3. THE AFFECTED ENVIRONMENT

The affected environment descriptions in this chapter provide the background for understanding the environmental consequences described in Chapter 4 and serve as a baseline from which to identify and evaluate any environmental changes that may result from implementation of the proposed actions and alternatives. The resources that may be affected by the proposed action are grouped into the following interest areas for analysis in this environmental impact statement (EIS):

- Site infrastructure
- Air quality
- Socioeconomics
- Public and occupational health and safety
- Waste management

As discussed in Chapter 4, Section 4.1.1, impacts on the following resource areas are not expected to occur and, so, were not evaluated quantitatively: land and water, noise, geology and soils, ecological and cultural and paleontological. The potential impacts of the proposed action involve consideration only of the existing conditions for site infrastructure, air quality, socioeconomics, public and occupational health and safety, and waste management; therefore, only these resource areas are described in detail in this chapter. Pertinent summary information and references to sources providing additional information are provided for the other resource areas, however.

The following paragraphs describe the resource areas potentially impacted by the actions assessed in this EIS. Sections 3.1 through 3.3 present information on the resources that exist at each of the sites being evaluated.

❒ **Site Infrastructure—**Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions. The resources described and analyzed in this EIS include electrical power and electrical load capacity requirements; natural gas, coal, and oil fuel requirements; and transportation networks, including roads and rail interfaces.

❒ **Air Quality**

- *Meteorology and Climatology*—Meteorology and climatology combine to provide an overall description of regional temperature, precipitation, and wind direction and speed, as well as an overall characterization of the regional climate (e.g., mild winters and long, humid summers).

- *Air Quality*—Air quality is affected by air pollutant emission characteristics, meteorology, and topography. Air pollution refers to any substance in the air that could harm human or animal populations, vegetation, or structures, or that unreasonably interferes with the comfortable enjoyment of life and property. For the purpose of this EIS, only outdoor air pollutants are addressed. Pollutants may include almost any natural or artificial compound capable of being airborne and may be in the form of solid particles, liquid droplets, gases, or combinations of these forms. Generally, pollutants can be categorized as primary pollutants (those emitted directly from identifiable sources) and secondary pollutants (those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation). Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions.

Ambient air quality in a given location can be characterized by comparing the concentration of various pollutants in the atmosphere to their corresponding standards. Ambient air quality standards have been established by Federal and State agencies, allowing an adequate margin of safety for protection of public health and welfare from adverse effects associated with pollutants in the ambient air. Pollutant concentrations higher than the corresponding standards are considered unhealthy. Maintaining concentrations below the corresponding standards would protect most members of the public from adverse health effects.

The primary pollutants of concern are those for which Federal and State ambient air quality standards have been established, including criteria pollutants, hazardous air pollutants, and other toxic air pollutants. Criteria pollutants are those defined in Title 40 of the Code of Federal Regulations (CFR) Part 50, "National Primary and Secondary Ambient Air Quality Standards." Hazardous air pollutants and other toxic compounds include those listed in Title III of the 1990 Clean Air Act, and those that have been proposed or adopted in regulations or are listed in guidelines by the respective states.

❐ **Socioeconomics—**Socioeconomics comprises the social, economic, and demographic characteristics of an area. The socioeconomic environment can be affected by changes in employment, income, and population, which, in turn, can affect area resources such as housing, community services, and infrastructure.

The socioeconomic analysis assesses the environmental consequences of demographic and economic changes resulting from proposed alternatives, especially the potential impacts of additional workers and their families on the economy, housing availability, community services, and infrastructure.

❐ **Public and Occupational Health and Safety—**Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from exposure to ionizing radiation and hazardous chemicals. The degree of hazard is directly related to the type and quantity of the particular radioactive or chemical material to which the person is exposed and to the duration of the exposure.

The current radiological and chemical environments at the various sites considered in this EIS help characterize the setting and serve as baselines against which impacts associated with the various program actions can be compared. Of particular importance are the radiological and hazardous chemical doses that workers and the public receive from exposures associated with both the natural background and existing site operations. These doses may result in adverse health effects.

❐ **Waste Management—**Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing U.S. Department of Energy (DOE) activities. Waste management covers waste produced by DOE's processing, manufacturing, remediation, decontamination and decommissioning, and research activities. The waste is managed using appropriate treatment, storage, and disposal technologies in compliance with all applicable Federal and State statutes and DOE Orders. Wastes are generated and categorized by their health hazard and handling requirements. Treated waste is waste that, following generation, has been altered chemically or physically to reduce its toxicity or to prepare it for storage or disposal. Waste treatment can include volume reduction activities, such as incineration or compaction, which may be performed on waste before either storage, disposal, or both. Stored waste is waste that, following generation (and usually some treatment), is being retained (temporarily) in a retrievable manner and monitored pending disposal. Disposed waste is waste that has been put in final emplacement to ensure its isolation from the environment with no intention of retrieval.

Deliberate action would be required to regain access to the waste. Disposed wastes include materials placed in a geological repository or buried in landfills.

3.1 ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Rocky Flats Environmental Technology Site (Rocky Flats) is located in rural northern Jefferson County, Colorado, 26 kilometers (km) (16 miles [mi]) northwest of downtown Denver and approximately 19 km (12 mi) south of Boulder. Once a remote site, Rocky Flats is now next to a large and growing metropolitan area that includes the communities of Boulder, Arvada, Westminster, Broomfield, and Golden. The Rocky Flats Industrial Area occupies approximately 155 hectares (ha) (384 acres [ac]) in the middle of the site. The remaining 2,495 ha (6,165 ac) form a buffer zone around the active part of Rocky Flats and provide more than 1.6 km (1 mi) between the developed portion of the site and any public road or private property. DOE property boundaries for the site are shown in **Figure 3–1**.

Rocky Flats' mission is to perform environmental restoration, cleanup, and waste management. The locations of major plutonium facilities at Rocky Flats are shown in **Figure 3–2**. Current activities at Rocky Flats are all related to DOE activities. Rocky Flats missions are listed in **Table 3–1**.

Table 3–1 Current Missions at Rocky Flats

Mission	*Description*
Interim Plutonium Storage	Maintain Buildings 371, 559, 707, 771, and 776/777 for interim plutonium storage, with eventual consolidation into a single facility.
Rocky Flats Environmental Restoration and Waste Management	As buildings are released from storage and stabilization missions, decontaminate and decommission, remove all plutonium and other toxic and/or hazardous materials and prepare plutonium wastes for final transport to long-term storage facility.

Source: DOE 1996a.

❐ **DOE Activities—**The site will continue its plutonium storage function, using existing buildings for nonsurplus and surplus plutonium materials. Plutonium component fabrication and production support activities have been stopped permanently; any future activities would take place at other DOE sites.

The current Rocky Flats long-term mission is to prepare plutonium processing and fabrication facilities for decontamination and decommissioning with final disposition by DOE's Office of Environmental Management. The plutonium storage mission involves materials designated as either strategic reserve for current or anticipated program needs, surplus that can be converted to stable metal or oxide forms for storage and transport, or residue that is destined for disposal as waste. Plutonium storage capabilities would be maintained in Buildings 371, 559, 707, 771, and 776/777, with eventual consolidation into a single facility.

The previous primary mission of Rocky Flats was to produce components for nuclear weapons from such materials as plutonium, uranium, beryllium, and various alloys of stainless steel. Production was stopped in 1989. Until that time, the details of plant operations were classified, with little mission and management information given to the public. The site was off-limits to the general public. In 1992, the plant's production of nuclear weapon components was officially discontinued with the end of the Cold War.

Rocky Flats now has a new mission—focusing on environmental restoration, waste management, management of special nuclear materials onsite (including plutonium), decontamination and decommissioning of facilities, and economic development. Although the site remains off-limits to the general public for health and safety considerations, DOE provides information to the public concerning management and operations and works closely with the public on issues related to Rocky Flats.

❒ **Non-DOE Activities—**None.

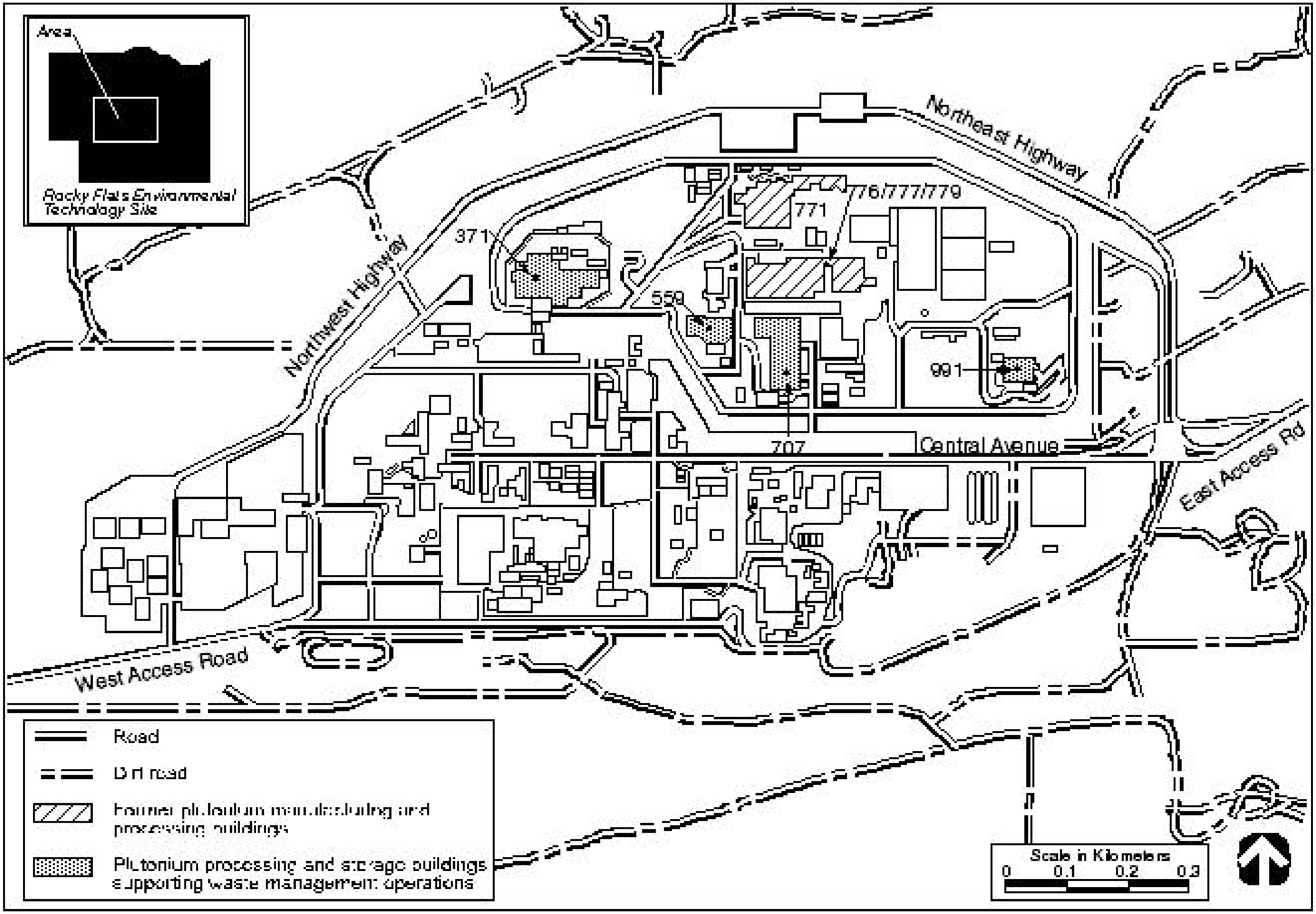

Figure 3–1 Site Designations, Principal Facilities, and Testing Areas at Rocky Flats

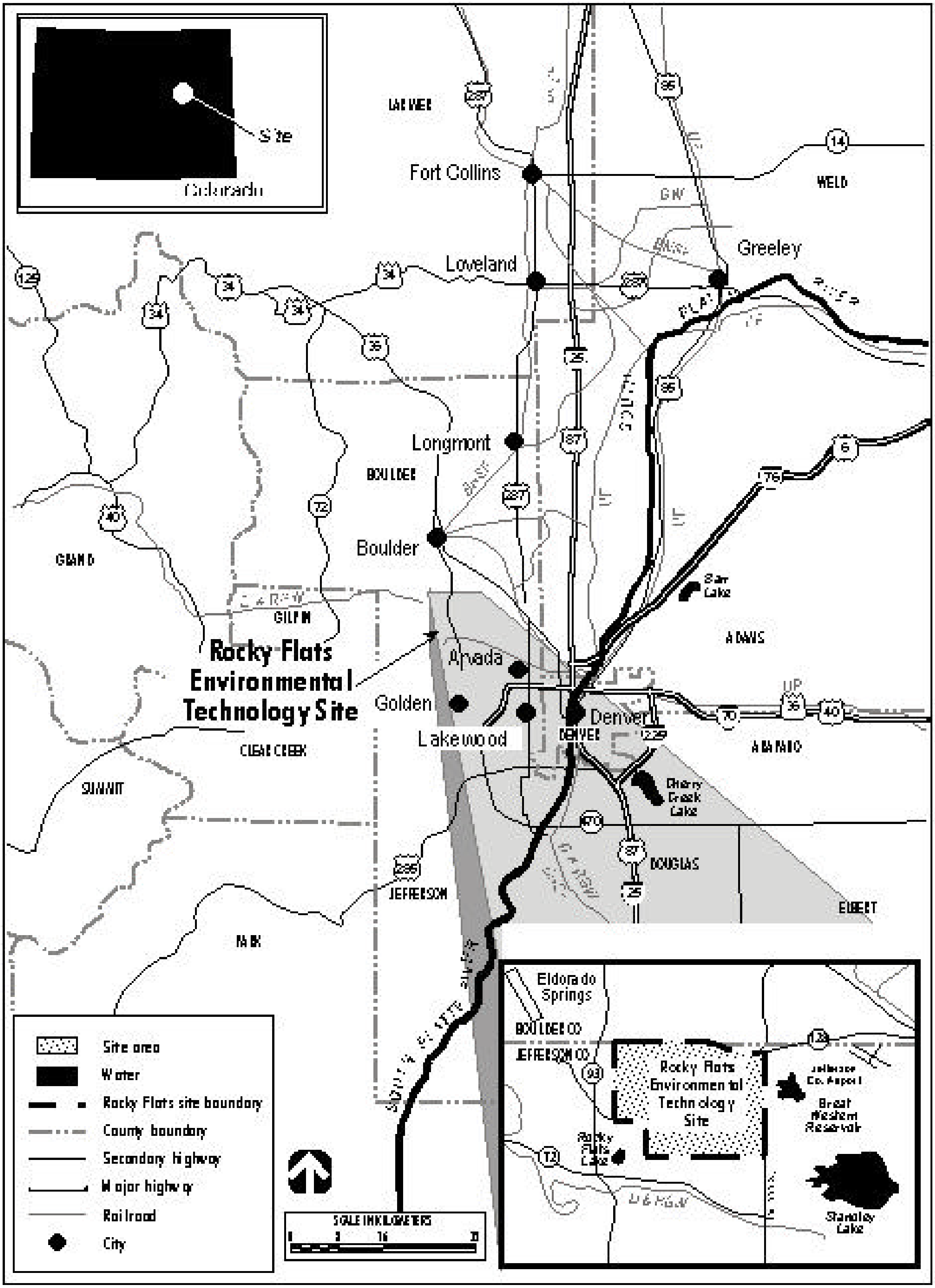

Figure 3–2 Rocky Flats, Colorado, and Region

3.1.1 Land Resources

❒ **Land Use—**The 2,530-ha (6,260-ac) Rocky Flats Site is located in northern Jefferson County, Colorado, approximately 26 km (16 mi) northwest of downtown Denver. All land within Rocky Flats is owned by the Federal Government and managed and controlled by DOE.

Generalized land uses within Rocky Flats and the immediate vicinity are illustrated in **Figure 3–3**. Rocky Flats contains two major categories of land use: industrial and undeveloped. Former production facilities occupy approximately 155 ha (384 ac), or 6 percent of the site, and are centrally located on the site. The approximately 2,380 ha (5,880 ac) that remain are used as a security buffer zone and are mostly open space (undeveloped). However, there are several other uses, including approximately 8 ha (20 ac) of former production support facilities, approximately 45 ha (111 ac) of sanitary waste disposal, and 211 ha (523 ac) of aggregate and clay mining. No prime farmland exists onsite. There are no public recreation facilities onsite. Land uses surrounding the site include primarily open space, industrial, and rural residential and agricultural (grazing and hay production) (DOE 1993a).

Land use planning does not occur at the State level within Colorado; however, regional planning within the Rocky Flats vicinity occurs through the advisory Denver Regional Council of Governments. Rocky Flats is located within Jefferson County, one of six counties that comprise the Denver Regional Council of Governments. Jefferson County does not currently have a countywide comprehensive plan; however, the county has adopted community plans. Community plans function as land-use plans for specific areas of the county; their recommendations are used for making and granting future land-use decisions. The North Plains Community Plan designates Rocky Flats as a "Special Use Area" (JCPD 1990). The zoning resolution for Jefferson County classifies Rocky Flats land with the following zoning districts: agricultural, industrial, and special use.

❒ **Visual Resources—**The terrain of Rocky Flats is mostly grazing land with low hills and ridges. Construction and operation of DOE's facilities have heavily disturbed the character of the landscape. The most dominant features of the site include two large stacks and a water tank. Existing facilities are separated from public roads by the open land in the buffer area. The Rocky Mountains start to rise approximately 3.2 km (2 mi) to the west of Rocky Flats. Because access to the site is limited to authorized personnel, public visual access is limited to views from the outside (DOE 1993a). The facilities are brightly lit at night and are highly visible from many areas within a 4.8- to 8-km (3- to 5-mi) radius of the site. The area within the central developed area is consistent with the Bureau of Land Management's designation of Visual Resource Management Class 5. Class 5 designates areas in which cultural activities are dominant features of the landscape. For the remainder of the site, the natural landscape dominates or natural features are discernible.

3.1.2 Site Infrastructure

❒ **Baseline Characteristics—**Activities at Rocky Flats are concentrated in facilities located near the middle of the site. Baseline site infrastructure characteristics are shown in **Table 3–2**.

Two-lane county and State highways pass around the site, including State Highway 93 to the west, State Route 128 to the north, and Indiana Street to the east. No roads exist along the southern boundary of the site and no public access roads extend across Rocky Flats. Rocky Flats has controlled access gates to the east and west; a controlled access paved road runs through the middle of the site, connecting Highway 93 to Indiana Street. The site also has numerous dirt firebreak and access roads for management. Nuclear wastes from Rocky Flats are transported by truck primarily along the interstate highway system. Nuclear shipments are restricted to off-peak periods when traffic activity is low.

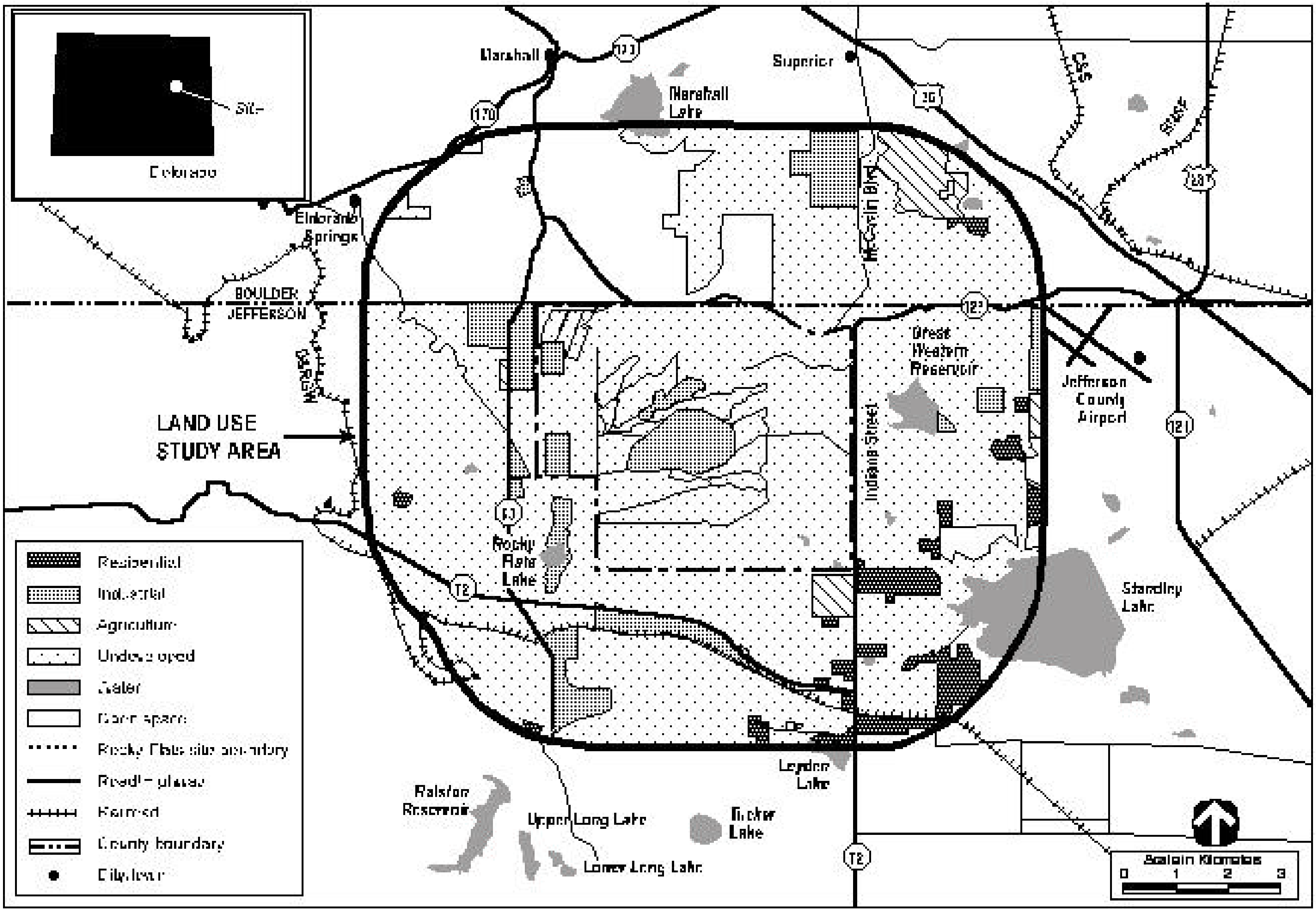

Figure 3–3 Generalized Land Use at Rocky Flats and Vicinity

Table 3–2 Rocky Flats Baseline Characteristics

Characteristics	*Current Usage*
Transportation	
Roads (km)	40
Railroads (km)	5
Electrical	
Energy consumption (MWh/yr)	184,000
Peak Load (MWe)	26
Fuel	
Natural gas (m^3/yr)	18,600,000
Oil (L/yr)	8,140,000
Coal (t/yr)	0
Steam (kg/hr)	41,000

km = kilometer MWh/yr = megawatt hours per year MWe = megawatts electric m^3/yr = cubic meters per year
L/yr = liters per year t/yr = tons per year kg/hr = kilograms per hour
Source: Adapted from DOE 1996a.

Normal and alternate power is supplied by the Public Service Company of Colorado through two electrical switching stations. Currently, one station (to the north of the site) supplies primary services, and the other (just outside the west gate) supplies service to a small portion of the western side of the site and serves as backup electrical power. Emergency diesel generators provide additional backup power capabilities. The subregional electric power pool from which Rocky Flats draws its power is the Rocky Mountain Power Area. Capabilities of this power pool are summarized in **Table 3–3**.

Table 3–3 Rocky Mountain Area Subregional Power Pool Electrical Summary

Characteristics	*Energy Production*
Type Fuel	
Coal	71 percent
Nuclear	0 percent
Hydro/Geothermal	15 percent
Oil/Gas	5 percent
Other (includes power from both utility and nonutility sources)	9 percent

Source: NERC 1993.

The site is connected to a Public Service Company natural gas line. The line passes through the site and continues west to serve residential customers in the Coal Creek Canyon area.

The site acquires water by either of two methods; the method used at any particular time is at the discretion of the Denver Water Board. The preferred supply comes from a diversionary canal between Gross and Ralston Reservoirs. The canal passes the site between the west gate and Route 93 and provides gravity-fed flow to a holding pond, also to the west of the site. The second method involves pumping water directly from Ralston Reservoir to the holding pond, overcoming more than 300 feet of head pressure.

The locations of buildings at Rocky Flats were shown earlier in Figure 3–1. Descriptions of pertinent buildings follow.

- ❒ **Building 371—**Building 371 currently stores Category I and II special nuclear material and will be the primary special nuclear material consolidation and interim storage facility until long-term storage and disposition actions are decided and implemented. Currently, some of Rocky Flats' plutonium residues, transuranic waste, and Resource Conservation and Recovery Act waste inventories are stored in Building 371. The 4-level facility has approximately 17,300 m^2 (186,000 ft^2) of floor space and contains 6 plutonium storage vaults and vault-type rooms. A stacker/retriever moves radioactive materials between the central storage vault and the input and output stations. In addition to this transport capability, the central storage vault was designed for storage of Category I and II special nuclear material. Building 371 was built to nuclear design standards; other buildings at the site were constructed to industrial standards.

- ❒ **Building 707—**Building 707 formerly was the location for plutonium foundry, machining, and assembly operations related to plutonium weapons components. Currently, small amounts of residue and waste inventories and the majority of plutonium metal at the site are stored in this building. The facility is a two-story building with a single-story section on the east side. The 2-story section has 6,900 m^2 (74,240 ft^2) per floor and the single-story section has 1,724 m^2 (18,560 ft^2). There is a small basement with an area of 93 m^2 (1,000 ft^2). The annex, Building 707A, is a 2-story, freestanding structure with 1,210 m^2 (13,000 ft^2) per floor. The main floor of the building is compartmentalized into eight modules (Modules A through H). There are two additional modules within the annex, Modules J and K. Several of the modules in both the main building and the annex are proposed for processing of the plutonium residues. The main facility has a remote-handled plutonium storage vault.

3.1.3 Air Quality and Noise

- ❒ **Meteorology and Climatology—**The Rocky Flats region is characterized as a dry climate, middle-latitude steppe, with mild, sunny, semiarid conditions and few temperature extremes. The average annual temperature at Rocky Flats is 10.2°C (50.3°F); temperatures vary from an average daily minimum of -8.8°C (16.1°F) in January to an average daily maximum of 31.2°C (88.2°F) in July. The average annual precipitation at Rocky Flats is 39.1 centimeters (15.4 inches) (DOE 1994a).

  Annual mean windspeeds and wind direction frequencies for Rocky Flats for 1990 are presented in **Figure 3–4**. Data are from the meterological tower on the west buffer zone. The wind rose shows that the predominant wind direction frequency is toward the west-northwest with a secondary maximum toward the west. The mean windspeed toward the west-northwest is 6.3 m/s (14.1 mph) and the maximum mean windspeed toward the west is 5.7 m/s (12.8 mph) (NOAA 1994). Storms in the Rocky Flats area can generate winds with speeds as high as 44.6 m/s (100 mph) (Kaiser-Hill 1994). Meteorological monitoring station data collected at Rocky Flats indicate that unstable conditions occurred about 59 percent of the time in 1990, neutral conditions occurred about 26 percent, and stable conditions occurred about 15 percent of the time (DOE 1996a).

  The historical data for Denver indicated that the average annual windspeed is 3.8 m/s (8.6 mph) (DOE 1996a). The fastest 1-minute windspeed recorded in Denver, Colorado, was 20.6 m/s (46 mph) (NOAA 1994).

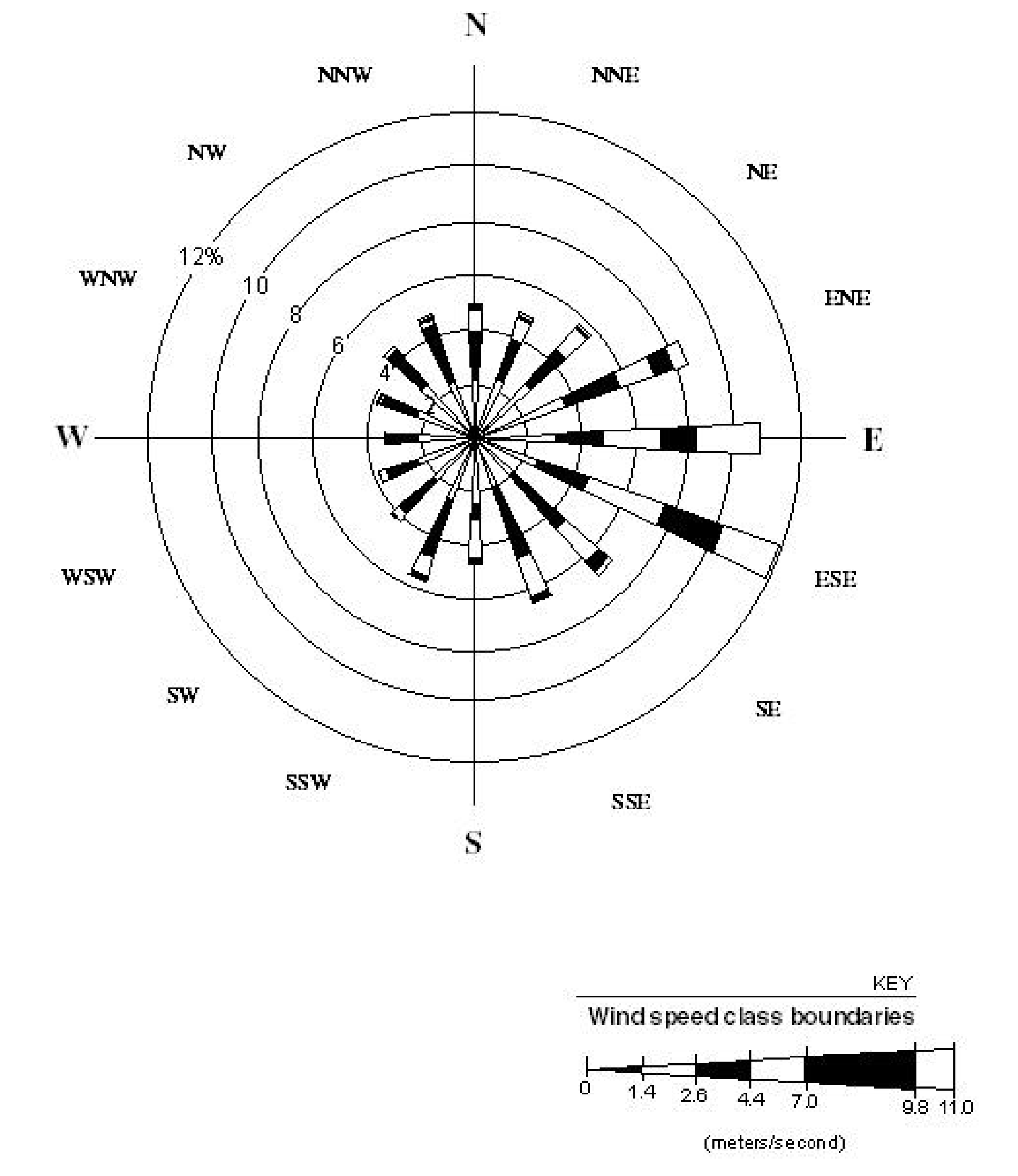

Figure 3–4 Wind Rose for the Rocky Flats Environmental Technology Site (1991-1994) (61-meter level)

❒ **Air Quality—**Rocky Flats is located within the Metropolitan Denver Intrastate Air Quality Control Region No. 36. This Air Quality Control Region is designated nonattainment with respect to the National Ambient Air Quality Standards for particulate matter (≤10 microns in diameter) (moderate), ozone (transitional), and carbon monoxide (serious) and is listed as attainment for sulfur dioxide and nitrogen dioxide (Title 40 CFR 81.306). The particulate matter (≤10 microns in diameter) (PM_{10}) standard is exceeded primarily because of fugitive dust. Vehicular traffic is a major contributor to the high concentrations of ozone and carbon monoxide in the region (DOE 1996a). Recent monitoring data has shown no violations of the ambient air quality standards for PM_{10}, ozone, and carbon monoxide and the region is in the process of being redesignated into attainment.

For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Allowable Prevention of Significant Deterioration increments currently exist for three pollutants (NO_2, SO_2, and PM_{10}). Three Prevention of Significant Deterioration classifications are designated based on criteria established in the Clean Air Act amendments. Class I areas include national wilderness areas, memorial parks larger than 2,020 ha (5,000 acres), and national parks larger than 2,430 ha (6,000 acres). Class II areas include all areas not designated as Class I. No Class III areas have been designated.

Since the creation of the Prevention of Significant Deterioration program in 1977, Prevention of Significant Deterioration permits have not been required for any new Rocky Flats emission sources. Several Prevention of Significant Deterioration (40 CFR 52.21) Class I areas exist near Rocky Flats. The closest, Rocky Mountain National Park, is located approximately 46 km (30 mi) northwest of Rocky Flats.

The emissions inventory from existing sources at Rocky Flats is shown in **Table 3–4**. The emissions inventory is based on maximum permitted or reported emission rates for 1994. Historically, the principal sources of criteria pollutants at Rocky Flats are the steam plant boilers. Minor combustion sources include various small boilers and diesel generators. Other sources of criteria pollutants included coating operations and particulate matter from various manufacturing operations.

Table 3–4 Emission Rates of Criteria and Toxic/Hazardous Air Pollutants at Rocky Flats Environmental Technology Site

Pollutant	*Annual Emission Rate (kg/yr)*	*Hourly Emission Rate (gm/sec)*
Criteria Pollutants		
CO	37,200	24.1
NO_2	156,000	108
PM_{10}	11,300	12.3
SO_2	10,200	67.0
Lead	1.54×10^{-9}	2.14×10^{-13}
Other Regulated Pollutants[a]		
Hydrogen Sulfide	962	0.0328
Total Suspended Particulates	12,000	13.4
Toxic/Hazardous Pollutants		
Carbon Tetrachloride	163	0.0113
Hydrochloric Acid	245	0.0214

[a] Only toxic pollutants emitted from the alternatives being evaluated are presented. The Draft EIS listed additional toxic pollutants which would not be emitted from any of the proposed alternatives and so are not necessary to assess baseline or cumulative air quality impacts.

Source: Adapted from DOE 1997b.

The State of Colorado Department of Public Health and Environment has not adopted State hazardous and toxic air pollutant standards. **Table 3–5** presents the existing (baseline) air concentrations attributable to Rocky Flats for criteria pollutants and other pollutants of concern at Rocky Flats. These concentrations are based on modeling performed with the maximum emission rates listed in Table 3-4, except for total suspended particulates and PM_{10}, which are based on data from monitors located along the eastern boundary of the Rocky Flats site and operated by the Colorado Department of Public Health and the Environment. The monitored concentrations are expected to be conservative estimates of Rocky Flats impacts because they also include impacts from other nearby industrial sources. As shown in the table, baseline concentrations are in compliance with applicable guidelines and regulations.

Ambient background concentrations were estimated from Colorado Department of Public Health and Environment monitoring data from 1992-1994, plus modeled impacts of other industrial sources located in the vicinity of Rocky Flats. Ambient background carbon monoxide 8-hour and 1-hour concentrations were estimated as 3,997.2 $\mu g/m^3$ and 13,713.8 $\mu g/m^3$ respectively. Annual ambient background concentrations of nitrogen dioxide are estimated as 19.7 $\mu g/m^3$. Ambient annual, 24-hour and 3-hour sulfur dioxide concentrations are estimated as 10.7 $\mu g/m^3$, 46.1 $\mu g/m^3$, and 178.5 $\mu g/m^3$, respectively. Annual background concentrations of carbon tetrachloride (based on modeling of nearby sources) are estimated at 0.0078 $\mu g/m^3$. One-hour hydrogen sulfide background concentrations are estimated at 0.0025 $\mu g/m^3$. Annual hydrochloric acid background concentrations are estimated at 0.0022 $\mu g/m^3$. These concentrations are also based on modeling of nearby sources. No ambient background values were available for lead (DOE 1997b).

- **Noise—**Major noise sources at Rocky Flats include various facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). No sound-level measurements have been made at Rocky Flats to determine background sound levels. Most Rocky Flats industrial facilities are far enough from the site boundary that their noise is barely distinguishable from background noise.

The acoustic environment along the Rocky Flats boundary and at nearby residences away from traffic noise is typical of a rural location or quiet suburban residential area, with day-night average sound levels in the range of 35 to 52 decibels A-weighted (EPA 1974). Traffic is the primary source of noise at the site boundary and at nearby residences. Rocky Flats onsite traffic contributes little to overall traffic noise; however, traffic noise from other sources is expected to dominate sound levels along major roads in the area. Except for the prohibition of nuisance noise, neither the State of Colorado nor its local governments have established environmental noise standards applicable to Rocky Flats.

3.1.4 Water Resources

- **Surface Water—**The main surface water features at Rocky Flats are Walnut Creek, North Walnut Creek, South Walnut Creek, and Woman Creek (**Figure 3–5**). Streams at Rocky Flats are considered part of the Big Dry Creek drainage basin, although Big Dry Creek is not directly affected by Rocky Flats activities.

Rocky Flats lies on the divide between the Walnut Creek and Woman Creek drainage basins. North Walnut Creek and South Walnut Creek drain the central and northern areas of Rocky Flats, and Woman Creek drains the southern areas. South and North Walnut Creeks flow together and form Walnut Creek, which flows downstream from Rocky Flats and empties into the Broomfield Diversion Ditch. The Broomfield Diversion Ditch routes water around the Great Western Reservoir, which is a public water supply, then into Big Dry

Creek, and eventually into the South Platte River. Woman Creek flows east across the southern portion of Rocky Flats into Woman Creek Reservoir, which was constructed by DOE to intercept flows from Woman Creek to keep the flows from Standley Lake.

Table 3–5 Comparison of the Rocky Flats Contribution to Baseline Air Pollutant Concentrations with Most Stringent Applicable Regulations and Guidelines at Rocky Flats, 1994

Pollutant	*Averaging Time*	*Most Stringent Regulations or Guidelines[a] (μg/m³)*	*Modeled Concentration[b] (μg/m³)*
Criteria Pollutants			
CO	8-hour	10,000[c]	304
	1-hour	40,000[c]	1,160
NO_2	Annual	100[c]	1.4
Ozone	8-hour	157[c, e]	e
	1-hour	160[d, e]	e
PM_{10}[f]	Annual	50[c]	14.0
	24-hour	150[c]	32.0
$PM_{2.5}$[f]	Annual	15	f
	24-hour	65	f
SO_2	Annual	80[c]	0.1
	24-hour	365[c]	91.2
	3-hour	700[d]	270
Lead	Calendar Quarter	1.5[c]	4.8×10^{-14}
	30-day	1.5[c]	4.8×10^{-14}
Other Regulated Pollutants			
Hydrogen Sulfide	1-hour	142[d]	35.4
Total Suspended Particulates	Annual	75[d]	31.0
	24-hour	150[d]	73.0
Toxic/Hazardous Pollutants[h]			
Carbon Tetrachloride	Annual	g	0.0024
Hydrochloric Acid	Annual	g	0.0052

[a] The more stringent of the Federal and State standards is presented.
[b] Modeled concentration based on maximum emissions, except for TSP and PM_{10} concentrations, which are based on data from monitors located at the eastern boundary of the site.
[c] Federal standard.
[d] State standard.
[e] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. EPA recently revised the ambient air quality standards for ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 μg/m³ (0.12 ppm) to an 8-hour concentration of 157 μg/m³ (0.08 ppm). During a transition period, the 1-hour ozone standard would continue to apply in nonattainment areas such as the area in which Rocky Flats is located.
[f] EPA recently revised the ambient air quality standards for particulate matter. The current PM_{10} (particulate matter size less than or equal to 10 micrometers) annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 μg/m³ (3-year average arithmetic mean based on community-oriented monitors) and 65 μg/m³ (3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors). The current 24-hour PM_{10} standard is revised to be based on the 99th percentile of 24-hour concentrations. Insufficient emissions, modeling, and monitoring data exist for estimating concentrations of $PM_{2.5}$.
[g] No State or Federal standards exist.
[h] Only toxic pollutants emitted from the alternatives being evaluated are presented. The Draft EIS listed additional toxic pollutants which would not be emitted from any of the proposed alternatives and so are not necessary to assess baseline or cumulative air quality impacts.

Source: Adapted from DOE 1997b.

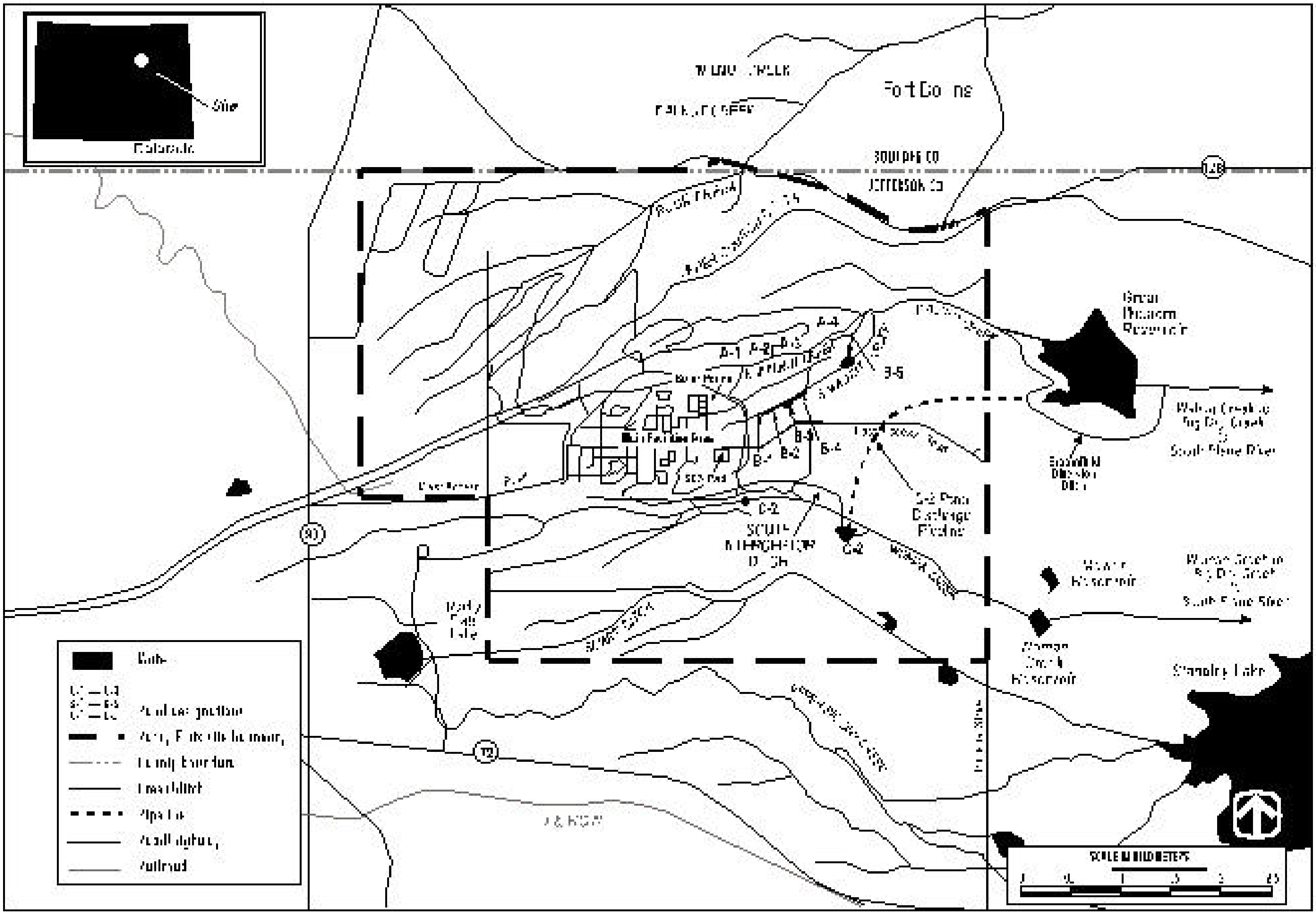

Figure 3–5 Surface Water Features at Rocky Flats

All natural surface water flow on Rocky Flats occurs in temporary channels that flow only as a result of precipitation, discharge of site effluents, surface seeps, or release of water from storage areas west of the site to supplement water supplies in the Great Western Reservoir or Standley Lake. On North Walnut Creek, South Walnut Creek, and Woman Creek, a series of unlined ponds serve to impound waters from the site. Along North Walnut Creek, the ponds are numbered A-1 through A-4; on South Walnut Creek, the ponds are numbered B-1 through B-5; and on Woman Creek, the ponds are numbered C-1 and C-2. Pond C-2 does not receive direct flow from Woman Creek; flow into Pond C-2 is from runoff into South Interceptor Ditch and then into Pond C-2.

Wastewater from industrial processes is treated at a treatment plant that is isolated from other sources and does not discharge to surface water features. Existing sanitary wastewater generation is estimated at approximately 260 million liters per year (L/yr) (70 million gallons per year [gal/yr]). Sanitary wastewater is treated and discharged to Pond B-3. Storm water runoff from the plant is conveyed in storm sewers that discharge to creeks on the undeveloped portion of the site. Discharges from Ponds A-3, A-4, B-3, B-5, and C-2 are monitored under the National Pollutant Discharge Elimination System permit program.

Terminal ponds (A-4, B-5, and C-2) are designed to capture the flow from a 100-year storm if maintained at less than 10 percent of capacity. Rocky Flats has exceeded the 10 percent capacity limit because of added monitoring requirements and associated delays in receiving approval for certain discharges.

Rocky Flats does not withdraw any water from streams on or near the site. All water for the plant is obtained from surface waters from the City of Denver via the South Boulder Diversion Canal from the South Boulder Creek and Ralston Reservoir. The water supply contract with the City and County of Denver through the Denver Water Board is for an unguaranteed supply of up to 5.7 million L/day (1.5 million gal/day). This equates to about 2 billion L/yr (550 million gal/yr). The current average water consumption is approximately 485 million L/yr (128 million gal/yr). Raw water is stored in a 5.7-million L (1.5-million gal) storage pond west of the plant.

- *Surface Water Quality*—The water from Woman Creek, North Walnut Creek, and South Walnut Creek flows into ponds that restrict offsite discharges, allow water testing, and permit any treatment necessary to meet water quality standards. A treatment facility is located at Pond A-4, and water from Pond B-5 is transferred to Pond A-4. Treatment consists of filtration and carbon absorption to reduce potential radionuclides and organic chemical contaminants.

  With permission from the Colorado Department of Public Health and Environment, water is released from Pond A-4 to Walnut Creek and from Pond C-2 to Woman Creek.

  Discharges from Ponds A-4 and B-5 enter Walnut Creek and are diverted around the Great Western Reservoir by the Broomfield Diversion Ditch. Pond C-2 discharges to Woman Creek, which flows into recently constructed Woman Creek Reservoir immediately east of Indiana Street.

  An unlined surface water control pond exists immediately downstream and downhill from the landfill and from current waste disposal operations at the eastern end of the landfill. The landfill is considered a hazardous waste management landfill due to the past disposal of some materials that may now qualify as regulated hazardous wastes. The landfill pond routinely exceeds the Rocky Flats standard for strontium and has exceeded standards for copper, iron, lithium, manganese, mercury, nickel, plutonium, and zinc. Water in the landfill pond is transferred to Pond A-3, detained, and monitored during discharge to Pond A-4. No Notices of Violation under the National Pollutant Discharge Elimination System were received by the site during the 1993-1996 period. Additional information about surface water quality at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

- *Surface Water Rights and Permits*—Surface water rights are not an issue at Rocky Flats because Rocky Flats facilities do not withdraw surface water for use. As previously mentioned, the water supply contract with the City and County of Denver is for an unguaranteed supply of up to 5.7 million L/day (1.5 million gal/day).

❒ **Groundwater—**Two hydraulically connected groundwater systems are present at Rocky Flats. The upper hydrostratigraphic unit exists as an unconfined system while the lower unit is a semi-confined system. The contact separating the two units is identified as the base of the weathered zone.

The unconfined system at Rocky Flats is composed primarily of unconsolidated sand, gravel, and clay. The average depth to the water table in the unconsolidated surficial deposits ranges from about 21 m (70 ft) at the western boundary of Rocky Flats to less than 3 m (10 ft) in the industrial area. Seeps are common along stream drainage. Groundwater flow direction is generally toward the east. Recharge to the unconfined aquifer occurs from infiltration of precipitation and as seepage from ditches, creeks, and ponds. In addition, unlined retention ponds along South Walnut and Woman Creeks probably recharge this unit.

In the semi-confined system, groundwater is in discontinuous sandstone lenses within claystone bedrock. Flow within the sandstones is assumed to be from west to east. In some places, the sandstones are in contact with the alluvium so that the unit is part of the unconfined system at those places. Recharge to the sandstones occurs where they are in direct contact with the alluvium and valley fill of the upper hydrostratigraphic unit or by leakage through claystones in contact with alluvium.

- *Groundwater Quality*—Groundwater monitoring has been conducted at Rocky Flats since 1960. By the end of 1994, approximately 400 wells were monitored to determine the groundwater quality and the distribution of contaminant constituents in groundwater at Rocky Flats. Groundwater quality in uncontaminated portions in surficial materials (alluvium, colluvium, valley fill, and weathered bedrock) is relatively good and can be classified as calcium bicarbonate water. The semi-confined system can be distinguished from the surficial system by relatively higher sodium and sulfate content.

  The unconfined system contains both radiological and nonradiological contaminants. To date, there are no known bedrock pathways through which groundwater contamination can directly leave Rocky Flats and migrate into the confined aquifer system offsite (DOE 1996a). Additional information about groundwater quality at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

- *Groundwater Availability, Use, and Rights*—Currently, no groundwater is used for drinking purposes by the facility. Approximately 10.6 million L/yr (2.8 million gal/yr) of groundwater is withdrawn from the site for contaminant removal as part of the environmental restoration program.

  Generally, the rights to groundwater resources in Colorado are unrelated to ownership of the land over those groundwater resources. For the Denver Basin aquifers, which include the lower systems at Rocky Flats, however, the right to groundwater resources derives from land ownership as long as the water is not tributary to any surface water supplies.

3.1.5 Geology, Soils, and Seismology

❒ **Geology—**Rocky Flats is located on the western edge of the Colorado Piedmont section of the Great Plains Province. The site is located on the west flank of the Denver Basin, an extensive sedimentary basin bordered on the west by the base of the Colorado Front Range. The site is located on a geomorphic surface composed of gravel on sand and clay.

The surface geology at Rocky Flats consists of rock fragments, sand, and gravel deposits that range in thickness from several centimeters to more than 30.5 m (100 ft). The most important unit is Rocky Flats Alluvium, which consists of deposits of sand, gravel, and cobbles in a clay matrix that thins from west to east across the site (DOE 1985). The Arapahoe Formation (Cretaceous period, formed from 65 million to 130 million years ago), which immediately underlies the Rocky Flats Alluvium at Rocky Flats, is approximately 0 to 36.5 m (0 to 120 ft) thick and consists of claystones with interbedded sandstones and siltstones (DOE 1985; DOE 1994a).

Landslides and other mass earth movements are present as shallow features where slopes are steep. Nearly all of the site, however, has slopes averaging only 2 percent. Slopes may be greater than 2 percent along the sides of washes.

❒ **Soils—**Rocky Flats is underlain mainly by soils of the Denver-Kutch and Flatirons-Velscamp soil associations. The erosion potential of the Denver-Kutch soil is low to moderate; shrink-swell potential is moderate to high. The Flatirons-Velscamp soil does not pose an erosion hazard; its shrink-swell potential is low to moderate.

❒ **Seismology—**Rocky Flats lies in Seismic Zone 1, indicating minor damage could occur as a result of earthquakes. No major faults cut the Arapahoe Formation or overlying alluvium in the vicinity of Rocky Flats. The Livingston fault, located approximately 5 km (3 mi) to the west, and the Golden fault, located approximately 8 km (5 mi) to the south, are the mountain-front faults closest to the facility. Neither fault is recognized as a capable fault according to 10 CFR Part 100, Appendix A. No other capable faults are present in the immediate vicinity of Rocky Flats. There are no active volcanos in the Denver Basin (DOE 1996a). Additional details are in Appendix D, Section D.3.3.3.1.

3.1.6 Ecology

❒ **Terrestrial Resources—**Rocky Flats is located at an elevation of 1,829 m (6,000 ft) above sea level, at the approximate elevation where plains grassland vegetation meets lower montane forest. Plant facilities occupy approximately 6 percent of the total site area, and the buffer zone around the site is primarily undeveloped. Vegetative communities on Rocky Flats have been divided into four basic types: grassland, marshland, woodland, and shrubland. Grassland is the most common community onsite, with mesic and zeric grasslands being the predominant subtypes. Marshland occurs along several creeks that cross the site. Woodlands and shrublands are not common communities on Rocky Flats. Habitats that are considered important to wildlife (especially waterfowl and passerine birds) include riparian zones along creeks and trees on south facing slopes. A total of 362 species of vascular plants have been identified on the site (DOE 1996a).

Vegetation is recovering from the grazing that occurred before Government acquisition of the land. Most areas formerly mapped as annual weed communities now qualify as perennial grassland. Indicator species for perennial grassland, such as western wheatgrass and Canada bluegrass, have increased in abundance and now dominate over much of the site (DOE 1996a).

Animals identified on Rocky Flats include 4 amphibian, 8 reptile, 167 bird, and 36 mammal species. Common animals of the site include the common bull snake, prairie rattlesnake, western meadowlark, mourning dove, coyote, and mule deer (DOE 1996a). A variety of game animals occur on the site; however, hunting is not permitted. Numerous raptors, such as the red-tailed hawk and rough-legged hawk, and carnivores, such as the coyote and long-tailed weasel, are found on Rocky Flats. Migratory birds and their nests and eggs are protected by the Migratory Bird Treaty Act (16 U.S.C. 703-711). Eagles are protected by the Bald Eagle Protection Act (16 U.S.C. 668-668D).

❒ **Wetlands—**Rocky Flats contains a variety of wetlands, including intermittent streams, ditches, ponds, and hillside seeps. Most wetlands that occur onsite are found along ephemeral streams and are classified as palustrine. Several manmade wetlands exist on the site, including vegetated sections of ditches, such as the South Interceptor Ditch, the A, B, and C-series ponds, and the landfill pond. Additionally, various locations around the site have wetlands that are fed by drains and storm water from paved areas and other surface runoff (DOE 1996a). Numerous seeps are scattered on the hillsides of the site. Vegetation typical of wetlands at Rocky Flats includes sandbar willow, American watercress, plains cottonwood, broad-leaf cattail, and bulrush. In total, there are approximately 43 ha (107 acres) of non-riparian wetlands and 26 km (16 mi) of riparian wetlands within Rocky Flats (DOE 1996a).

❒ **Aquatic Resources—**Aquatic habitat on Rocky Flats consists of ephemeral streams, ditches, ponds, and springs. Four streams flow within the site boundaries: North Walnut Creek, South Walnut Creek, Woman Creek, and Rock Creek. Each of these streams supports a series of on-channel retention reservoirs or ponds that collect surface water runoff and wastewater.

North and South Walnut Creek, which are located in the northeast portion of the site, flow eastward offsite and into Great Western Reservoir. Fathead minnows are found in these streams. There are three holding ponds along North Walnut Creek and four ponds along South Walnut Creek. These ponds support crayfish and various other macroinvertebrates.

Woman Creek, which is located in the southern portion of the site, flows eastward offsite and into Standley Lake. Seven species of fish have been identified in Woman Creek, including several minnows, largemouth bass, green sunfish, and the white sucker (DOE 1996a).

❒ **Threatened and Endangered Species—**The 43 Federal- and State-listed threatened, endangered, and other special-status species that may be found on or in the vicinity of Rocky Flats area are listed in **Table 3–6.** Sixteen of these species have been observed on or near the site. Potential suitable habitat for 27 other species exists on Rocky Flats. No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on Rocky Flats.

Three Federally listed threatened or endangered species (bald eagle, peregrine falcon [both subspecies], and Preble's meadow jumping mouse, are known to occur on the Rocky Flats site. Bald eagles have been observed flying over and occasionally foraging on Rocky Flats and are known to roost at Standley Lake and Great Western Reservoir, approximately 1.8 km (1.1 mi) and less than 0.5 km (0.3 mi), respectively, from the site. Peregrine falcons have been observed flying over and hunting onsite. Two historical nest sites are within 16 km (10 mi) of the site. The Preble's meadow jumping mouse is known to occupy riparian corridors and impoundment margins at the site. The U.S. Fish and Wildlife Service published a proposal to list the Preble's meadow jumping mouse as an endangered species in March 1997 (62 FR 14093). On May 13, 1998, the U.S. Fish and Wildlife Service published a final rule listing the Preble's meadow jumping mouse as a threatened species (USFWS 1998).

Ute ladies'-tresses are known to occur approximately 13 km (8 mi) north of the site in Boulder County. Suitable habitat exists on Rocky Flats for this species, but no specimens were found during site surveys. Although the complex of prairie dog towns on the site provides suitable habitat for the endangered black-footed ferret, occurrence of the ferret is highly unlikely (DOE 1991), and the area has been cleared of the requirement for verifying surveys (DOE 1996a).

Four Federal candidate species occur on Rocky Flats. Western burrowing owls have been observed in prairie dog colonies at the site. Loggerhead shrikes are seen year-round and usually are seen at the edges of the grasslands adjoining woodlands and shrublands. The ferruginous hawk is a fall and winter resident of the site and has been reported onsite during the breeding season. Although any of these species may breed on Rocky Flats, no breeding activities have been confirmed.

Suitable habitat for the eastern short-horned lizard exists on approximately one-third of the site and this species has been recorded sitewide. The northern goshawk and Baird's sparrow have been observed onsite but are both considered occasional migrant visitors.

Table 3–6 Federal- and State-Listed Threatened, Endangered, and Other Special Status Species that may be Found at or in the Vicinity of Rocky Flats

Federal Endangered Species Known to Occur at Rocky Flats	
Birds	American Peregrine Falcon (*Falco peregrinus*)[1] (ST)[2]
Federal Threatened Species Known to Occur at Rocky Flats	
Birds	Bald Eagle (*Haliaeetus leucocephalus*)[3] (ST)
Mammals	Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*) (SC)
Federal Special-Concern Species Known to Occur at Rocky Flats	
Reptiles	Eastern Short-horned Lizard (*Phrynosoma douglassii brevirostra*)[4, 5]
Birds	Northern Goshawk (*Accipiter gentilis*)[5, 6]
	Baird's Sparrow (*Ammodranius bairdii*)[5]
	Western Burrowing Owl (*Athene cunicularia hypugea*)[4, 5]
	Ferruginous Hawk (*Buteo regalis*)[4, 5] (SC)[7]
	Black Swift (*Cyseliodes niger*) [5, 6]
	Loggerhead Shrike (*Lanius ludovicianus*)[4, 5]
	White-faced Ibis (*Plegadis chihi*)[5]
Mammals	Small-footed Myotis (*Myotis subulatus = M. ciliolabrum*)[5, 6]
Colorado Species of Special Concern Known to Occur at Rocky Flats	
Amphibians	Northern Leopard Frog (*Rana pipiens*) (SC)
Birds	Long-billed Curlew (*Numenius americanus*)[6] (SC)
	Greater Sandhill Crane (*Grus canadensis tibida*)[6] (ST)
	American White Pelican (*Pelecanus erythrorhynchos*)[4] (SC)
Federal Endangered Species with Potential Habitat at Rocky Flats	
Birds	Whooping Crane (*Grus americana*)
	Least Tern (*Sterna antillarum*)
	Piping Plover (*Charadrius melodus*)
Mammals	Black-footed Ferret (*Mustela nigripes*)[8]
Federal Threatened Species with Potential Habitat at Rocky Flats	
Plants	Ute Ladies'-tresses (*Spiranthes diluvialis*)[9]
Insects	Pawnee Montane Skipper (*Hesperia leonardus montana*)
Federal Candidate Species with Potential Habitat at Rocky Flats	

Plants	Colorado Butterfly Plant (*Gaura neomexicana var. coloradensis*) (Cl)[10]
Birds	Mountain Plover (*Charadrius montanus*) (Cl)
	Southwestern Willow Flycatcher (*Empidonax traillii extimus*) Cl)

Federal Special-Concern Species with Potential Habitat at Rocky Flats	
Plants	Bell's Twinpod *(Physaria bellii)*[5]
	Tulip Gentian (*Eustoma grandiflora*)[5]
	Adder's Mouth Orchid (*Malaxis brachypoda*)[5]
Insects	Regal Fritillary (*Speyeria idalia*)[5]
Fish	Plains Topminnow (*Fundulus sciadicus*)[5]
Birds	Western Snowy Plover (*Charadrius alexandrinus nivosus*)[5]
	Black Tern (*Chlidonias niger*)[5]
Mammals	Spotted Bat (*Euderma maculatum*)[5]
	Long-eared Myotis (*Myotis evotis*)[5]
	Fringed Bat (*Myotis thysanodes*)[5]
	Long-legged Myotis (*Myotis volans*)[5]
	Pale Townsend's Big-eared Bat (*Plecotus townsendii pallescens*)[5]
	Plains Spotted Skunk (*Spilogale putorius interrupta*)[5]
	Swift Fox (*Vulpes velox*)[8, 5]
Colorado Species of Special Concern with Potential Habitat at Rocky Flats	
Fish	Common Shiner (*Notropis conutus*) ((SC)
	Stonecat (*Noturus flavus*) (SC)
Birds	Barrow's Goldeneye (*Bucephala islandica*) ((SC)
	Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*) (SE)[11]

Notes:

1. The species *Falco peregrinus* is listed as endangered wherever found in the coterminous 48 states. Some subspecies are listed separately.
2. Colorado State threatened species (ST)
3. The U.S. Fish and Wildlife Service has down-listed the Bald Eagle to threatened status.
4. This species is resident or regularly visits Rocky Flats.
5. In February 1996, the U. S. Fish and Wildlife Service revised the list of candidate species. All former candidate species except C-1 species are now classified unofficially as "at risk" and are still considered special-concern species. This table includes these species because they may be upgraded to C-1 species at any time.
6. The species has been observed infrequently on Rocky Flats.
7. Colorado species of special concern (SC).
8. This species was previously collected near Rocky Flats.
9. These species have historically used areas in the vicinity, and suitable habitat exists at Rocky Flats.
10. Federal candidate species for listing as threatened or endangered (C-1).
11. Colorado State endangered species.

Source: DOE 1997b.

3.1.7 Cultural and Paleontological Resources

Thirty-five historic sites have been identified at Rocky Flats. Most of the historic resources in the area are archaeological sites or standing structures associated with ranching or transportation routes. Several Native American groups, including the Plains Apache, Comanche, Ute, Arapaho, and Cheyenne, historically occupied or crossed the foothills around Rocky Flats. No paleontological materials have been recovered from the Rocky Flats alluvium, and it is considered nonfossiliferous. Additional information about cultural resources at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

3.1.8 Socioeconomics

- **Regional Economy Characteristics—**Between 1980 and 1990, the civilian labor force in the regional economic area increased 39.9 percent to the 1990 level of 1,868,628. The regional economic area encompasses 49 counties around Rocky Flats located in Colorado, Nebraska, and Kansas. The 1994 unemployment rate in the regional economic area was 4.1 percent, which parallels the unemployment rate for Colorado. The unemployment rate for Kansas is approximately 1 percent higher than that of the regional economic area, and Nebraska is about 1 percent lower than the regional economic area unemployment rate. The region's per capita income of $21,958 in 1993 was approximately 2 percent greater than Colorado's per capita income of $21,498. The Kansas per capita income ($19,849) was 9.6 percent lower than the region's, and Nebraska's per capita income ($19,673) was 10.4 percent lower (DOE 1996a).

The composition of the regional economic area economy was similar to that of the statewide economy of Colorado. During 1993, the services sector constituted more than 31 percent of the region's total employment, followed by retail trade (approximately 17 percent) and manufacturing (approximately 9 percent). For Colorado, the service sector accounted for slightly more than 30 percent of the total employment, retail trade accounted for 17 percent, and manufacturing accounted for 8 percent. Kansas and Nebraska paralleled each other, with the service sector representing 25 and 26 percent, respectively, of total employment, retail trade representing 17 percent for both States, and manufacturing representing 12 and 10 percent, respectively (DOE 1996a).

❒ **Population and Housing—**In 1994, the region of influence population totaled 1,957,797. The region of influence is a five-county area (Adams County, Araphahoe County, Boulder County, Denver County, and Jefferson County) located in Colorado in which over 90 percent of all Rocky Flats employees reside. From 1980 to 1994, the region of influence population grew by 22.9 percent, compared to 26.5 percent for Colorado. Within the region of influence, Arapahoe County experienced the greatest population increase, 51.2 percent; Denver County's population increased by only 0.2 percent (DOE 1996a).

The increase in number of housing units in the region of influence between 1980 and 1990, 22.5 percent, was about 1 percent less than the increase in Colorado housing units. The total number of housing units in the region of influence for 1990 was 788,480. The 1990 region of influence homeowner and renter vacancy rates, 3.2 and 11.7 percent, respectively, were similar to those in Colorado (DOE 1996a).

Figure 3–6 shows the racial and ethnic composition of minorities residing within an 80-km (50-mi) radius of Rocky Flats at the time of the 1990 census. This 80-km (50-mi) radius defines the region of potential influence for radiological impacts evaluated in Chapter 4 of this EIS. The minority population as a percentage of total population residing in the region of influence was approximately 5 percent less than the national percentage of minorities residing in the continental United States at the time of the 1990 census (24.2 percent). Hispanics comprised nearly 63 percent of the minority population in the region of influence (DOE 1996a).

Figure 3–7 illustrates the geographical distribution of the minority population living within the region of influence expressed as a percentage of the total population. Areas in which the percentage minority population exceeded the national average by a factor of 1.5 or more are designated with horizontal and vertical crosshatching. Areas with the largest percentage minority population are found within the City of Denver and along Highway 85 near Fort Lupton and Greeley (DOE 1996a).

As shown in Table F-3 of Appendix F, approximately 10 percent of the individuals living within the region of influence had a self-reported income less than the poverty level. The poverty level is a function of family size and number of unmarried children in the family under 18 years of age (Appendix F). The national percentage of individuals with income less than the poverty-level in 1995 is estimated by the Census

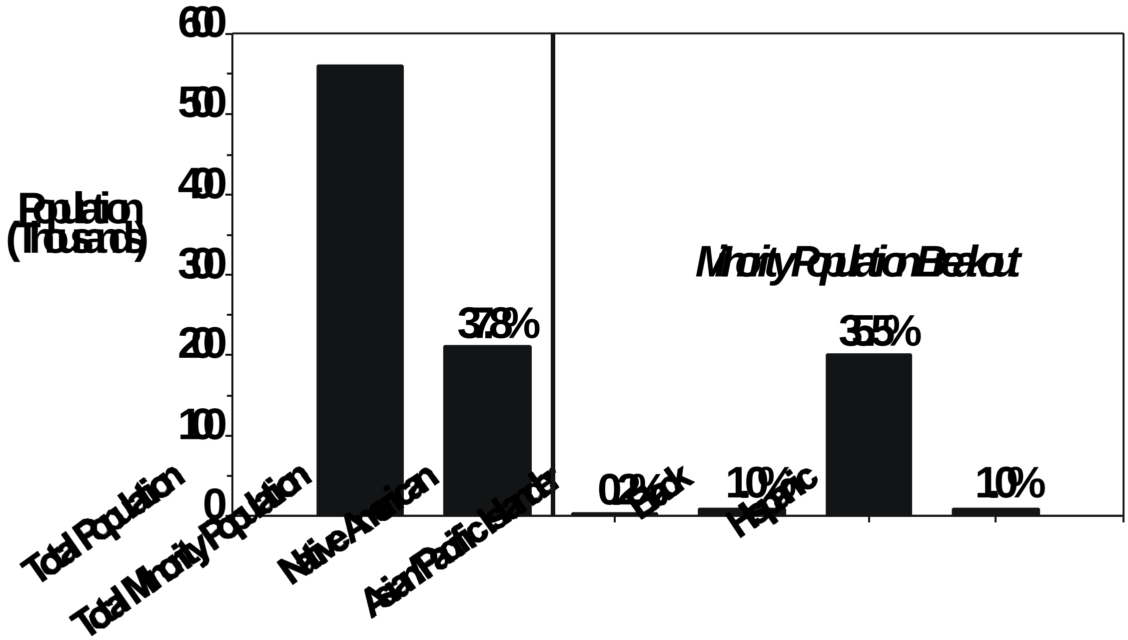

Figure 3–6 Racial and Ethnic Composition of the Minority Population Residing Within 80 km (50 mi) of Rocky Flats

Bureau to be 13.8 percent. At the time of the 1990 census, the national percentage of individuals with income less than the poverty level for the continental United States was 13.3 percent. **Figure 3–8** shows the distribution of poverty-level individuals living within the region of influence.

❒ **Education—**In 1994, 18 school districts provided public education services and facilities in the Rocky Flats region of influence. These school districts operated at between 67.5-percent (Denver County School District) and 102.5-percent (Byers School District) capacity. The average student-to-teacher ratio for the Rocky Flats region of influence in 1994 was 19:1. The Jefferson County School District had the highest ratio at 23.7:1.

❒ **Public Safety—**City, county, and State law enforcement agencies provide police protection to the residents of the region of influence. In 1994, a total of 3,811 sworn police officers were serving the 5-county region of influence. The City of Denver employed the largest number of officers (1,378) and had the highest officer-to-population ratio (2.8 sworn officers per 1,000 persons). The average region of influence officer-to-population ratio was 2.0 officers per 1,000 persons.

Fire protection services in the Rocky Flats region of influence were provided by 5,408 regular and volunteer firefighters in 1995. The fire district with the highest firefighter-to-population ratio was Adams County, with 9.5 firefighters per 1,000 persons. Adams County also employed the greatest number of firefighters (1,396). The average firefighter-to-population ratio in the region of influence was 2.7 firefighters per 1,000 persons.

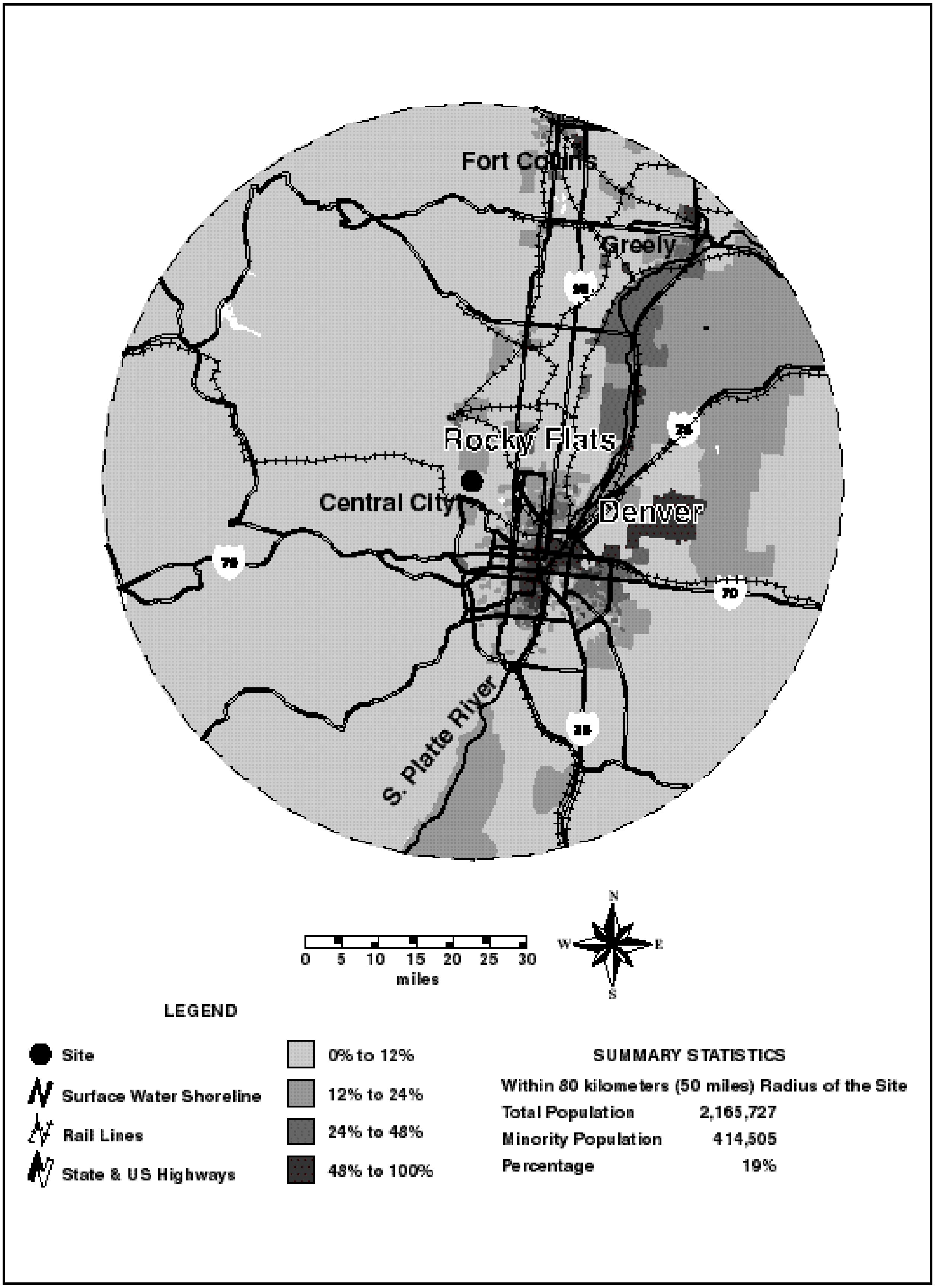

Figure 3–7 Distribution of Minority Population Living Within 80 km (50 mi) of Rocky Flats

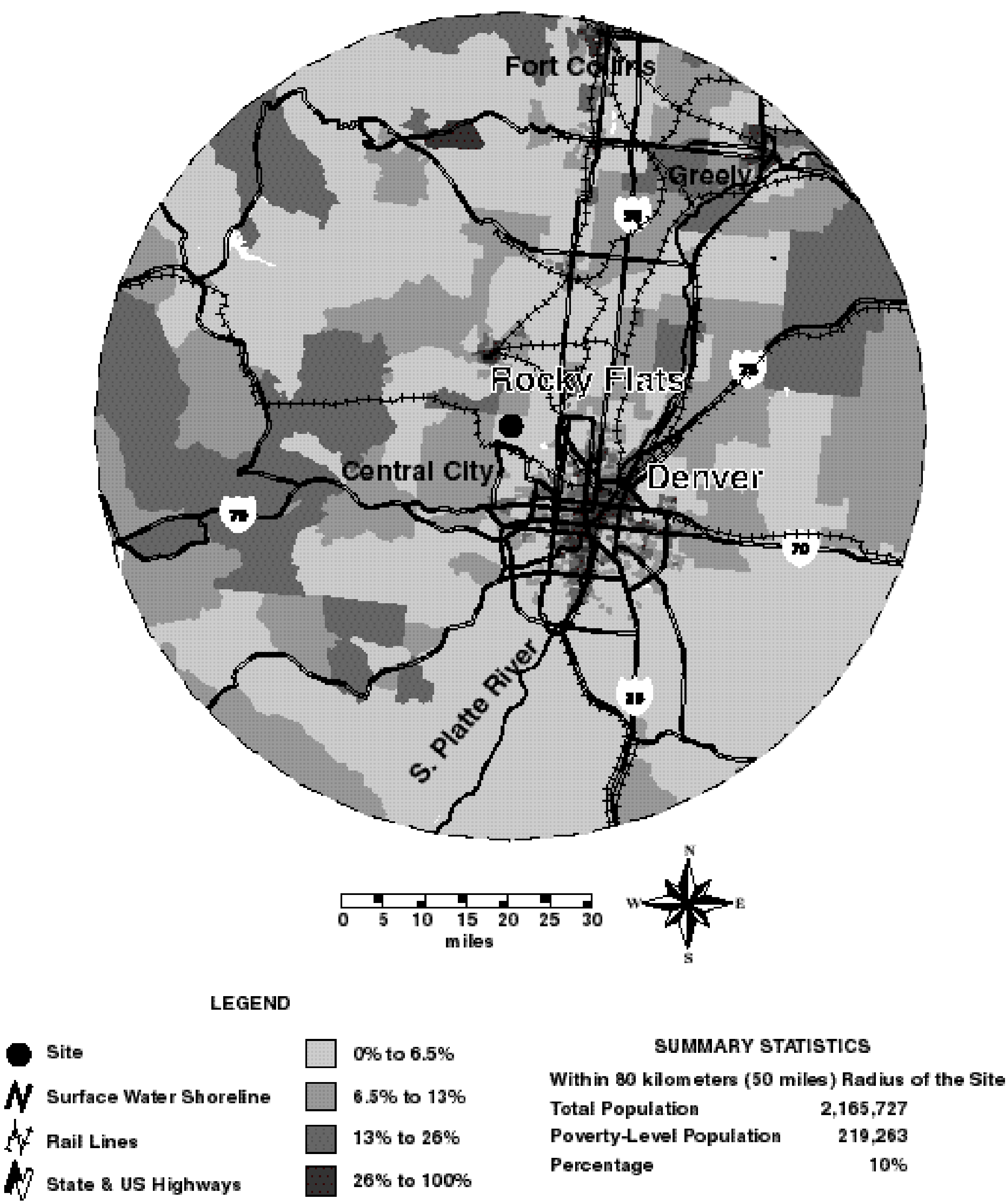

Figure 3–8 Distribution of Poverty-level Population Living Within 80 km (50 mi) of Rocky Flats

- **Health Care—**Nineteen hospitals served the five-county region of influence in 1994. More than 64 percent of the hospital bed capacity was located in 9 hospitals in the City of Denver. During 1994, all 19 hospitals operated at below capacity, with bed occupancy rates ranging from 22.4 percent in Adams County to 60.2 percent in Denver County.

During 1994, 5,017 physicians practiced in the region of influence with the majority (2,649) operating in Denver County. Physician-to-population ratios ranged from 1.2 physicians per 1,000 persons in Jefferson County to 5.4 physicians per 1,000 persons in Denver County. The average region of influence physician-to-population ratio was 2.6 physicians per 1,000 persons.

- **Local Transportation—**Vehicular access to Rocky Flats is provided by Colorado State Highway 93 to the west and Jefferson County Road 17 (Indiana Street) to the east. Road improvements for segments providing access to Rocky Flats include bridge replacement and reconstruction along Colorado State Highway 93 before the year 2000. There are no current road improvements that would affect access to Rocky Flats. There is no public transportation to Rocky Flats (DOE 1995c).

Major railroads in the region of influence include the Union Pacific, the Burlington Northern and Santa Fe Railroad, and the Union Pacific Railroad. A single-track spur from the Union Pacific main line enters Rocky Flats from the west. No navigable waterways within the region of influence are capable of accommodating waterborne transportation of material shipments to Rocky Flats (DOE 1993a). The Denver International Airport, which began operation in 1995, provides passenger and cargo service in the region of influence on national and international carriers.

3.1.9 Public and Occupational Health and Safety

- **Radiation Environment—**Major sources and levels of background radiation exposure to individuals in the vicinity of Rocky Flats are shown in **Table 3–7.** Annual background radiation doses to individuals remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to Rocky Flats operations.

Releases of radionuclides to the environment from Rocky Flats operations provide another source of radiation exposure to individuals in the vicinity of Rocky Flats. Types and quantities of radionuclides released from Rocky Flats operations in 1994 are listed in the *Site Environmental Report for 1994* (Kaiser-Hill 1995). Doses to the public resulting from these releases are presented in **Table 3–8.** These doses fall within radiological limits stated in DOE Order 5400.5 and are small in comparison to background radiation.

Workers at Rocky Flats receive the same dose as the general public from background radiation; they receive an additional dose from working in the facilities. **Table 3–9** presents the average and cumulative dose to Rocky Flats workers from operations in 1996.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Site Environmental Report for 1994* (Kaiser-Hill 1995). Concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Table 3–7 Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Rocky Flats Operations

Source	*Effective Dose Equivalent (mrem/yr)*
Natural Background Radiation[a]	
Cosmic and cosmogeneric radiation	51
External terrestrial radiation	63
Internal terrestrial radiation	39
Radon in homes (inhaled)	200
Other Background Radiation[b]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	< 1
Air travel	1
Consumer and industrial products	10
Total	418

[a] DOE 1994a.
[b] NCRP 1987.
Note: Value for radon is an average for the United States.

Table 3–8 Radiation Doses to the Public from Incident-Free Rocky Flats Operations in 1994 (Committed Effective Dose Equivalent)

Members of the General Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard[a]	*Actual*	*Standard*[a]	*Actual*	*Standard*[a]	*Actual*
Maximally exposed individual (mrem)	10	0.14	4	~0	100	0.14
Population within 80 km (50 mi)[b] (person-rem)	None	0.26	None	0[c]	None[d]	0.26
Average individual within 80 km (50 mi)[e] (mrem)	None	0.00012	None	0[c]	None	0.00012

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10 mrem/yr limit from airborne emissions is required by the Clean Air Act, the 4 mrem/yr limit is required by the Safe Drinking Water Act, and the total dose of 100 mrem/yr is the limit from all pathways combined.
[b] In 1994, this population was approximately 2,200,000.
[c] No population groups are exposed to any liquid pathways.
[d] A 100 person-rem value for the population is given in proposed 10 CFR Part 834 (58 *Federal Register* 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Source: Kaiser-Hill 1995.

Table 3–9 Radiation Doses to Workers from Incident-Free Rocky Flats Operations in 1996 (Committed Effective Dose Equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual*
Average worker (mrem)	None	57
Total workers[b] (person-rem)	None	263

[a] DOE's goal is to maintain radiological exposures as low as reasonably achievable. This includes maintaining doses to individual workers so far below the DOE limit of 5,000 mrem/year (10 CFR Part 835) that no dose is expected to exceed the DOE Administrative Control Level of 2,000 mrem/year (DOE 1992a).

[b] The number of badged workers in 1996 was approximately 4,600.
Source: DOE 1997b.

- **Chemical Environment—**The background chemical environment important to human health consists of the atmosphere (hazardous chemicals may be inhaled), drinking water (hazardous chemicals may be swallowed), and other parts of the environment people encounter (such as surface waters during swimming and soil through direct contact or via the food pathway).

Effective administrative and design controls help minimize potential health impacts to the public by decreasing hazardous chemical releases to the environment and by helping achieve compliance with permit requirements, such as air emissions and National Pollutant Discharge Elimination System permit requirements. The effectiveness of these controls is verified through the use of monitoring information and the inspection of mitigation measures. During incident-free operations at Rocky Flats, health impacts to the public may occur from breathing air containing hazardous chemicals released to the atmosphere by Rocky Flats operations. Other risks to public health, such as drinking contaminated water or direct exposure, are low compared to risks from breathing.

Baseline air emission concentrations for hazardous chemicals and their applicable standards are included in the data already presented in Section 3.1.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. These concentrations are in compliance with applicable guidelines and regulations.

Exposure pathways to Rocky Flats workers during incident-free operations may include inhaling the workplace atmosphere and direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Rocky Flats workers are also protected by adherence to Occupational Safety and Health Administration and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that shows the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements (DOE Order 440.1) ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

- **Emergency Preparedness—**Each of DOE's sites have established an emergency management program that would be activated in the event of an accident. Each program has been developed and maintained to ensure adequate response for most accident conditions. The emergency management program incorporates activities associated with emergency planning, preparedness, and response.

Rocky Flats has emergency plans that provide guidance and procedures designed to protect: (1) life and property within the facility, (2) the health and welfare of surrounding metropolitan communities, and (3) the defense interests of the Nation during any credible emergency situation. Mutual assistance and coordination with Federal, State, and local agencies is provided on a cooperative basis.

DOE's Rocky Flats Area Office Manager coordinates activities for emergencies affecting offsite personnel or property and is responsible for communication with the supporting Federal, State, and local agencies. The Rocky Flats Area Office Manager may obtain further assistance through the Interagency Radiological Assistance Plan, which provides that each of the signatory Federal agencies will assist one another in the event of a major emergency involving radioactivity.

The Rocky Flats Emergency Plan is designed to enable Rocky Flats to be as self-sufficient as possible in handling onsite emergency situations. Assistance may be requested from outside sources through written agreements with St. Anthony Hospital, St. Luke's Hospital, the University of Colorado, the Jefferson County Sheriff's Office, and the Federal Bureau of Investigation.

In the event of an offsite emergency, the *Rocky Flats Radiological Assistance Plan* interfaces with the *DOE Radiological Assistance Plan*, the *Interagency Radiological Assistance Plan*, and the Joint Nuclear Accident Coordinating Center through the DOE Rocky Flats Area Office at Rocky Flats. Additionally, in the event of an incident at Rocky Flats involving the release of radioactive material that may endanger the health and safety of the general public, the *Colorado Radiological Emergency Response Plan* would be activated.

3.1.10 Waste Management

| **Table 3–10** presents a summary of waste management activities at Rocky Flats for 1995. DOE is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operations at Rocky Flats. DOE engaged in several activities to bring its operations into regulatory compliance. These activities are set forth in negotiated agreements that contain schedules for complying with applicable requirements and financial penalties for not meeting agreed-upon milestones.

The focus of the Rocky Flats mission is on stabilization, decommissioning, and environmental restoration. The legal framework establishing the scope, schedule, and approach for projects in the cleanup program is the Rocky Flats Cleanup Agreement, which provides a uniform framework for decommissioning, waste management, and environmental restoration onsite. The agreement integrates the actions required under the authority and jurisdiction of the Comprehensive Environmental Response, Compensation, and Liability Act | and the Resource Conservation and Recovery Act. The primary objective of the environmental restoration program is to assess and to clean up Rocky Flats in compliance with applicable environmental laws and regulations.

Rocky Flats manages the following waste categories: transuranic, low-level, hazardous, toxic substances, mixed, and nonhazardous. Waste management includes the treatment, storage, shipment, and disposal of waste. Waste disposal activities include disposal of low-level waste and low-level mixed waste at the Nevada Test Site, Envirocare of Utah, and the Hanford Site; preparing, transporting, and disposing of hazardous and other regulated wastes by commercial vendors; and the disposing of sanitary waste in the onsite landfill. A discussion of the waste management operations associated with each waste category follows.

❒ **Transuranic Waste—**Transuranic and mixed transuranic wastes generated at Rocky Flats before 1970 were shipped to Idaho National Environmental Engineering Laboratory and disposed of underground. After 1970, this waste was shipped to Idaho National Environmental Engineering Laboratory for interim storage until a permanent disposal facility becomes available. As a result of delays in opening the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, the Governor of Idaho placed a moratorium on out-of-state waste shipments to Idaho National Environmental Engineering Laboratory in October 1988, forcing Rocky Flats to store transuranic and mixed transuranic wastes onsite.

Table 3–10 Waste Management Activities at Rocky Flats

Waste Category	*1996 Generation[a] (m³)*	*Treatment Method*	*Treatment Capacity (m³/yr)*	*Storage Method*	*Storage Capacity (m³)*	*Disposal Method*	*Disposal Capacity*
Transuranic							
Liquid	None	Solidification	Included in liquid mixed LLW	None	N/A	NA	NA
Solid	25	Compaction	Included in solid mixed LLW	Drums on pads	1,500[b]	None - WIPP or alternate facility in the future	NA
Transuranic (Mixed)							
Liquid	None	Solidification	Included in liquid mixed LLW	None	N/A	NA	NA
Solid	5	Compaction	Included in solid mixed LLW	Drums on pads	1,300[c]	None - WIPP or alternate facility in the future	NA
Low-Level							
Liquid	5	Evaporation and Solidification	Included in liquid mixed LLW	Staged	105[d]	NA	NA
Solid	617	None	None	Staged	4,540[d]	Offsite - DOE	NA
Hazardous							
Liquid	None	Neutralization & Precipitation	None	Staged in Department of Transportation containers	Included in solid hazardous waste	Offsite	NA
Solid	23 (tonnes)	None	None	Staged in Department of Transportation containers	263[e]	Offsite	NA
Mixed (Low-Level)							
Liquid	4	Solidification	47,700[f]	Staged for treatment	Included in solid mixed low-level waste	None	N/A
Solid	47	None	7,100[g,h]	Department of Transportation containers	13,600[i]	Offsite	N/A
Nonhazardous (Sanitary)							
Liquid	None	Sedimentation	568,000	None	N/A	Surface water	N/A
Solid	10,268 (tonnes)	None	None	None	N/A	Onsite landfill	Expandable

LLW = low-level waste   N/A = Not applicable.

[a] Values per *Rocky Flats Comprehensive Waste Management Plan*.

[b] Value taken from *Draft Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*.

[c] Value taken from *Rocky Flats Proposed Site Treatment Plan* dated March 1995 and is based on the sum of the current mixed-transuranic storage and the expected 20-year generation.

[d] Cumulative volume of low-level waste stored at the end of 1993 as per memorandum from McGlochlin, EG&G, to Reece, DOE, on updated information for non-nuclear consolidation Environmental Assessment.

[e] Value based on the 1991 Waste Storage Inventory Report and the memorandum from McGlochlin, EG&G, to Reece, DOE, on updated information for non-nuclear consolidation Environmental Assessment.

[f] Based on the operating capacities of Buildings 374 and 774 as described in the 1995 Mixed Waste Inventory Report.

[g] Based on the operating capacities of Building 776 as described in the 1995 Mixed Waste Inventory Report.

[h] Value calculated using the conversion ratio of 1,500 kg/m³.

[I] Value taken from Rocky Flats Proposed Site Treatment Plan dated March 1995 and based on the mixed low-level waste in storage at Rocky Flats.

Sources: Adapted from DOE 1996a and DOE 1997a.

This onsite storage violated Resource Conservation and Recovery Act storage provisions and led to several interim agreements. Storage of transuranic and mixed transuranic wastes at Rocky Flats is governed by the provisions of the Colorado Department of Health Settlement Agreement and Compliance Order on Consent, Number 89-07-10-01, related to mixed wastes, that was signed on July 14, 1989. The Order required Rocky Flats to submit a Part A Permit Application for all its interim status mixed transuranic and mixed low-level waste storage and treatment units. The Order granted interim status to all mixed transuranic waste units, except Unit 60, included in applications filed by July 1, 1988, and also granted interim status to units used for storage and treatment of hazardous and mixed low-level waste identified in an August 2, 1988, Part A Application. The mixed residues were subsequently incorporated into the existing Rocky Flats Part B Permit for the treatment and storage of mixed and hazardous waste.

Finally, the Order set the total capacity limit for interim status container storage for mixed transuranic waste at 1,220 cubic meters (m^3) (1,601 cubic yards [yd^3]) (DOE 1996a), although a capacity exists for 1,500 m^3 (1,960 yd^3). The Federal Facility Compliance Act of 1992 requires DOE to develop site-specific mixed waste treatment plans and to submit the plans to the EPA or the authorized State for approval. The final proposed plan was published in March 1995.

Residues are process byproducts that contain plutonium in concentrations that would allow its recovery for a cost less than the cost of new plutonium. Initially, DOE did not consider residues at Rocky Flats to be a waste form. However, events at Rocky Flats have led to the classification of some of these plutonium residues as waste in the State of Colorado. Those residues that contain hazardous constituents have undergone characterization to determine compliance with the Resource Conservation and Recovery Act and court orders.

On November 3, 1989, DOE and the State of Colorado signed the Residue Compliance Agreement and Consent Order, which requires DOE to submit a plan for removing all mixed residue inventory at Rocky Flats by January 1, 1999. Also, the U.S. District Court, Colorado, issued a Judgment and Order on August 13, 1991, that declared Rocky Flats mixed residues to be hazardous materials that must be managed in accordance with the Resource Conservation and Recovery Act. This ruling further ordered that DOE must obtain a permit for the mixed residues without a Resource Conservation and Recovery Act permit. The mixed residues were subsequently incorporated into the existing Rocky Flats Part B Permit for the treatment and storage of mixed and hazardous wastes.

WIPP has specific Resource Conservation and Recovery Act hazardous waste codes that it can accept without requiring the treatment of the waste forms. After stabilization, Rocky Flats mixed wastes will not contain Resource Conservation and Recovery Act wastes outside of the acceptable waste codes for WIPP. WIPP's waste acceptance criteria must be met by each site seeking to ship mixed wastes to WIPP. Each site has developed a WIPP transuranic waste characterization program (including hazardous waste characterization) to meet the waste acceptance criteria.

- ❒ **Low-Level Waste—**Low-level waste has typically been packaged and disposed of at either the Nevada Test Site or the Hanford Site. Prior to shipment and acceptance for disposal at these facilities, each waste form must be characterized and shown not to contain Resource Conservation and Recovery Act hazardous constituents.

- ❒ **Mixed Low-Level Waste—**A great deal of the solid radioactive waste at Rocky Flats consists of mixed low-level waste. Mixed low-level waste shipments to the Nevada Test Site were suspended in May 1990 when the Resource Conservation and Recovery Act Land Disposal Restriction regulations went into effect. Low-level mixed waste is currently shipped to Envirocare of Utah for disposal. Prior to the acceptance of any waste for disposal at Envirocare of Utah, DOE must fully characterize each waste to prove that hazardous constituents are below treatment standards.

DOE and EPA entered into a Federal Facility Compliance Agreement for Land Disposal Restriction wastes on May 20, 1991. This agreement requires DOE to submit the following: a Comprehensive Treatment and Management Plan addressing treatment proposed for Rocky Flats nonresidue mixed wastes to bring them into compliance with the treatment and storage requirements of the Resource Conservation and Recovery Act; a Waste Minimization Plan identifying process changes proposed to minimize or eliminate wastes; and an Annual Progress Report evaluating Rocky Flats' progress in achieving compliance with the Resource Conservation and Recovery Act Land Disposal Restriction.

Negotiations began in June 1992 for a new Federal Facility Compliance Agreement. This 1993 agreement was entitled the "Settlement Agreement and Compliance Order on Consent No. 93-04-23-01," and it replaced the 1991 Federal Facility Compliance Agreement and the 1989 Agreement in Principle. DOE continues to manage its mixed waste compliance program in accordance with the existing 1993 Settlement Agreement. For example, the Waste Minimization Program Plan, Waste Stream and Residue Identification and Characterization Report, and the Annual Progress Report continue to be updated and submitted on an annual basis. However, because the Federal Facility Compliance Act gives the State primacy in approval of the site treatment plan and issuance of a compliance order, the Colorado Department of Public Health and Environment is now considered the lead regulatory agency in regard to DOE's mixed waste compliance program.

- **Hazardous Waste—**Hazardous wastes are shipped to various Resource Conservation and Recovery Act-permitted commercial vendors for disposal. In 1991, DOE and the Colorado Department of Public Health and Environment agreed on radioactivity limits for waste garage oil. This waste form is now being shipped to a commercial vendor for recycling.

- **Nonhazardous Waste—**DOE and EPA agreed to and signed, on March 25, 1991, a Federal Facility Compliance Agreement for the National Pollutant Discharge Elimination System program. The agreement requires the following actions:

  - Upgrade the sewage treatment plant and change sewer sludge and spray irrigation management practices.
  - Enhance groundwater monitoring for the sewage sludge drying beds.
  - Prepare a compliance plan describing those actions necessary for Rocky Flats to remain in compliance with the National Pollutant Discharge Elimination System permit.
  - Submit to the EPA a variety of new reports and studies describing the status of compliance.

  Solid sanitary waste will be sent to an off site landfill starting in fiscal year 1998. Liquid nonhazardous waste is treated and released to surface waters.

3.2 SAVANNAH RIVER SITE

The Savannah River Site is one of the Department of Energy's primary facilities for research and production of nuclear materials. It is also used for the interim management of radioactive waste. The site occupies 80,130 ha (198,000 ac) in portions of Aiken, Barnwell, and Allendale Counties in South Carolina and is adjacent to the border between South Carolina and Georgia. It is located approximately 19 km (12 mi) south of Aiken, South Carolina, and approximately 40 km (25 mi) southeast of Augusta, Georgia (**Figure 3–9**). The site was built in the early 1950s to produce nuclear materials used to manufacture nuclear weapons. Today, the site includes 16 major production, service, research, and development areas, not all of which are currently in operation.

There are more than 3,000 facilities at the Savannah River Site, including 740 buildings with 511,000 m^2 (5,500,000 ft^2) of floor area. Major nuclear facilities at the Savannah River Site include (or have historically included operation of) fuel and target fabrication facilities, nuclear material production reactors, plutonium storage facilities, chemical separations facilities, a tritium processing area, liquid high-level waste tank farms, a waste vitrification facility, and the Savannah River Technology Center. Nuclear materials are processed into forms suitable for continued safe storage, use, or transportation to other DOE sites. In accordance with the Records of Decision for the *F-Canyon Plutonium Solutions Environmental Impact Statement (60 FR 9824) and the Interim Management of Nuclear Materials Environmental Impact Statement* (60 FR 65300), plutonium solutions have been stabilized and targets have been dissolved and processed in the F-Canyon.

❒ **DOE Activities—**Current missions at the Savannah River Site are listed in **Table 3–11**. In the past, the Savannah River Site complex produced nuclear materials. The complex consisted of various plutonium storage facilities, five reactors (the C-, K-, L-, P-, and R-reactors, all currently inactive), a fuel and target fabrication plant (currently inactive), two chemical separation plants, a tritium-target processing facility, a heavy water rework facility, and waste management facilities. The K-Reactor (the last operational reactor) has been shut down with no planned provision for restart. The Savannah River Site is still conducting tritium recycling operations for stockpile requirements using retired weapons as the tritium supply source. The separations facilities and the processing facilities are scheduled for use through the year 2003 to complete DOE's commitment to the Defense Nuclear Facilities Safety Board regarding stabilization of site inventories of legacy nuclear materials.

DOE's Office of Environmental Management is pursuing a 30-year plan to treat, store, and dispose of existing wastes; reduce generation of new wastes; clean up inactive waste sites; remediate contaminated groundwater; and dispose of surplus facilities (DOE 1996a).

The Savannah River Technology Center provides technical support to DOE's operations at the Savannah River Site. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. The Savannah River Site has an expanding mission to transfer unique technologies developed at the site to industry. In addition, the Savannah River Site is an active participant in the Strategic Environmental Research and Development Program established to develop technologies to mitigate environmental hazards at Department of Defense and DOE sites.

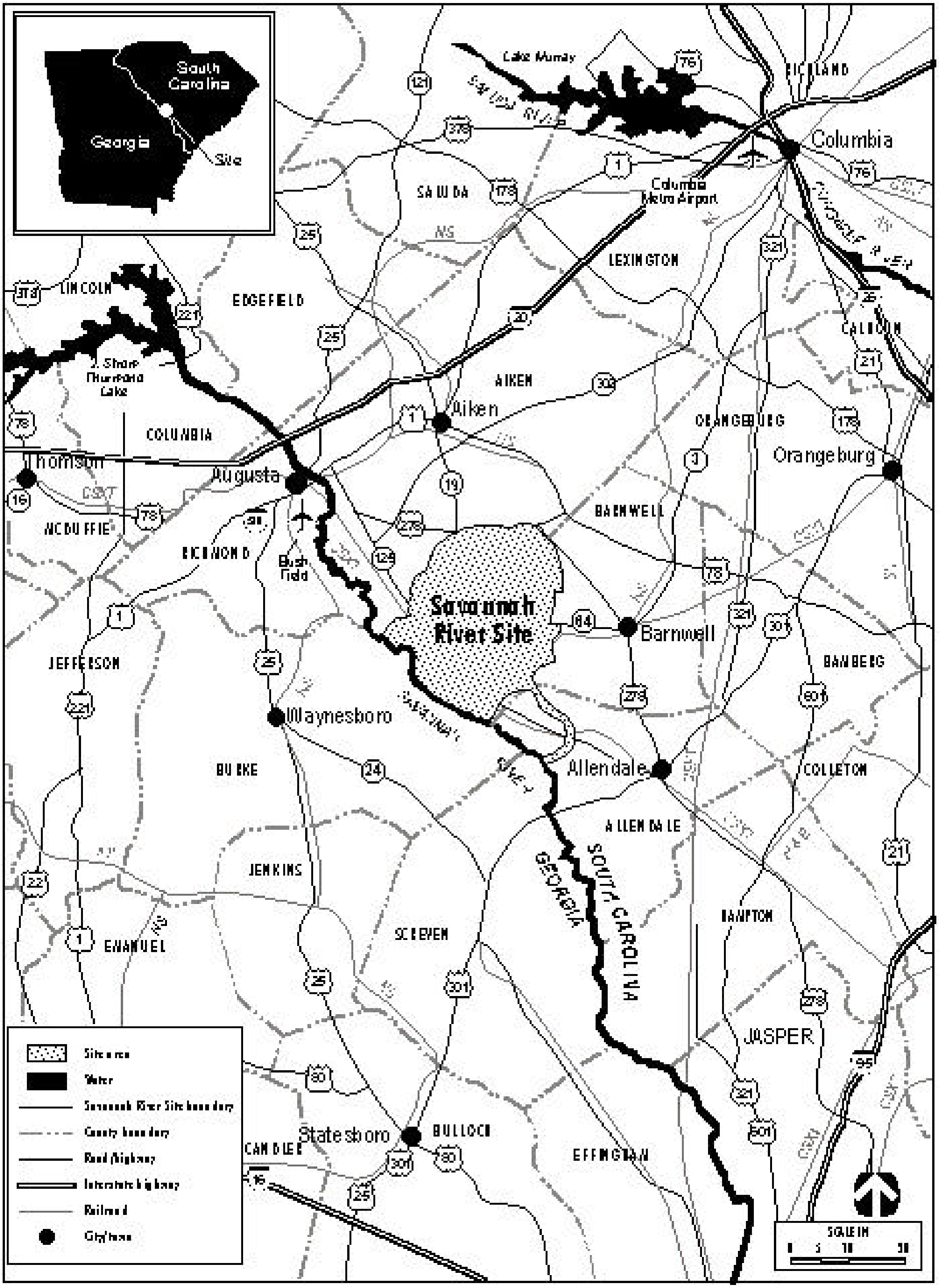

Figure 3–9 Savannah River Site, South Carolina, and Region

Table 3–11 Current Missions at the Savannah River Site

Mission	*Description*
Plutonium storage	Maintain F-Area plutonium storage facilities
Tritium recycling	Operate H-Area tritium facilities
Stabilize targets, spent nuclear fuels, and other nuclear materials	Operate F- and H-Canyons
Waste management	Operate waste processing facilities
Environmental monitoring and restoration	Operate remediation facilities
Research and development	Savannah River Technology Center technical support of Defense Programs, Environmental Management, and Nuclear Energy programs
Other non-DOE missions	Various, as described below, with the U.S. Forest Service, University of Georgia, and University of South Carolina

Source: WSRC 1995.

❐ **Non-DOE Activities—**Non-DOE facilities and operations at the Savannah River Site include the Savannah River Forest Station, the Savannah River Ecology Laboratory, and the Institute of Archaeology and Anthropology. The Savannah River Forest Station is an administrative unit of the U.S. Forest Service, which provides timber management, research support, soil and water protection, wildlife management, secondary roads management, and fire management to DOE. The Savannah River Forest Station manages 62,300 ha (154,000 ac), comprising approximately 80 percent of the site area. It has been responsible for reforestation and manages an active timber business. The Savannah River Forest Station assists with the development and updating of sitewide land use and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects.

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. The University has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and provide an understanding of the impact of energy technologies on the ecosystems of the southeastern United States. This information is communicated to the scientific community, Government agencies, and the general public.

The Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of the Savannah River Site. These surveys are used by DOE when planning new facility additions or modifications.

The information in the following subsections is based primarily on the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

3.2.1 Land Resources

❐ **Land Use—**Land use at the Savannah River Site can be grouped into three major categories: forest/undeveloped, water, and developed facility locations. Forest/undeveloped lands (e.g., open fields and pine or hardwood forests) make up approximately 58,500 ha (144,500 ac) or nearly 73 percent of the total land within the site boundary; water (e.g., wetlands, streams, and lakes) comprises approximately 17,600 ha (43,500 ac) or 22 percent of the site area; and developed facility (e.g., production and support areas, roads, and utility corridors) accounts for approximately 4,000 ha (9,900 ac) or 5 percent of the total land area of the Savannah River Site. Land use bordering the Savannah River Site is primarily forest and agricultural, although there is a substantial amount of open water and nonforested wetland along the Savannah River

Valley. Incorporated and industrial areas are the only other significant land uses in the vicinity. A small amount of urban and residential development borders the Savannah River Site; the nearest residences are located within approximately 60 m (200 ft) of the west, north, and northeast boundaries of the site. Additional information about land resources at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a) and the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995f).

❒ **Visual Resources—**The Savannah River Site landscape is characterized by wetlands and upland hills. The vegetation is composed of bottom land hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE's facilities are scattered throughout the Savannah River Site and are lit brightly at night. The developed areas and utility corridors (transmission lines and aboveground pipelines) of the Savannah River Site are consistent with a Bureau of Land Management Visual Resource Management Class 5 designation (Class 5 designates areas in which cultural activities so dominate the landscape that natural features are not discernible). In other areas of the Savannah River Site, the natural landscape dominates or the natural landscape features are discernible. Additional information about visual resources can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

3.2.2 Site Infrastructure

❒ **Baseline Characteristics—**The Savannah River Site contains extensive production, service, and research facilities. Not all of these facilities are in operation today. To support current missions and functions, an extensive infrastructure exists, as shown in **Table 3–12**. The Savannah River Site does not have a connection to the local natural gas lines.

Table 3–12 Savannah River Site Baseline Characteristics

Characteristics	*Current Usage*	*Site Availability*
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electrical		
Energy consumption (MWh/yr)	420,000	5,200,000
Peak load (MWe)	70	330
Fuel		
Natural gas (m^3/yr)	0	0
Oil (L/yr)*	15,151,355	N/A
Coal (t/yr)	12,000	N/A
Steam (kg/hr)*	81,818	777,273

MWh/yr = megawatt hours per year MWe = megawatts electric m^3/yr = cubic meters per year L/yr = liters per year
t/yr = tons per year kg/hr = kilograms per hour
Source: DOE 1993b.
*Winter usage only.

The subregional electrical power pool area in which the Savannah River Site is located and from which it draws its power is the Virginia-Carolina Subregion, a part of the Southeastern Electric Reliability Council. The Savannah River Site draws most of its electrical power from coal-fired plants and from 17 nuclear-powered generating plants. Characteristics of this power pool are given in **Table 3–13**.

Table 3–13 Virginia–Carolina Subregional Power Pool Electrical Summary

Characteristics	*Energy Production*
Type Fuel[a]	
Coal	50%
Nuclear	36%
Hydro/geothermal	2%
Oil/gas	3%
Other[b]	8%

[a] Percentages do not total 100 percent because of rounding.
[b] Includes power from nonutility sources only.
Source: NERC 1993.

3.2.3 Air Quality and Noise

❒ **Meteorology and Climatology—**The Savannah River Site has a temperate climate with mild winters and humid summers. Warm, moist maritime air masses affect the climate throughout the year.

- The annual average temperature at the Savannah River Site is 17.8° C (64° F), and monthly averages range from a low of 7.22° C (45° F) in January to a high of 27.2° C (81° F) in July. Average daily relative humidity ranges from a maximum of 90 percent in the morning to a minimum of 43 percent in the afternoon.

- The average annual precipitation at the Savannah River Site is approximately 121.9 cm (48 in) (WSRC 1996). Precipitation distribution is fairly even throughout the year, with the highest precipitation in the summer (36.1 cm [14.2 in]) and the lowest in autumn (22.5 cm [8.8 in]) (Arnett, et. al. 1993). Snowfall has occurred October through March, with an average annual snowfall of 3.0 cm (1.2 in). Large snowfalls are rare (DOE 1995d).

- **Figure 3–10** shows annual wind direction frequencies and wind speeds for the Savannah River Site from 1987 through 1991. Data are from the meteorological tower network at the Savannah River Site. There is no prevailing wind at the Savannah River Site, which is typical for the midlands of South Carolina (WSRC 1996). Maximum frequency of 7.8 percent is from northeast to southwest. The average wind speed for this 5-year period was 3.8 m/s (8.5 mph). Calm winds (less than 2 m/s or 4.5 mph) occurred less than 10 percent of the time during the 5-year period. Seasonally, wind speeds were greatest during the winter, at 4.1 m/s (9.2 mph), and lowest during the summer, at 3.4 m/s (7.6 mph) (Shedrow 1993).

  Winter snowstorms in the Savannah River Site area occasionally bring strong and gusty surface winds with speeds as high as 32 m/s (72 mph). Thunderstorms can generate winds with speeds as high as 18 m/s (40 mph) or even stronger gusts. The fastest wind speed recorded at Augusta between 1950 and 1986 was 37 m/s (83 mph) (DOE 1995d).

  Data collected from the Savannah River Site meteorological monitoring network for 1987-1991 indicate that neutral conditions occur approximately 43 percent, and stable conditions approximately 19 percent on an annual basis.

❒ **Air Quality—**The Savannah River Site is located near the center of the Augusta-Aiken Interstate Air Quality Control Region (#53). The areas within Savannah River and its surrounding counties are in attainment with respect to the National Ambient Air Quality Standards for criteria pollutants (40 CFR 81.311; 40 CFR 81.341).

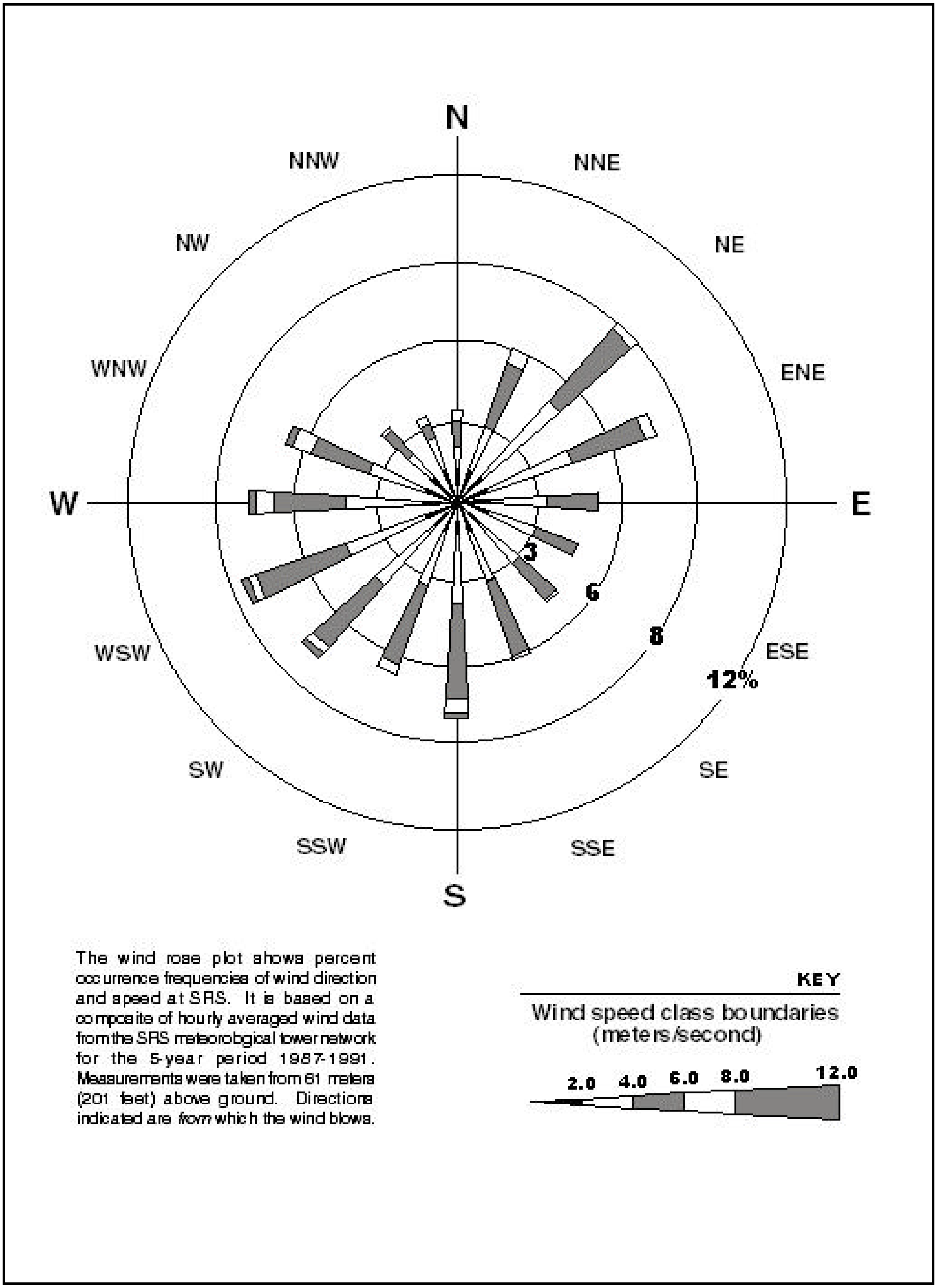

Figure 3–10 Wind Rose for the Savannah River Site (1987–1991)

For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Allowable Prevention of Significant Deterioration increments currently exist for three pollutants (NO_2, SO_2, and PM_{10}). Three Prevention of Significant Deterioration classifications are designated based on criteria established in the Clean Air Act amendments. Class I areas include national wilderness areas, memorial parks larger than 2,020 ha (5,000 acres), and national parks larger than 2,430 ha (6,000 acres). Class II areas include all areas not designated as Class I. No Class III areas have been designated.

There are no Prevention of Significant Deterioration Class I areas within 100 km (62 mi) of the Savannah River Site. The area in which the Savannah River Site is located is classified as a Class II area. None of the facilities at the Savannah River Site has been required to obtain a Prevention of Significant Deterioration permit.

The primary emissions sources of criteria air pollutants at Savannah River Site are the nine coal-burning boilers and four fuel oil-burning package boilers that produce steam and electricity, diesel-engine powered equipment, the Defense Waste Processing Facility, the in-tank precipitation process, groundwater air strippers, and various other process facilities. Other emissions and sources include fugitive particulates from coal piles and coal-processing facilities, vehicles, controlled burning of forestry areas, and temporary emissions from various construction-related activities.

Savannah River Site's contribution to the baseline air concentrations and their applicable standards are included in the data shown in **Table 3–14**. These concentrations are estimates of the highest existing offsite concentrations based on modeling analyses conducted with 1994 emissions data. These concentrations are in compliance with applicable guidelines and regulations (DOE 1998, DOE 1996a).

Ambient air quality monitoring data for 1995 from nearby South Carolina monitors at Beech Island, Jackson, and Barnwell indicate that the National Ambient Air Quality Standards for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around the Savannah River Site (SCDHEC 1995). Air pollutant measurements at these monitoring locations during 1995 showed for NO_2 an annual average concentration of 9.4 $\mu g/m^3$; for SO_2, concentrations of 99 $\mu g/m^3$ for 3-hour averaging, 24 $\mu g/m^3$ for 24-hour averaging, and 5 $\mu g/m^3$ for the annual average; for total suspended particulates, an annual average concentration of 37 $\mu g/m^3$; and for PM_{10}, concentrations of 62 $\mu g/m^3$ for 24-hour averaging and 19 $\mu g/m^3$ for the annual average.

- **Noise—**The major noise sources at the Savannah River Site are in developed operational areas, including various facilities, equipment, and machines (e.g., cooling towers, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most major noise sources outside the operational areas are from vehicles and railroad operations. The remote locations of the Savannah River Site operational areas keep existing onsite noise sources from adversely affecting individuals at offsite locations. Noise limits are established for the workplace to protect workers' hearing in accordance with Occupational Health and Safety Administration standards. Existing Savannah River Site–related noise sources of importance to the public are those associated with road and rail traffic. Additional information about noise sources can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

Table 3–14 Comparison of Savannah River Site's Contribution to the Baseline Air Pollutant Concentrations with Most Stringent Applicable Regulations and Guidelines at Savannah River Site, 1994

Pollutant	*Averaging Time*	*Most Stringent Regulation or Guideline[a] (μg/m³)*	*Modeled Concentration[f] (μg/m³)*
Criteria Pollutants			
CO	8-hour	10,000[b]	632
	1-hour	40,000[b]	5000
NO_2	Annual	100[b]	8.8
Ozone	8-hour	157[b]	c
PM_{10}	Annual	50[b]	4.8
	24-hour	150[b]	80.6
$PM_{2.5}$ [d]	Annual	15[b]	d
	24-hour	65[b]	d
SO_2	Annual	80[b]	16.3
	24-hour	365[b]	215
	3-hour	1,300[b]	690
Lead	Calendar Quarter	1.5[b]	<0.01
Other Regulated Pollutants			
Hydrogen fluoride	30-day	0.8[e]	0.09
	7-day	1.6[e]	0.39
	24-hour	2.9[e]	1.04
	12-hour	3.7[e]	1.99
Total suspended particulates	Annual	75[e]	43.3
Hazardous and Other Toxic Pollutants[g]			
Nitric acid	24-hour	125.00[e]	50.960
Phosphoric acid	24-hour	25.00[e]	0.462

[a] The more stringent of the Federal and State standards is presented.
[b] Federal standard.
[c] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. EPA recently revised the ambient air quality standards for ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 μg/m³ (0.12 ppm) to an 8-hour concentration of 157 μg/m³ (0.08 ppm).
[d] EPA recently revised the ambient air quality standards for particulate matter. The current PM_{10} (particulate matter size less than or equal to 10 micrometers) annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 μg/m³ (3-year average arithmetic mean based on community-oriented monitors) and 65 μg/m³ (3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors). The current 24-hour PM_{10} standard is revised to be based on the 99th percentile of 24-hour concentrations. Insufficient emissions, modeling and monitoring data exist for estimating concentrations of $PM_{2.5}$.
[e] State standard.
[f] Based on maximum potential emissions for 1994 for all Savannah River Site sources. Gaseous fluorides, nitric acid, and phosphoric acid concentrations based on 1990 emissions, as no 1994 data are available.
[g] Only toxic pollutants emitted from the alternatives being evaluated are presented. The Draft EIS listed additional toxic pollutants which would not be emitted from any of the proposed alternatives and so are not necessary to assess baseline or cumulative air quality impacts.

Source: Adapted from DOE 1998 and DOE 1996a.

3.2.4 Water Resources

❒ **Surface Water—**The Savannah River bounds the Savannah River Site on its southwestern border for about 32 km (20 mi), approximately 260 river km (160 river mi) from the Atlantic Ocean. At the Savannah River Site, the Savannah River flow averages about 283 m³/s (74,760 gal/s). Five principal tributaries to the Savannah River are found on the Savannah River Site: Upper Three Runs Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek (**Figure 3–11**). These tributaries drain almost all of the Savannah River Site. Each of these streams originates on the Aiken Plateau in the Coastal Plain and descends 15 to 60 m (50 to 200 ft) before flowing into the river. The streams, which historically have received varying amounts of discharge from the Savannah River Site operations, are not commercial sources of water.

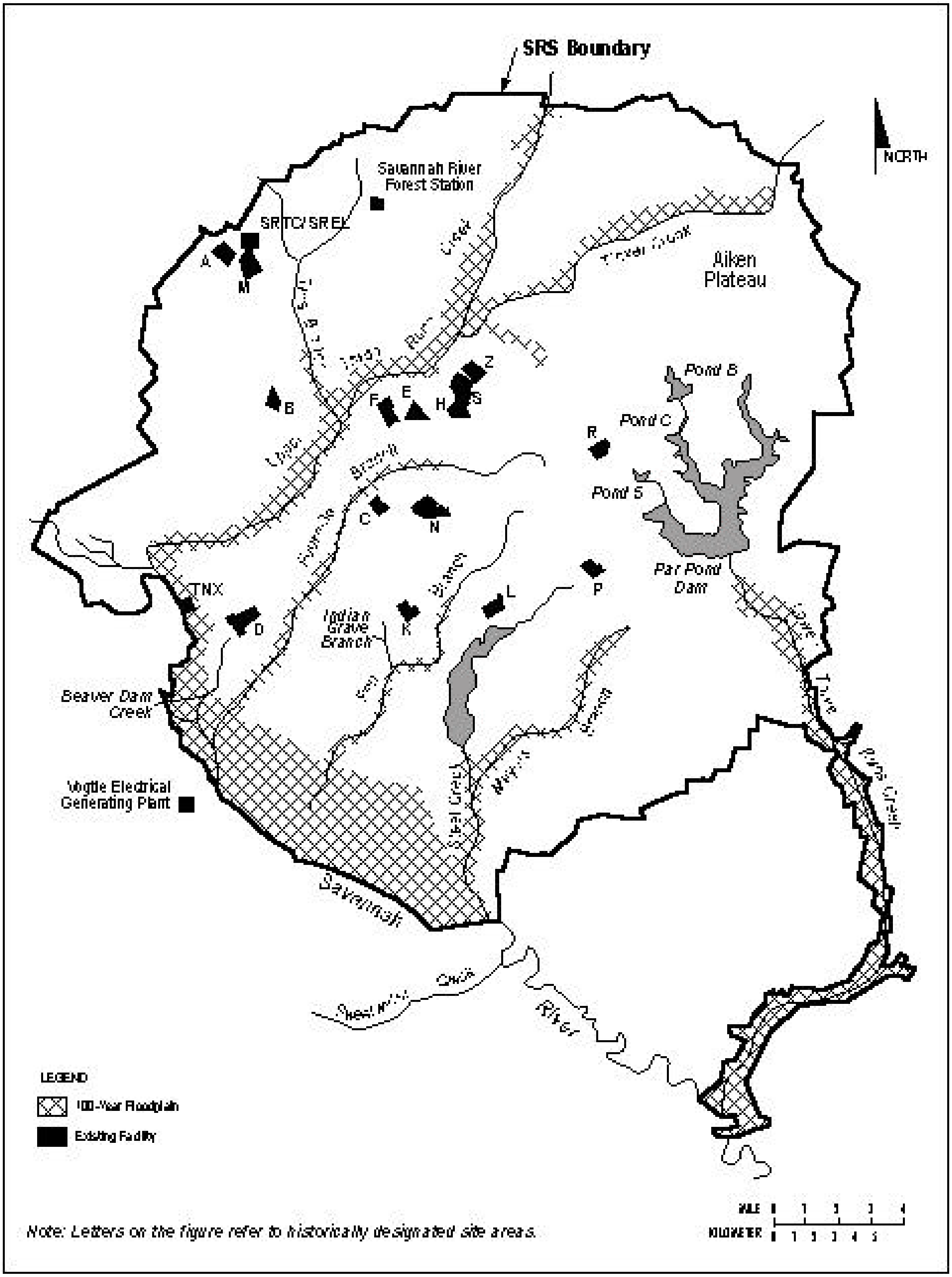

Figure 3–11 The Savannah River Site, Showing 100-Year Floodplain, Major Stream Systems, and Facilities

The natural flow of the Savannah River Site streams ranges from less than 1 m^3/s (264 gal/s) in smaller streams such as Pen Branch to 6.8 m^3/s (1,795 gal/s) in Upper Three Runs. Three large upstream reservoirs—Hartwell, Richard B. Russell, and Strom Thurmond—minimize the effects of droughts and the impacts of low flow on downstream water quality and fish and wildlife resources in the Savannah River.

- *Surface Water Quality*—The Savannah River, which forms the boundary between the States of Georgia and South Carolina, supplies potable water to several areas. Upstream of the Savannah River Site, the river supplies domestic and industrial water needs for Augusta, Georgia and North Augusta, South Carolina. Downstream of the Savannah River Site, the river supplies domestic and industrial water needs for Savannah, Georgia and for Beaufort and Jasper Counties in South Carolina. The South Carolina Department of Health and Environmental Control regulates the physical properties and concentrations of chemicals and metals in the Savannah River Site effluent under the National Pollutant Discharge Elimination System and the chemical and biological water quality standards for Savannah River Site waters. On April 24, 1992, South Carolina Department of Health and Environmental Control changed the classification of the Savannah River and the Savannah River Site streams from "Class B waters" to "Freshwaters." The definitions of Class B waters and Freshwaters are the same, but the Freshwaters classification imposes a more stringent set of water quality standards (Arnett, et. al. 1993). Additional information about surface water quality at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

❒ **Groundwater—**At the Savannah River Site, groundwater in the water table (or most shallow) aquifer flows downward to the Congaree Aquifer or discharges to nearby streams that intersect the water table. Depending on the location at the Savannah River Site, the Congaree Aquifer flows downward to the Cretaceous Aquifer or horizontal to Upper Three Runs Creek or the Savannah River. The Cretaceous Aquifer discharges predominantly along the Savannah River and to upper Three Runs Creek (DOE 1996b).

Most of the rural population in the region draws water from either the Congaree or the water table aquifer. All groundwater at the Savannah River Site is classified by EPA as a Class II water source, meaning it is a current and potential source of drinking water. Groundwater quality ranges from excellent to below EPA drinking water standards for several constituents in the vicinity of some waste sites. For example, the water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several waste sites and facilities (DOE 1996b).

Groundwater depth ranges from at or very near the ground surface (near streams) to about 46 m (151 ft). Groundwater usage in support of site operations totaled 13,247 million L/yr (3,500 million gal/yr) in 1993 (DOE 1996b). Additional information about groundwater hydrology and quality at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

3.2.5 Geology, Soils, and Seismology

The Savannah River Site is located in the Upper Atlantic Coastal Plain physiographic province of western South Carolina, approximately 32 km (20 mi) southeast of the Fall Line, which separates the Piedmont and Coastal Plain provinces. Sands and sandy loams are the primary types of soil. There is no evidence of recent displacement along any fault within the site (DOE 1991).

The Savannah River Site is located within Seismic Zone 2, indicating moderate earthquake damage could occur. Earthquakes capable of producing structural damage to buildings are not likely to occur in the vicinity of the site. Volcanic activity has not been experienced in the area of the site within the last 230 million years (DOE 1996b).

Areas of seismic activity within a 350-km (200-mi) radius of the Savannah River Site include the Charleston, South Carolina, seismic zone on the coastline of South Carolina and the Bowman, South Carolina, seismic zone east of the site. Known seismic activity within 50 km (30 mi) of the site is located primarily to the east and southeast. Several earthquakes of unknown magnitude/intensity occurred in 1897, and about eight earthquakes have been recorded since the 1970's. The majority of the earthquakes recorded since site operations began have been isolated events of low magnitude (m<3), with no dependent foreshocks or aftershocks detected. The most recent earthquake occurred on August 8, 1993. This quake (M=3.2) had an epicenter located about 40 km (25 mi) northeast of the center of the site and about 12 km (9 mi) northeast of Aiken, South Carolina. The event was not associated with any identified seismic source zones, but instead seemed to be characteristic of widely spread events throughout the central Piedmont and Upper Coastal Plain of the State (WSRC 1995).

3.2.6 Ecology

- **Terrestrial Resources—**At present, more than 90 percent of the Savannah River Site is forested. With the exception of the Savannah River Site production and support areas, natural succession has reclaimed other previously disturbed areas. Satellite imagery of the site shows a circle of wooded habitat within a matrix of cleared uplands and narrow forested riparian corridors. The Savannah River Site provides nearly 73,250 ha (181,000 acres) of contiguous forested cover broken only by unpaved secondary roads, transmission line corridors, and a few paved primary roads. Carolina bays, the Savannah River swamp, and several relatively intact longleaf pine-wiregrass communities make important contributions to the biodiversity of the region.

  The Savannah River Site is near the transition area between the oak-hickory-pine forest and the southern mixed forest. A variety of vascular plant communities occur in the upland areas. Typically, scrub oak communities occur on the drier, sandier areas. Longleaf pine, turkey oak, bluejack oak, blackjack oak, and dwarf post oak dominate these communities, which typically have understories of wire grass and huckleberry. Oak-hickory hardwood communities occur on more fertile, dry uplands, and characteristic species are white oak, post oak, southern red oak, mockernut hickory, pignut hickory, and loblolly pine, with an understory of sparkleberry, holly, greenbriar, and poison ivy (DOE 1995b).

  Savannah River Site has provided excellent habitat to wildlife associated with the wetlands of the Savannah River and the pine-dominated sandhills of coastal South Carolina. Furbearers such as gray fox, raccoon, opossum, and beaver are relatively common throughout the Savannah River Site. Game species such as gray and fox squirrel, cottontail rabbit, and wild turkey are also common. The Savannah River Site contains suitable habitat for white-tailed deer and feral hogs, as well as other faunal species common to the mixed pine/hardwood forests of South Carolina.

- **Wetlands—**The Savannah River Site has extensive, widely distributed wetlands, most of which are associated with floodplain, creeks, and impoundments. The southwestern Savannah River Site boundary adjoins the Savannah River for approximately 32 km (20 mi). The river floodplain supports an extensive swamp, covering about 4,916 ha (12,148 acres) of the site. At present, the swamp forest consists of second-growth bald cypress, black gum, and other hardwood species. Five major streams drain the Savannah River Site and eventually flow into the Savannah River. Each stream has floodplain characterized by bottomland hardwood forests or scrub-shrub wetlands in varying stages of succession.

Dominant species include red maple, box elder, bald cypress, water tupelo, sweetgum, and black willow (DOE 1995b). Carolina bays, unique wetland features of the southeastern United States, are islands of wetland habitat dispersed throughout the uplands of the Savannah River Site. The more than 200 bays on the site exhibit extremely variable hydrology and a range of plant communities from herbaceous marsh to forested wetland.

❒ **Threatened and Endangered Species—Table 3-15** presents the threatened, endangered, and candidate plant and animal species that are known to occur on the Savannah River Site.

Table 3–15 Federal or South Carolina Endangered or Threatened Plants and Animals Known to Occur on the Savannah River Site

Species	*Status*
Plant	
Echinacea laevigata (smooth purple coneflower)	Federally endangered/2 colonies on Savannah River Site
Animals	
Haliaeetus leucocephalus (bald eagle)	Federally threatened/2 nesting sites on Savannah River Site
Picoides borealis (red-cockaded woodpecker)	Federally endangered/numerous colonies on Savannah River Site
Mycteria americana (wood stork)	Federally endangered/feed in Savannah River Site swamps and reservoirs
Acipenser brevirostrum (shortnose sturgeon)	Federally endangered/eggs and larvae collected from Savannah River adjacent to Savannah River Site
Elanoides forficatus (American swallow-tailed kite)	State endangered/1 sighting reported
Gopherus polyphemus (gopher tortoise)	State endangered/1 reported; habitat on site
Myotis austroriparius (southeastern myotis)	State threatened
Condylura cristata (star-nosed mole)	State endangered
Corynorhinus rafinesquii (southeastern big-eared bat)	State endangered

Source: WSRC 1997c.

The following Federally listed endangered animals are known to occur on the Savannah River Site or in the Savannah River adjacent to the Site: the red-cockaded woodpecker, the southern bald eagle, the wood stork, and the shortnose sturgeon (DOE 1995e). Researchers have found one Federally listed endangered plant species, the smooth coneflower, on the site, and several state listed species (DOE 1995e).

F- and H-Areas contain no habitat suitable for any of the Federally listed threatened or endangered species found on the Savannah River Site. The Southern bald eagle and the wood stork feed and nest near wetlands, streams, and reservoirs, and thus would not be attracted to the densely forested upland area. Shortnose sturgeon, typically residents of large coastal rivers and estuaries, have never been collected in Fourmile Branch or any of the tributaries of the Savannah River that drain the Savannah River Site.

3.2.7 Cultural and Paleontological Resources

Prehistoric resources at Savannah River Site consist of villages, base camps, limited activity sites, quarries, and workshops. Historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. Approximately 400 historic sites or sites with historic components have been identified within the Savannah River Site. Native American groups with traditional ties to the area include the

Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. Paleontological materials at the Savannah River Site include fossil plants, numerous invertebrate fossils, deposits of giant oysters (*Crassostrea gigantissima*), mollusks, and bryozoa. Additional information about cultural and paleontological resources at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a).

3.2.8 Socioeconomics

❒ **Regional Economy Characteristics—**The Savannah River Site region of influence includes Aiken, Allendale, Bamberg, and Barnwell Counties in South Carolina and Columbia and Richmond Counties in Georgia. Between 1980 and 1990, total employment in the region of influence increased from 139,504 to 199,161, an average annual growth rate of approximately 5 percent. By the year 2000, employment levels should increase 27 percent to approximately 253,000. The unemployment rates for 1980 and 1990 were 7.3 percent and 4.7 percent, respectively (DOE 1995d).

In Fiscal Year 1992, employment at the Savannah River Site totaled 23,351, with an associated payroll of more than $1.1 billion. In 1990, 75.3 percent of the region of influence labor force lived in Richmond and Aiken Counties, South Carolina (DOE 1995d). The Savannah River Site employed 16,562 people in 1996, accounting for about 7 percent of the regional economic area employment (Section 4.20.4).

❒ **Population and Housing—**Between 1980 and 1990, population in the region of influence increased 13 percent, from 376,058 to 425,607. More than 88 percent of the 1990 population lived in Aiken (28.4 percent), Columbia (15.5 percent), and Richmond (44.6 percent) Counties. According to 1990 census data, the estimated average number of persons per household in the six-county region was 2.72, and the median age of the population was 31.2 years (DOE 1995d). **Figure 3–12** shows the racial and ethnic composition of minorities residing within an 80-km (50-mi) radius of Savannah River Site at the time of the 1990 census. This 80-km (50-mi) radius defines the region of potential influence for radiological effects evaluated in Chapter 4 of this EIS.

The minority population as a percentage of total population residing in the region of influence at that time is 13 percent more than the national percentage of minorities (24.2 percent) residing in the continental United States at the time of the 1990 census. Blacks comprised nearly 94 percent of the minority population residing in the region of influence. As illustrated in **Figure 3–13**, the percentage of minority residents equaled or exceeded the national percentage in areas throughout the region of influence.

As shown in Table F–3 of Appendix F, approximately 17 percent of the individuals residing within the region of influence had a self-reported income less than the poverty level. As discussed in Appendix F, the poverty level is a function of family size and number of unmarried children in the family under 18 years of age. The national percentage of individuals with income less than the poverty level in 1995 is estimated by the Census Bureau to be 13.8 percent. The national percentage of individuals residing in the United States with income below the poverty level was 13.3 percent at the time of the 1990 census. **Figure 3–14** shows the distribution of poverty-level individuals residing within the region of influence.

❒ **Local Transportation—**The Savannah River Site is surrounded by a system of interstate highways, U.S. highways, State highways, and railroads. The regional transportation networks service the four South Carolina counties (Aiken, Allendale, Bamberg, and Barnwell) and the two Georgia counties (Columbia and Richmond) that generate about 90 percent of the Savannah River Site commuter traffic (DOE 1995f). Two major railroads—CSX Transportation and Norfolk Southern Corporation—also serve the Savannah

River Site vicinity. Norfolk Southern serves Augusta and Savannah, Georgia, as well as Columbia and Charleston, South Carolina. CSX serves the same locations and the Savannah River Site.

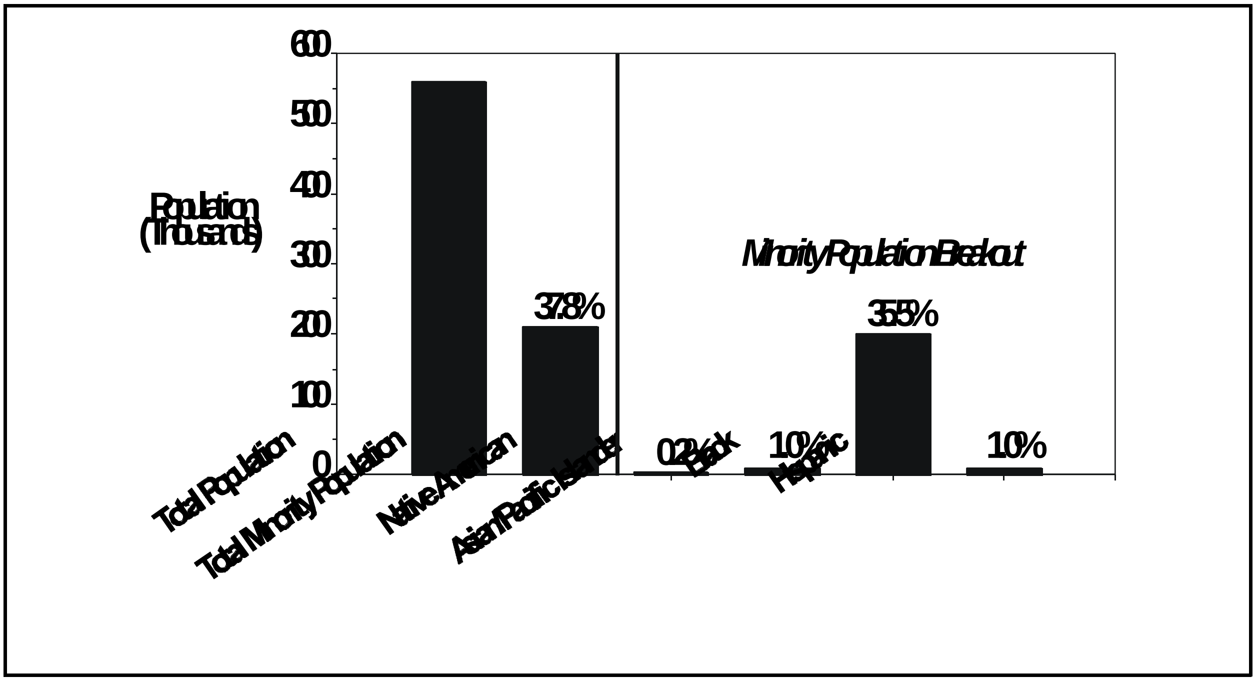

Figure 3–12 Racial and Ethnic Composition of the Minority Population Residing Within 80 km (50 mi) of the Savannah River Site

Two interstate highways serve the Savannah River Site area. Interstate 20 (I-20) provides a primary east-west corridor and I-520 links I-20 with Augusta, Georgia. U.S. Highways 1 and 25 are principal north-south routes, and U.S. 78 provides east-west connections. Several other highways (U.S. 221, U.S. 301, U.S. 321, and U.S. 601) provide additional transport routes in the region. Several State routes provide direct access to the Savannah River Site. From the northwest and north, access is provided by SC 125 and SC 19, respectively, and SC 125 is open to through traffic. Access to the site is provided from the northeast by SC 39, from the east by SC 64, and from the southeast by SC 125. These are all two-lane roads. The public has access to U.S. 278 and SC 125, but only the Savannah River Site employees are permitted access to the site on the other routes.

The Savannah River Site transportation infrastructure consists of more than 230 km (143 mi) of primary roads, 1,931 km (1,200 mi) of unpaved secondary roads, and 103 km (64 mi) of railroad track (DOE 1995b). These roads and railroads provide connections among the various Savannah River Site facilities and offsite transportation linkages.

Two major public highways traverse the Savannah River Site—SC 125 and U.S. 278. SC 125 connects Allendale, South Carolina, to Augusta, Georgia, by crossing the site in a northwest-to-southeast direction. U.S. 278 also connects Augusta and Allendale, but its route generally follows the northern and eastern Savannah River Site boundaries. In general, the primary Savannah River Site roadways are in good condition and are smooth and free from potholes. Typically, wide, firm shoulders border roads that are either straight or have wide gradual turns. Intersections are well marked for both traffic and safety identification, and are sufficiently cleared of trees and brush that might obstruct a driver's view of oncoming traffic. Railings along the side of the roadways offer protection at appropriate locations from dropoffs or other hazards. In general, the roadways are lighted only at gate areas and near major facilities.

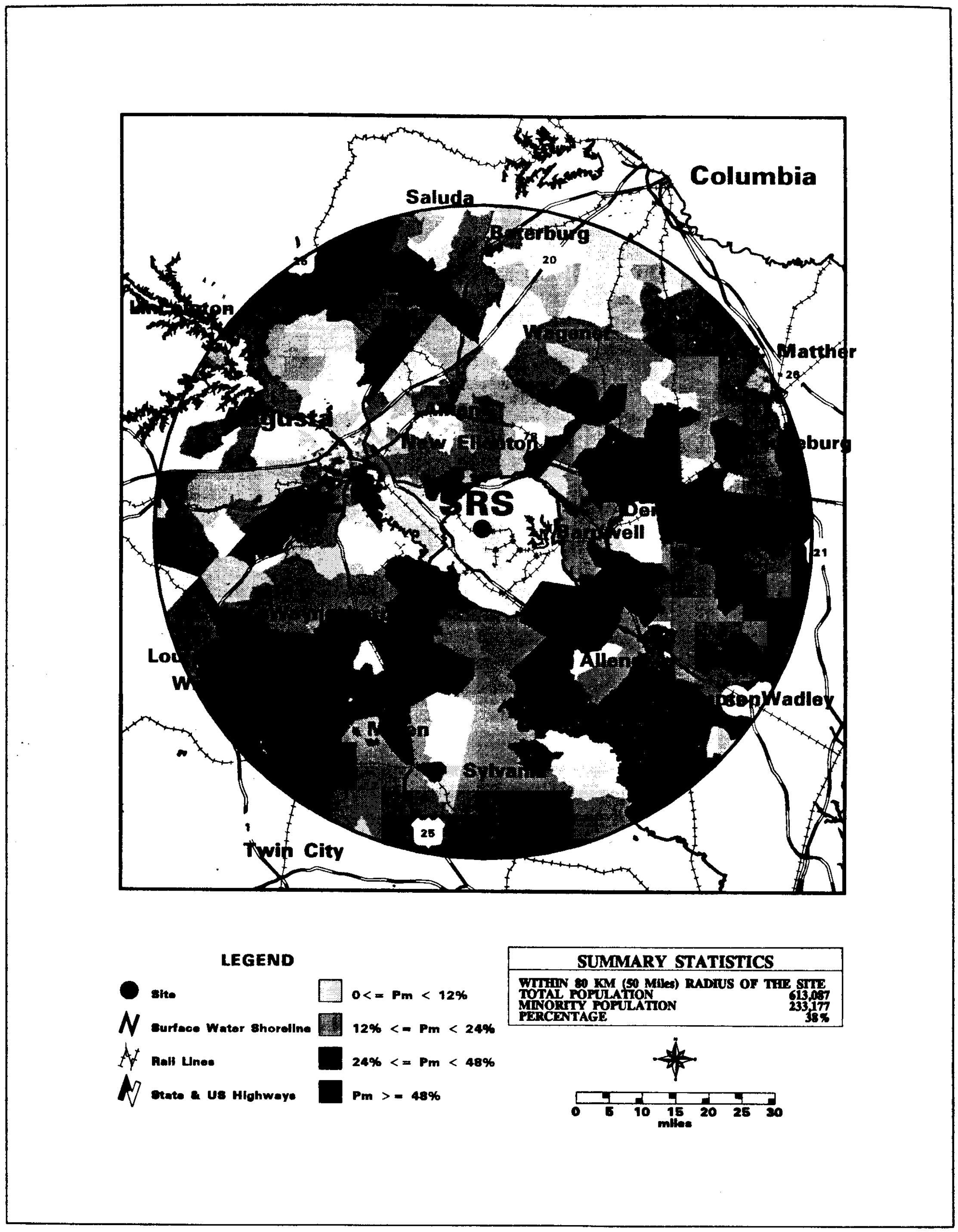

Figure 3–13 Distribution of Minority Population Residing Within 80 km (50 mi) of the Savannah River Site

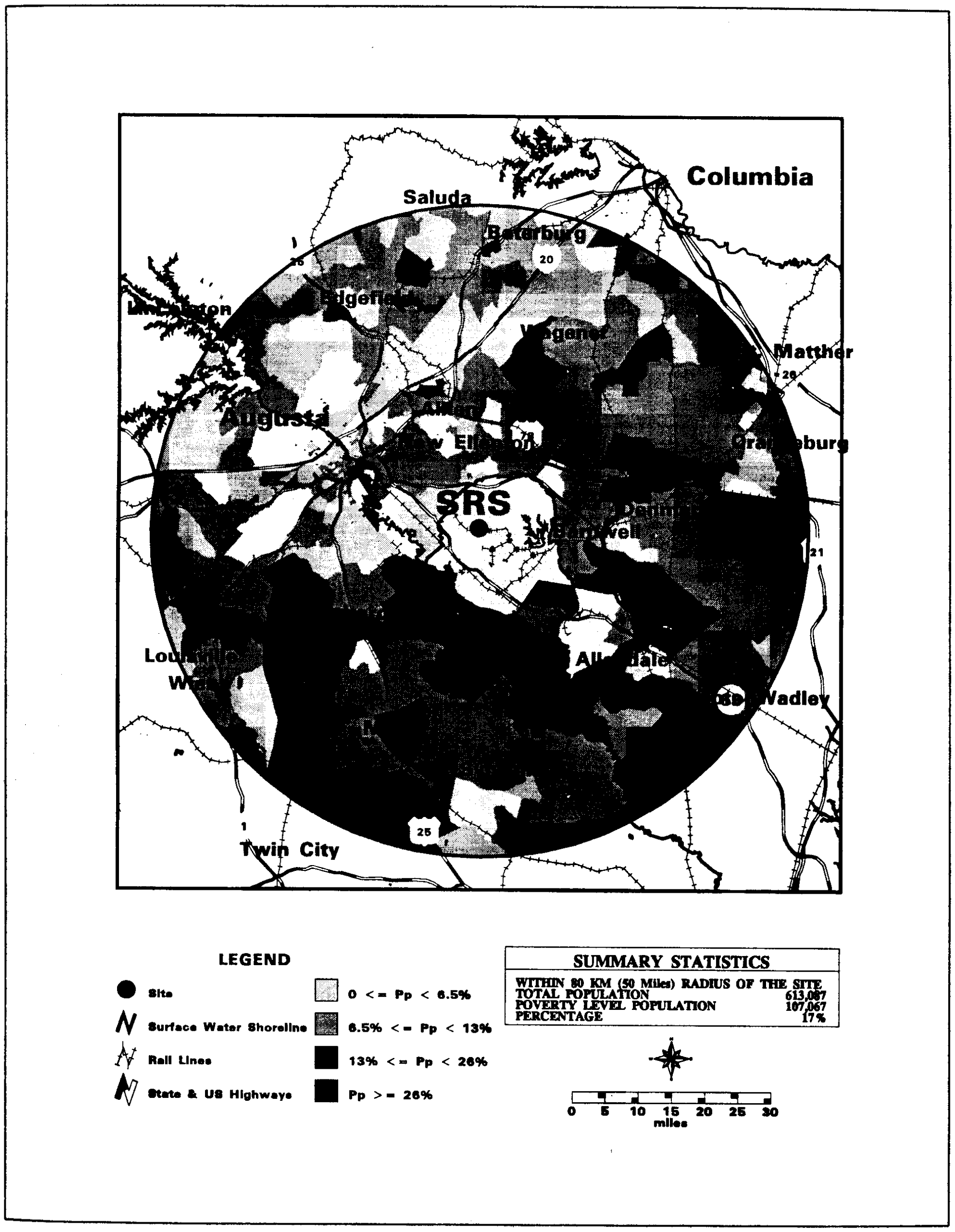

Figure 3–14 Distribution of Poverty-Level Population Residing Within 80 km (50 mi) of the Savannah River Site

In general, heavy traffic occurs early in the morning and late in the afternoon when workers from surrounding communities commute to and from the Savannah River Site. During working hours, official vehicles and logging trucks constitute most of the traffic. At any time, as many as 60 logging trucks, which can impede traffic, might be operating on the Savannah River Site, with an annual average of about 25 trucks per day. **Table 3–16** provides data on traffic counts for various roads and access points around the Savannah River Site (DOE 1995f).

Table 3–16 Savannah River Site Traffic Counts—Major Roads

Measurement Point	*Date*	*Direction*	*Day Total*	*Peak*[a]	*Peak Time*[b]	*Average Speed (mph)*[c]
Road 2 between Roads C and D	2-23-93 4-21-93	East West	3,031 3,075	800 864	1530 0630	47 DNA
Road 4 between Roads E and C	12-9-92 12-9-92	East West	1,624 1,553	352 306	1530 0615	DNA DNA
Road 8 at Pond C	2-23-92 2-23-92	East West	634 662	274 331	1530 0615	58 56
Road C between landfill and Road 2	12-16-92 12-16-92	North South	6,931 6,873	2,435 2,701	1530 0630	53 58
Road C north of Road 7	1-20-93 1-20-93	North South	742 763	288 223	0630 1530	53 54
Road D	9-29-93 9-29-93	North South	1,779 1,813	218 220	1500 0845	43 52
Road E at E-Area	8-25-93 8-25-93	North South	3,099 3,054	669 804	1530 0630	35 38
Road F at Upper Three Runs Creek	2-2-93 2-2-93	North South	3,239 3,192	1,438 1,483	1530 0630	53 51
H-Area Exit	12-2-92	Outbound	2,181	406	1530	12

DNA = data not available mph = miles per hour
[a] Number of vehicles in peak hour.
[b] Start of peak hour.
[c] To convert miles per hour to kilometers per hour, multiply by 1.6093.
Source: Swygert (DOE 1995f).

Railroads on the Savannah River Site include both CSX tracks and the Savannah River Site rolling stock and tracks. Two routes of the CSX distribution system run through the Savannah River Site: a line between Florence, South Carolina and Augusta, Georgia, and a line between Yemassee, South Carolina and Augusta. The two lines join on the site near the L-Lake dam. Early in 1989, CSX discontinued service on the line from the Savannah River Site junction to Florence. The 103 km (64 mi) of the Savannah River Site railroad tracks are well maintained. The rails and crosslines are in good condition, and the track lines are clear of vegetation and debris. Significant clear areas border the tracks on both sides. Intersections of railroads and roadways are marked by railroad crossing signs with lights where appropriate. The Savannah River Site rail classification yard is east of P-Reactor. This eight-track facility sorts and redirects railcars. Deliveries of the Savannah River Site shipments occur at two onsite rail stations at the former towns of Ellenton and Dunbarton. From these stations, a Savannah River Site engine moves the railcars to the appropriate receiving facility. The Ellenton station, which is on the main Augusta-Yemassee line, is the preferred delivery point. The Dunbarton station, which is on the discontinued portion of the Augusta-Florence line, receives less use.

3.2.9 Public and Occupational Health and Safety

❒ **Radiation Environment—**Major sources and levels of background radiation exposure to individuals in the vicinity of the Savannah River Site are shown in **Table 3–17**. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population changes as the population size changes. Background radiation doses are unrelated to Savannah River Site operations.

Table 3–17 Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Savannah River Site Operations

Source	*Effective Dose Equivalent (mrem/yr)*
Natural Background Radiation[a]	
Cosmic radiation	27
External radiation	28
Internal terrestrial radiation	40
Radon in homes (inhaled)[b]	200
Other Background Radiation[c]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	360

[a] WSRC 1997a.
[b] Value for radon is an average for the United States.
[c] NCRP 1987.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Savannah River Site Environmental Report* for 1996 (WSRC 1997a). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (onsite and offsite) are also presented in this reference.

Releases of radionuclides to the environment from Savannah River Site operations provide another source of radiation exposure to individuals in the vicinity of the Savannah River Site. Types and quantities of radionuclides released from Savannah River Site operations in 1996 are listed in the *Savannah River Site Environmental Report* for 1996 (WSRC 1997a). Doses to the public resulting from these releases are presented in **Table 3–18**. These doses fall within the radiological limits described in DOE Order 5400.5 and are less than dose levels from background radiation.

The Savannah River Site workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in the Savannah River Site facilities. **Table 3–19** presents the average worker and worker population dose to Savannah River Site workers from operations in 1996. These doses fall within radiological regulatory limits (10 CFR Part 835).

Table 3–18 Radiation Doses to the Public from Normal Savannah River Site Operations in 1995 (Committed Effective Dose Equivalent)

Members of the General Public	Atmospheric Releases		Liquid Releases		Total	
	Standard [a]	Actual	Standard [a]	Actual [b]	Standard [a]	Actual
Maximally exposed individual (mrem)	10	0.06	4	0.14	100	0.20
Population within 80 km (50 mi)[c] (person-rem)	None	6.4	None	2.2	None[d]	8.6
Average individual within 80 km (50 mi)[e] (mrem)	None	0.010	None	0.0032	None	0.014

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10 mrem/yr limit from airborne emissions is required by the Clean Air Act, the 4 mrem/yr limit is required by the Safe Drinking Water Act, and the total dose of 100 mrem/yr is the limit from all pathways combined.
[b] The actual dose value given in the column under liquid releases conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of the Savannah River Site to the Atlantic Ocean.
[c] In 1996, this population was approximately 620,100. For liquid releases, an additional 70,000 water users in Port Wentworth, Georgia and Beaufort, South Carolina (approximately 160 km [100 mi] downstream), are included in the assessment.
[d] A 100 person-rem value for the population is given in proposed 10 CFR Part 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site for atmospheric releases; for liquid releases, the number of people includes water users who live more than 80 km (50 mi) downstream of the site.
Source: WSRC 1997a.

Table 3–19 Radiation Doses to Workers from Normal Savannah River Site Operations in 1996 (Committed Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard [a]	Actual
Average worker dose (mrem)	None	19
Total worker population dose[b] (person-rem)	None	237

[a] DOE's goal is to keep radiological exposures as low as reasonably achievable. This includes maintaining doses to individual workers so far below the DOE limit of 5,000 mrem/year (10 CFR Part 835) that no dose is expected to exceed the DOE Administrative Control Level of 2,000 mrem/year (DOE/EH-0256T).
[b] The number of badged workers in 1996 was approximately 12,500.
Source: WSRC 1997b.

❒ **Chemical Environment—**The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., surface waters during swimming and soil through direct contact or via the food pathway).

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., air emissions and National Pollutant Discharge Elimination System permit requirements) contribute toward minimizing potential health impacts to the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Savannah River Site via inhalation of air containing hazardous chemicals released to the atmosphere by Savannah River Site operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water, or direct exposure, are low relative to the inhalation pathway.

Savannah River Site workers may be exposed to hazardous chemicals during normal operations by inhaling the workplace atmosphere and by direct contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a detailed estimation and summation of these impacts. However, the workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Savannah River Site workers are also protected by adherence to Occupational Safety and Health Administration and EPA standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring that reflects the frequency and amounts of chemicals used in the operational processes ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, worker health conditions at the Savannah River Site are expected to be better than required by the standards.

❒ **Emergency Preparedness—**Each of DOE's sites has established an emergency management program that would be used in the event of an accident. These programs have been developed and maintained to ensure an adequate response to accident conditions. The emergency management programs incorporate activities associated with emergency planning, preparedness, and response. The Emergency Operations Facility at the Savannah River Site provides overall direction and control for onsite responses to emergencies and coordinates with Federal, State, and local agencies and officials on the technical aspects of an emergency.

The Savannah River Site Emergency Operations Facility consists of the following centers that provide distinct emergency response support functions:

- *Savannah River Site Operations Center*—The Savannah River Site Operations Center coordinates the initial response to all Savannah River Site emergencies and functions as the heart of the Savannah River Site's emergency response communications network.
- *Technical Support Center*—The Technical Support Center provides command and control of emergency response activities for the affected facility or operational area.
- *Emergency Operations Center*—The Emergency Operations Center provides command and control of emergency response activities for Savannah River Site locations outside the affected area.
- *Security Management Center*—The Security Management Center coordinates activities relating to the security and safeguarding of materials by providing security staff in the affected area and contractor management in the Emergency Operations Center.
- *Dose Assessment Center*—The Dose Assessment Center assesses the health and environmental consequences of any airborne or aqueous releases of radioactivity or toxic chemicals and recommends onsite and offsite protective actions to other centers.

3.2.10 Waste Management

This section outlines the major environmental regulatory structure and ongoing waste management activities for the Savannah River Site. **Table 3–20** presents an overview of waste management activities at the Savannah River Site for 1993.

Table 3–20 Waste Management Activities at Savannah River Site

Category	*1996 Generation (m^3)*	*Treatment Method*	*Treatment Capacity (m^3/yr)*	*Storage Method*	*Storage Capacity (m^3)*	*Disposal Method*	*Disposal Capacity (m^3)*
High-Level							
Liquid	2,379	Settle, separate, evaporate	53,700[b]	F- & H-Area Tank Farm	133,000[c]	N/A[d]	N/A
Solid	None	Vitrification[e]	None	Air Cooled Shielded Facility	2,286 canisters[f]	None; high-level waste program in the future	N/A
Transuranic							
Liquid	None	N/A	N/A	N/A	N/A	N/A	N/A
Solid	165	None	None	Pads, buildings	14,600[g]	None; WIPP or alternate facility in the future	None
Low-Level							
Liquid	None	Absorption, evaporation, filtration, neutralization, saltstone	503,000[h]	Ponds, tanks - awaiting processing	N/A	N/A	N/A
Solid	5,779	Compaction	3,980[i]	N/A	N/A	Burial vaults and trenches	2,578,000[j]
Mixed Low-Level							
Liquid	444	Stabilization, adsorption, neutralization, precipitation, filtration, ion exchange, evaporation	511,000[k]	RCRA permit Bldgs. E, 600, 700, M-Area Liquid Effluent Treatment Facility	11,500[l]	None	None
Solid	8	None	N/A	RCRA permit Bldg. 600	1,990[m]	None	None

Category	*1996 Generation (m^3)*	*Treatment Method*	*Treatment Capacity (m^3/yr)*	*Storage Method*	*Storage Capacity (m^3)*	*Disposal Method*	*Disposal Capacity (m^3)*
Hazardous							
Liquid	None	None	None	DOT containers	Included in solid	Offsite	N/A
Solid	57 (tonnes)	None	None	DOT containers	2,618[n]	Offsite	N/A
Nonhazardous (Sanitary)							
Liquid	None	Filter, settle, strip	1,451,000[o]	Flowing ponds	N/A	Permitted discharge	Varies by each permitted outfall
Solid	2,780 (tonnes)	Compaction	Expandable, as required	N/A	N/A	Landfill (onsite and offsite)	Expandable, as required

DOT = Department of Transportation
Note: N/A = Not applicable.
[a] Some fuel will be processed in the F- and H-Canyons in accordance with the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (DOE 1995b).
[b] Savannah River Technology Center ion exchange, evaporators.
[c] F- and H-Area Tank Farms.
[d] Treatment removes the high-level constituents (salt and sludge) from the liquids. The salt and sludge are vitrified.
[e] Defense Waste Processing Facility started operation in 1995.
[f] Defense Waste Processing Facility.
[g] Transuranic waste storage pads.
[h] Includes F- and H-Area Effluent Treatment Facility.
[i] Onsite compactors.
[j] Saltstone vaults, E-Area vaults, slit trenches.
[k] Includes F- and H-Area Effluent Treatment Facility, M-Area Effluent Treatment Facility, and Savannah River Technology Center Ion-exchange Treatment.
[l] Hazardous Waste Storage Facility, mixed waste storage buildings, Process Waste Interim Treatment, Defense Waste Processing Facility organic waste storage tank, burial ground storage tank, Savannah River Technology Center mixed waste storage.
[m] Hazardous Waste Storage Facility, mixed waste storage buildings.
[n] Pads and buildings in B-, M-, and N-Areas.
[o] Centralized Sanitary Wastewater Treatment Facility.
Sources: DOE 1996b and DOE 1997a.

DOE is working with Federal and State regulatory authorities to address compliance and cleanup obligations arising from past operations at the Savannah River Site. DOE is engaged in several activities to bring its operations into full regulatory compliance. These activities are set forth in negotiated agreements that contain both schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones.

The EPA has placed the Savannah River Site on the National Priorities List and has identified approximately 150 potential operable units. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, DOE entered into a Federal Facility Agreement with the EPA and the State of South Carolina, effective January 15, 1993. The agreement provides for cleanup activities at the Savannah River Site under one comprehensive strategy.

The Savannah River Site has an aggressive waste minimization program in progress to improve the operation of existing and planned liquid and solid waste generating, treatment, and storage facilities. An approach to these activities is being developed based on technology and experience from the commercial nuclear industry. This approach has reduced the generation of transuranic waste (48 percent), low-level waste (13 percent), mixed waste (96 percent), and hazardous waste (58 percent) (DOE 1993c). The Savannah River Site generates and manages the following waste categories: high-level, transuranic, low-level, mixed, hazardous, and nonhazardous. A discussion of the waste management operations associated with each of these categories follows.

- **High-Level Waste—**Liquid high-level waste at the Savannah River Site is made up of many waste streams generated during the recovery and purification of transuranic waste products and unburned fissile material from spent reactor fuel elements. These wastes are separated by waste form, radionuclide, and heat content before their transfer to underground storage tanks in the F- and H-Area tank farms. Processes routinely used to treat liquid high-level waste are separation, evaporation, and ion exchange. Evaporation produces a cesium-contaminated condensate. Cesium is removed from the condensate, resulting in a low-level waste stream that is treated in the Effluent Treatment Facility. The remaining high-level waste stream salts are precipitated; some can be decontaminated. The decontaminated salt solution is sent with residues from the Effluent Treatment Facility to the Defense Waste Processing Z-Area Saltstone Facility, where it is mixed with a blend of cement, flyash, and blast furnace slag to form grout. The grout is pumped into disposal vaults where it hardens for permanent disposal as solid low-level waste. The remaining high-level salt and sludge are permanently immobilized as a glass solid cast in stainless steel containers at the Defense Waste Processing Facility Vitrification Plant. The stainless steel containers are decontaminated to the U.S. Department of Transportation standards, welded closed, and temporarily stored onsite for eventual transport to and disposal in a permanent Federal repository. Future high-level waste generation could result from the processing and stabilization of spent fuel for long-term storage as a result of 60 FR 28680 and from remediation or materials recovery activities performed in the F- and H-Canyons.

- **Transuranic Waste—**Under the Federal Facilities Compliance Agreement on the Resource Conservation and Recovery Act Land Disposal Restrictions signed by the EPA and DOE on March 13, 1991, the Savannah River Site is required to prepare transuranic waste for shipment. The Savannah River Site will begin discussions with the South Carolina Department of Health and Environmental Control on alternative treatment options in January 1998 if the Secretary of Energy does not decide to operate WIPP by that time. If a delayed opening date for WIPP is determined, DOE will propose modifications to the *Savannah River Site Treatment Plan* for approval by the State of South Carolina. The status of the WIPP readiness schedule will be included in the updates. Certified transuranic waste is stored on transuranic waste storage pads until it can be shipped to an approved transuranic waste disposal facility. Should additional treatment be necessary for disposal, the Savannah River Site would develop the appropriate treatment capability. All transuranic waste currently generated is stored in containers on above-ground pads.

The Experimental Transuranic Waste Assay and Certification Facility began operations in 1986 to certify newly generated transuranic waste. It since has been shut down. A new transuranic waste characterization and certification facility is planned that would provide extensive containerized waste processing certification capabilities. This facility is needed to prepare and certify transuranic waste for disposal at WIPP. Waste drums containing transuranic waste that can be certified for shipment to WIPP are placed in temporary storage on concrete pads in E-Area. Buried and stored waste containing concentrations of transuranic waste nuclides between 10 and 100 nanocuries (nCi/g) (referred to as alpha-contaminated low-level waste or alpha waste) is managed in the same way as transuranic waste because its physical and chemical properties are similar and because similar procedures will be used to determine its final disposition. Because all of the transuranic waste placed on the above-ground pads prior to January 1990 is suspected of having hazardous constituents, a Resource Conservation and Recovery Act Part B permit application has been submitted for the transuranic waste storage pads and the Experimental Transuranic Waste Assay Certification Facility. The waste currently is being stored under Resource Conservation and Recovery Act interim status. The transuranic waste expected to be produced as a result of the processing of plutonium residues at the Savannah River Site should not contain any Resource Conservation and Recovery Act constituents). If residues containing such constituents are processed at Savannah River, Resource Conservation and Recovery Act permit applications would be submitted for the preprocessing storage of residues and postprocessing storage of transuranic wastes.

❒ **Low-Level Waste—**The bulk of liquid low-level waste is aqueous process waste, including effluent cooling water, decontaminated salt solutions, purge water, water from storage basins for irradiated reactor fuel or target elements, distillate from the evaporation of process waste streams, and surface water runoff from areas where there is a potential for radioactive contamination. Liquids are processed to remove and solidify the radioactive constituents and to release the balance of the liquids to permitted discharge points within standards established by the regulatory permit. Solid low-level waste includes operating plant and laboratory waste, contaminated equipment, reactor and reactor-fuel hardware, spent lithium-aluminum targets, and spent de-ionizer resin from reactor coolant treatment. Solid low-level waste is separated by radiation levels into low and intermediate categories. Solid low-level waste that radiates less than 200 mrem/hr at 5 cm (1.97 in) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm (1.97 in), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with greater than 10 Ci of tritium per container. The disposal mode for solid low-level waste is disposal in earthen trenches and concrete vaults. Saltstone generated in the solidification of decontaminated salts extracted from high-level waste is disposed of as low-level waste in separate vaults. Saltstone is the highest volume of solid low-level waste disposed at the Savannah River Site. Disposal facilities are projected to meet solid low-level waste storage requirements and to include low-level waste from offsite DOE facilities for the next 20 years.

❒ **Mixed Low-Level Waste—**The Federal Facility Compliance Agreement signed by EPA and DOE on March 13, 1991, addresses Savannah River Site compliance with Resource Conservation and Recovery Act Land Disposal Restrictions pertaining to past, ongoing, and future generation of mixed low-level waste (mostly solvents, dioxin, and California list wastes contaminated with tritium). The Savannah River Site is allowed to continue to operate, generate, and store mixed wastes subject to Land Disposal Restrictions; in return, the Savannah River Site will report to the EPA the characterization of all solid waste streams disposed of in land disposal units at the Savannah River Site and has submitted its waste minimization plan to the EPA for review. Schedules for measures to provide compliance through construction of the

Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility are included in the Federal Facility Compliance Agreement.

The Consolidated Incineration Facility will treat mixed low-level and hazardous waste. The Hazardous Waste and Mixed Waste Disposal Vaults are scheduled to be available in 2002. Mixed waste currently is placed in interim storage in the E-Area Solid Waste Disposal Facility and in two buildings in G-Area. These Resource Conservation and Recovery Act permitted facilities will be used until completion of the Consolidated Incineration Facility and the Hazardous Waste and Mixed Waste Storage Facility. The Federal Facility Compliance Act of 1992 requires DOE facilities storing mixed waste to develop site-specific treatment plans and to submit the plans for approval. The Federal Facility Compliance Act of 1992 formed the basis for the Savannah River Site Proposed Site Treatment Plan.

❒ **Hazardous Waste—**Lead, mercury, cadmium, 1,1,1-trichloroethane, leaded oil, trichlorotrifluoroethane, benzene, and paint solvents are typical hazardous wastes generated at the Savannah River Site. All hazardous wastes are stored onsite in U.S. Department of Transportation-approved containers in three Resource Conservation and Recovery Act-permitted hazardous waste storage buildings and on three interim status storage pads in the B- and N-Areas. Most of the waste is shipped offsite to commercial Resource Conservation and Recovery Act-permitted treatment and disposal facilities using U.S. Department of Transportation-certified transporters. Eight to nine percent of the hazardous waste (organic liquids, sludge, and debris) will be incinerated in the Consolidated Incineration Facility. Hazardous chemicals are stripped from aqueous liquids collected during ground water monitoring in the M-Area Stripper, and the treated wastewater is discharged in accordance with discharge limits appropriate to National Pollutant Discharge Elimination System permits.

❒ **Nonhazardous Waste—**In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at Savannah River were completed. The program included the replacement of 14 aging treatment facilities (out of 20) scattered across the site with a new 3,975 m^3/day (1.05 million gal/day) central treatment facility and connection of them with a new 29-km (18-mi) primary sanitary collection system. The collection system intercepts wastewater at points prior to discharge into old sanitary wastewater treatment facilities. The new central treatment facility treats sanitary wastewater by the extended aeration activated sludge process utilizing the oxidation ditch method. The treatment facility separates the wastewater into two forms, clarified effluent and sludge. The liquid effluent is further treated by nonchemical methods of ultraviolet light disinfection to meet National Pollutant Discharge Elimination System discharge limitations. The sludge goes through a composting process to reduce volume and pathogen levels to meet proposed land application criteria (40 CFR Part 503). The remaining existing sanitary wastewater treatment facilities are being upgraded as necessary to meet demands by replacing existing chlorination treatment systems with nonchemical ultraviolet light disinfection systems to meet National Pollutant Discharge Elimination System limitations. Savannah River Site-generated municipal solid waste is sent to a permitted offsite disposal facility. DOE is evaluating a proposal to participate in an interagency effort to establish a regional solid waste management center at the Savannah River Site (DOE 1994b, DOE 1995a).

3.3 LOS ALAMOS NATIONAL LABORATORY

Los Alamos National Laboratory was established in 1943 as a nuclear weapons design laboratory and was formerly known as the Los Alamos Scientific Laboratory. Its facilities are located on approximately 11,300 ha (28,000 ac), approximately 40 km (25 mi) northwest of Santa Fe, New Mexico.

Los Alamos National Laboratory is a multidisciplinary research facility engaged in a variety of programs for DOE and other Government agencies. Its primary mission is the nuclear weapons Stockpile Stewardship and Management Program and related emergency response, arms control, and nonproliferation and environmental activities. Los Alamos National Laboratory conducts research and development activities in the basic sciences, mathematics, and computing with applications to these mission areas and to a broad range of programs, including nonnuclear defense; nuclear and nonnuclear energy; atmospheric, space, and geosciences; bioscience and biotechnology; and the environment. **Table 3–22** illustrates current missions at Los Alamos National Laboratory.

Table 3–22 Current Major Missions at Los Alamos National Laboratory

Mission	*Description*
Nuclear Weapons	Stockpile stewardship; production of nuclear and nonnuclear components; pit surveillance; tritium production research and development
Arms Control and Nonproliferation	Intelligence analysis; technology research and development; treaty verification; fissile material control; counterproliferation analysis
Energy Research, Science, and Technology	Neutron science (e.g., at LANSCE); scientific computing; fusion energy; health and environmental research; high energy and nuclear physics; basic energy sciences
Energy Technology	Fossil; nuclear
Environmental	Environmental restoration; waste management and treatment
Non-DOE Missions	Conventional weapons; computing, modeling, and simulation

In regard to nuclear weapons, Los Alamos National Laboratory is responsible for the design of the nuclear explosive package in certain U.S. weapons. Los Alamos National Laboratory maintains research, design, development, testing (including nuclear testing), surveillance, assessment, and certification capabilities in support of the Stockpile Stewardship and Management Program. In addition, since the end of the Cold War, Los Alamos National Laboratory conducts the pit surveillance program and some manufacturing of nuclear and nonnuclear components due to termination of the nuclear weapons mission at the Mound, Pinellas, and Rocky Flats Plants.

3.3.1 Land Resources

- **Land Use—**Los Alamos National Laboratory is located in north-central New Mexico, 97 km (60 mi) north-northeast of Albuquerque, 40 km (25 mi) northwest of Santa Fe, and 32 km (20 mi) southwest of Espanola in Los Alamos and Santa Fe Counties. The associated communities of Los Alamos and White Rock are in Los Alamos County. **Figure 3–15** shows the geographical location of Los Alamos National Laboratory. The 11,300-ha (28,000-ac) Los Alamos National Laboratory site and adjacent communities are situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep canyons that run from the Jemez Mountains on the west toward the Rio Grande Valley on the east. Mesa tops range in elevation from approximately 2,400 m (7,800 ft) on the west to about 1,900 m (6,200 ft) on the east (LANL 1994b).

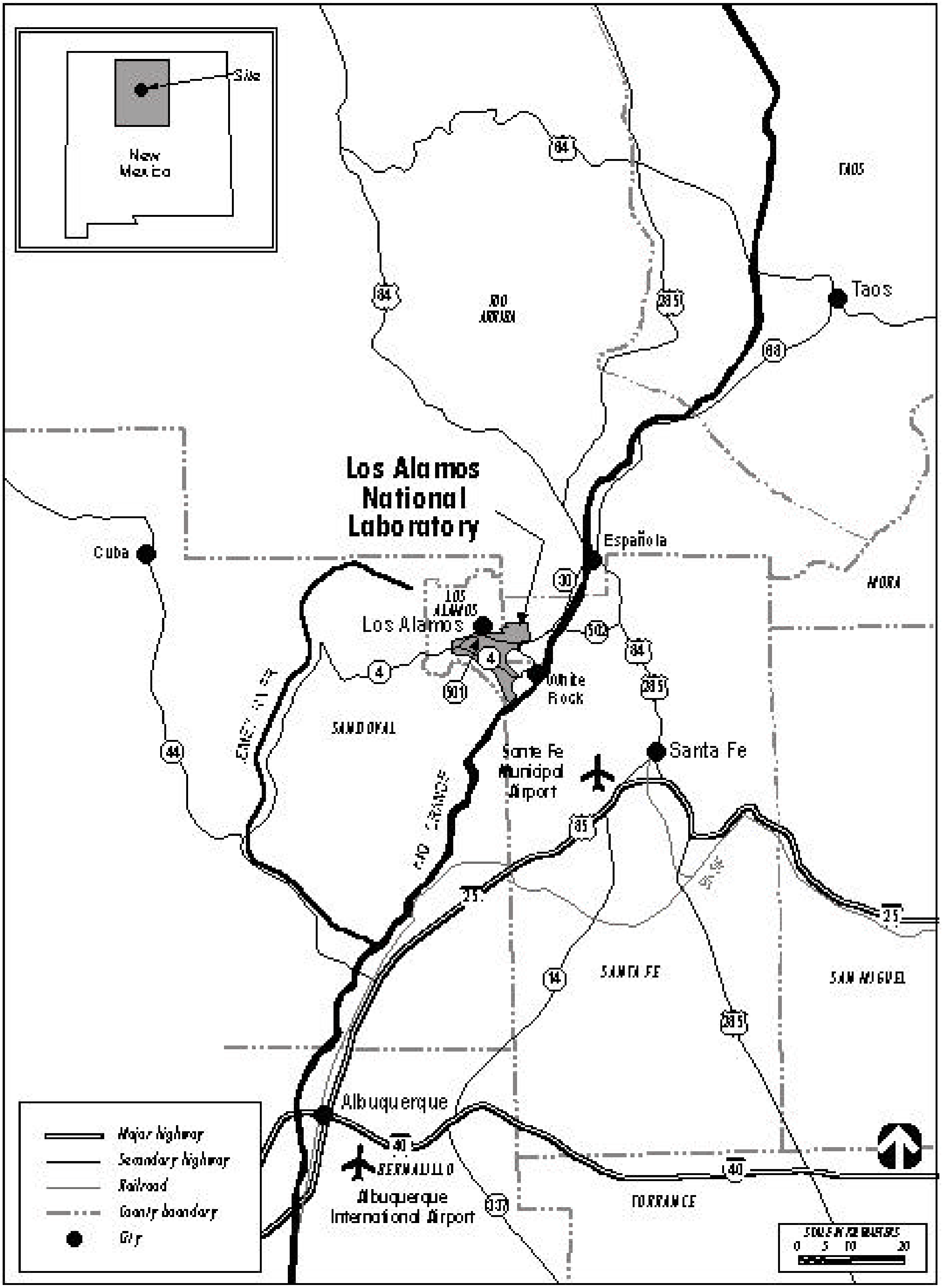

Figure 3–15 Los Alamos National Laboratory, New Mexico, and Region

The developed acreage of Los Alamos National Laboratory consists of 49 active technical areas of laboratory facilities and support infrastructure, which accounts for only a small portion of the total land area. Most of Los Alamos National Laboratory is undeveloped to provide security, safety, and expansion possibilities for future mission requirements. There are no agricultural activities present at Los Alamos National Laboratory, nor are there any prime farmlands. However, a trailer court with a population of approximately 500 persons is located on a parcel of private property that is surrounded by Los Alamos National Laboratory. This court is located along Route 501 in the northern part of Los Alamos National Laboratory (**Figure 3–16**).

The surrounding land is largely undeveloped with large tracts north, west, and south of the Los Alamos National Laboratory site administered by the U.S. Forest Service (Santa Fe National Forest), the National Park Service (Bandelier National Monument), and Los Alamos County. The San Ildefonso Pueblo borders the Los Alamos National Laboratory site to the east (LANL 1994b). The closest offsite residences to Los Alamos National Laboratory, other than those in the trailer park, are approximately 3 m (10 ft) from the northern boundary.

Additional information about land resources at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a) and the *Draft Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL 1998).

3.3.2 Site Infrastructure

❐ **Baseline Characteristics—**Los Alamos National Laboratory contains extensive research and development facilities. To support current missions and functions, an extensive infrastructure exists. Baseline characteristics for this infrastructure are presented in **Table 3–23**.

Table 3–23 Los Alamos National Laboratory Baseline Characteristics

Characteristics	*Current Usage*
Land	
Area (ha)	11,300
Roads (km)	137
Railroads (km)	0
Electrical	
Energy Consumption (MWh/yr)	381,425
Peak Load (MWe)	87
Fuel	
Natural Gas (m^3/yr)	43,414,560
Liquid (L/yr)	0
Coal (t/yr)	0
Steam (kg/hr)	33,554

MWh/yr = megawatt hours per year MWe = megawatts electric m^3/yr = cubic meters per year L/yr = liters per year
t/yr = tons per year
Source: Adapted from DOE 1996a.

Locally, Los Alamos National Laboratory is supplied with electricity by a Los Alamos County/DOE power pool. It also has a 20-megawatt electric gas-fired generating plant in Technical Area 3. Electricity is transmitted to the site and the county over two 115-kilovolt lines, one from Santa Fe (Norton Generating Station) and one from Albuquerque (Reeves Generating Station). These lines enter Los Alamos National

Laboratory near Technical Area 5 (Eastern Technical Area substation). Electricity is distributed throughout the site via 13.2-kilovolt lines. The 115-kilovolt system includes a loop that ties substations at Technical

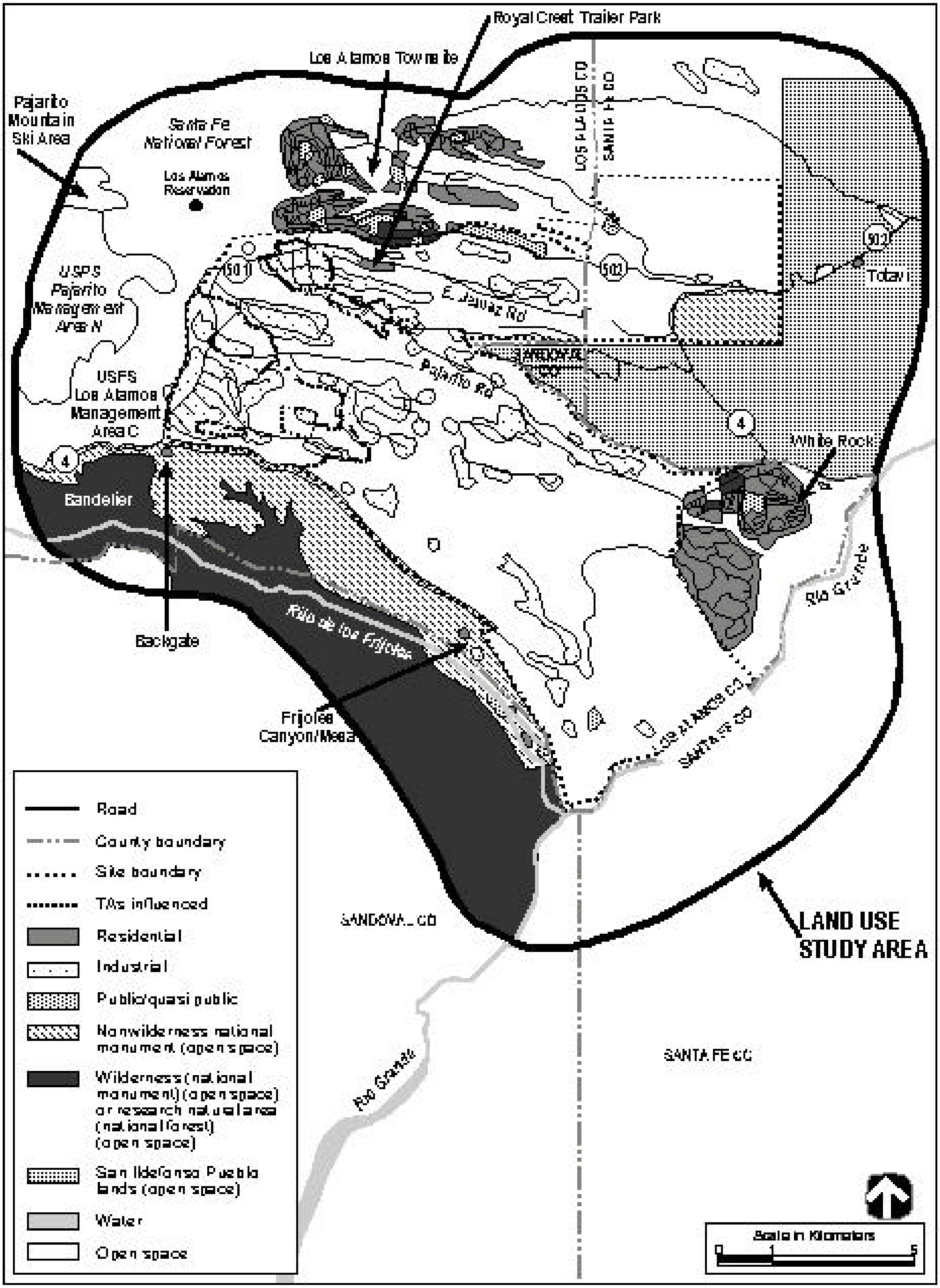

Figure 3–16 Generalized Land Use at Los Alamos National Laboratory and Vicinity

Areas 3, 5, and 53 together. This looping ensures a power supply throughout Los Alamos National Laboratory should outages occur in any major line. The total annual power consumption is considerably below the transmission capacity of the system. The subregional electric power pool from which Los Alamos National Laboratory draws its power is the Arizona-New Mexico Power Area. Capabilities of this power pool are summarized in **Table 3–24.**

Table 3–24 Arizona–New Mexico Subregional Power Pool Electrical Summary

Characteristics	***Energy Production***
Type Fuel[a]	
Coal	57%
Nuclear	24%
Hydro/geothermal	4%
Oil/gas	15%
Other[b]	0.3%

[a] Percentages do not total 100 percent due to rounding.
[b] Includes power from both utility and nonutility sources.
Source: Adapted from DOE 1996a.

3.3.3 Air Quality and Noise

❒ **Meteorology and Climatology—**Los Alamos has a semiarid, temperate mountain climate. The climate averages for atmospheric variables such as temperature, moisture, and precipitation are based on observations made at the technical area (TA)-6 Los Alamos National Laboratory weather station from 1961 through 1990. The meteorological conditions described here are representative of conditions on the Pajarito Plateau at an elevation of approximately 2,250 m (7,400 ft) above sea level, including the area in and around TA-55. The average annual temperature at Los Alamos National Laboratory is 8.8°C (47.9°F); temperatures vary from an average daily minimum of -8.3°C (17°F) in January to an average daily maximum of 27.2°C (81°F) in July. The large daily range in temperature of approximately 13°C (23°F) results from the site's relatively high elevation and dry, clear atmosphere, which allows high insolation during the day and rapid radiative losses at night. The average annual precipitation is 47.6 cm (18.7 in), but is quite variable from year to year (LANL 1997).

Los Alamos winds are generally light, averaging 2.8 m/s (6.3 mph). Strong winds are most frequent during the spring when peak gusts often exceed 22 m/s (50 mph). The highest recorded wind gust was 34.4 m/s (77 mph). Because the terrain is complex, heating and cooling rates are uneven over the Los Alamos National Laboratory area, which results in local thermally generated winds (LANL 1994b).

Figure 3–17 shows annual mean windspeed and wind direction frequencies for Los Alamos National Laboratory for 1991. Data are from the Technical Area (TA)-6 meteorological tower, which is the most representative tower data for TA-55. The maximum wind direction frequency is from the south-southwest with secondary maxima from the south and southwest. The mean windspeed toward the north-northeast is 3.2 m/s (7.2 mph). The average annual windspeed is 2.8 m/s (6.3 mph) (DOE 1996a). Data collected at the TA-6 meteorological tower for 1991 indicate that unstable conditions occur approximately 4.5 percent of the time, neutral conditions approximately 21 percent of the time, and stable conditions approximately 34 percent of the time, on an annual basis.

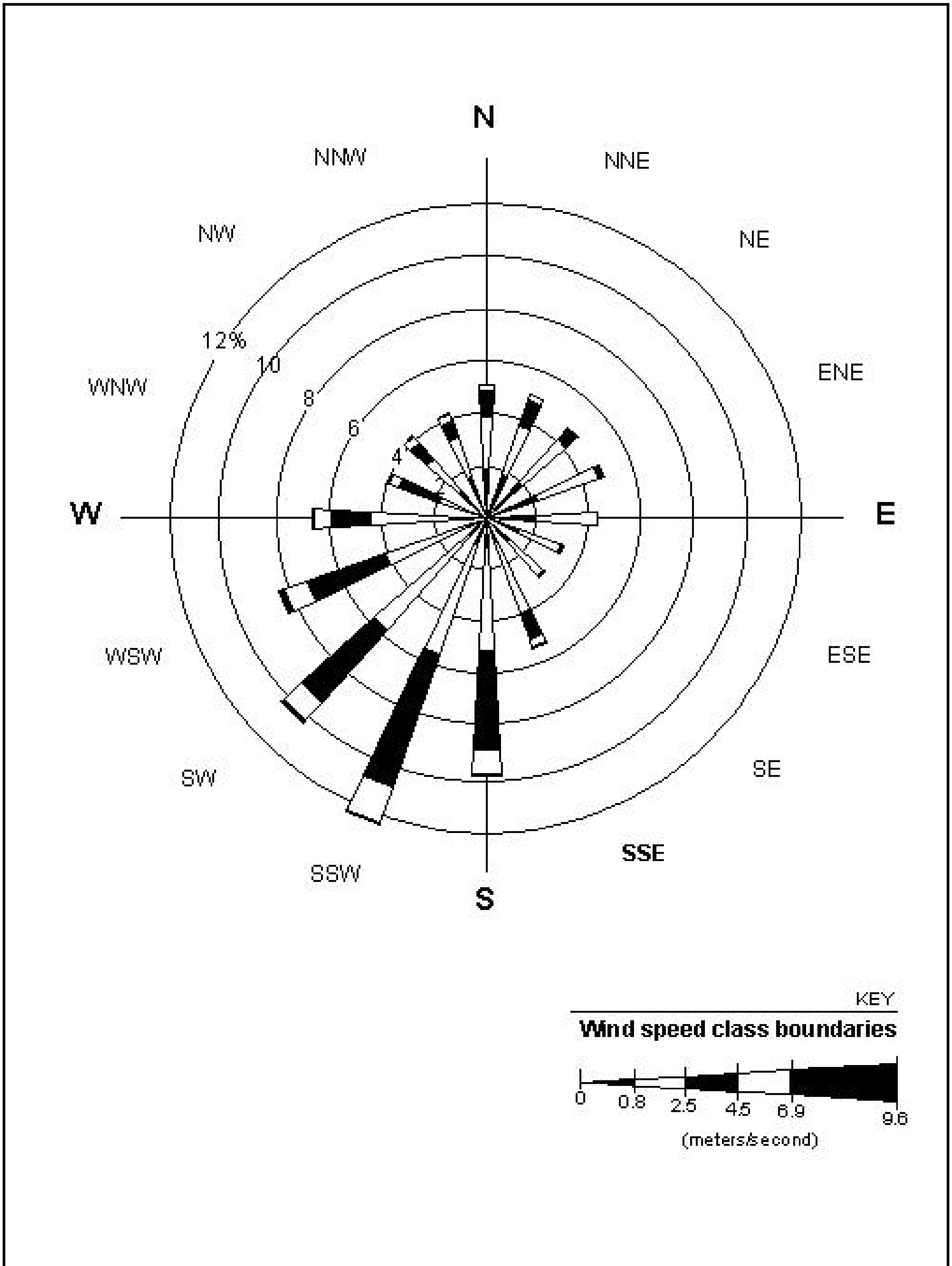

Figure 3–17 Wind Rose for the Los Alamos National Laboratory (1991) (11.5-meter level)

- **Air Quality—**Los Alamos National Laboratory is located within the New Mexico Intrastate Air Quality Control Region No. 157. None of the areas within Los Alamos National Laboratory and its surrounding counties are designated as nonattainment areas with respect to any of the National Ambient Air Quality Standards (40 CFR Part 81.332).

  For locations that are in an attainment area for criteria air pollutants, Prevention of Significant Deterioration (PSD) regulations limit pollutant emissions from new sources and establish allowable increments of pollutant concentrations. Allowable PSD increments currently exist for three pollutants (NO_2, SO_2, and PM_{10}). Three PSD classifications are designated based on criteria established in the Clean Air Act amendments. Class I areas include national wilderness areas, memorial parks larger than 2,020 ha (5,000 acres), and national parks larger than 2,430 ha (6,000 acres). Class II areas include all areas not designated as Class I. No Class III areas have been designated.

  One Prevention of Significant Deterioration Class I Area, the Bandelier National Monument's Wilderness Study Area, borders Los Alamos National Laboratory to the south. Los Alamos National Laboratory has not been subject to Prevention of Significant Deterioration requirements (LANL 1994b).

  Table 3-25 presents estimated emission rates for criteria and toxic/hazardous air pollutants at Los Alamos.

Table 3–25 Emission Rates of Criteria and Toxic/Hazardous Air Pollutants at Los Alamos National Laboratory[a]

Pollutant	*Emission Rate (kg/yr)*
Criteria Pollutants	
CO	16,756
NO_2	67,904
PM_{10}	2,731
SO_2	246
Lead	26
Other Regulated Pollutants	
Asbestos	(b)
Beryllium	(b)
Heavy Metals	(b)
Hydrogen Sulfide	(b)
Nonmethane Hydrocarbons	(b)
Photochemical Oxidants	(b)
Total Reduced Sulfur	(b)
Total Suspended Particulates	2,731
Hazardous and Other Toxic Pollutants	(c)

[a] Estimated 1996 emissions for all pollutants except lead. Estimated 1990 emissions for lead; no 1996 data available.
[b] No emissions of this pollutant listed.
[c] No toxic pollutants would be emitted by the proposed processing alternatives. The Draft EIS listed various toxic pollutants which would not be emitted from any of the proposed alternatives and so are not necessary to assess baseline or cumulative air quality impacts.
Source: LANL 1997, DOE 1996a.

These emissions are presented for the purpose of comparison with other sites addressed in this EIS and were not modeled to estimate air pollutant concentrations.

Criteria pollutants—nitrogen dioxide, carbon monoxide, ozone, lead particulate matter, and sulfur dioxide—make up approximately 79 percent of the stationary source emissions at Los Alamos National Laboratory. The source of these criteria pollutants is combustion in power plants, steam plants, asphalt plants, and local space heaters. Toxic and other hazardous pollutants represent the remaining 21 percent of emissions from stationary sources at Los Alamos National Laboratory. These emissions are generated by equipment surface cleaning, coating processes, and acid baths and include gases, vapors, metal dusts, and miscellaneous emissions such as wood dust, hazardous gases, and plastics (LANL 1994b).

Table 3–26 presents the monitored ambient air concentrations for criteria pollutants for 1992 and other pollutants of concern for 1990 at Los Alamos National Laboratory. These concentrations are based on monitoring data from monitors located adjacent to the Bandelier National Monument. These concentrations are in compliance with applicable guidelines and regulations.

Table 3–26 Comparison of Baseline Air Pollutant Concentrations with Most Stringent Applicable Regulations and Guidelines at Los Alamos National Laboratory, 1990 and 1992

Pollutant	*Averaging Time*	*Most Stringent Regulation or Guideline (μg/m³)*	*Monitored Concentration (μg/m³)*
Criteria Pollutants			
CO	8-hour	7,689[a]	115
	1-hour	11,578[b]	630
NO_2	Annual	73[a]	3.8
	24-hour	145[a]	c
Ozone	8-hour	157[b]	d
PM_{10}[e]	Annual	50[b]	8
	24-hour	150[b]	21
$PM_{2.5}$[e]	Annual	15[b]	e
	24-hour	65[b]	e
SO_2	Annual	40[a]	1.3
	24-hour	262[a]	c
	3-hour	1,300[b]	c
Lead	Calendar quarter	1.5[b]	c
Other Regulated Pollutants[g]			
Asbestos	30-day	0.01[a]	c
Beryllium	Calendar quarter	f	0.00002
	30-day	0.01[a]	c
Heavy metals	30-day	10[a]	c
Hydrogen sulfide	1-hour	14[a]	c
Nonmethane hydrocarbons	3-hour	100[a]	c
Photochemical oxidants	1-hour	118[a]	151
Total reduced sulfur	30-minute	3.9[a]	c
Total suspended particulates	Annual	60[a]	8
	30-day	90[a]	<21
	7-day	110[a]	<21
	24-hour	150[a]	21

[a] State standard.
[b] Federal standard.
[c] No monitoring data available; baseline concentrations assumed less than applicable standard.
[d] Ozone, as a criteria pollutant, is not directly emitted or monitored by the site. EPA recently revised the ambient air quality standards for ozone. The new standards, finalized on July 18, 1997, change the ozone primary and secondary standards from a 1-hour concentration of 235 μm/m^3 (0.12 ppm) to an 8-hour concentration of 157 μg/m^3 (0.08 ppm).
[e] EPA recently revised the ambient air quality standards for particulate matter. The current PM_{10} (particulate matter size less than or equal to 10 micrometers) annual standard is retained and two $PM_{2.5}$ (particulate matter size less than or equal to 2.5 micrometers) standards are added. These standards are set at 15 μg/m^3 (3-year average arithmetic mean based on community-oriented monitors) and 65 μg/m^3 (3-year average of the 98th percentile of 24-hour concentrations at population-oriented monitors). The current 24-hour PM_{10} standard is revised to be based on the 99th percentile of 24-hour concentrations. Insufficient emissions, modeling, and monitoring data exist for estimating concentrations of $PM_{2.5}$.
[f] No standard.
[g] Mandated by New Mexico.
Source: Adapted from DOE 1996a.

3.3.4 Water Resources

❒ **Surface Water—**The Rio Grande River is the major surface water feature in north-central New Mexico. All surface water drainage and groundwater discharge from the Pajarito Plateau ultimately arrives at the Rio Grande. The Rio Grande at Otowi, just east of Los Alamos, has a drainage area of 37,037 square kilometers (km^2) (14,300 square miles [mi^2]) in southern Colorado and northern New Mexico (DOE 1995e).

Eleven drainage areas, with a total area of 212 km^2 (82 mi^2) pass through the eastern boundary of Los Alamos National Laboratory. Runoff from heavy thunderstorms and heavy snowmelt reaches the Rio Grande several times a year from some drainages. Los Alamos, Pajarito, and Water Canyons have drainage areas greater than 26 km^2 (10 mi^2). Pueblo Canyon has a drainage area of 21 km^2 (8 mi^2); all others have less than 13 km^2 (5 mi^2). The overall flood risk to Los Alamos National Laboratory is low because nearly all the structures are located on the mesa tops, from which runoff drains rapidly into the deep canyons (DOE 1995e). The hydrological features at Los Alamos National Laboratory are depicted in **Figure 3–18**. No surface water is withdrawn at Los Alamos National Laboratory for either drinking water or facility operations (DOE 1993c).

Existing wastewater generation from Los Alamos National Laboratory is approximately 1,351 million L/yr (357 gal/yr). Permitted effluent discharges at Los Alamos National Laboratory into 10 of the major watersheds from the currently active National Pollutant Discharge Elimination System permitted industrial outfalls (Bradford 1996, DOE 1996c).

Los Alamos National Laboratory has three wastewater treatment facilities: Sanitary Waste Water Systems Consolidation plant, the Radioactive Liquid Waste Treatment Facility, and the High Explosives Wastewater Treatment Facility. Industrial effluent that does not go through these centralized treatment facilities is discharged to the environment through outfalls. The outfalls at Los Alamos National Laboratory are covered by National Pollutant Discharge Elimination System Permit NM0028355. In the National Pollutant Discharge Elimination System Permit, these outfalls are grouped by category according to effluent source type. The National Pollutant Discharge Elimination System Permit contains discharge limitations for each category of outfall based on the physical and chemical characteristics of each wastewater type. Any effluent discharging to a watercourse must also meet the New Mexico Water Quality Control Commission's Standards for Interstate and Intrastate Streams which are promulgated by New Mexico's Environmental Improvement Board and established in the New Mexico Water Quality Act (74-6-1 to 74-6-4, 7-6-6 to

74-6-13, NMSA 1978). The c\urrent designated uses include livestock watering and wildlife habitat. The number of Los Alamos National Laboratory outfalls in use at any given time changes

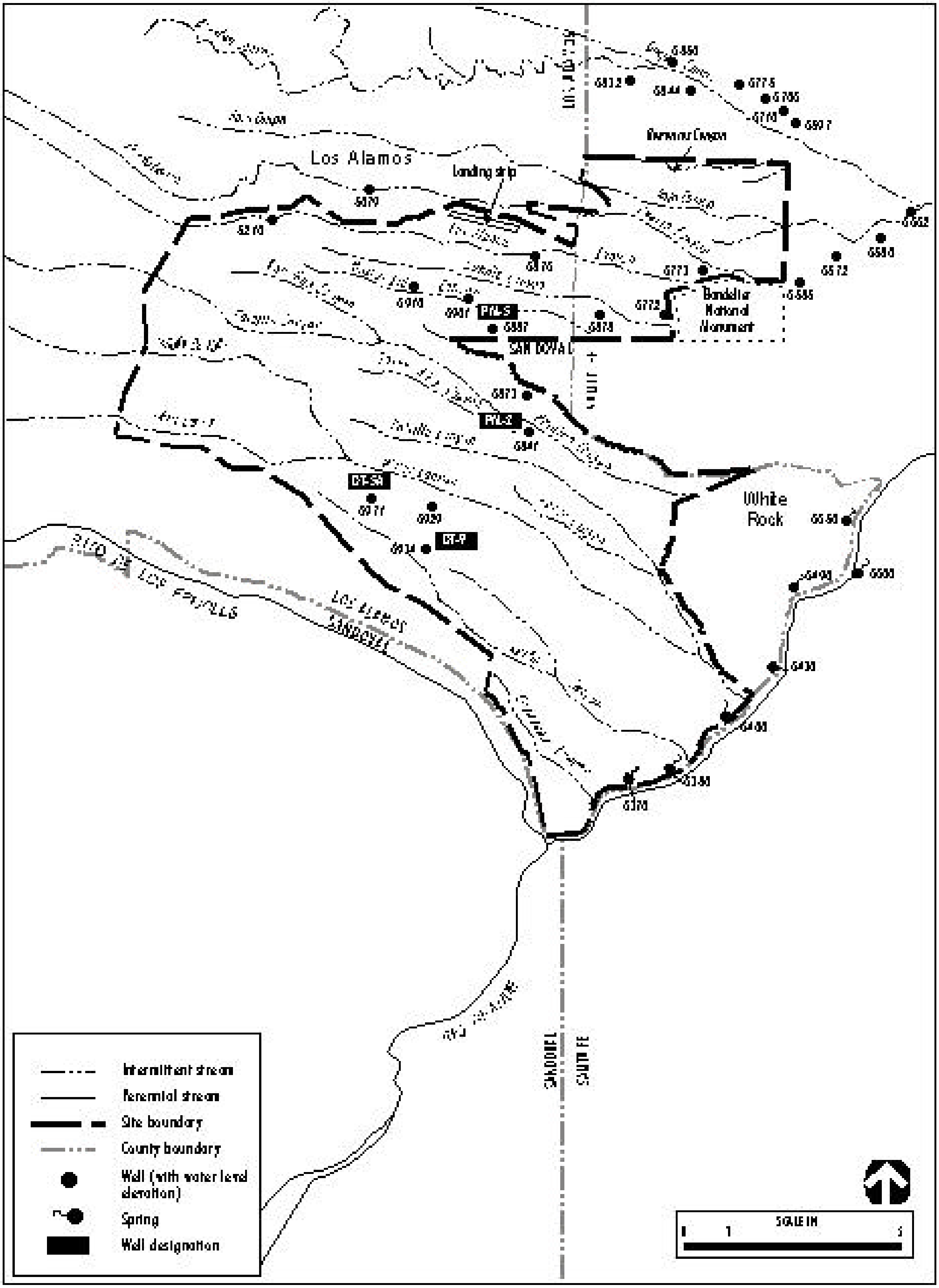

Figure 3–18 Surface Water Features Near Los Alamos National Laboratory

as individual projects, such as research and development projects, are started and completed at various Los Alamos National Laboratory locations (DOE 1996c).

Surface water quality monitoring results indicate that the overall compliance for sanitary and industrial discharges during 1995 was 100 percent and 98 percent, respectively. Additional information about surface water quality at the site can be found in the publication *Environmental Surveillance at Los Alamos During 1995* (LANL 1996).

- *Water Rights and Permits*—Water rights in New Mexico fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriated water for a beneficial use has priority to use the available water supply over a user claiming rights at a later time. All natural water flowing in streams and water courses in New Mexico is considered to be public and subject to appropriation for beneficial use. Beneficial use is the basis, measure, and limit of the right to use water. No water right, therefore, may be granted or claimed for more than the amount that can be beneficially used. DOE owns combined surface and groundwater rights. These rights include the withdrawal of 5,541.3 acre-ft/yr (approximately 6,835 million L/yr) from a variety of wells and surface diversions under licenses RG–485 through RG–488, 1503, 1802, and 1802–B. DOE also owns a contract for 1,200 acre-ft/yr (1,480 million L/yr) of San Juan/Chama Diversion water.

❒ **Groundwater—**Groundwater in the Los Alamos National Laboratory area exists in three modes—in shallow alluvium in canyons, in perched groundwater, and in the main aquifer. The main aquifer consists mostly of clastic sediments within the Santa Fe Group and the Puye Formation. Nearly all groundwater at Los Alamos National Laboratory is obtained from deep wells that produce water from this aquifer. A minor amount of groundwater at Los Alamos National Laboratory is obtained from springs. Most aquifers that lie beneath Los Alamos National Laboratory, with the exception of perched zones, are considered Class II aquifers, having current sources of drinking water and other beneficial uses (DOE 1993c).

The most productive area lies in the central portion of the Pajarito Plateau and includes the Pajarito well field. The average drawdown for these wells is 12 m (39.4 ft). The rate of movement of water in the aquifer is approximately 12 to 29 m (39.4 to 95.1 ft) per year (DOE 1996a).

- *Groundwater Quality*— Most of the wells in the Pajarito Plateau yield fresh water (total dissolved solids less than 500 mg/l), although some wells east of the site have a higher total dissolved solids content (1,000 mg/L or more). The primary, secondary, and radiochemical groundwater quality, as measured from wells and springs in the main aquifer, were below DOE's derived concentration guides or the New Mexico standards applicable to a DOE drinking water system (DOE 1993c). All parameters were below the applicable water quality criteria or standard in the main aquifer in 1993. Additional information about groundwater quality at the site can be found in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a) and the *Draft Site-wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL 1998).

- *Groundwater Availability and Use*—Los Alamos National Laboratory, the nearby communities of Los Alamos and White Rock, and Bandelier National Monument are entirely dependent on groundwater for their water supply. The water supply is primarily obtained from well fields. During 1993, total production from the wells for potable and nonpotable use was 5,519 million L (1,458 million gal). Los Alamos National Laboratory's water system had an average demand equal to about 81 percent of its current allotment of 6,800 million L/yr (1,800 million gal/yr). The site's water system and wells supply the Los Alamos townsite, the White Rock Community, and the Bandelier National Monument facilities.

Two new wells have been drilled at Los Alamos National Laboratory, one of which began pumping in the summer of 1992. The new wells are expected to supplant the now abandoned Los Alamos field. Water is taken from depths of 245 to 550 m (804 to 1,805 ft).

Over the next 50 years, increases in water use may require one of the following: use of the 1,500 million L/yr (396 million gal/yr) of San Juan-Chama water (releasing the water in exchange for excess pumping) and/or establishment of credit for return flow (DOE 1993c).

3.3.5 Geology, Soils, and Seismology

❒ **Geology and Soils—**Los Alamos National Laboratory is located on the Pajarito Plateau. The surface of the plateau is dissected by deep, southeast-trending canyons separated by long, narrow mesas. The Pajarito Plateau is capped by the Bandelier Tuff, a geologic unit comprising a massive pumiceous tuff breccia of ash-flow origin and a succession of cliff-forming welded ash flows. The tuff is underlain by sedimentary and volcanic rocks of the Santa Fe Group (DOE 1979).

The site is underlain by soil types varying in texture from clay and clay loam to gravel. More than 95 percent of the soils are developed on acidic volcanic rocks. Because of the topographic relief of the Pajarito Plateau, rock outcrops occur on more than 50 percent of the site area. The soils are acceptable for standard construction techniques. No soils in Los Alamos County have been designated prime farmland or Soil of Statewide Importance for New Mexico (DOE 1996a).

Detailed information about site geology and soils can be found in the *Draft Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (LANL 1998).

❒ **Seismology—**Los Alamos National Laboratory lies within seismic Zone 2. The strongest earthquake in the last 100 years within an 80-km (50-mi) radius was estimated to have a magnitude of 5.5 to 6 and a modified Mercalli intensity of VII. Studies suggest that several faults have produced seismic events with a magnitude of 6.5 to 7.8 in the last 500,000 years. Los Alamos National Laboratory operates a seismic hazards program that monitors seismicity through a seismic network and conducts studies in paleoseismology. Major faults at Los Alamos National Laboratory include the Pajarito, Rendija Canyon, and Guaje Mountain faults (**Figure 3–19**). Specific details regarding these faults are shown in **Table 3-27**. As presented in the table, the Guaje Mountain fault last moved between 4,000 and 6,000 years ago. There is no evidence of movement along the Pajarito fault system during historical times (DOE 1995e). It is believed that the Rendija Canyon Fault (which is closest to TA-55) last moved between 8,000 and 9,000 years ago (LANL 1998). The 100-year earthquake at Los Alamos is regarded as having a magnitude of 5, with an event of magnitude 7 being the maximum credible earthquake (DOE 1979). These values are currently used in design considerations at Los Alamos National Laboratory. In 1996 through 1997, LANL geologists conducted detailed geologic mapping studies in and around TA-55 and geologic trenching studies on the Pajarito Fault. Results from these studies are currently under review (LANL 1998). Geological concerns associated with the Los Alamos National Laboratory area include potential downslope movements in association with regional seismic activity. Although isolated rockfalls commonly occur from the canyon rims, landslides are an unlikely hazard at Los Alamos because of the dry climate, the deep water table, and the rock characteristics. Although the area has the potential for future volcanic eruptions, the periodicity and structural development of past eruptions indicate a low probability of an eruption occurring within the next 1,000 years (DOE 1979). Additional details can be found in Appendix D, Section D 3.3.3.3.

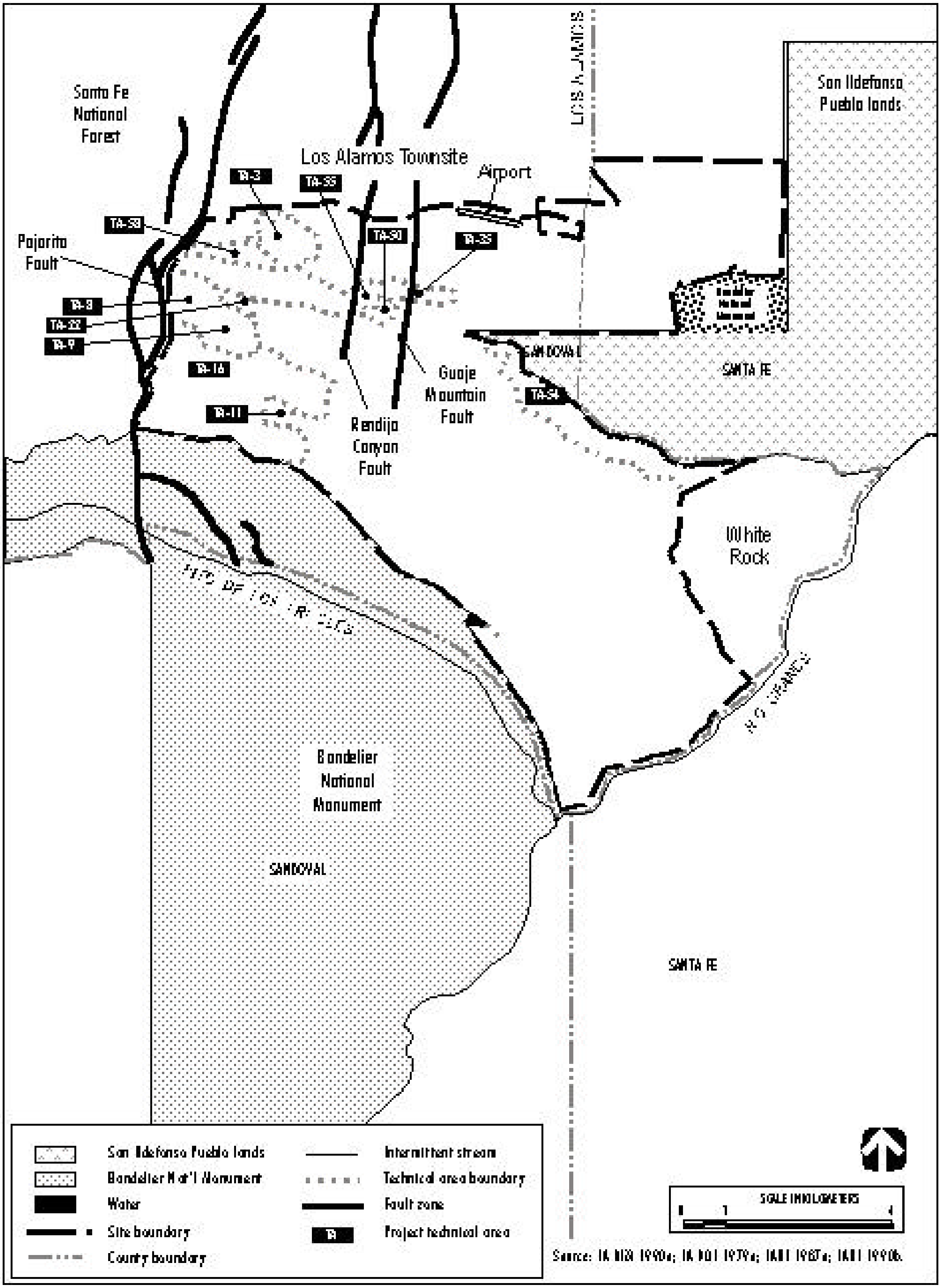

Figure 3–19 Major Fault Systems Near the Los Alamos National Laboratory Region

Table 3–27 Summary of Major Faults at Los Alamos National Laboratory

Name	*Approximate Length Mi (km)*	*Type*	*Most Recent Movement*	*Maximum Potential Earthquake* [a]
Pajarito	26 mi (42 km)	Normal, down-to-the-east [b]	Approximately 45,000 to 55,000 years ago	7
Rendija Canyon	6 mi (10 km)	Normal, down-to-the-west	8,000 to 9,000 or 23,000 years ago	6.5
Guaje Mountain	8 mi (14 km)	Normal, down-to-the-west	4,000 to 6,000 years ago	6.5

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

3.3.6 Ecology

❒ **Terrestrial Resources—** Los Alamos National Laboratory lies within the Colorado Plateau Province. Ecosystems within the laboratory site itself are diverse due to the 1,500-m (5,000-ft) elevational gradient from the Rio Grande on the southeastern boundary to the Jemez Mountains, 20 km (12.4 mi) to the west, and to the many canyons with abrupt slope changes that dissect the site. Only a small portion of the total land area at Los Alamos National Laboratory has been developed. The remaining land has been classified into six major vegetative communities. Within Los Alamos National Laboratory, the predominant community types are juniper grassland in the eastern third, pinyon-juniper in the central third, and ponderosa pine in the western third. The juniper-grassland community is found along the Rio Grande on the eastern border of the Pajarito plateau and extends upward on the south-facing sides of the canyons at 1,700 to 1,900 m (5,600 to 6,200 ft). The pinyon-juniper community, generally found in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, includes large portions of the mesa tops and north-facing slopes at the lower elevations. The ponderosa pine community is found in the western portion of the plateau and on mesa tops in the 2,100- to 2,300 m (6,900- to 7,500-ft) elevation range. Coniferous trees are the dominant vegetation in the Los Alamos National Laboratory environs, with pinyon pine and one-seed juniper predominant below 2,100 m (6,900 ft), and ponderosa pine and Douglas fir predominant above that elevation (DOE 1995). Almost 350 vascular plant species have been found, or are likely to be found, on Los Alamos National Laboratory (DOE 1979).

Terrestrial animal species that can be found on or near Los Alamos National Laboratory include 1 amphibian, 9 reptile, 189 bird, and 45 mammal species. Undeveloped areas within Los Alamos National Laboratory provide habitat for a diversity of terrestrial wildlife. Species lists have been compiled from observational data and published data, but the occurrence of some species has not been verified. Among vertebrates, the collared lizard, eastern fence lizard, and whiptail lizard are some of the reptiles found at Los Alamos National Laboratory. Typically, these are found at elevations between 1,910 and 2,134 m (6,265 and 7,000 ft). Bird species that nest in the area include the Mexican spotted owl, great-horned owl, and red-tailed hawk among the raptors, and Say's phoebe lesser goldfinch, and American robin among other types.

Overwintering species include the scrub jay, common raven, and house finch. Migratory birds and their nests and eggs are protected by the Migratory Bird Treaty Act. Eagles are similarly protected by the Bald Eagle Protection Act (DOE 1996a).

Some of the larger mammals at Los Alamos National Laboratory are the American black bear, coyote, and raccoon, while the smaller species include the Mexican woodrat, deer mouse, Abert's squirrel, and mountain cottontail. The most important and prevalent big game species at Los Alamos National Laboratory are mule deer and elk. Since 1980, the number of elk using Los Alamos National Laboratory lands increased significantly. Studies of elk conducted from 1991 to 1993 revealed increased use of habitats north and northeast of previously documented high-use areas. There have also been concerns about increases in motor vehicle accidents involving elk and deer in the Los Alamos National Laboratory area. Los Alamos National Laboratory lands have traditionally been a transitional area for wintering elk and mule deer. More recently, these two species have been using Los Alamos National Laboratory property on a year-round basis (DOE 1996a).

- **Wetlands—**National Wetland Inventory maps show that most Los Alamos National Laboratory wetlands occur in canyons that drain to the Rio Grande. Wetlands are found in most of the canyons on the laboratory site including Pueblo, Los Alamos, Sandia, Mortendad, Pajarito, Water, Ancho, Chaquchi, and White Rock (Rio Grande) Canyons. Wetlands have also developed in the vicinity of outfalls from Los Alamos National Laboratory facilities. Most wetlands are classified as riverine intermittent, meaning they may contain flowing water part of the year and may contain pooled water or be dry the remainder of the year. Palustrine emergent and/or scrub-shrub wetlands are also indicated in sections of Pueblo, Los Alamos, Sandia, Pajarito, and Ancho Canyons. Most of the riverine and palustrine wetlands known to exist at Los Alamos National Laboratory are designated as temporary or seasonal by the National Wetlands Inventory maps (DOE 1996a).

- **Aquatic Resources—**Aquatic habitats at Los Alamos National Laboratory are limited to the Rio Grande and several springs and intermittent streams in the canyons. Some of these habitats currently receive National Pollutant Discharge Elimination System-permitted wastewater discharges. The springs and streams at Los Alamos National Laboratory do not support fish; however, many other aquatic species thrive in these waters.

The Rio Grande is located along the southeastern property boundary and supports populations of common carp, chub, white sucker, and carpsucker. Game fish inhabiting the Rio Grande in the vicinity of Los Alamos National Laboratory include the channel catfish and brown trout.

- **Threatened and Endangered Species—Table 3-28** lists Federal- or State-listed threatened, endangered, and other special status species may be found on and in the vicinity of Los Alamos National Laboratory. Four of these species have been observed on Los Alamos National Laboratory. The Federal-listed species recorded onsite include the Mexican spotted owl, the bald eagle, which winters along the Rio Grande River, and the peregrine falcon, which historically nested onsite and occasionally still forages there. Los Alamos National Laboratory canyons provide suitable nesting, roosting, and foraging habitats for the Mexican spotted owl. No critical habitat for threatened or endangered species, as designated under the Endangered Species Act (50 CFR 17.95; 50 CFR 17.96), exists on Los Alamos National Laboratory; however, critical habitat for the Mexican spotted owl has been designated in areas bordering the northern and western boundaries of Los Alamos National Laboratory (60 FR 29914).

3.3.7 Cultural and Paleontological Resources

More than 1,300 prehistoric sites and 80 historic resources have been recorded at Los Alamos National Laboratory, and approximately 95 percent of these sites and 90 percent of the resources are considered eligible or potentially eligible for the National Register of Historic Places. Native Americans in the area include the six Tewa-speaking Pueblos of the northern Rio Grande Valley (San Ildefonso, San Juan, Santa Clara, Nambe, Tesuque, and Pojoaque) and the Cochiti and Jemez Pueblos. None of the formations within Los Alamos National Laboratory are known to be fossiliferous. Additional information about cultural and paleontological resources at the site can be found in the *Draft Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (LANL 1998).

Table 3–28 Federal- and State-Listed Threatened, Endangered, and Other Special Status Species That May Be Found at or in the Vicinity of Los Alamos National Laboratory

		Status[a]	
Common Name	***Scientific Name***	***Federal***	***State***
Mammals			
Big free-tailed bat	*Nyctinomops macrotis*	C2	NL
Cave myotis	*Myotis velifer*	C2	NL
Fringed myotis	*Myotis thysanodes*	C2	NL
Goat peak pika	*Ochotona princeps nigrescens*	C2	NL
Long-eared myotis	*Myotis evotis*	C2	NL
Long-legged myotis	*Myotis volans*	C2	NL
New Mexican meadow jumping mouse	*Zapus hudsoniums luteus*	C2	T
Occult little brown bat	*Myotis lucifugus occultus*	C2	NL
Pale Townsend's big-eared bat	*Plecotus townsendii pallescens*	C2	NL
Small-footed myotis	*Myotis ciliolabrum*	C2	NL
Spotted bat	*Euderma maculatum*	C2	T
Yuma myotis	*Myotis yumanensis*	C2	NL
Birds			
Bald eagle[b, c]	*Haliaeetus leucocephalus*	T	T
Broad-billed hummingbird	*Cynanthus latirostris*	NL	T
Common black hawk	*Beuteogallus athracinus*	NL	T
Ferruginous hawk	*Buteo regalis*	C2	NL
Gray vireo	*Vireo vicinior*	NL	T
Mexican spotted owl[c]	*Strix occidentalis lucida*	T	NL
Northern goshawk[c]	*Accipiter gentilis*	C2	NL
Peregrine falcon[b, c]	*Falcon peregrinus*	E (S/A)	E
Southwestern willow flycatcher	*Empidonax traillii extimus*	E	T
Western burrowing owls	*Athene cunicularia hypugea*	C2	NL
White-faced ibis	*Plegadis chihi*	C2	NL
Whooping crane[b]	*Grus americana*	E	E
Fish			
Flathead chub	*Platygobio gracilis*	C2	NL
Rio Grande silvery minnow	*Hybognathus amarus*	E	T
Invertebrates			
Say's pond snail	*Lymnaea caperata*	NL	E
Plants			
Checker lily	*Fritillaria atropurpurea*	NL	R
Giant helleborine orchid[c]	*Epipactis gigantea*	NL	RS
Paper-spined cactus	*Pediocactus papyracanthus*	C2	NL
Sandia alumroot	*Heuchera pulchella*	NL	RS
Santa Fe cholla	*Opuntia viridiflora*	C2	E
Wood lily	*Lilium philadelphicum var. andinum*	NL	E

[a] Status codes: C2 - Federal candidate - Category 2 (possibly appropriate for listing); E - Endangered; NL - not listed; R - State rare plant review list; RS - State rare and sensitive plant species; T - threatened; S/A - protected under the similarity of appearances provision of the *Endangered Species Act*.
[b] U.S. Fish and Wildlife Service Recovery Plan exists for this species.
[c] Species recorded on Los Alamos National Laboratory.
Source: Adapted from DOE 1996a.

3.3.8 Socioeconomics

- **Regional Economy—**Between 1980 and 1990, the civilian labor force in the regional economic area increased from 74,759 to 100,257, a 34-percent increase (annual average increase of 3.4 percent). The regional economic area encompasses seven counties around the site located in New Mexico. In 1994, unemployment in the regional economic area was 6.2 percent compared to 6.3 percent for New Mexico. The region's per capita income of $17,689 in 1993 was approximately 8.2 percent higher than New Mexico's per capita income of $16,346. The regional economic area and New Mexico have similar employment patterns. The service sector accounts for the largest share of total employment in both the region (31 percent) and in New Mexico (28 percent). Manufacturing employment accounted for 4 percent of the total regional employment but 6 percent of the total State employment (DOE 1996a).

- **Population and Housing—**Between 1980 and 1992, the population residing within the Los Alamos National Laboratory region of influence grew from 122,241 to 158,249, an increase of 29.5 percent (annual average increase of 2.5 percent). The region of influence is a three-county area (Los Alamos County, Rio Arriba County, and Santa Fe County) in which almost 90 percent of all site employees reside. Within the region of influence, however, Santa Fe County increased by 39.6 percent (annual average increase of 3.3 percent). Population growth in Los Alamos was nearly stagnant during the same period. The unincorporated communities of Los Alamos and White Rock in Los Alamos County are included in the county population and housing analysis (DOE 1996a).

The number of housing units increased from 46,006 in 1980 to 63,386 units in 1990, an increase of 37.8 percent (annual average increase of 3.8 percent). The 1990 homeowner vacancy rate in the region of influence was 2.3 percent. The rental vacancy rate for the region of influence counties was 7.7 percent. **Figure 3–20** shows the racial and ethnic composition of minorities residing within an 80-km (50-mi) radius of Los Alamos National Laboratory at the time of the 1990 census.

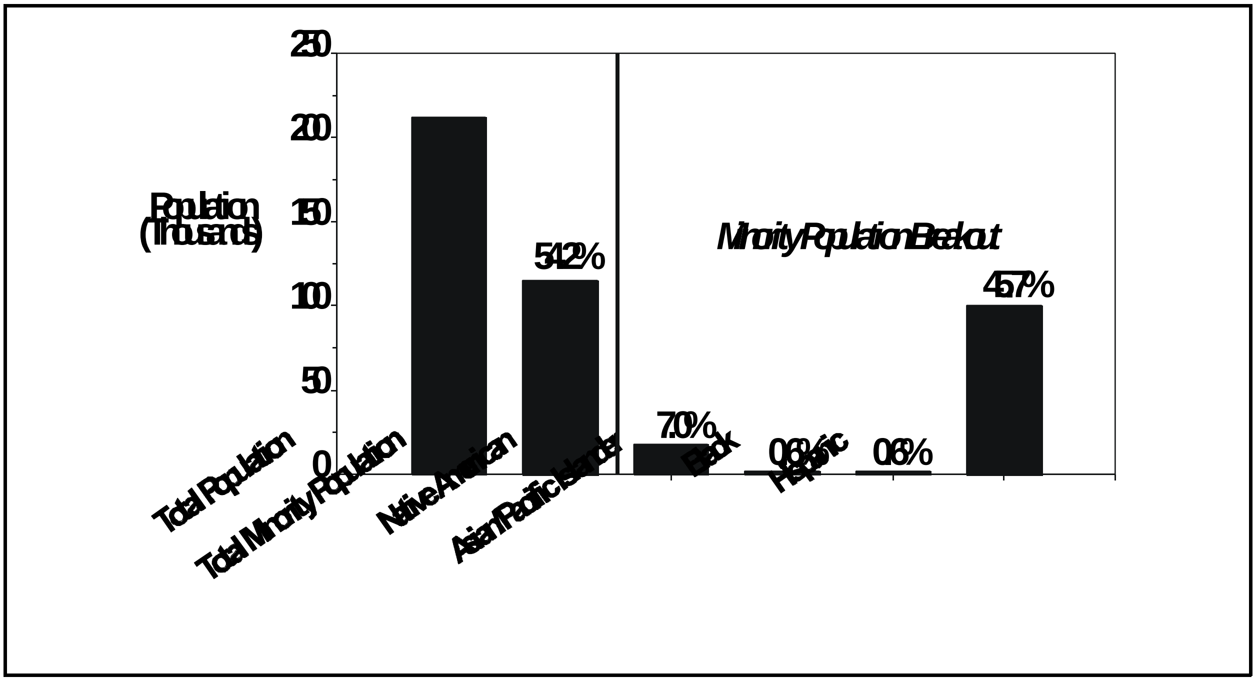

Figure 3–20 Racial and Ethnic Composition of the Minority Population Residing Within 80 km (50 mi) of the Los Alamos National Laboratory

As a percentage of the total state population, the State of New Mexico has the largest minority population among the contiguous Unites States. During the decennial census of 1990 (DOC 1992b), minorities were found to comprise nearly 50 percent of New Mexico's population. Minorities comprised approximately 54 percent of the population residing within 80 km (50 mi) of candidate facilities at Los Alamos National Laboratory. Nearly 46 percent of the total population at risk was Hispanic, while 7 percent of the total population at risk was comprised of Native Americans. Together, Hispanics and Native Americans comprised over 97 percent of the total minority population in the area potentially impacted by the proposed action and alternatives. Among the Native American pueblos in the Los Alamos-Santa Fe Area, the Pueblo of San Ildefonso, Pueblo of Santa Clara, Pueblo de Cochiti, and Pueblo of Jemez are closest in proximity to Los Alamos National Laboratory. Lands of the San Ildefonso Pueblo are adjacent to the eastern boundary of Los Alamos National Laboratory (see Figure 3–19). As illustrated in **Figure 3-21**, the minority population exceeded 48 percent of the total population (more than twice the national minority percentage in 1990) in areas throughout the potentially affected region.

As shown in Table F-3 of Appendix F, about 15 percent of the individuals residing within the region of influence had a self-reported income less than the poverty level. As discussed in Appendix F, the poverty level is a function of family size and number of unmarried children in the family under 18 years of age. The national percentage of individuals with income less than the poverty level in 1995 is estimated by the Census Bureau to be 13.8 percent. The national percentage of individuals residing in the continental United States with income below the poverty level was 13.3 percent at the time of the 1990 census. **Figure 3–22** shows the distribution of poverty-level individuals residing within the region of influence. As shown in the figure, there are areas throughout the region of influence in which the percentage of residents with income below the poverty level was a factor of two or more larger than the national average.

3.3.9 Public and Occupational Health and Safety

- **Radiation Environment—**Major sources of background radiation exposure to individuals in the vicinity of Los Alamos National Laboratory are shown in **Table 3–29**. Annual doses to individuals from background radiation are expected to remain constant over time. Total dose to the population changes as the population size changes. Background radiation doses are unrelated to Los Alamos National Laboratory operations.

Releases of radionuclides to the environment from Los Alamos National Laboratory operations provide another source of radiation exposure to individuals in the vicinity of Los Alamos National Laboratory. The radionuclides and quantities released from Los Alamos National Laboratory operations in 1995 are listed in *Environmental Surveillance at Los Alamos During 1995* (LANL 1996). Doses to the public resulting from these releases and direct radiation are presented in **Table 3–30.** These doses fall within regulatory limits given in DOE Order 5400.5 and are small in comparison to background radiation.

Workers at Los Alamos National Laboratory receive the same dose as the general public from background radiation, but also receive an additional dose from working in the facilities. **Table 3–31** includes the average, maximum, and total occupational doses to Los Alamos National Laboratory workers from operations during the period of 1991 through 1995.

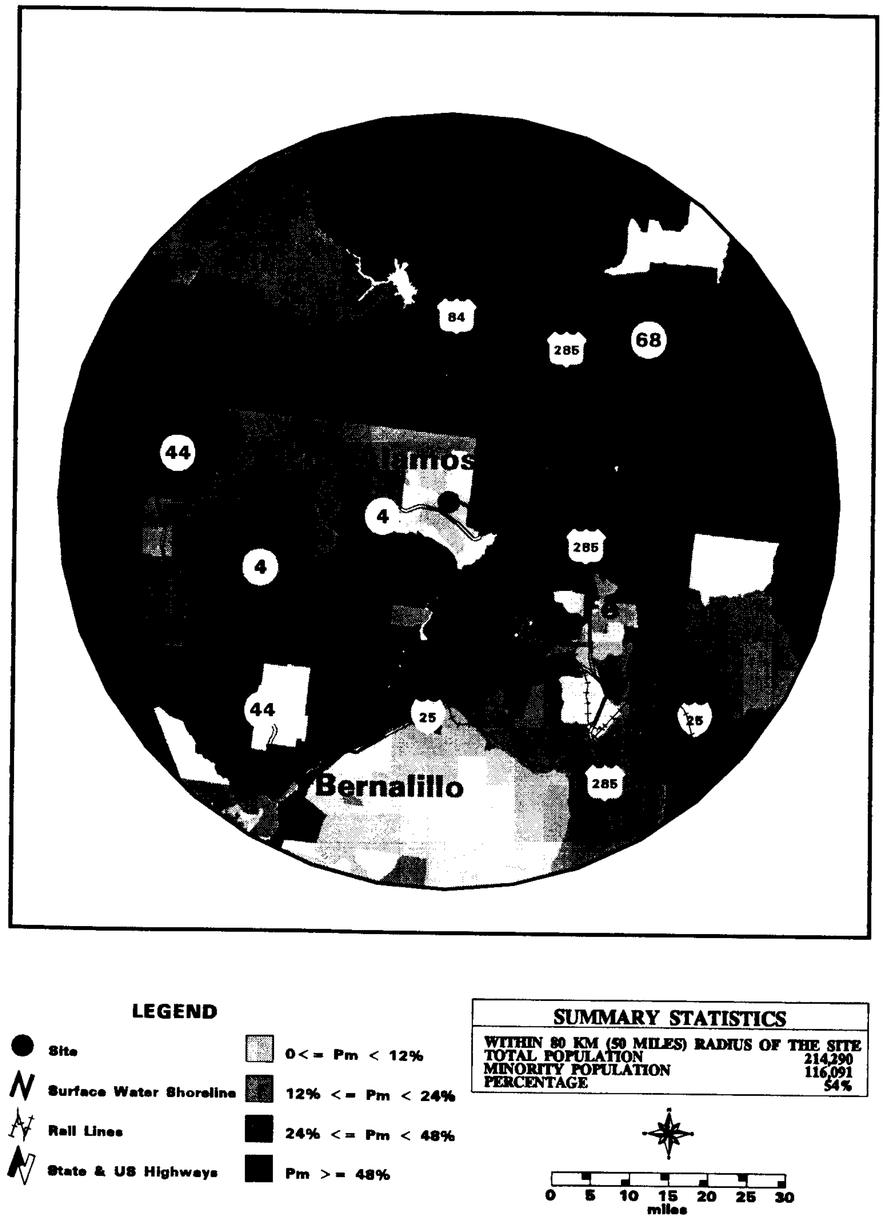

Figure 3–21 Distribution of Minority Population Residing Within 80 km (50 mi) of Los Alamos National Laboratory

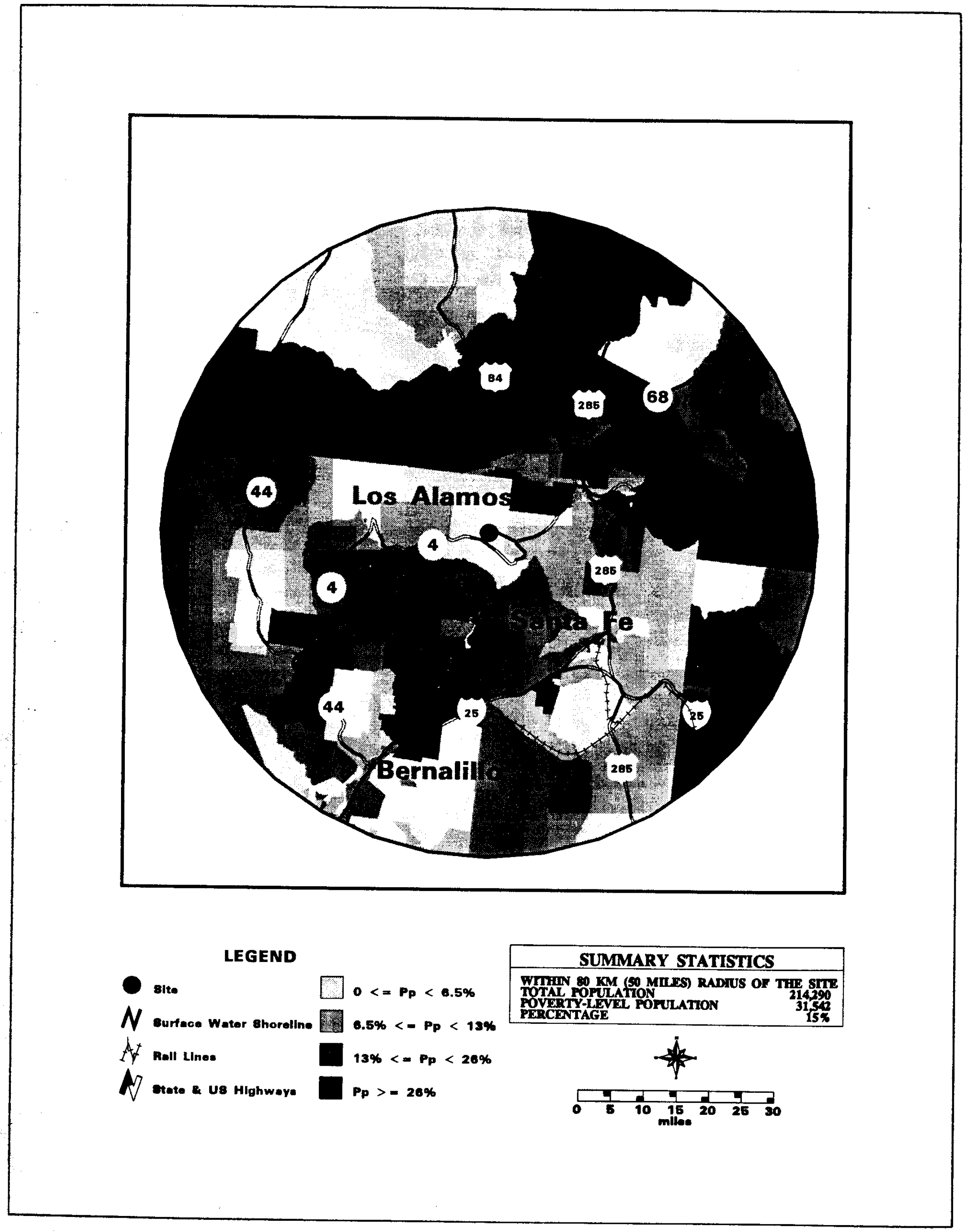

Figure 3–22 Distribution of Low-Income Population Residing Within 80 km (50 mi) of Los Alamos National Laboratory

| **Table 3–29 Sources of Radiation Exposure to Individuals in the Vicinity, Unrelated to Los Alamos National Laboratory Operations**

Source	*Committed Effective Dose Equivalent (mrem/yr)*
Natural Background Radiation[a]	
Cosmic and external terrestrial radiation	109
Internal terrestrial radiation	40
Radon in homes (inhaled)[b]	200
Other Background Radiation [a, c]	
Diagnostic x-rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	414

[a] LANL 1996 (Chapter 3).
[b] Value for Radon is an average for the United States.
[c] NCRP 1987.

| **Table 3–30 Doses to the General Public from Normal Operations at Los Alamos National Laboratory, 1995 (Committed Effective Dose Equivalent)**

Members of the General Public	*Atmospheric Releases*		*Liquid Releases*		*Total*	
	Standard [a]	*Actual*	*Standard* [a]	*Actual*	*Standard* [a]	*Actual*
Maximally exposed individual (mrem)	10	5.1	4	0.58	100	5.7
Population within 80 km (50 mi)[b] (person-rem)	None	3.2	None	~0[c]	None[d]	3.2
Average individual within 80 km (50 mi)[e] (mrem)	None	0.013	None	~0[c]	None	0.013

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10 mrem/yr limit for airborne emissions is required by the Clean Air Act. The 4 mrem/yr limit is required by the Safe Drinking Water Act, and the total dose of 100 mrem/yr is the limit from all pathways combined.
[b] In 1995, this population was approximately 241,000.
[c] Although the maximally exposed individual receives a dose, no population groups are exposed to any liquid pathways.
[d] A 100 person-rem value for the population is found in proposed 10 CFR Part 834 (58 FR 16268). If the potential total dose exceeds this value, it is required that the contractor operating the facility notify DOE.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Source: LANL 1996 (Chapter 3).

| **Table 3–31 Annual Doses to Onsite Workers from Normal Operations at Los Alamos National Laboratory, Period 1991–1995**

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard [a]	*Actual* [b]
Average Worker (mrem)	None	16
Maximally exposed worker (mrem)	5,000	2,000
Total workers (person-rem)	None	165

[a] 10 CFR Part 835. DOE's goal is to maintain radiological exposure as low as reasonably achievable. This includes maintaining doses to individual workers so far below the DOE limit of 5,000 mrem/year that no dose is expected to exceed the DOE Administrative Control Level of 2,000 mrem/year (DOE 1992a).
[b] DOE 1997c. The annual doses are averaged over the 5-year period.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in *Environmental Surveillance at Los Alamos During 1995* (LANL 1996). In addition, the concentrations of radioactivity in various environmental media (e.g., air, water, and soil) in the onsite and offsite regions are presented in the same reference.

- **Chemical Environment—**The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media with which people may come in contact (e.g., soil through direct contact or via the food pathway). The baseline data for assessing potential health impacts from the chemical environment are those presented in Section 3.3.3 on air quality and Section 3.3.4 on surface and groundwater quality.

Adverse impacts to the public are minimized through administrative and design controls to decrease hazardous chemical releases to the environment and to achieve compliance with permit requirements. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts to the public may occur during normal operations at Los Alamos National Laboratory via inhalation of air containing hazardous chemicals released to the atmosphere. Risks to public health from ingestion of contaminated drinking water or direct exposure are also potential concerns.

Baseline air emission concentrations for hazardous air pollutants and their applicable standards were presented in Section 3.3.3. These concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed.

Exposure pathways to Los Alamos National Laboratory workers during normal operations may include inhaling air in the workplace atmosphere, drinking water, and possible other contact with hazardous materials associated with work assignments. The potential for health impacts varies from facility to facility and from worker to worker, and available information is not sufficient to allow a numerical estimation and summation of these impacts. However, workers are protected from hazards specific to the workplace through appropriate training, protective equipment, monitoring, and management controls. Los Alamos National Laboratory workers are also protected by adherence to Occupational Safety and Health Administration and EPA occupational standards that limit workplace atmospheric and drinking water concentrations of potentially hazardous chemicals. Appropriate monitoring, which reflects the frequency and amounts of chemicals utilized in the operation processes, ensures that these standards are not exceeded. Additionally, DOE requirements ensure that conditions in the workplace are as free as possible from recognized hazards that cause or are likely to cause illness or physical harm.

- **Emergency Preparedness—**Each of DOE's sites have established an emergency management program that would be activated in the event of an accident. These programs have been developed and maintained to ensure adequate response for most accident conditions. Emergency management programs incorporate activities associated with emergency planning, preparedness, and response. The Los Alamos National Laboratory Emergency Preparedness Plan is designed to minimize or mitigate the impact of any emergency upon the health and safety of employees and the public.

3.3.10 Waste Management

| **Table 3–32** presents a summary of waste management activities at Los Alamos National Laboratory. DOE cooperates with Federal and State regulatory authorities to address compliance and cleanup obligations arising from its past operation of Los Alamos National Laboratory. Several activities are now conducted to bring its current operations into full regulatory compliance. These activities are set forth in permits and negotiated agreements that contain schedules for achieving compliance with applicable requirements and financial penalties for nonachievement of agreed-upon milestones. These agreements have been reviewed to ensure the proposed actions are allowable under the terms of these agreements.

Los Alamos National Laboratory is not listed on the National Priorities List. As a function of obtaining a Resource Conservation and Recovery Act permit, however, the Hazardous and Solid Waste Amendments of 1984 mandate that permits include provisions for corrective actions to clean up contamination in areas designated as solid waste management units. By the end of 1995, over 60 of the approximately 2,100 potential release sites identified had been remediated, no further action was proposed for 575 sites, and 1,100 sites were slated for investigation or cleanup; for the remaining sites, action is still pending. Cleanup activities are expected to be completed by 2010 (LANL 1996).

Through its research activities, Los Alamos National Laboratory manages a small quantity of the following five broad waste categories: transuranic waste, low-level, mixed, hazardous, and nonhazardous wastes:

❒ **Transuranic Waste—**In 1993, Los Alamos National Laboratory generated approximately 54 m^3 (70 yd^3) of transuranic waste (LANL 1994a). The Plutonium Facility (Technical Area 55) is the principal generator of liquid transuranic waste at Los Alamos National Laboratory. Principal sources include process acidic and caustic wastewaters, evaporator distillates from the nitrate recovery area, cooling water from glove boxes, and wet vacuum seal water. Sludges that remain after treatment through filtration and residual evaporator bottoms are loaded into 208-L (55-gal) drums, solidified, and transported to Area G for storage. Liquid wastes remaining after filtration are transferred from Technical Area 55 to the Radioactive Liquid Waste Treatment Facility (Technical Area 50) by gravity drain in double-wall pipelines. After treatment at Technical Area 50 involving sedimentation, clarification, and flocculation, the residual radioactive sludge is loaded into drums, solidified, and transported to Area G for storage. Most of Los Alamos National Laboratory's transuranic waste is currently stored on four asphalt pads. Transuranic wastes are currently being stored until they can be shipped to the Waste Isolation Pilot Plant (WIPP), if that facility can demonstrate compliance with the requirements of 40 CFR Part 191 and 40 CFR Part 268, or to another transuranic waste disposal facility, should WIPP prove unsatisfactory.

Should additional treatment be necessary for disposal at WIPP, Los Alamos National Laboratory would develop the appropriate treatment to meet WIPP waste acceptance criteria and package the wastes in accordance with DOE, Nuclear Regulatory Commission, and U.S. Department of Transportation requirements for transport to WIPP for disposal. Los Alamos National Laboratory is presently upgrading transuranic waste storage facilities to comply with Resource Conservation and Recovery Act requirements under the terms of a consent order with the State of New Mexico.

Table 3–32 Waste Management Activities at Los Alamos National Laboratory

Category	*1996 Generation (m^3)*	*Treatment Method*	*Treatment Capacity (m^3/yr)*	*Storage Method*	*Storage Capacity (m^3)*	*Disposal Method*	*Disposal Capacity (m^3)*
Transuranic							
Liquid	None	Pretreatment at TA-50: neutralization, clariflocculation, filtration, precipitate, cement mixing	48,800	N/A	N/A	N/A	N/A
Solid	77	Volume reduction	1,080	Storage pads at TA-54, modified LLW burial pits and shafts	24,355	None: Federal repository in the future	None
Mixed Transuranic							
Liquid	None	See transuranic	Included in transuranic	N/A	N/A	N/A	N/A
Solid	4	See transuranic	Included in transuranic	N/A	Included in transuranic	See transuranic	None
Low-Level Waste							
Liquid	11	Chemical treatment and ion-exchange, solidification; and volume reduction (vial crusher)	45 m^3/hour	Chemical and Ion-Exchange Plant at TA-50 and the Chemical Plant at TA-21	663	Treated effluent is discharged to the environment. Residual sludge is solidified and disposed of at TA-54, Area G, as solid LLW	None
Solid	521	Compaction	76	TA-54 in Area G	Variable	Currently solid LLW goes to TA-54, Area G for burial. Continued construction at Area G under evaluation in sitewide EIS	Estimated available capacity is 25,000 m^3
Mixed LLW							
Liquid	2	Neutralization, precipitation, oxidation, thermal treatment; solidification; volume reduction; liquid scintillation cocktail vials	Capabilities under development per site treatment plan	RCRA-permitted buildings (not built yet) and interim status container storage areas	583	N/A	None
Solid	5	None	Capabilities under development per site treatment plan	RCRA-permitted Bldgs. (not built yet) and interim status container storage areas	583	Capabilities under development as per Site Treatment Plan for Mixed Wastes	None
Hazardous Waste							
Liquid	None	Thermal treatment, treatment tanks, neutralization, precipitation, and evaporation	Varies depending on the waste stream	Thermal treatment TAs-14,-15,-16,-36, and -39 and storage and treatment TA-54, Area L	1,864	Offsite	N/A

Category	1996 Generation (m^3)	Treatment Method	Treatment Capacity (m^3/yr)	Storage Method	Storage Capacity (m^3)	Disposal Method	Disposal Capacity (m^3)
Solid	89 (tonnes)	Thermal treatment and flashpad	Varies depending on the waste stream	See above	See above	Offsite	N/A
Nonhazardous (Sanitary) Liquid	None	Filtration, settling, and stripping	1,060,063	N/A	N/A	Permitted discharge sanitary tile fields	2,271 m^3/day
Solid	2,057 (tonnes)	None	None	N/A	N/A	Offsite county landfill and onsite landfill Area J	N/A

TA = technical area   N/A = not applicable   LLW = low-level waste   RCRA = Resource Conservation and Recovery Act

Source: Adapted from DOE 1996a, DOE 1997a, and DOE 1997c.

Los Alamos National Laboratory generates mixed transuranic wastes. Newly generated mixed transuranic wastes are identified, characterized, and stored in compliance with the Resource Conservation and Recovery Act. In 1993, Los Alamos National Laboratory generated approximately 255 m^3 (334 yd^3) of mixed transuranic wastes. The Federal Facility Compliance Act of 1992 requires DOE to provide specific information to the EPA and the State of New Mexico on Los Alamos National Laboratory's mixed transuranic waste streams, treatment facilities, and technology development activities. This waste category covers a broad range of physical matrix categories for Los Alamos National Laboratory. The Federal Facility Compliance Order for the Site Treatment Plan requires treatment of all mixed wastes not in compliance with the land disposal provisions of the Resource Conservation and Recovery Act. This compliance order is the implementation of the Federal Facility Compliance Act at Los Alamos National Laboratory. WIPP waste acceptance criteria specifies limiting parameters for waste containers, waste form, waste packaging, accompanying data, and miscellaneous packaging and Resource Conservation and Recovery Act requirements. WIPP has specific Resource Conservation and Recovery Act hazardous waste codes that it can accept without requiring the treatment of the waste forms. WIPP's waste acceptance criteria must be met prior to the shipment of mixed wastes to WIPP. Los Alamos National Laboratory has developed a WIPP transuranic waste characterization program (including hazardous waste characterization) to meet the waste acceptance criteria.

- **Low-Level Waste—**Both liquid and solid low-level waste are generated and managed by Los Alamos National Laboratory. In 1993, Los Alamos National Laboratory generated approximately 21,400 m^3 (5,653,000 gal) of liquid and 2,693 m^3 (3,523 yd^3) of solid low-level waste. Liquid low-level waste is generated from many areas throughout Los Alamos National Laboratory. There are two wastewater treatment facilities used for treatment of aqueous low-level waste, one of which utilizes ion-exchange technology. As part of a new radioactive liquid waste treatment facility project, a facility for the solidification and subsequent volume reduction of the radioactive liquid waste treatment plant sludge containing plutonium, americium, and other radionuclides is proposed but not funded at Los Alamos National Laboratory.

  Solid low-level waste is generated from many areas throughout Los Alamos National Laboratory. Solid low-level waste, such as paper, plastic, glassware, and rags, is separated into compactible and noncompactible materials by the waste generators. Compactible bales are banded, wrapped and sealed in plastic, and moved to Area G for disposal in landfill pits located at Technical Area 54 Low-level waste noncompactible items, such as large equipment and much of the decontamination and decommissioning waste, generally are not packaged but delivered to the burial site in covered or enclosed vehicles. Continued construction at Area G is dependent on decisions made in conjunction with the Los Alamos National Laboratory *Draft Site-Wide Environmental Impact Statement for Continued Operation of Los Alamost National Laboratory* (LANL 1998).

- **Mixed Low-Level Waste—**In 1993, Los Alamos National Laboratory generated approximately 45 m^3 (59 yd^3) of mixed low-level waste (LANL 1994b). Mixed low-level waste includes solvents, pyrophoric substances, spray cans, scintillation vials, uranium-contaminated lithium hydride, miscellaneous reagent chemicals, vacuum pump oil contaminated with mercury, gas cylinders, and other contaminated material. It is stored at Technical Area-54 Areas L and G. Currently, Los Alamos National Laboratory does not dispose of mixed low-level waste. In accordance with the Federal Facility Compliance Act of 1992, Los Alamos National Laboratory has developed a site treatment plan that covers management of all mixed waste at Los Alamos National Laboratory. The State of New Mexico Environment Department issued a Compliance Order in the Site Treatment Plan for Mixed Waste in October 1995. The compliance order addresses land disposal restricted mixed waste. For mixed waste with identified treatment technologies, the plan provides a schedule for submitting permit applications, entering into contracts, initiating construction, conducting systems testing, starting operations, and processing mixed wastes. For mixed waste without an identified treatment technology, the plan includes a schedule for identifying and developing technologies, identifying the funding requirements for research and development, submitting treatability study notifications, and submitting research and development permit applications.

Mixed waste treatment skids are being designed to treat onsite hazardous and mixed waste streams that are not amenable to offsite treatment. Examples of the waste streams potentially amenable to skid treatment are reactive metals, plating wastes, acids, bases, ignitable liquids, spent solvents, and decontamination debris. Not all of the technologies to be included have been chosen. The mixed waste treatment skids would be housed in an existing Los Alamos National Laboratory structure. An environmental restoration high-energy plasma technology is being tested as a technique for total destruction of mixed low-level waste that has been treated to land disposal restrictions standards. This technique will allow Los Alamos National Laboratory to stay in compliance with the Federal Facility Compliance Act of 1992.

❒ **Hazardous Waste—**Los Alamos National Laboratory received a permit for treatment, storage, and disposal of hazardous waste under the Resource Conservation and Recovery Act in November 1989 and for the Hazardous and Solid Waste Amendments of 1984 provisions from the EPA on March 8, 1990. All hazardous waste treatment and storage facilities at Los Alamos National Laboratory are either fully permitted or are operating under interim status, while other waste management facilities are being developed.

Los Alamos National Laboratory produces a wide variety of hazardous wastes. In 1993, Los Alamos National Laboratory generated approximately 84 metric tons (93 tons) of Resource Conservation and Recovery Act-regulated, 460 metric tons (507 tons) of State-regulated waste, and 124 metric tons (137 tons) of solid hazardous waste (LANL 1994b). Small volumes of almost all wastes listed under 40 CFR Part 261 are generated as a result of a wide variety of ongoing research. High explosive waste is generated during the processing and testing of various high explosive materials. All high explosive hazardous waste and potentially contaminated high explosive waste is picked up from the generating facility and treated by open detonation, open burning, or incineration at Technical Areas 14, 15, 16, 36, and 39. Ash residue is then treated and, when its hazardous characteristic can be removed and it is determined that this residue does not contain radioactive constituents, it is disposed of onsite in the landfill, Technical Area 54, Area J. The high explosive wastewater is treated by gravity settlement in a sump and discharged from outfalls permitted under the National Pollutant Discharge Elimination System. Los Alamos National Laboratory is developing a high explosive wastewater treatment facility that will collect and treat these wastewaters with stepped filtration.

Los Alamos National Laboratory does not landfill Resource Conservation and Recovery Act hazardous waste onsite, but contracts with certified transporters to deliver hazardous waste to commercial offsite Resource Conservation and Recovery Act-permitted treatment, storage, and disposal facilities. Before waste is sent offsite, the potential treatment or disposal facility is inspected by Los Alamos National Laboratory personnel. Operating records and permits are also reviewed. Los Alamos National Laboratory has an EPA Letter of Authorization allowing disposal of solid polychlorinated biphenyl-contaminated articles at the Technical Area 54, Area G landfill. Other polychlorinated biphenyl waste and liquid polychlorinated biphenyl-contaminated articles are sent offsite to Toxic Substances Control Act-regulated disposal facilities. Asbestos mixed waste is buried at Technical Area 54, Area G. Asbestos waste is shipped offsite to an approved disposal site in accordance with Toxic Substances Control Act and National Emission Standards for Hazardous Air Pollutants regulations. Infectious wastes are managed according to State of New Mexico regulations.

❒ **Nonhazardous Waste—**In 1993, Los Alamos National Laboratory generated 8,180 metric tons (9,017 tons) of solid sanitary wastes. Solid sanitary wastes are generated routinely and include general facility refuse such as paper, cardboard, glass, wood, plastic, scrap, metal containers, dirt, and rubble. Solid sanitary wastes are segregated and recycled whenever possible. Trash is accumulated onsite in dumpsters, which are emptied on a regular basis by a commercial waste disposal firm and taken to the county sanitary landfill. The Los Alamos County landfill is located on property owned by DOE and is operated under a special-use permit. Approximately one-third of the solid sanitary waste disposed of at the county landfill originates from Los Alamos National Laboratory. The Area J special waste landfill, which is operated by and under the administrative control of Los Alamos National Laboratory, receives only administratively controlled solid sanitary waste. Solid sanitary waste will be managed and disposed of at the Los Alamos County Landfill until about the year 2012, when it is estimated that the existing sanitary landfill may reach the end of its useful life. At that time, either a new landfill will have to be constructed or provisions made for offsite disposal.

Los Alamos National Laboratory generates approximately 693,000 m^3 (183,000,000 gal) of liquid sanitary waste (DOE 1993c). A new sanitary wastewater treatment plant and collection system to replace 7 existing wastewater treatment facilities and 30 existing septic tanks have been completed. The new treatment plant enables reuse of the treated wastewater for nondrinking water uses such as cooling and irrigation. The plant and collection system is designed to meet the requirements of Los Alamos National Laboratory's existing Federal Facility Compliance Agreement and is expected to meet all of Los Alamos National Laboratory's needs for the next 20 years.

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