deposits that are unsaturated, such as those that occur beneath LANL, are unlikely to undergo liquefaction.

**Table 3.2.9.2-1. Summary of Major Faults in the LANL Region**

| NAME | APPROXIMATE LENGTH mi (km) | TYPE | MOST RECENT MOVEMENT | MAXIMUM EARTHQUAKE[a] POTENTIAL |
|---|---|---|---|---|
| Pajarito Fault Zone | 26 mi (42 km) | Normal, down-to-the-east[b] | Approximately 45,000 to 55,000 years ago | 7 |
| Rendija Canyon Fault | 6 mi (10 km) | Normal, down-to-the-west | 8,000 to 9,000 or 23,000 years ago | 6.5 |
| Guaje Mountain Fault | 8 mi (14 km) | Normal, down-to-the-west | 4,000 to 6,000 years ago | 6.5 |

**Notes:** mi = miles, km = kilometers

[a] Richter magnitude.

[b] The crustal block on the east side of the Pajarito Fault slips downward toward the east when fault movement occurs. This results in a fault plane for the Pajarito Fault, for example, that runs under LANL toward the east. A normal west fault involves the crustal block on the west side of the fault slipping downward toward the west.

**Source:** DOE 1999c

### 3.2.9.3 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate. Soils that formed on mesa tops of the Pajarito Plateau include the Carjo, Frijoles, Hackroy, Nyjack, Pogna, Prieta, Seaby, and Tocal soil series (DOE 1999c).

All of the soils in the aforementioned soil series are well-drained and range from very shallow (0 to 10 inches [0 to 25 centimeters]) to moderately deep (20 to 40 inches [51 to 102 centimeters]), with the greatest depth to the underlying Bandelier Tuff being 40 inches (102 centimeters) (DOE 1999c). The geochemistry, geomorphology, and formation of soils in the LANL area have been characterized in the LANL SWEIS (DOE 1999c).

**Soil Monitoring**

Soils on and surrounding LANL are sampled annually as a part of the LANL Environmental Surveillance and Compliance Program to determine if they have been affected by LANL operations. Sediments occur along most segments of LANL canyons as narrow bands of canyon-bottom deposits, which can be transported by surface water during runoff events or by LANL outfall effluent flows.

LANL onsite and perimeter soil samples are collected and analyzed for radiological and nonradiological constituents and are compared to the regional (background) locations. In general, the average concentrations of tritium, strontium-90, cesium-137, plutonium-239, plutonium-240, americium-241, and gross alpha and beta activity in soils collected from perimeter stations were not significantly different than radionuclide concentrations and activity in soil samples collected from regional background locations. In contrast, the average levels of uranium, plutonium-238, and gross gamma activity were significantly higher than uranium, plutonium-238, and gross gamma in background soils. Although the average levels of uranium and gross gamma activity in perimeter soils were significantly higher than background, they were still within the regional statistical reference levels (RSRLs) of 4.05 micrograms per gram and 7.3 picocuries per gram, respectively.

Trend analyses show that most radionuclides and radioactivity, with the exception of plutonium-238 and gross alpha, in soils from onsite and perimeter areas have been decreasing over time (DOE 1999c). Tritium, which has a half-life of about 12 years, exhibited the greatest decrease in activity over the 21 years in almost all of the soil sites studied, including regional locations. Plutonium-238 and gross alpha activity generally increased over time in most onsite, perimeter, and even regional background sites; all sites, however, were far from being statistically significant (probability less than 0.05). The source of most plutonium-238 detected in the environment is from nuclear weapons testing in the atmosphere and from the reentry burn-up of satellites containing a plutonium-238 power source (DOE 1999c). Only a few gross alpha readings and a few gross beta readings showed significantly increasing trends (probability less than 0.05) over time. In these cases, however, the measurement period was both early and very short (1978 to 1981).

Soils also were analyzed for trace and heavy metals, and most metals were within RSRLs and were well below LANL screening action levels (SALs) (DOE 1999c). Only beryllium and lead, both products of firing site activities, exhibited any kind of trend; that is, both were consistently higher in perimeter and onsite soils than in background soils. Concentrations over time show that average beryllium in perimeter soils decreased from 1992 to 1995. Lead decreased from 1992 to 1995. Similarly, beryllium in onsite soils decreased from 1992 to 1995. Lead in onsite soils, on the other hand,

increased slightly in concentration from 1992 to 1995.

**Soil Erosion**

Soil erosion can have serious consequences to the maintenance of biological communities and also may have been a mechanism for moving contaminants across LANL and off the site. Soil erosion rates vary considerably on the mesa tops at LANL, with the highest rates occurring in drainage channels and areas of steep slopes and the lowest rates occurring on gently sloping portions of the mesa tops away from the channels (DOE 1999c).

Areas where runoff is concentrated by roads and other structures are especially prone to high erosion rates. High erosion rates appear to be relatively recent, most likely resulting from loss of vegetative cover, decreased precipitation, past logging practices, and past livestock grazing (DOE 1999c).

Runoff and erosion would increase after a wildfire because without a protective ground cover, runoff quantities and velocities are magnified, and soil erosion by water and wind begins immediately. Contributing to this condition is the likely formation of an ash layer that inhibits the infiltration of runoff.

#### 3.2.9.4 Mineral Resources

There are no active mines, mills, pits, or quarries in Los Alamos County or on DOE land at LANL. Sand, gravel, and pumice are mined throughout the surrounding counties.

#### 3.2.9.5 Paleontological Resources

No paleontological sites are reported to occur within LANL boundaries, and the near-surface stratigraphy is not conducive to preserving plant and animal remains (DOE 1999c).

### *3.2.10 Water Resources*

The following sections describe water resources in the vicinity of the 10 subject land tracts based upon the regional hydrogeologic setting, environmental surveillance and monitoring data, and current land uses. A more detailed discussion of water resources at LANL can be found in LANL SWEIS (DOE 1999c). Additional detailed information on water monitoring programs can be found in the annual Environmental Surveillance Reports.

The geography of the Pajarito Plateau strongly influences hydrologic conditions in the vicinity of the 10 subject land tracts. In addition, a relatively arid climate, high evapotranspiration rate (evaporation and water uptake by plants), and thick sequence of unsaturated volcanic deposits underlying LANL have a strong influence on water resources (both quality and quantity) in the area.

#### 3.2.10.1 Surface Water Hydrology

The predominant surface water features at LANL are perennial, ephemeral, and intermittent streams in canyon bottoms that provide drainage. In addition to naturally occurring streams, several National Pollutant Discharge Elimination System (NPDES) outfalls provide sources of surface water at LANL.

Surface water from intermittent streams and drainages is not used for municipal, industrial, or irrigation purposes but supports wildlife living in or migrating through the canyon reaches. The only surface water developed for economic use is contained in the Los Alamos Reservoir. This reservoir is in upper Los Alamos Canyon, west of LANL property, and has a capacity of 41 acre-feet (51,000 cubic meters). It has been used in the past for landscape irrigation in the Los Alamos townsite but is not currently used due to high maintenance costs (DOE 1999c). The Los Alamos municipal storm drain system

also contributes to the surface water flow into DP and Los Alamos Canyons. Eleven canyon drainage systems cross the eastern boundary of LANL (toward the Rio Grande), draining a watershed of approximately 82 square miles (212 square kilometers) (LANL 1996a).

Flash flooding in canyons following heavy precipitation is common during July and August. Several of the land tracts proposed for conveyance or transfer contain land in the 100-year and 500-year floodplains. These land tracts include the TA 74, Rendija Canyon, the White Rock Y, and White Rock Tracts.

**Surface Water Quality**

Surface water quality in the vicinity of LANL is monitored and reported annually in the annual Environmental Surveillance Reports. The LANL SWEIS describes the surface water monitoring program and results (DOE 1999c). Movement of sediments by surface water could be a mechanism for the transport of contaminants.

Radiation (gross alpha, gross beta, and gross gamma) and radionuclide levels in surface waters are generally below or close to analytical detection limits and well below drinking water and public dose standards. Metals in surface water samples are typically below applicable standards when the samples are filtered prior to analysis. However, metals concentrations exceeding drinking water standards are relatively widespread when samples are not filtered. In addition, in 1996 selenium was detected in surface water samples at concentrations greater than the New Mexico Wildlife Habitat Stream Standard.

Plutonium concentrations exceed regional comparison values in several sediment samples. In general, while some sediment samples exceed regional comparison value concentrations for metals, most of these metals may occur naturally in the sediments. The exception to this is selenium in sediments from upper Los Alamos Canyon, which far exceeds regional comparison concentrations (DOE 1999c).

**National Pollutant Discharge Elimination System Outfalls**

Planned releases from industrial and sanitary facility discharges (point sources) are regulated under the *Clean Water Act* and NPDES permits. The LANL SWEIS provides a detailed discussion of NPDES-permitted outfalls (DOE 1999c, Section 4.3.1.3). LANL currently has 87 active NPDES-permitted outfalls that discharge into 10 different watersheds.

Two additional NPDES-permitted outfalls are associated with Los Alamos County water treatment plants and discharge into canyon reaches. NPDES-permitted outfalls may impact specific land tracts proposed for conveyance or transfer and the level of regulatory oversight of stormwater generated surface flows.

### 3.2.10.2 Groundwater Hydrology

Groundwater hydrology in the LANL region is discussed in detail in the LANL SWEIS (DOE 1999c) and the Hydrogeologic Workplan (LANL 1996a). Additional detailed information on water monitoring programs can be found in the annual Environmental Surveillance Reports produced by the LANL Environmental, Safety and Health Division.

The major economic source for groundwater in the LANL area is the regional aquifer. Groundwater also is present in shallow alluvial systems beneath canyon bottoms and as perched groundwater beneath both mesas and canyons; however, these sources are not present in sufficient quantity for development.

**Regional Aquifer**

The regional aquifer (or main aquifer) is the only aquifer in the LANL region that can provide large-scale municipal water supplies

(DOE 1999c). Eleven supply wells in the regional aquifer provide water to LANL, the Los Alamos townsite, White Rock, and BNM. Depth to the regional aquifer beneath the mesa tops ranges from about 1,200 feet (366 meters) along the western margins of the Pajarito Plateau to about 600 feet (183 meters) at the eastern margin of the Plateau. The regional aquifer is separated from intermediate perched groundwater zones by approximately 350 to 620 feet (107 to 189 meters) of tuff, basalt, and sediments (LANL 1996a). Mechanisms for recharge to the regional aquifer are not fully understood, but recent studies have indicated that there is minimal recharge to the regional aquifer, and water is being pumped from storage (DOE 1999c).

There has been a decline in water levels in the regional aquifer since pumping began in the 1950s (LANL 1996a), and it is apparent that groundwater withdrawal exceeds recharge in the vicinity of LANL. From 1947 to 1991, water level declines in the four DOE water supply well fields have ranged from 24 to 76 feet (7.3 to 23 meters) (DOE 1999c).

**Groundwater Quality**

According to requirements of the DOE and LANL Hazardous and Solid Waste Amendments (HWSA) Permits, groundwater quality is monitored annually. Groundwater samples are collected from the regional aquifer, intermediate perched zones, alluvial groundwater, and springs in the LANL region.

In the regional aquifer, drinking water standards were met for all radionuclides in all samples collected from 1990 through 1994. Trace amounts of tritium, plutonium, americium, and strontium have been detected, however, but not in the water supply wells. Organic compounds also have been detected in samples from test wells at TA 49, and nitrate has been detected down-canyon from the Bayo Wastewater Treatment Plant. Contaminants also have been detected in alluvial and intermediate perched groundwater.

- The EPA drinking water standard (40 CFR Part 141) for strontium-90 was exceeded in at least half of the alluvial groundwater samples collected from Mortandad and Los Alamos Canyons from 1990 through 1994, and the EPA standard for tritium was exceeded for 20 of 22 samples (DOE 1999c).
- Standards for some water quality parameters and metals were exceeded in samples of alluvial groundwater from Pueblo Canyon, Pajarito Canyon, and Cañada del Buey.
- High explosives at levels above EPA health advisories have been found in groundwater beneath the southwest portion of LANL (LANL 1999).
- Tritium and nitrates have been detected in intermediate perched groundwater in Pueblo and Los Alamos Canyons at levels below EPA drinking water standards.

In addition, high explosives, volatile organic compounds, and nitrates have been detected in springs in Pajarito Canyon. Primary LANL sources of contamination include historic discharges of treated and untreated waters, discharges from the Radioactive Liquid Waste Treatment Facility into Mortandad Canyon, leaks from the Omega West reactor into Los Alamos Canyon, and past and present releases from the County sewage treatment facility into Pueblo Canyon.

Additional information about groundwater quality can be found in the LANL SWEIS (DOE 1999c), and in the annual LANL Environmental Surveillance Reports.

### *3.2.11 Air Resources*

This section discusses air quality as it exists today in the Los Alamos region. It

begins with an overview of the climate and then presents information on the three major types of air pollutants: criteria pollutants, hazardous air pollutants (HAPs), and radioactive air pollutants. A detailed discussion of air quality and climate is presented in the LANL SWEIS (DOE 1999c, Section 4.4).

#### 3.2.11.1 Climate

Los Alamos has a temperate mountain climate with four distinct seasons. Spring tends to be windy and dry. Summer has a 2-month rainy season during July and August, followed by a dry September. In autumn, there is a return to drier, cooler, and calmer weather. In winter, storms keep the ground covered with snow for about 2 months (LANL 1997, page 17).

The record high temperature is just 95 degrees Fahrenheit (°F) (35 degrees Celsius [°C]) and the record low is –18°F (–8°C). The average annual precipitation (rainfall plus the water-equivalent of snow and frozen precipitation) is 18 inches (46 centimeters), with considerable variation from year to year.

The Los Alamos region does not often experience severe weather. Lightning is quite common over the Pajarito Plateau, averaging 57 thunderstorm days annually. These brief downpours also can cause local flash flooding in canyons, streams, and other low spots. Hail falls frequently during the summer, occasionally causing damage.

Adjacent to LANL and within the Los Alamos region, BNM is one of the nine Class I Federal air quality areas in New Mexico. EPA regulations (40 CFR 51.300) require that states "…assure reasonable progress toward meeting the national goal of preventing any future, and remedying any existing, impairment of visibility in mandatory Class I Federal areas." Future actions must thus account for, and avoid, potential degradation of the air quality at BNM.

#### 3.2.11.2 Criteria Pollutants

The *Clean Air Act* (42 U.S.C. 1857-18571) mandates that the EPA establish National Ambient Air Quality Standards (NAAQS) for pollutants of national concern. EPA has identified six criteria pollutants and has issued standards for all six. The criteria pollutants are nitrogen dioxide, carbon monoxide, lead, ozone, particulates, and sulfur dioxide. New Mexico also has enacted standards for three other criteria pollutants: hydrogen sulfide, total reduced sulfur, and total suspended particulates (20 New Mexico Administrative Code [NMAC] 3.109-110).

The Los Alamos region is included in New Mexico Region 3. Monitoring by the State Air Quality Bureau has demonstrated that Region 3 meets all air quality standards, and is an attainment area for all six criteria pollutants.

#### 3.2.11.3 Hazardous Air Pollutants

Many air pollutants threaten human health through toxic effects by causing cancer and/or genetic mutations. Such pollutants are referred to as hazardous air pollutants, even though other pollutants also are "hazardous" to humans and the environment in the general sense of the term.

The State of New Mexico does not monitor ambient air quality for concentrations of HAPs. However, the State does require that stationary sources (such as stacks) obtain air quality permits if they have the potential to emit more than a minimum amount of air pollutants.

For LANL, emissions estimates were made for many different chemicals, some of them HAPs, in the LANL SWEIS (DOE 1999c). Results of the analyses indicated that the highest estimated concentration of each chemical pollutant

would be below standards established to protect human health, with an ample margin of safety. It was determined that cancer risk for each pollutant and all receptors was below the guideline value of one in one million ($1 \times 10^{-6}$) for excess latent cancer fatality (LCF) risk (DOE 1999c). A conservative analysis was performed to calculate the cancer risk from all pollutants combined. For the combined pollutants, only two potential receptors had a cancer risk greater than $1 \times 10^{-6}$. These two receptors were located at or near the Medical Center in TA 43. The combined cancer risks for these two receptors were $1.17 \times 10^{-6}$ and $1.07 \times 10^{-6}$, respectively.

### 3.2.11.4 Radioactive Air Pollutants

In the Los Alamos region, LANL is the only facility that emits radioactive air pollutants. Emission limits are set forth in EPA regulations at 40 CFR 61, Subpart H, "National Emissions Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities." The standard states that emissions "…shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 millirem per year" (40 CFR 61.92).

Radioactive air pollutants emitted by LANL are of four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) gaseous/mixed activation products (GMAP). About 95 percent of all emissions, however, are GMAP emissions from the Los Alamos Neutron Science Center (LANSCE) at TA 53.

Emissions have been in compliance with the EPA standard (see Table 3.2.11.4-1). In addition, modeling for 1996 emissions shows that doses to residents in White Rock (0.04 millirem) and the Los Alamos townsite (0.05 millirem) are insignificant (LANL 1997, page 51).

**Table 3.2.11.4-1. Dose to the Maximally Exposed Individual from Exposure to LANL Radioactive Air Pollutants**

| YEAR | DOSE (millirem) | PERCENT OF EPA STANDARD |
|---|---|---|
| 1991 | 6.5 | 65 |
| 1992 | 7.9 | 79 |
| 1993 | 5.6 | 56 |
| 1994 | 7.6 | 76 |
| 1995 | 5.1 | 51 |
| 1996 | 5.3 | 53 |
| 1997 | 2.2 | 22 |

**Source** for 1991 to 1995 data: DOE 1998a, page 4-93.
**Source** for 1996 data: LANL 1997, page 50.
**Source** for 1997 data: LANL 1998d, page 50.

### 3.2.11.5 Global Climate Change

Although not all scientists are in agreement, there is evidence of an increase in global temperatures, which may be related to human activities that produce greenhouse gases. These gases are believed to absorb radiated energy in the atmosphere, reflecting it back to Earth, causing warming and climate change.

Water vapor (1 percent of the atmosphere) is the most common and dominant greenhouse gas; only small amounts of water vapor are produced as the result of human activities. The principal greenhouse gases resulting from human activities are carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (CFCs). Other gases of concern are hydrofluorocarbons (HFCs), which are replacing CFCs as refrigerants and air conditioner gases; perfluorocarbons (PFCs), which are a byproduct of aluminum smelting; and sulfur hexafluoride, which is widely used in insulation for electrical

equipment (Morrissey and Justus 1998, page 4). These gases are released in different quantities and have different potencies in their contributions to global warming.

Greenhouse gas emissions in the Los Alamos region include carbon dioxide from multiple sources: the burning of natural gas for home and commercial heating; the use of gasoline and diesel to power automobiles, trucks, construction equipment, and other vehicles; and the burning of wood in residential fireplaces, etc. Although there are no power plants in the region, the generation of electricity for private and government use in the region results in carbon dioxide emissions in other parts of the State (for example, the Farmington area) or nation. Globally, power plants account for one-third of all carbon dioxide emissions, space heating (residential, commercial, industrial, government) for another third, and transportation the remaining third (DOE 1999c).

Pipeline leaks from oil and gas processing plants and stations contribute 9 percent to global emissions of methane. There are 65 compressor stations and 2 natural gas plants, most in Rio Arriba County, that are likely contributors to worldwide total methane emissions.

There likely are small emissions of CFCs and HFCs, which are used locally in refrigeration and air conditioning units at residential, commercial, industrial, and government facilities. Emissions of the remaining greenhouse gases are largely absent in the region.

### *3.2.12 Human Health*

The following sections summarize historical and current information on public health in the LANL vicinity. The public health concerns are for the radiological and nonradiological contributions of LANL to the environment in the Los Alamos area. Because this information was recently prepared for the LANL SWEIS (DOE 1999c), the material presented here is summarized from that document. Additional information is in the accompanying Appendix G, reprinted from the LANL SWEIS (DOE 1999c) and the annual LANL Environmental Surveillance and Compliance Reports (for example, LANL 1997).

The public health information is presented in two major topics: (1) the radiological environment in the LANL vicinity and (2) the nonradiological environment in the LANL vicinity. The LANL SWEIS describes emergency preparedness, management, and response programs implemented at LANL for protecting the public and workers. This information is not revisited here, but the reader is encouraged to examine those sections in the LANL SWEIS (DOE 1999c, Sections 4.6.2.5 through 4.6.3.3).

#### 3.2.12.1 The Radiological Environment in the LANL Vicinity

Sources of radiation exposure for individuals in the vicinity of LANL include radon, cosmic and terrestrial radiation, self-irradiation, exposures from medical and dental procedures, and LANL operations.

Background doses are those to which an individual would be exposed regardless of LANL operations. In 1996, the total effective dose equivalent (TEDE) to residents from all background environmental sources was 360 millirem at Los Alamos and 340 millirem at White Rock (see Table 3.2.12.1-1). It is projected that these residents on average would be exposed to an additional 53 millirem per year effective dose equivalent (EDE) from medical and dental sources of radiation (NCRP 1987).

**Table 3.2.12.1-1. Total Effective Radiation Dose Equivalent from Natural or Manmade Sources**

| SOURCE | LOS ALAMOS (millirem per year) | WHITE ROCK (millirem per year) |
|---|---|---|
| Radon | 200 | 200 |
| Self-Irradiation[a] | 40 | 40 |
| Total External[b] | 120 | 100 |
| Total Effective Background Dose | 360 | 340 |
| Medical and Dental | 53 | 53 |

[a] Dose from radionuclides occurring naturally within the body, such as potassium-40.

[b] Includes correction for shielding.

**Source:** Adapted from DOE 1999c

Release of radionuclides to the environment from LANL operations provides another source of radiation exposure to individuals in the vicinity of LANL. In order to quantify the potential exposure to the public from LANL's radiation, a hypothetical individual who resides at the location receiving the maximum dose is evaluated in the LANL radiation protection program (LANL 1997). This individual is described as the offsite maximally exposed individual (MEI).

Based on data gathered by both LANL's Environmental Surveillance and Compliance Program and the radiological effluent monitoring, LANL operations account for about 1 percent of the total contributions to the 1996 dose for the offsite MEI (DOE 1999c). Of this 1 percent, 68.1 percent is from direct or external penetrating radiation, 29.6 percent is from air immersion, 0.4 percent is from inhalation, and 1.9 percent is from ingestion (LANL 1997).

### 3.2.12.2 The Nonradiological Environment in the LANL Vicinity

Environmental media and foodstuffs have been selectively analyzed for chemical contaminants since the early 1990s. Appendix C of the LANL SWEIS (DOE 1999c) presents summaries of the numbers of analyses, numbers of samples with detectable concentrations, and average and 95th percentile concentrations of these chemicals. For those chemicals in the LANL Environmental Surveillance and Compliance Program, there are no significant differences in concentration between media at the existing perimeter of the site (currently including the 10 land tracts) and those of the general region (DOE 1999c, Appendix D, Section D.3.4).

Appendix C of the LANL SWEIS also contains summaries of contaminated site concentrations for inorganic and organic chemicals. These onsite data were developed by the LANL ER Project to characterize the contaminated sites in order to determine whether remediation was needed. These contaminated soil sites were determined in the LANL SWEIS as not significant contributors to public exposures by any exposure pathway under the current circumstances (DOE 1999c).

**Risk due to Chemicals from Ingestion**

Regionally, the human health risk due to chemicals is predominantly from inorganic chemicals and, more specifically, metals. Organic chemicals with ingestion potential are for the most part manmade and not found in the regional or local environment. The potential for ingestion of chemicals by the public is through ingestion of foodstuffs and drinking water. The potential for ingestion of chemicals in the vicinity of LANL is believed to be the same as that posed by ingestion within the general region.

Three chemical elements identified in the LANL Environmental Surveillance and

Compliance Program were identified as having potential health risk: arsenic, beryllium, and lead. None of the identified concentrations in the environmental media were determined to have been derived from current or historic LANL operations.

**Risk due to Chemicals from Inhalation**

Chemical emissions of HAPs and toxic air pollutants (TAPs) are sufficiently small from LANL operations that they are not routinely measured. HAPs and TAPs from LANL are emitted primarily from laboratory, maintenance, and waste management facilities. The LANL SWEIS (DOE 1999c) provided an extensive analysis of HAPs and TAPs from chemical use and potential emissions for the current condition or affected environment. No recent chemical usage was found to result in emissions of significance from the standpoint of potential human health effects.

### 3.2.12.3 Cancer Incidence and Mortality in the Los Alamos Region

An extensive discussion of cancer incidence and mortality in the Los Alamos region was presented in the LANL SWEIS (DOE 1999c).

**Los Alamos Cancer Rate Study**

The Los Alamos Cancer Rate Study was a study of cancer incidence among populations residing near LANL.

Results of the incidence study showed that Los Alamos County experienced a 70 to 80 percent excess of brain cancer as compared with the New Mexico reference population and national statistics.

A review of incidence rates for 22 other major cancers and childhood cancers showed that the incidence of some cancers in Los Alamos County was greater than that observed in the reference populations, while the incidence of other cancers was lower than or comparable to that observed in the reference populations. Cancers with incidence rates consistently elevated in Los Alamos County during 1970 to 1990 included melanoma of the skin, prostate cancer, non-Hodgkin's lymphoma, ovarian cancer, and female breast cancer. Leukemia and major cancers of the respiratory and digestive systems occurred at or below the incidence levels observed in the reference populations.

Several cancers showed distinct temporal patterns of increasing incidence. Most notable was the marked increase in thyroid cancer incidence observed in the mid 1980s. Thyroid cancer incidence in Los Alamos County during 1986 to 1990 was nearly four times higher than that observed in the New Mexico reference population. Based on the findings of the study, a study of the elevated thyroid cancer incidence in Los Alamos County was made (DOE 1999c). Results of the investigation showed the incidence of thyroid cancer in Los Alamos County fluctuated slightly above the statewide incidence between 1970 and the mid 1980s before rising to a statistically significant, four-fold elevated level during the late 1980s and early 1990s.

The investigation described in this report did not identify a specific cause of the unusually high number of thyroid cancers diagnosed in Los Alamos County. The likelihood is that the excess had multiple causes. Potential risk factors for thyroid cancer include therapeutic irradiation, genetic susceptibility, occupational radiation exposure, and weight.

### 3.2.12.4 Facility Accidents

The DOE maintains equipment and procedures to respond to situations where human health or the environment are threatened. These include specialized response teams such as Radiological Assistance Teams, and specialized training and equipment for the fire department, local hospitals, and State and other government public safety organizations that may

participate in response actions. Response programs include notification of local governments whose constituencies may be threatened. A broad range of exercises are run to ensure the systems are working properly, from facility-specific exercises such as fire drills, to regional exercises involving several government organizations. Additionally, the emergency procedures are periodically used in response to actual events, such as the Dome Fire in the spring of 1996.

LANL's emergency planning, preparedness, and response program is required by various Federal regulations. Emergency management and response personnel are responsible for coordinating actions necessary to minimize adverse accident impacts. These personnel are available on a 24-hour basis, and maintain an Emergency Operations Center that is staffed around the clock. Memoranda of Understanding have been established among the DOE, Los Alamos County, and the State of New Mexico to effectively operate during an emergency by providing mutual assistance and open access to medical facilities.

### *3.2.13 Environmental Justice*

Environmental justice impacts occur if there are any disproportionately high and adverse human health or environmental effects on minority or low-income populations that could result from the actions undertaken by the DOE. Environmental justice impacts are assessed for a 50-mile (80-kilometer) area surrounding LANL. The shaded areas in Figure 3.2.13-1 show 1990 Census tracts where racial or ethnic minorities comprise 50 percent or more of the total population, or where minorities comprise less than 50 percent but greater than 25 percent of the total population in the census tract. Figure 3.2.13-2 shows low-income communities, which are generally defined as those where 25 percent or more of the population is characterized as living in poverty (annual income of less than $8,076 for a family of two).

## 3.3 General Setting of the Land Tracts

The 10 subject tracts of land within this study total approximately 4,800 acres (1,944 hectares). Of the total, 3,000 acres (1,215 hectares) are located in Santa Fe County, and the remainder are in Los Alamos County. The 10 parcels range in size from less than 0.5 acre (0.2 hectare) for the smallest, to approximately 2,715 acres (1,100 hectares) for the largest. Current land use at seven of the parcels is considered urban, in that they reflect or are adjacent to some urban development and are readily served by urban services. The three remaining parcels (Rendija Canyon, TA 74, and the White Rock Y) are more rural in nature and would require additional infrastructure to accommodate future development (DOE 1999c).

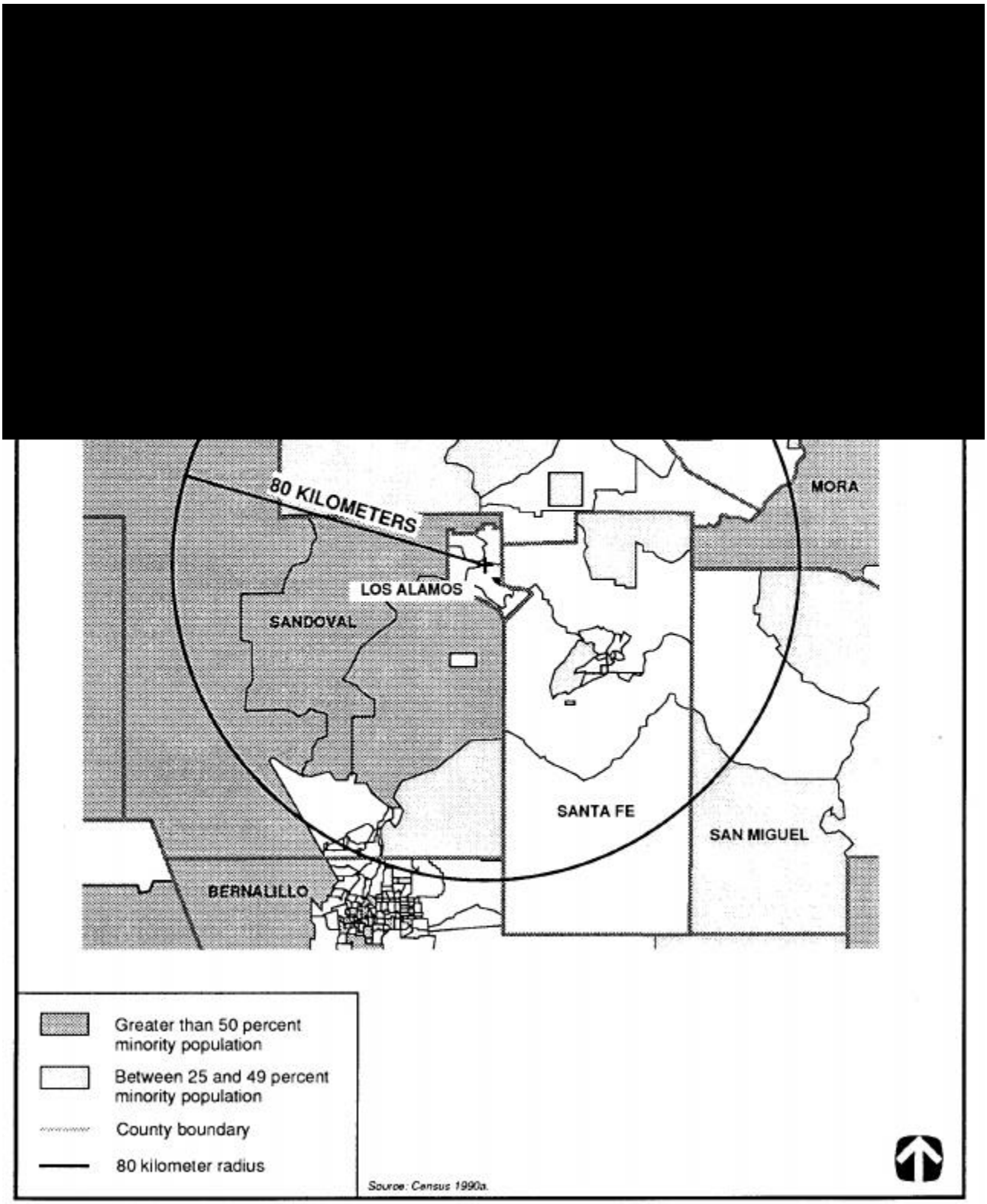


**Figure 3.2.13-1. Minority Population Distribution for Los Alamos National Laboratory and Surrounding Counties.**

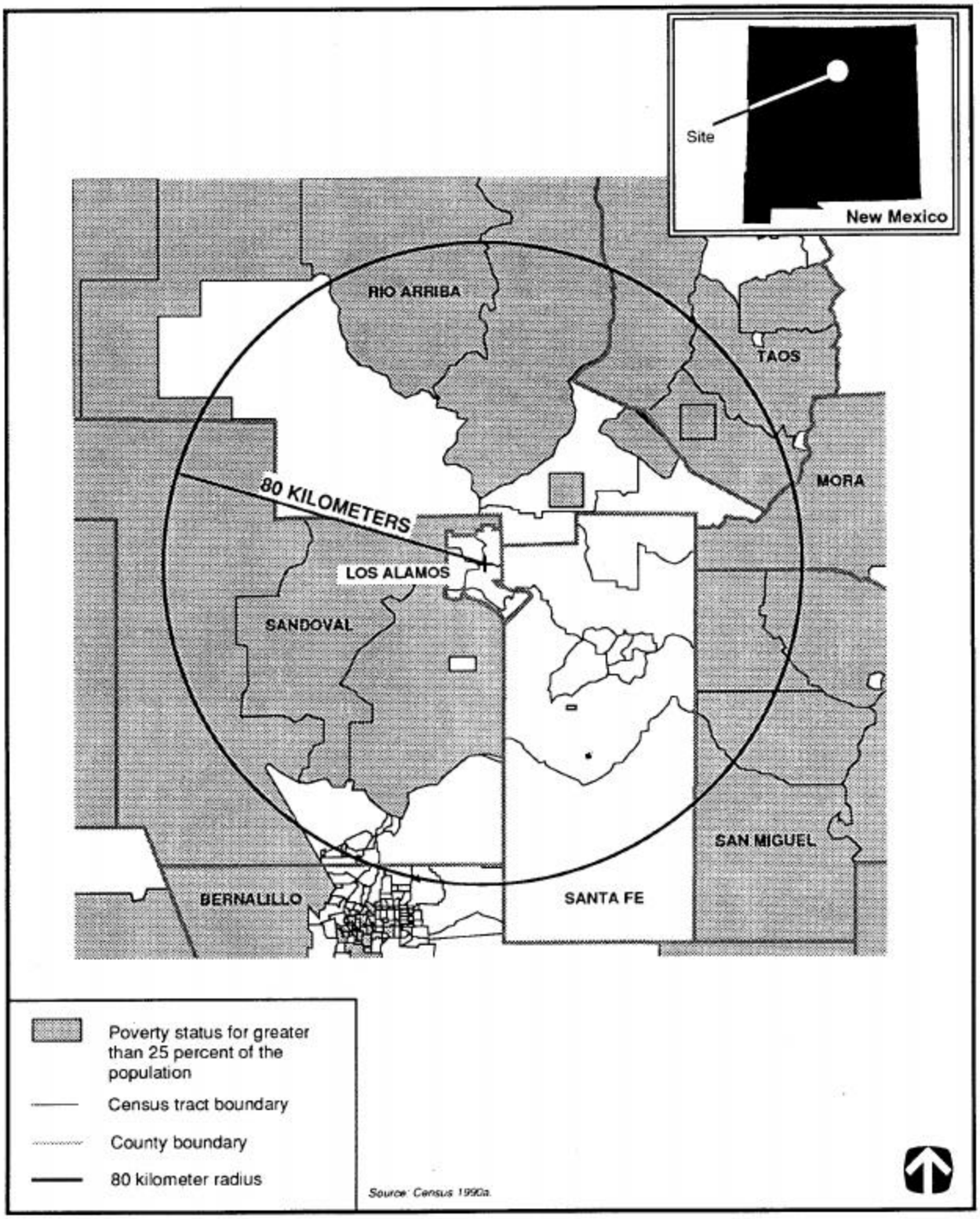


**Figure 3.2.13-2. Low-Income Population Distribution by Poverty Status for Los Alamos National Laboratory and Surrounding Counties.**