Chapter 3
Affected Environment

3.1 APPROACH TO DEFINING THE AFFECTED ENVIRONMENT

In accordance with the Council on Environmental Quality National Environmental Policy Act (NEPA) regulations (CEQ 1986) on preparing an environmental impact statement (EIS), the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions presented in this chapter provide the context for understanding the environmental consequences described in Chapter 4. As such, they serve as a baseline from which any environmental changes that may be brought about by implementing the proposed action and alternatives can be identified and evaluated. For this *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), the baseline conditions are the existing conditions.

The candidate sites for the proposed surplus plutonium disposition facilities are the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). As described in Chapter 2, areas within the boundaries of the sites that are potential locations for the proposed facilities include the 200 East and 400 Areas at Hanford, the Idaho Nuclear Technology and Engineering Center (INTEC)[1] at INEEL, Zone 4 West at Pantex, and F- and S-Areas at SRS. The resources that are described for the candidate sites are air quality and noise, waste management, socioeconomics, human health risk, environmental justice, geology and soils, water resources, ecological resources, cultural and paleontological resources, land use and visual resources, and infrastructure.

Selected Characteristics of the Candidate Sites for the Proposed Surplus Plutonium Disposition Facilities

		Population			Dose per Year[a]	
Site	Area (km^2)	Health Risk ROI[a]	Socio-economic ROI	Site Work Force	MEI (mrem)	Population (person-rem)
Hanford	1,450	380,000	179,949	12,882	0.0074	0.20
INEEL	2,300	121,500	213,547	8,291	0.031	0.24
Pantex	60	275,000	212,729	2,944	0.000088	0.0021
SRS	800	620,100	453,778	15,032	0.20	8.6

[a] For 1996.
Key: MEI, maximally exposed individual; ROI, region of influence.

Candidate sites for mixed oxide (MOX) fuel lead assembly fabrication and postirradiation examination are described in Section 3.6. These sites are Hanford, INEEL (at Argonne National Laboratory–West [ANL–W]), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge Reservation (ORR) (at Oak Ridge National Laboratory [ORNL]), and SRS. These additional sites are evaluated for related plutonium disposition activities only; therefore, they are not described in detail. Sites that would supply uranium dioxide are not described in this section because these activities are routinely performed at these locations, would be conducted in existing buildings with existing personnel, and would not be expected to result in additional impacts at these sites. See Figure 2–1 for the location of these sites.

Proposed reactor sites where the irradiation of MOX fuel would be performed are described in Section 3.7. The reactors that would be used are Catawba Nuclear Station Units 1 and 2, McGuire Nuclear Station Units 1 and 2, and North Anna Power Station Units 1 and 2. As described in Section 2.4.3, these reactors would be used for the irradiation of MOX fuel only.

[1] Formerly known as the Idaho Chemical Processing Plant (ICPP).

The U.S. Department of Energy (DOE) evaluated the environmental impacts of the surplus plutonium disposition alternatives within defined regions of influence (ROI) at each of the four candidate sites and along transportation routes. The ROIs are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions were assessed for an area within an 80 km (50 mi) radius of the proposed facilities. The human health risks of shipping materials among sites were evaluated for populations living along the roadways linking the DOE sites. Economic effects such as job and income growth were evaluated within a socioeconomic ROI that includes the county in which the site is located and nearby counties in which a substantial portion of the site's workforce resides. Brief descriptions of the ROIs are given in Table 3–1. More detailed descriptions of the ROI and the methods used to evaluate impacts are presented in Appendix F.

Table 3–1. General Regions of Influence for the Affected Environment

Environmental Feature	Region of Influence
Air quality and noise	The site and nearby offsite areas within local air quality control regions and the transportation corridors between the sites
Waste management	Waste management facilities on the site
Socioeconomics	The counties where at least 90 percent of site employees reside
Human health risk	The site and nearby offsite areas (within 80 km of the site and the transportation corridors between the sites) where worker and general population radiation, radionuclide, and hazardous chemical exposures may occur
Environmental justice	The minority and low-income populations within 80 km of the site and along the transportation corridors between the sites
Geology and soils	Geologic and soil resources within the site and nearby offsite areas
Water resources	Onsite and adjacent surface water bodies and groundwater
Ecological resources	The site and adjacent areas where ecological communities exist including nonsensitive and sensitive habitats and species
Cultural and paleontological resources	The area within the site and adjacent to the site boundary
Land use and visual resources	The site and the areas immediately adjacent to the site
Infrastructure	Power, fuel supply, water supply, and road systems on the site

At each of the four candidate sites, baseline conditions for each environmental resource area were determined from information provided in previous environmental studies, relevant laws and regulations, and other government reports and databases. More detailed information on the affected environment at the candidate sites can be found in annual site environmental reports and site NEPA documents.

For More Detailed Information on Environmental Conditions at the Candidate Sites for the Proposed Surplus Plutonium Disposition Facilities[a]

Draft Hanford Remedial Action EIS and Comprehensive Land Use Plan, 1996

DOE Programmatic Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management Final EIS, 1995

Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components, 1996

SRS Waste Management Final EIS, 1995

[a] Also consult annual site environmental reports.

3.2 HANFORD

Hanford, established in 1943 as one of the three original Manhattan Project sites, is in Washington State just north of Richland (Figure 2–2). Hanford was a U.S. Government nuclear materials production site that included nuclear reactor operation, storage and reprocessing of spent nuclear fuel, and management of radioactive and dangerous wastes. Present Hanford programs are diversified and include management of radioactive wastes, research and development (R&D) for advanced reactors, renewable energy technologies, waste disposal technologies and contamination cleanup, and plutonium stabilization and storage (DOE 1996a:3-20).

Hanford is owned and used primarily by DOE, but portions of it are owned, leased, or administered by other government agencies. Public access is limited to travel on the Route 4 and Route 10 access roads as far as the Wye Barricade, State Routes 24 and 240, and the Columbia River. By restricting access to the site, the public is buffered from the areas formerly used for production of nuclear materials and currently used for waste storage and disposal. Only about 6 percent of the land area has been disturbed and is actively used, leaving mostly vacant land with widely scattered facilities. The entire Hanford Site has been designated a National Environmental Research Park (DOE 1996a:3-20).

Hanford includes extensive production, service, and R&D areas. Onsite programmatic and general purpose facilities total approximately 799,000 m^2 (8.6 million ft^2) of space. Fifty-one percent (408,000 m^2 [4.4 million ft^2]) is general purpose space, including offices, laboratories, shops, warehouses, and other support facilities. The remaining 392,000 m^2 (4.2 million ft^2) of space are programmatic facilities comprising processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories. More than half of the general purpose and programmatic facilities are more than 30 years old. Facilities designed to perform previous missions are being evaluated for reuse in the cleanup mission. The existing facilities are grouped into the following numbered operational areas (DOE 1996a:3-20, 3-21).

- The 100 Areas, in the northern part of the site on the southern shore of the Columbia River, are the site of eight retired plutonium production reactors and the dual-purpose N Reactor, all of which have been permanently shut down since 1991. The 100 Areas cover about 1,100 ha (2,720 acres).

- The 200 West and 200 East Areas are in the center of the site and are about 8 and 11 km (5 and 6.8 mi), respectively, south of the Columbia River. Historically, these areas have been used for fuel reprocessing; plutonium processing, fabrication, and storage; and waste management and disposal activities. The 200 Areas cover about 1,600 ha (3,950 acres).

- The 300 Area is in the southern part of the site, just north of the city of Richland. A few of the facilities continue to support nuclear and nonnuclear R&D to include the Pacific Northwest National Laboratory (PNNL). Many of the facilities in the 300 Area are in the process of being deactivated. This area covers 150 ha (370 acres).

- The 400 Area, about 8 km (5 mi) northwest of the 300 Area, is the location of the recently shut down Fast Flux Test Facility (FFTF) and Fuels and Materials Examination Facility (FMEF). FFTF is an advanced liquid-metal-cooled research reactor that was used in the testing of breeder reactor systems. The six-level process building (427 Building) is the main structure of FMEF and encloses about 17,000 m^2 (183,000 ft^2) of operating area. FMEF also consists of several connected buildings. This building has never been operated and is free of contamination. The exterior walls are reinforced concrete, and the cell walls are constructed of high-density concrete. The facility was designed and constructed for spent fuel examination and was subsequently partially converted for MOX fuel fabrication.

- The 600 Area comprises the remainder of Hanford, which includes most of the undisturbed land and support facilities and infrastructure (e.g., roads, railroads, telecommunications, water treatment and distribution, electrical transmission lines and substations, fire and ambulance, access control facilities, borrow pits, and a landfill).

- The 700 Area is the administrative center in downtown Richland and consists of government-owned buildings (e.g., the Federal Building).

- The 3000 Area is a support area in north Richland that is being vacated but still contains some administrative and support facilities.

In addition, there are DOE-leased facilities and DOE contractor-owned facilities that support Hanford operations. These facilities are on private land south of the 300 Area and outside of the 3000 Area (DOE 1996a:3-21).

DOE Activities. The Hanford mission is to clean up the site, provide scientific and technological excellence to meet global needs, and partner the economic diversification of the region. Current DOE activities that support Hanford's mission are shown in Table 3–2. In the area of waste management, Hanford has embarked on a long-range cleanup program in compliance with the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) and applicable Federal, State, and local laws. DOE has set a goal of cleaning up Hanford's waste sites and bringing its facilities into compliance with Federal, State, and local environmental laws by the year 2028. In addition, as part of the cleanup mission, DOE has the responsibility to safely store, handle, and stabilize plutonium materials and spent fuel (DOE 1996a:3-21, 3-22).

Table 3–2. Current Missions at Hanford

Mission	Description	Sponsor
Waste management	Store defense wastes and handle, store, and dispose of radioactive, hazardous, mixed, or sanitary wastes from current operations	Assistant Secretary for Environmental Management
Environmental restoration	Restore approximately 1,100 inactive radioactive, hazardous, and mixed waste sites and about 100 surplus facilities	Assistant Secretary for Environmental Management
Research and development	Conduct research in the fields of energy, health, safety, environmental sciences, molecular sciences, environmental restoration and waste management R&D, and national security activities	Various DOE Program Managers
Technology development	Develop new technologies for environmental restoration and waste management, including site characterization and assessment methods, and waste minimization	Various DOE Program Managers

Source: DOE 1996a:3-22.

Non-DOE Activities. In addition to the DOE mission-related activities, Hanford has some unique and diverse assets and non-DOE missions that include the following (DOE 1996a:3-22):

- The Fitzner-Eberhardt Arid Lands Ecology Reserve, 31,100 ha (76,800 acres), established in 1967, managed by the U.S. Fish and Wildlife Service (USFWS) for DOE as a habitat and wildlife reserve and nature research center (Sandberg 1998a).

- C The area north of the Columbia River, managed in part by the Washington State Department of Wildlife as the Wahluke Slope Wildlife Recreation Area and in part by the USFWS as the Saddle Mountain National Wildlife Refuge.

- C The Washington Nuclear Plant–2 (WNP–2), 1,100-MWe reactor operated by Energy Northwest (formerly Washington Public Power Supply System [WPPSS]) and also the partially completed WNP–1 reactor.

- C The Laser Interferometer Gravitational-Wave Observatory, operated by the National Science Foundation as one of two widely separated installations (within the United States) that are operated in unison as a single gravitational-wave observatory.

- C The Hanford Meteorological Station and towers.

- C An observatory and radio telescope facilities on Rattlesnake Mountain.

- C The U.S. Ecology commercial low-level radioactive waste disposal site on State-leased lands south of the 200 Areas near the center of Hanford.

3.2.1 Air Quality and Noise

3.2.1.1 Air Quality

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. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.2.1.1.1 General Site Description

The climate at Hanford and the surrounding region is characterized as that of a semiarid steppe. The humidity is low, and winters are mild. The average annual temperature is 11.8 EC (53.3 EF); average monthly temperatures range from a minimum of -1.5 EC (29.3 EF) in January to a maximum of 24.7 EC (76.5 EF) in July. The average annual precipitation is 16 cm (6.3 in). Prevailing winds at the Hanford Meteorological Station are from the west-northwest. The average annual windspeed is 3.4 m/s (7.6 mph) (DOE 1996a:3-29). Additional information related to meteorology and climatology at Hanford is presented in Appendix F of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996a:F-2–F-5) and in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Neitzel 1996).

Most of Hanford is within the South-Central Washington Intrastate Air Quality Control Region (AQCR) #230, but a small portion of the site is in the Eastern Washington-Northern Idaho Interstate AQCR #62. None of the areas within Hanford and its surrounding counties are designated as nonattainment areas with respect to National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (EPA 1997a). Applicable NAAQS and Washington State ambient air quality standards are presented in Table 3–3.

There are no prevention of significant deterioration (PSD) Class I areas within 100 km (62 mi) of Hanford. Hanford operates under a PSD permit issued in 1980 that limits emissions of nitrogen dioxide from the Plutonium-Uranium Extraction (PUREX) and Uranium Trioxide Plants in the 200 Area (DOE 1996a:3-29). These facilities have not been operated since 1994 and have been deactivated and transferred to the

Table 3–3. Comparison of Ambient Air Concentrations From Hanford Sources With Most Stringent Applicable Standards or Guidelines, 1994

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	Concentration (Fg/m^3)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	0.7
	1 hour	40,000[b]	2.6
Nitrogen dioxide	Annual	100[b]	0.2
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	0.01
	24 hours	150[b]	0.1
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	50[f]	0.8
	24 hours	260[f]	6.6
	3 hours	1,300[b]	22.9
	1 hour	1,000[f]	47.9
	1 hour	660[f,g]	47.9
Other regulated pollutants			
Gaseous fluoride	30 days	0.84[f]	(i)
	7 days	1.7[f]	(i)
	24 hours	2.9[f]	(i)
	12 hours	3.7[f]	(i)
	8 months (Mar-Oct)	0.50[f]	(i)
Total suspended particulates	Annual	60[f]	0.01
	24 hours	150[f]	0.1
Hazardous and other toxic compounds			
Benzene	24 hours	0.12[h]	(i)
[Text deleted.]			

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997a), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is #1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 Fg/m^3. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is #1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] Not to be exceeded more than twice in any 7 consecutive days.

[h] State's risk-based acceptable source impact levels.

[i] No sources identified at the site.

Note: NAAQS also include standards for lead. No sources of lead emissions have been identified at the site. Emissions of other air pollutants not listed here have been identified at Hanford, but are not associated with any alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition PEIS* (DOE 1996a). EPA recently revised

ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 Fg/m^3 (0.12 ppm) to an 8-hr concentration of 157 Fg/m^3 (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997b:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ (particulate matter with an aerodynamic diameter less than or equal to 2.5 Fm) standards are added. These standards are set at a 15-Fg/m^3 3-year annual arithmetic mean based on community-oriented monitors and a 65-Fg/m^3 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997c:38652).
Source: DOE 1996a:3-30; EPA 1997a; WDEC 1994.

DOE Office of Environmental Restoration for continued surveillance and maintenance awaiting eventual decommissioning.

Ambient air quality near the Hanford boundary is currently monitored for particulate matter. Particulate concentrations can reach rather high levels in eastern Washington because of extreme natural events (dust storms, volcanic eruptions, and large brush fires [DOE 1996b:4-46–4-50]). The 24-hr standard for particulate matter with an aerodynamic diameter less than or equal to 10 Fm (PM_{10}) was exceeded in 1993 at Columbia Center in Kennewick, about 10 km (6.2 mi) southeast of Hanford, likely as a result of windblown dust. Ambient air quality at Hanford is discussed in more detail in the *Hanford Site 1995 Environmental Report* (Dirkes and Hanf 1996:56, 61, 62, 95–108). Routine monitoring of most nonradiological pollutants is not conducted at the site. Monitoring of nitrogen oxides and total suspended particulates at Hanford has been discontinued as a result of phasing out programs for which the monitoring was required. Carbon monoxide, sulfur dioxide, and nitrogen dioxide have been monitored periodically in communities and commercial areas southeast of Hanford. In 1995, air samples of semivolatile organic compounds were collected on the site and at an offsite location, and the results are discussed in the annual environmental report (Dirkes and Hanf 1996:95–108). All concentrations of these compounds were below the applicable risk-based concentrations.

The primary sources of air pollutants at Hanford include process emissions, vehicular emissions, and construction activities. Table 3–3 presents the existing ambient air pollutant concentrations at the site boundary attributable to sources at Hanford. These concentrations are based on emissions for the year 1994. The emissions were modeled using meteorological data from 1989–1990 (DOE 1996a:3-30). Only those pollutants that would be emitted by any of the surplus plutonium disposition alternatives are presented. With the exception of particulate matter, as discussed previously, the concentrations of these pollutants—concentrations from Hanford combined with those from background (non-Hanford) sources—are in compliance with the ambient air quality standards. All coal-fired steam generation facilities have been shut down at Hanford. The conversion to oil, natural gas, and electric energy sources was completed in 1998. This will result in a significant reduction in air pollutant emissions from the site. Detailed information on emissions of other pollutants at Hanford is discussed in the *Hanford Site NEPA Characterization* (Neitzel 1996:4.28–4.32, 6.12).

3.2.1.1.2 Proposed Facility Locations

Prevailing winds in the 200 Areas (Hanford Meteorological Station) are from the west-northwest (Neitzel 1996:4.3, 4.6; Hoitink and Burk 1996:2.10). The 200 East Area has emissions of various air pollutants from oil-fired steam generation and releases of various toxic pollutants from tank farms, waste processing, and laboratories. Emissions from these sources are quantified in the *Tank Waste Remediation System EIS* (DOE 1996c:G-35–G-111).

Prevailing winds in the 400 Area are from the south-southwest, with a secondary maximum from the northwest (Neitzel 1996:4.6; Hoitink and Burk 1996:2.10). The 400 Area has no nonradioactive air pollutant emission sources of concern (Neitzel 1996:4.30).

3.2.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.2.1.2.1 General Site Description

Major noise sources within Hanford 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). Data from two noise surveys indicate that background noise levels (measured as the 24-hr equivalent sound level) at Hanford range from 30 to 60.5 decibels A-weighted (dBA) (DOE 1996a:3-29). The 24-hr background sound level in undeveloped areas at Hanford ranges from 24 to 36 dBA, except when high winds elevate sound levels (Neitzel 1996:4.127). The primary source of noise at the site and nearby residences is traffic. Most Hanford industrial facilities are far enough from the site boundary that noise levels from these sources at the boundary are not measurable or are barely distinguishable from background noise levels (DOE 1996a:3-29). Hanford is currently in compliance with the State noise regulations (DOE 1996a:3-29–3-31). Noise sources, existing noise levels at Hanford, and noise standards are described in the *Storage and Disposition PEIS* (DOE 1996a:3-29–3-31, F-31, F-32) and in the *Hanford Site NEPA Characterization* (Neitzel 1996:4.125–4.130).

The potential impact of traffic noise resulting from Hanford activities was evaluated for a draft EIS addressing the siting of the proposed New Production Reactor. Estimates were made of baseline traffic noise along two major access routes: State Route 24, leading from the Hanford Site west to Yakima, and State Route 240, south of the site and west of Richland, where it handles maximum traffic volume. Modeled traffic noise levels (equivalent sound level [1-hr]) at 15 m (50 ft) from State Route 24 for both peak and offpeak periods were 62 dBA. Traffic noise levels from State Route 240 for both peak and offpeak periods were 70 dBA (Neitzel 1996:4.127, 4.130). These traffic noise levels were projections based on employment levels about 30 percent higher than actual levels at Hanford in 1997. About 9 percent of Hanford's employees commute by vanpool or bus (Mecca 1997a). Existing traffic noise levels may be different as a result of changes in site employment and ride-sharing activities.

The U.S. Environmental Protection Agency (EPA) guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near Hanford, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

3.2.1.2.2 Proposed Facility Locations

No distinguishing noise characteristics have been identified at either the 200 East Area or the 400 Area. Both are far enough from the site boundary—the 200 East Area is 12.6 km (7.8 mi) and the 400 Area is 6.1 km (3.8 mi) away—that noise levels from the facilities at the boundary are not measurable or are barely distinguishable from background levels.

3.2.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.2.2.1 Waste Inventories and Activities

Hanford manages the following types of waste: high-level waste (HLW), transuranic (TRU), mixed TRU, low-level waste (LLW), mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at Hanford, and thus is not discussed further. Waste generation rates and the inventory of stored waste from activities at Hanford are provided in Table 3–4. Table 3–5 summarizes the Hanford waste management capabilities. More detailed descriptions of the waste management system capabilities at Hanford are included in the *Storage and Disposition PEIS* (DOE 1996a:3-61, E-12).

Table 3–4. Waste Generation Rates and Inventories at Hanford

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	450	11,450
Remotely handled	72	273
LLW	3,902	0
Mixed LLW		
RCRA	840	8,170
TSCA	7	103
Hazardous	560	NA[b]
Nonhazardous		
Liquid	200,000	NA[b]
Solid	43,000	NA[b]

[a] Includes mixed TRU waste.

[b] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: LLW, low-level waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996d:15, 16, except hazardous and nonhazardous solid wastes (DOE 1996a:3-62, E-19), and nonhazardous liquid wastes (Teal 1997).

EPA placed Hanford on the National Priorities List on November 3, 1989. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), DOE entered into a Tri-Party Agreement with EPA and the State of Washington to govern the environmental compliance and cleanup of Hanford. That agreement meets the legal requirements specified under the Federal Facility Compliance Agreement (FFCA). An aggressive environmental restoration program is under way using priorities established in the Tri-Party Agreement (DOE 1996a:3-61). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.2.2.2 Transuranic and Mixed Transuranic Waste

All currently generated contact-handled TRU waste is being placed in above-grade storage buildings at the Hanford Central Waste Complex and the TRU Waste Storage and Assay Facility (DOE 1996a:3-64). TRU waste will be maintained in storage until shipped to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, for disposal, beginning in 2000 (Aragon 1999). The new Waste Receiving and Processing Facility has the capability to process retrieved suspect TRU waste and certify newly generated and stored TRU waste for shipment to WIPP (Dirkes and Hanf 1996:10). Treatment of TRU waste will be provided in the future at the Stabilization Facility and Thermal Treatment Facility. TRU waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and U.S. Department of Transportation (DOT) requirements, and transported to WIPP for disposal (DOE 1996a:3-144). Mixed TRU

Table 3–5. Waste Management Capabilities at Hanford

			Applicable Waste Type					
Facility Name/Description	**Capacity**	**Status**	**TRU**	**Mixed TRU**	**LLW**	**Mixed LLW**	**Haz**	**Non-Haz**
Treatment Facility (m^3/yr except as otherwise specified)								
242-A Evaporator, m^3/day	265	Online	X	X	X	X		
Waste Receiving and Processing Facility	1,820	Online	X	X	X	X		
Stabilization Facility Contract	1,860	Planned for 1999	X	X		X		
Thermal Treatment Facility Contract	5,135	Planned for 2001	X	X		X		
Grout Treatment Facility	15,000	Online				X		
Shielded Analytical Lab Waste Treatment Unit, kg/hr	4	Online				X		
Maintenance & Storage Facility, batch/yr	26	Online				X		
200 Area Effluent Treatment Facility, m^3/min	0.57	Online			X	X		
200 East Area Sanitary Wastewater Treatment Facility	120,000	Online						X
Storage Facility (m^3)								
Central Waste Complex	16,800	Online	X	X	X	X		
TRU Waste Storage and Assay Facility	416	Standby	X	X	X	X		
305-B Storage Facility	20	Online			X	X	X	
B-Plant Canyon Waste Pile	5	Online			X			
B-Plant Container Storage	51	Online				X		
PUREX Tunnel 1	4,141	Online			X	X		
PUREX Tunnel 2	19,528	Online			X	X		
PUREX Canyon Waste Pile	432	Online				X		
200 Area Liquid Effluent Retention Facility	59,000	Online			X	X		
4843 Alkali Metal Storage Facility	95	Standby				X	X	
Disposal Facility (m^3 except as otherwise specified)								
Grout Vaults	230,000	Online			X			
LLW Burial Ground	1,740,000	Online			X			
Radioactive Mixed Waste Disposal Facility	14,200	Standby			X	X		
200 Area Treated Effluent Disposal Facility, m^3/min	8.7	Online						X
Energy Northwest Sewage Treatment Facility, m^3/yr	235,000	Online						X

Key: Haz, hazardous; LLW, low-level waste; PUREX, Plutonium-Uranium Extraction (Plant); TRU, transuranic.

Source: Dirkes and Hanf 1996:46; Kovacs 1997; Rhoderick 1998; Sandberg 1998a; Teal 1997.

wastes are included in the TRU waste category because these wastes are expected to go to WIPP for ultimate disposal (DOE 1996a:3-64).

3.2.2.3 Low-Level Waste

Solid LLW is compacted and sent to the LLW Burial Ground in the 200 West Area for disposal in trenches. Additional LLW is received from offsite generators and disposed of at the LLW Burial Ground. LLW resulting from the tank waste remediation system waste pretreatment program will be vitrified; as a contingency, the Grout Facility will be maintained in standby condition. The vitrified LLW will be disposed of on the site in the 200 Area under the tank waste remediation system program (DOE 1996a:3-64).

U.S. Ecology operates a licensed commercial LLW Burial Ground on a site southwest of the 200 East Area that is leased to the State of Washington. The facility is not a DOE facility and is not considered part of DOE's Hanford operations (DOE 1996a:E-17).

3.2.2.4 Mixed Low-Level Waste

One of the existing treatment facilities for mixed LLW is the 242-A Evaporator in the 200 East Area, which reduces the volume of these wastes and removes cesium via ion exchange (DOE 1996a:3-64). The process condensate from the evaporator is temporarily stored in the Liquid Effluent Retention Facility until it is treated in the Liquid Effluent Treatment Facility. The Liquid Effluent Retention Facility consists of three Resource Conservation and Recovery Act (RCRA)–compliant surface impoundments for storing process condensate from the 242-A Evaporator. This facility provides equalization of the flow and pH to the Liquid Effluent Treatment Facility. The Liquid Effluent Treatment Facility provides ultraviolet light/peroxide destruction of organic compounds, reverse osmosis to remove dissolved solids, and ion exchange to remove the last traces of contaminants. Discharge of the treated effluent is via a dedicated pipeline to an underground drain field. The effluent treatment process produces a mixed LLW sludge that is concentrated, dried, packaged in 208-l (55-gal) drums, and transferred to the Central Waste Complex. This secondary waste is stored prior to treatment (if necessary) and disposal in the Mixed Waste Trench (Dirkes and Hanf 1996:10, 45, 46). In a recent modification to the Tri-Party Agreement, DOE has agreed to begin designing a vitrification facility to treat liquid mixed LLW (DOE 1996a:E-17; E-18).

The Waste Receiving and Processing Facility, near the Central Waste Complex in the 200 West Area, eventually will provide size reduction, decontamination, condensation, melting, amalgamation, incineration, ash stabilization, and shipping for Hanford mixed waste. The Waste Receiving and Processing Facility is being constructed in two phases: module 1 and module 2 (2A and 2B) and is designed to process 6,800 drums of waste annually (Dirkes and Hanf 1996:40). Module 1 will be designed to prepare retrieved and stored TRU waste and will be operational in 1999. Module 2A is designed to process LLW, TRU waste, mixed LLW, and mixed TRU waste, and is operational. Module 2B, if authorized, will be designed to process LLW, TRU waste, mixed LLW, and mixed TRU waste with a dose rate greater than 200 mrem/hr. Module 2B has an undetermined startup date (DOE 1996a:E-18).

The Radioactive Mixed Waste Disposal Facilities are in the Hanford LLW Burial Ground and are designated as 218-W-5, Trench 31, and Trench 34. The facilities consist of rectangular trenches with approximate dimensions of 76 by 30 m (250 by 100 ft). These facilities are RCRA compliant, with double liners and leachate collection and removal systems (Dirkes and Hanf 1996:40).

3.2.2.5 Hazardous Waste

There are no treatment facilities for hazardous waste at Hanford; therefore, the wastes are accumulated in satellite storage areas (for less than 90 days) or at interim RCRA-permitted facilities such as the 305-B Waste Storage Facility. The common practice for newly generated hazardous waste is to ship it off the site by truck using

DOT-approved transporters for treatment, recycling, recovery, and disposal at RCRA-permitted facilities (DOE 1996a:3-65, E-18; Sandberg 1998a).

3.2.2.6 Nonhazardous Waste

Sanitary wastewater is discharged to onsite treatment facilities such as septic tanks, subsurface soil adsorption systems, and wastewater treatment plants. These facilities treat an average of 600,000 l/day (159,000 gal/day) of sewage (DOE 1996a:E-19).

The 200 Area Treated Effluent Disposal Facility industrial sewer collects the treated wastewater streams from various plants in the 200 Areas and disposes of the clean effluent at two 2-ha (5-acre) ponds permitted by the State of Washington (DOE 1996a:E-19). The design capacity of the facility is approximately 8,700 l/min (2,300 gal/min), although the discharge permit presently limits the average monthly flow to about 2,400 l/min (640 gal/min) (Dirkes and Hanf 1996:46).

Nonhazardous solid wastes include construction debris, office trash, cafeteria wastes, furniture and appliances, nonradioactive friable asbestos, powerhouse ash, and nonradioactive/nonhazardous demolition debris. Until 1997, nonhazardous solid wastes were disposed of in the 600 Area central landfill. Under an agreement between DOE and the city of Richland, most of the site's nonregulated and nonradioactive solid wastes are now sent to the Richland Sanitary Landfill for disposal (DOE 1996a:3-65, E-19). The Richland Sanitary Landfill is at the southern edge of the Hanford Site boundary. Nonradioactive friable asbestos and medical waste are shipped off the site for disposal (Dirkes and Hanf 1996:83; Sandberg 1998a).

3.2.2.7 Waste Minimization

The Hanford Site Pollution Prevention Program is a comprehensive and continual effort to systematically reduce the quantity and toxicity of hazardous, radioactive, mixed, and sanitary wastes; conserve resources and energy; reduce hazardous substance use; and prevent or minimize pollutant releases to all environmental media from all operations and site cleanup activities. In accordance with sound environmental management, preventing pollution through source reduction is the first priority in the Hanford Site Pollution Prevention Program, and the second priority is environmentally safe recycling. For instance, Hanford pollution prevention efforts in 1995 helped to prevent the generation of approximately 2,900 m^3 (3,790 yd^3) of radioactive mixed waste, 207 t (228 tons) of RCRA waste, 30,000 m^3 (39,200 yd^3) of process wastewater, and 4,400 t (4,850 tons) of sanitary waste. Also during 1995, Hanford recycled approximately 632 t (697 tons) of office paper, 20 t (22 tons) of cardboard, 3,600 t (3,970 tons) of ferrous metal, 215 t (237 tons) of nonferrous metal, 57 t (63 tons) of lead, 16 t (18 tons) of solid chemicals, and 78,000 l (20,600 gal) of liquid chemicals. In addition, Hanford's new centralized recycling center collects aerosol cans, fluorescent light ballasts, fluorescent light tubes, and lead acid batteries (Dirkes and Hanf 1996:44, 45).

3.2.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the *Waste Management Programmatic Environmental Impact Statement* (WM PEIS) (DOE 1997a:summary, 95) are shown in Table 3–6 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at Hanford and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of records of decision (RODs) to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a) with the hazardous waste ROD issued on August 5, 1998 (DOE 1998b). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at WIPP. Each DOE site that has, or will

Table 3–6. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers onsite treatment and storage of Hanford's TRU waste pending disposal at WIPP.[a]
LLW	DOE prefers to treat Hanford's LLW on the site. Hanford could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at Hanford. This includes the onsite treatment of Hanford's wastes and could include treatment of some mixed LLW generated at other sites. Hanford could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.[a]

[a] ROD for TRU waste (DOE 1998a) and ROD for hazardous waste (DOE 1998b) selected the preferred alternatives for these waste types at Hanford.

Key: LLW, low-level waste; ROD, record of decision; TRU, transuranic; WIPP, Waste Isolation Pilot Plant.

Source: DOE 1997a:summary, 95.

generate, TRU waste will, as needed, prepare and store its TRU waste on the site. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own hazardous waste on the site in existing facilities where this is economically favorable. More detailed information and DOE's alternatives for the future configuration of waste management facilities at Hanford is presented in the WM PEIS and the hazardous waste and TRU waste RODs.

3.2.3 Socioeconomics

Statistics for employment and regional economy are presented for the regional economic area (REA) as defined in Appendix F.9, which encompasses nine counties surrounding Hanford in Washington. Statistics for population, housing, community services, and local transportation are presented for the ROI, a two-county area in which 91 percent of all Hanford employees reside as shown in Table 3–7. In 1997, Hanford employed about 12,882 persons (about 3.7 percent of the REA civilian labor force) (Mecca 1997b).

Table 3–7. Distribution of Employees by Place of Residence in the Hanford Region of Influence, 1997

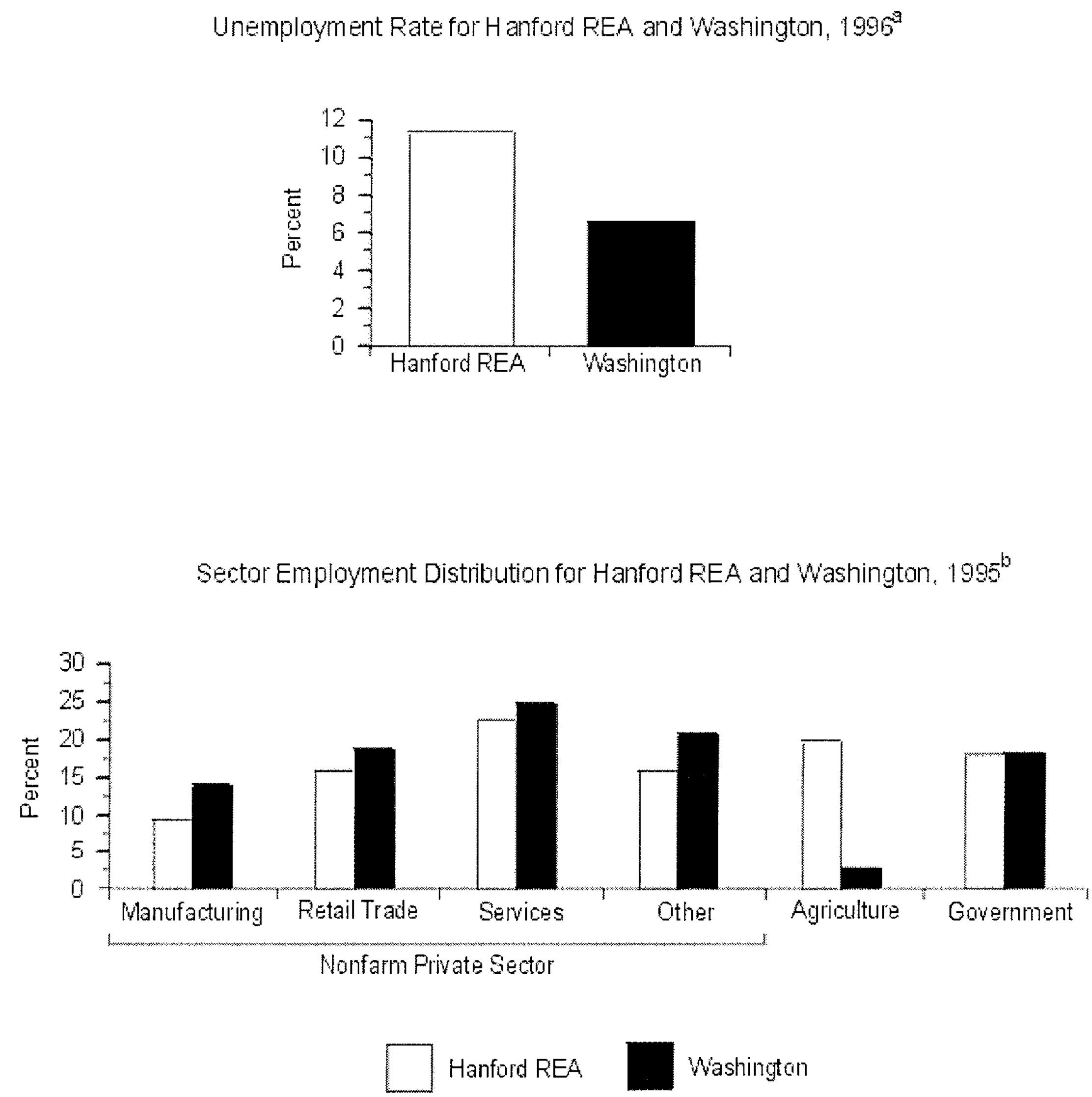
County	Number of Employees	Total Site Employment (Percent)
Benton	10,563	82
Franklin	1,159	9
ROI total	11,722	91

Source: Mecca 1997b.

3.2.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the Hanford REA and Washington are summarized in Figure 3–1. Between 1990 and 1996, the civilian labor force in the REA increased 35.3 percent to 344,611. In 1996, the unemployment rate in the REA was 11.1 percent, significantly higher than the rate of 6.5 percent in Washington State (DOL 1999).

In 1995, service activities represented the largest sector of employment in the REA (22.3 percent). This was followed by agriculture (19.6 percent) and government (17.4 percent). Overall, the State total for these employment sectors was 25.0 percent, 3.7 percent, and 18.0 percent, respectively (DOL 1997).



[a]DOL 1999.
[b]DOL 1997.

REA Regional economic area

Figure 3–1. Employment and Local Economy for the Hanford Regional Economic Area and the State of Washington

3.2.3.2 Population and Housing

In 1996, the ROI population totaled 179,949. Between 1990 and 1996, the ROI population increased 18.9 percent compared with the 12.9 percent increase experienced in Washington (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by about 4.6 percent, compared with a 20.3 percent increase in Washington. The total number of housing units within the ROI for 1990 was 58,541 (DOC 1994). The 1990 homeowner vacancy rates for the ROI was 1.4 percent compared with the State's rate of 1.3 percent. The ROI renter vacancy rate was 5.5 percent compared with 5.8 percent for the State (DOC 1990a). Population and housing trends in the ROI and Washington are summarized in Figure 3–2.

3.2.3.3 Community Services

3.2.3.3.1 Education

Ten school districts provide public education in the Hanford ROI. As shown in Figure 3–3, school districts in 1997 were operating at capacities ranging from 65 to 100 percent. In 1997, the student-to-teacher ratio in the ROI averaged 16:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Washington was 11.4:1 (DOC 1990b; 1994).

3.2.3.3.2 Public Safety

In 1997, a total of 281 sworn police officers were serving the ROI. The ROI average officer-to-population ratio was 1.6 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.7 police officers per 1,000 persons (DOC 1990b). In 1997, 616 paid and volunteer firefighters provided fire protection services in the Hanford ROI. The average firefighter-to-population ratio in 1997 in the ROI was 3.4 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1 firefighter per 1,000 persons (DOC 1990b). Figure 3–4 displays the ratio of sworn police officers and firefighters to population for the two counties in the Hanford ROI.

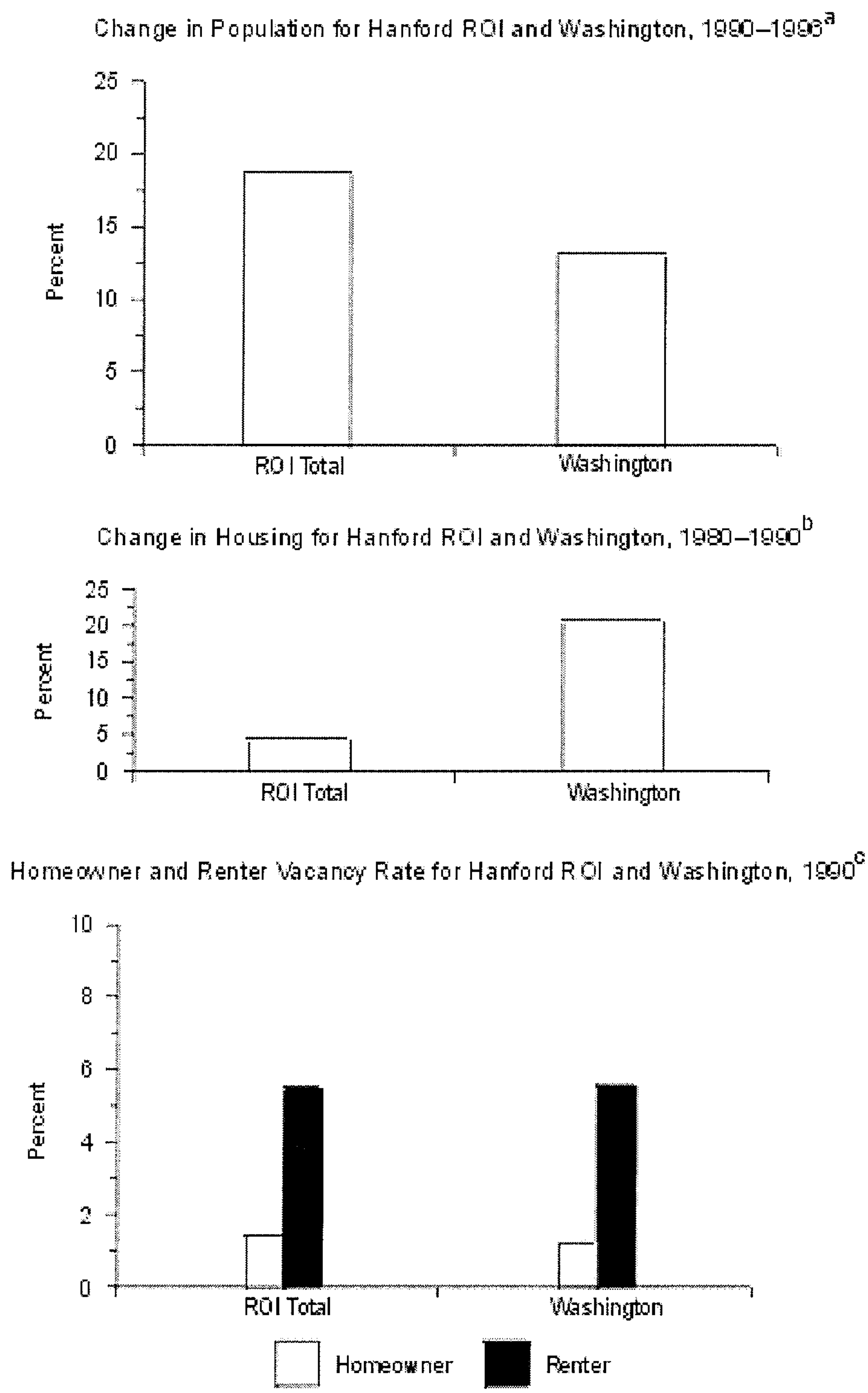
3.2.3.3.3 Health Care

In 1996, a total of 257 physicians served the ROI. The average physician-to-population ratio in the ROI was 1.4 physicians per 1,000 persons compared with the 1996 State average of 3.7 per 1,000 persons (Randolph 1997). In 1997, there were four hospitals serving the ROI. The hospital bed-to-population ratio averaged 2.1 beds per 1,000 persons (Nemeth 1997c). This compares with a State 1991 average of 2.4 beds per 1,000 persons (DOC 1996:128). Figure 3–4 displays the ratio of physicians-to-population and hospital bed-to-population for the two counties in the Hanford ROI.

3.2.3.4 Local Transportation

Vehicular access to Hanford is provided by State Routes 240, 243, 24, and Stevens Drive. State Route 240 connects to the Richland bypass highway, which interconnects with I–182. State Route 243 exits the site's northwestern boundary and serves as a primary link between the site and I–90. State Route 24 enters the site from the west and continues eastward across the northernmost portion of the site and intersects State Route 26 about 16 km (10 mi) east of the site boundary. Stevens Drive out of north Richland is the favored route to Hanford (see Figure 2–2).

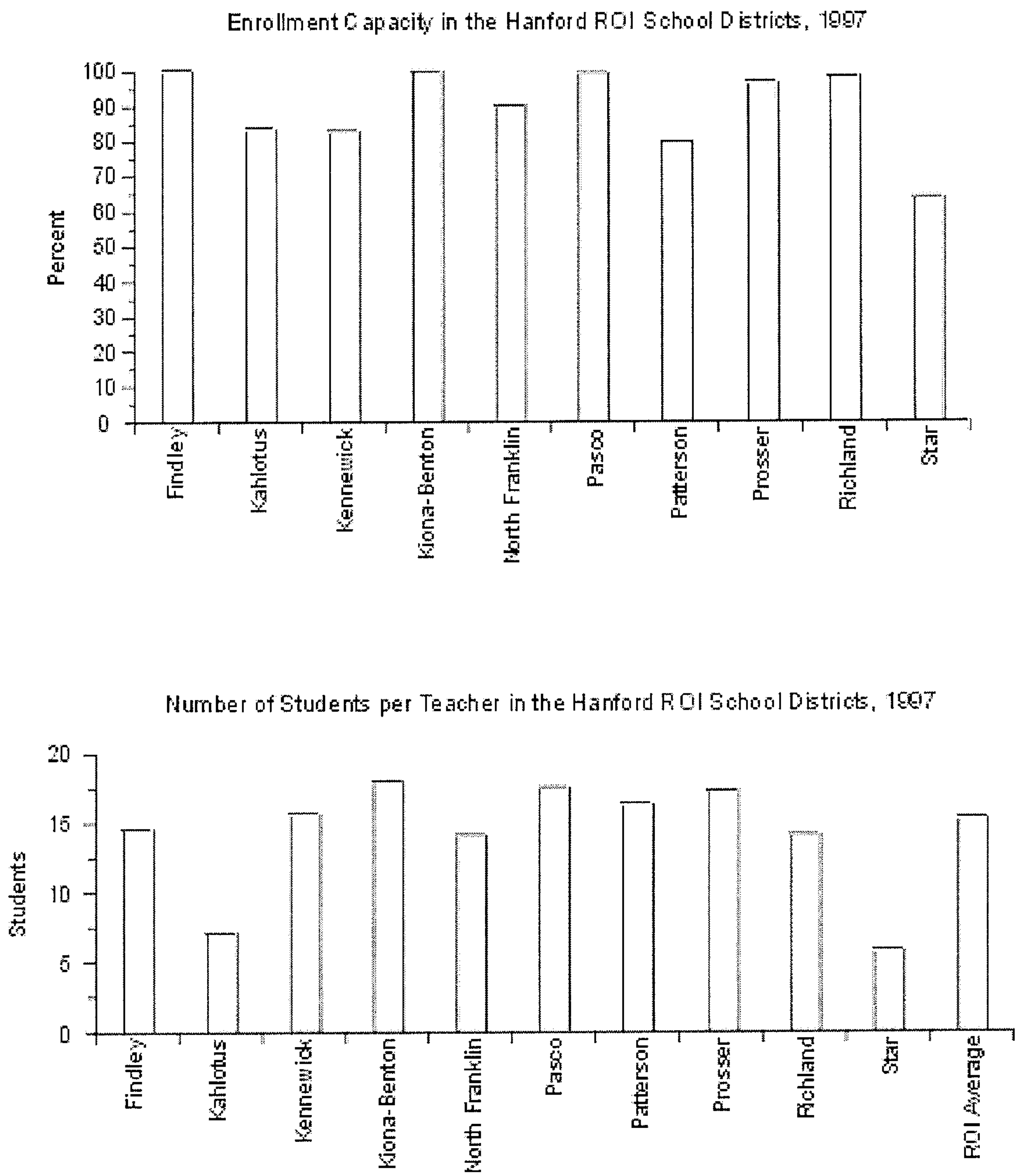
One current road improvement project that could affect vehicular access to Hanford is repaving and signal work at the intersection of State Route 240 and Stevens Drive. Two projects, currently in the planning stage, could affect vehicular access to Hanford in the future: a realignment of State Route 240 from Stevens Drive



[a] DOC 1997.
[b] DOC 1994.
[c] DOC 1990a.

ROI Region of Influence

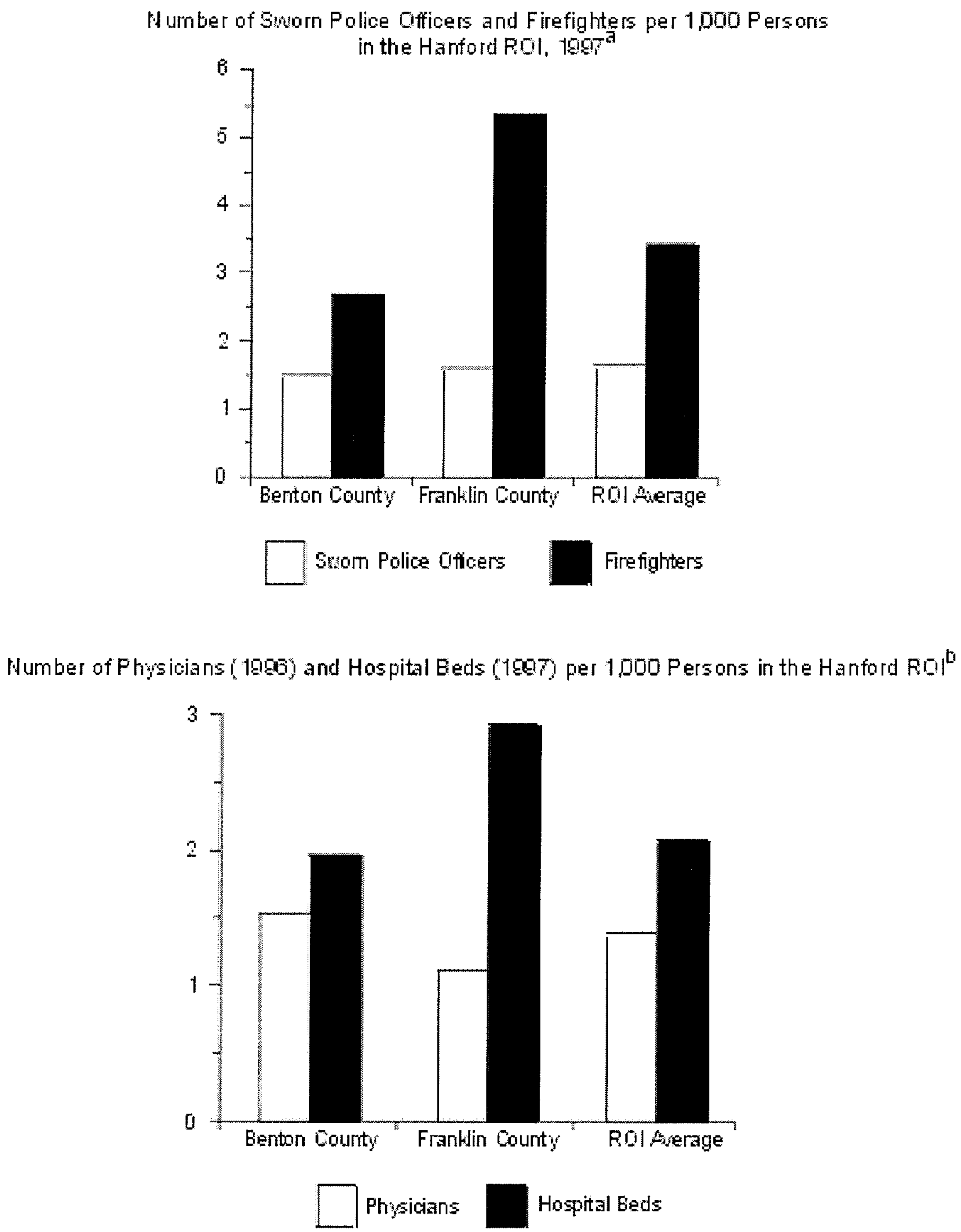
Figure 3–2. Population and Housing for the Hanford Region of Influence and the State of Washington



Source: Nemeth 1997a.

ROI Region of Influence

Figure 3–3. School District Characteristics for the Hanford Region of Influence



[a] Nemeth 1997b.
[b] Nemeth 1997c; Randolph 1997.

ROI: Region of Influence

Figure 3–4. Public Safety and Health Care Characteristics for the Hanford Region of Influence

to State Route 224 and the paving of asphalt overlay of State Route 224 from West Richland to State Route 240 in the year 2000 (MacNeil 1997). However, an improvement project on Grosscup Road would provide relief of congestion due to State Route 224 paving activities.

The local intercity transit system, Ben Franklin Transit, supplies bus service between the Tri-Cities and Hanford. Both private interests and Ben Franklin Transit provide vanpooling opportunities in the ROI.

Onsite rail transport is provided by a short-line railroad that connects with the Union Pacific line just south of the Yakima River. The Union Pacific line interchanges with the Washington Central and Burlington Northern and Santa Fe at the city of Kennewick. There is no passenger rail service at Hanford (see Section 3.2.11.1.1 for more information).

In the ROI, the Columbia River is used as an inland waterway for barge transportation from the Pacific Ocean. The Port of Benton provides a barge slip where shipments arriving at Hanford may be off-loaded.

Tri-Cities Airport, near the city of Pasco, provides jet air passenger and cargo service by both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOE 1996a).

3.2.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.2.4.1 Radiation Exposure and Risk

3.2.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of Hanford are shown in Table 3–8. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to Hanford operations.

Table 3–8. Sources of Radiation Exposure to Individuals in the Hanford Vicinity Unrelated to Hanford Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation[a]	
Cosmic radiation	30
External terrestrial radiation	30
Internal terrestrial radiation	40
Radon in homes (inhaled)	200[b]
Other background radiation[c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	365

[a] Dirkes and Hanf 1997:264.

[b] An average for the United States.

[c] NCRP 1987:11, 40, 53.

Releases of radionuclides to the environment from Hanford operations provide another source of radiation exposure to individuals in the vicinity of Hanford. Types and quantities of radionuclides released from Hanford operations in 1996 are listed in the *Hanford Site Environmental Report for Calendar Year 1996* (Dirkes and Hanf 1997:65–71). Doses to the public resulting from these releases are presented in Table 3–9. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Table 3–9. Radiation Doses to the Public From Normal Hanford Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases[a]		Liquid Releases		Total	
Members of the Public	**Standard[b]**	**Actual**	**Standard[b]**	**Actual**	**Standard[b]**	**Actual**
Maximally exposed individual (mrem)	10	4.6×10^{-3}	4	2.8×10^{-3}[c]	100	7.4×10^{-3}
Population within 80 km (person-rem)[d]	None	0.13	None	0.072	100	0.20
Average individual within 80 km (mrem)[e]	None	3.4×10^{-4}	None	1.9×10^{-4}	None	5.3×10^{-4}

[a] Includes direct radiation dose from surface deposits of radioactive material.

[b] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100 person-rem value, it is required that the contractor operating the facility notify DOE.

[c] Includes the drinking water dose.

[d] About 380,000 in 1996.

[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

Source: Dirkes and Hanf 1997:chap. 5.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Hanford operations in 1996 is estimated to be 3.7×10^{-9}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Hanford operations is less than 4 in 1 billion. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

According to the same risk estimator, 1×10^{-4} excess fatal cancers are projected in the population living within 80 km (50 mi) of Hanford from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1996 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected during 1996 from all causes in the population living within 80 km (50 mi) of Hanford was 760. This expected number of fatal cancers is much higher than the 1×10^{-4} fatal cancer estimated from Hanford operations in 1996.

Hanford workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–10 presents the average dose to the individual worker and the cumulative dose to all workers at Hanford from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk

Table 3–10. Radiation Doses to Workers From Normal Hanford Operations in 1996 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard**[a]	**Actual**
Average radiation worker (mrem)	None[b]	19
Total workers (person-rem)[c]	None	266

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] About 14,000 (badged) in 1996.

Source: Lyon 1997.

estimator of 400 fatal cancers per 1 million person-rem among workers[2] (Appendix F.10), the number of projected fatal cancers among Hanford workers from normal operations in 1996 is 0.11.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Hanford Site Environmental Report for Calendar Year 1996* (Dirkes and Hanf 1997). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

3.2.4.1.2 Proposed Facility Locations

External radiation doses have been measured in the 200 and 400 Areas. In 1996, the annual doses in the 200 and 400 Areas were roughly the same, about 85 mrem. This is 10 mrem higher than the value measured at the offsite control locations. The concentration of plutonium 239/240 in air in the 200 Area in 1996 was about 1×10^{-5} pCi/m^3. Although this was about 100 times higher than the value at the control location, it was still very small. No measurements of plutonium concentrations in air were reported for the 400 Area (Dirkes and Hanf 1997:75, 76, 124, 185, 186).

3.2.4.2 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 through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.2.1.

[2] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

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 [NPDES] permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal Hanford operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.2.1. The baseline 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. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to Hanford workers during normal operations may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to Occupational Safety and Health Administration (OSHA) 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 requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at Hanford are substantially better than required by standards.

3.2.4.3 Health Effects Studies

Three epidemiological studies and a feasibility study have been conducted on communities around Hanford to determine whether there are excess cancers in the general population. One study found no excess cancers but identified an elevated rate of neural tube defects in progeny. This elevated rate was not attributed to parental employment at Hanford. A second study suggested that neural tube defects were associated with cumulative radiation exposure, and showed other defects statistically associated with parental employment at Hanford, but not with parental radiation exposure. The third study did not show any cancer risk associated with living near the facility.

Many epidemiological studies have been carried out on the Hanford workers over the years. The studies have consistently shown a statistically significant elevated risk of death from multiple myeloma associated with radiation exposure among Hanford male workers. The elevated risk was observed only among workers exposed to 10 rads (~10 rem) or more. Other studies have also identified an elevated risk of death from pancreatic cancers, but a recent reanalysis did not conclude there was an elevated risk. Studies of female Hanford workers have shown an elevated risk of deaths from musculoskeletal system and connective tissue conditions. For a more detailed description of the studies reviewed and their findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current workers, refer to Appendix M.4.2 of the *Storage and Disposition PEIS* (DOE 1996a:M-224–M-230).

3.2.4.4 Accident History

Prior to 1997, there were 128 nuclear-process-related incidents with some degree of safety significance at Hanford over its period of operation. These do not include less-significant instances of radioactivity release or contamination during normal operations, which have been the subject of other reviews. The 128 incidents fall into three significant categories, based on the seriousness of the actual or potential consequences.

Fifteen of the incidents were Category 1, indicating that serious injury, radiation release or exposure above limits, substantial actual plant damage, or a significant challenge to safety resulted. Forty-six events were Category 2, less severe than Category 1, but involving significant cost or a less significant threat to safety. The remaining 67 incidents were Category 3, causing minor radiation exposure or monetary cost, or involving a violation of operating standards without a serious threat to safety (DOE 1996a:3-60).

On May 14, 1997, a chemical explosion occurred at the Hanford Plutonium Reclamation Plant in a room where nonradioactive bulk chemicals were mixed for the now-discontinued plutonium recovery process. The reclamation plant was designed to concentrate liquid feeds, dissolve and process solid material, and perform solvent-extraction recovery of plutonium from aqueous streams. Eight workers outside the plant at the time of the explosion complained of various symptoms, including headaches, light-headedness, and a strange metallic taste. All eight workers were transported to a nearby medical center, where they were examined and released. A small fire protection water line ruptured during the explosion, resulting in the release of water from the building. No one was injured and no radioactive materials were released to the environment. The explosion caused significant localized damage to the facility.

3.2.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

Accordingly, the DOE Richland Operations Office has developed and maintains a comprehensive set of emergency preparedness plans and procedures for Hanford to support onsite and offsite emergency management actions in the event of an accident. The DOE Richland Operations Office also provides technical assistance to other Federal agencies and to State and local governments. Hanford contractors are responsible for ensuring that emergency plans and procedures are prepared and maintained for all facilities, operations, and activities under their jurisdiction, and for directing implementation of those plans and procedures during emergency conditions. The DOE Richland Operations Office, contractor, and State and local government plans are fully coordinated and integrated. Emergency control centers have been established by the DOE Richland Operations Office and its contractors for the principal work areas to provide oversight and support to emergency response actions within those areas.

Following the May 1997 explosion at Hanford (discussed previously), a review of the emergency management response indicated that multiple programs and systems failed in the hours following the accident. In a letter to Secretarial Offices, Secretary of Energy Federico Peña identified actions to be taken at all DOE sites to implement lessons learned from the emergency response (Peña 1997). The actions involve the following elements:

1. Improve training for facility and site emergency personnel
2. Ensure that equipment and qualified personnel are ready for the wide variety of potential radiological and chemical hazards
3. Improve coordination with local medical communities
4. Have in place comprehensive procedures to attend to personnel who are potentially affected by an accident

3.2.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of Hanford, the potentially affected area includes parts of Washington and Oregon.

The potentially affected area around the 200 East Area is defined by a circle with an 80-km (50-mi) radius centered at the planned HLW vitrification facility (lat. 46E33'03.64" N, long. 119E30'13.95" W). The total population residing within that area in 1990 was 346,031. The proportion of the population that was considered minority was 26.2 percent. The potentially affected area surrounding the 400 Area is defined by a circle with an 80-km (50-mi) radius centered at FMEF (lat. 46E26'07" N, long. 119E21'55" W). The total population residing within that area in 1990 was 277,515, and the proportion of the population deemed minority was 25.4 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages for the States of Washington and Oregon were 13.3 and 9.2, respectively (DOC 1992).

Figure 3–5 illustrates the racial and ethnic composition of the minority population in the potentially affected area around the 200 East Area. At the time of the 1990 census, Hispanics were the largest minority group within the potentially affected area, constituting 21.5 percent of the total population. Native Americans contributed about 2 percent, and Asians, about 1.4 percent. Blacks made up about 1.2 percent of the population (DOC 1992).

As for the racial and ethnic composition of the minority population in the potentially affected area around the 400 Area, Hispanics were the largest minority group, constituting 21.5 percent of the total population during the 1990 census. Asians contributed about 1.4 percent, and Native Americans, about 2.0 percent. Blacks were about 1.2 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 64,780 persons (19.0 percent of the total population) residing within the potentially affected area around the 200 East Area reported incomes below that threshold. The data also show that 47,310 persons (17.3 percent of the total population) residing within the potentially affected area around the 400 Area reported incomes below the poverty threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for Washington and Oregon were 10.9 and 12.4 percent, respectively.

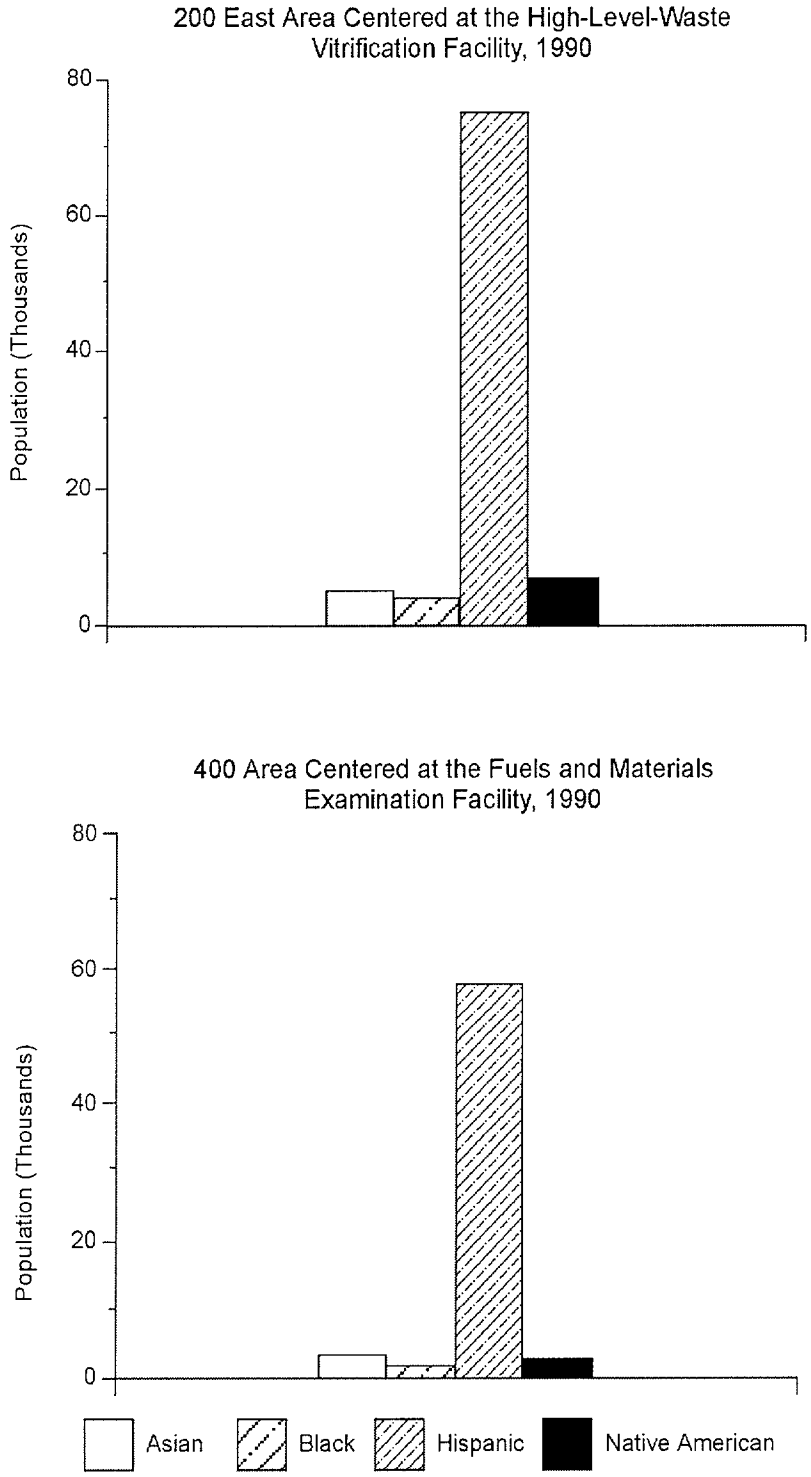
3.2.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.2.6.1 General Site Description

The rocks beneath Hanford consist of Miocene-age and younger rocks that overlay older Cenozoic sedimentary and volcanic basement rocks. The major geologic units underlying Hanford are, in ascending order: subbasalt (basement) rocks, the Columbia River Basalt Group (with alluvial interbeds of sand, gravel, or silt of the Ellensburg Formation), the Ringold Formation, the Plio-Pleistocene unit, early "Palouse" soil, and the Hanford Formation (DOE 1996a:3-38; DOE 1996c:4-5).

Basalt outcrops are exposed on ridges at Gable Mountain, Gable Butte, and the Saddle Mountains in the northern part of Hanford, and on Rattlesnake Hills and Yakima Ridge, overlapping the western and southwestern edges of Hanford (DOE 1996a:3-38). Other than crushed rock, sand, and gravel, no economically viable geologic resources have been identified at Hanford (DOE 1996c:4-10).



Source: DOC 1992.

Figure 3–5. Racial and Ethnic Composition of Minorities Around Hanford

Known faults in the Hanford area include those on Gable Mountain and the Rattlesnake-Wallula alignment. The faults in Central Gable Mountain are considered capable, although there is no observed seismicity on or near Gable Mountain. The Rattlesnake-Wallula alignment is interpreted as possibly being capable because there appear to be active portions of the fault system 56 km (35 mi) southwest of the central part of Hanford. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (Barghusen and Feit 1995:2.2-13, 2.2-14).

According to the Uniform Building Code, Hanford is in Seismic Zone 2B, meaning that moderate damage could occur as a result of an earthquake. Seismicity of the Columbia Plateau, as determined by the rate of earthquakes per area and the historical magnitude of these events, is lower than that of other regions in the Pacific Northwest (DOE 1996a:3-38, 3-39). The two largest earthquakes near Hanford occurred in 1918 and 1973; each had an approximate Richter magnitude of 4.5 and a Modified Mercalli Intensity of V. They occurred in the central portion of the Columbia Plateau north of Hanford (Neitzel 1996:4.49). An earthquake with a maximum horizontal acceleration of 0.25g is calculated to have an annual probability of occurrence of 1 in 10,000 at Hanford (Barghusen and Feit 1995:2.2-14).

There is some potential for slope failure at Hanford, although only the slopes of Gable Mountain and White Bluffs are steep enough to warrant landslide concern. White Bluffs, east of the Columbia River, poses the greatest concern because of the clay-rich nature of some beds above the river level, the discharge of large quantities of irrigation water into the ground atop the cliffs, the surface incline toward the Columbia River, and the eastward channel migration of the Columbia and its undercutting of the adjacent bluffs. A large landslide along White Bluffs could fill the Columbia River channel and divert water onto Hanford (DOE 1996a:3-40). Calculations of the potential impacts of such a landslide indicate a flood area similar to the probable maximum flood (Neitzel 1996:4.58–4.61).

Several major volcanoes are in the Cascade Range west of Hanford, including Mount Adams, 164 km (102 mi) from Hanford, and Mount St. Helens, 218 km (135 mi) west-southwest of the site (DOE 1996a:3-40). Ashfalls from at least three Cascade volcanoes have blanketed the central Columbia Plateau since the late Pleistocene epoch. Generally, ashfall layers have not exceeded more than a few centimeters in thickness, with the exception of the Mount Mazama (Crater Lake, Oregon) eruption, when as much as 10 cm (3.9 in) of ash fell over western Washington (Barghusen and Feit 1995:2.2-14).

Fifteen different soil types occur at Hanford. These soils vary from sand to silty and sandy loam. The dominant soil types are the Quincy (Rupert) sand, Burbank loamy sand, Ephrata sandy loam, and the Warden silt loam. No soils at Hanford are currently classified as prime farmlands because there are no current soil surveys, and the only prime farmland soils in the region are irrigated (DOE 1996b:4-15). The soils at Hanford are considered acceptable for standard construction techniques (DOE 1996a:3-40). More detailed descriptions of the geology and the soil conditions at Hanford are included in the *Storage and Disposition PEIS* (DOE 1996a:3-38–3-40) and the *Hanford Remedial Action EIS* (DOE 1996b).

3.2.6.2 Proposed Facility Locations

The nearest capable fault to the 200 East Area is about 10 km (6.2 mi) away (Mecca 1997a:6). The predominant soils of the 200 East Area are the Burbank loamy sand and the Ephrata sandy loam, and the soils are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1996:4-46).

The nearest capable fault to the 400 Area is about 19 km (12 mi) away (Mecca 1997a:6). The predominant soil type in the 400 Area is the Rupert sand, and the soils are not subject to liquefaction or other instabilities (Mecca 1997a:6; Neitzel 1996:4-46).

3.2.7 Water Resources

3.2.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.2.7.1.1 General Site Description

The major surface water features at Hanford are the Columbia River, the Yakima River, the springs along the Columbia River and on Rattlesnake Mountain, and onsite ponds. Flow of the Columbia River is regulated by several dams upstream and downstream from the site. The nearest dam upstream from Hanford is the Priest Rapids Dam, and the closest downstream dam is the McNary Dam. The Hanford Reach is the portion of the Columbia River that extends from Priest Rapids Dam to the upstream edge of the pool behind McNary Dam. Because the flows are regulated, flow rates in the Hanford Reach can vary considerably; it is the last remaining free-flowing, nontidal section of the river (DOE 1996a:3-32). The average flow rate at the Priest Rapids Dam is about 3,360 m^3/s (118,700 ft^3/s). About one-third of the Hanford Site drains into the Yakima River, which forms a portion of the southern site boundary (Neitzel 1996:4.53–4.55). The average annual flow rate for the Yakima River is about 104 m^3/s (3,670 ft^3/s). Rattlesnake Springs and Snively Springs are in the southwestern portion of the site and flow into intermittent streams. Flows received by these streams infiltrate rapidly into the surface sediments thereof (DOE 1996a:3-32).

Waters of the Columbia River are used primarily for hydroelectric power, transportation, irrigation and other agricultural purposes, recreation, and municipal domestic water. Hanford uses water from the river for domestic and industrial purposes (DOE 1996a:3-32).

Flooding of the site has occurred along the Columbia River, but chances of recurrence have been greatly reduced by the construction of dams to regulate river flow. No maps of flood-prone areas have been produced by the Federal Emergency Management Agency (FEMA). FEMA produces these maps for areas capable of being developed, and the Hanford Site is not designated for commercial or residential development (DOE 1996b:4-22). However, analyses have been completed to determine the potential for the probable maximum flood. This is determined through hydrologic factors, including the amount of precipitation within the drainage basin, snow melt, and tributary conditions. The probable maximum flood for the Columbia River below the Priest Rapids Dam has been calculated at 39,600 m^3/s (1.4 million ft^3/s). Figure 3–6 shows the elevations of the highest flood of record, the river at normal flow, the 1948 flood, and the probable maximum flood (DOE 1996b:4-23).

Potential flooding due to dam failure has been evaluated by the U.S. Army Corps of Engineers (USACE). Upstream failures could have any number of causes, the magnitude of the resultant flooding depending on the size of the breach in the dam. USACE evaluated various scenarios for failure of the Grand Coulee Dam and assumed flow conditions of about 11,300 m^3/s (400,000 ft^3/s). The worst-case scenario assumed a 50 percent breach in the dam (Figure 3–7). The flood wave from an instantaneous 50 percent breach was calculated to be 595,000 m^3/s (21 million ft^3/s). In addition to the areas affected by the probable maximum flood, the remainder of the 100 Area, the 300 Area, and nearly all of Richland, Washington, would be flooded. Determinations were not made for larger instantaneous breaches in the Grand Coulee Dam, because the 50 percent scenario was believed to be the largest conceivable flow from a natural or manmade breach. It was not considered credible that a structure as large as the Grand Coulee Dam could be 100 percent destroyed instantaneously. The analysis also assumed that the 50 percent breach would occur only as the result of direct explosive detonation, and not because of some natural event such as an earthquake (DOE 1996b:4-24).

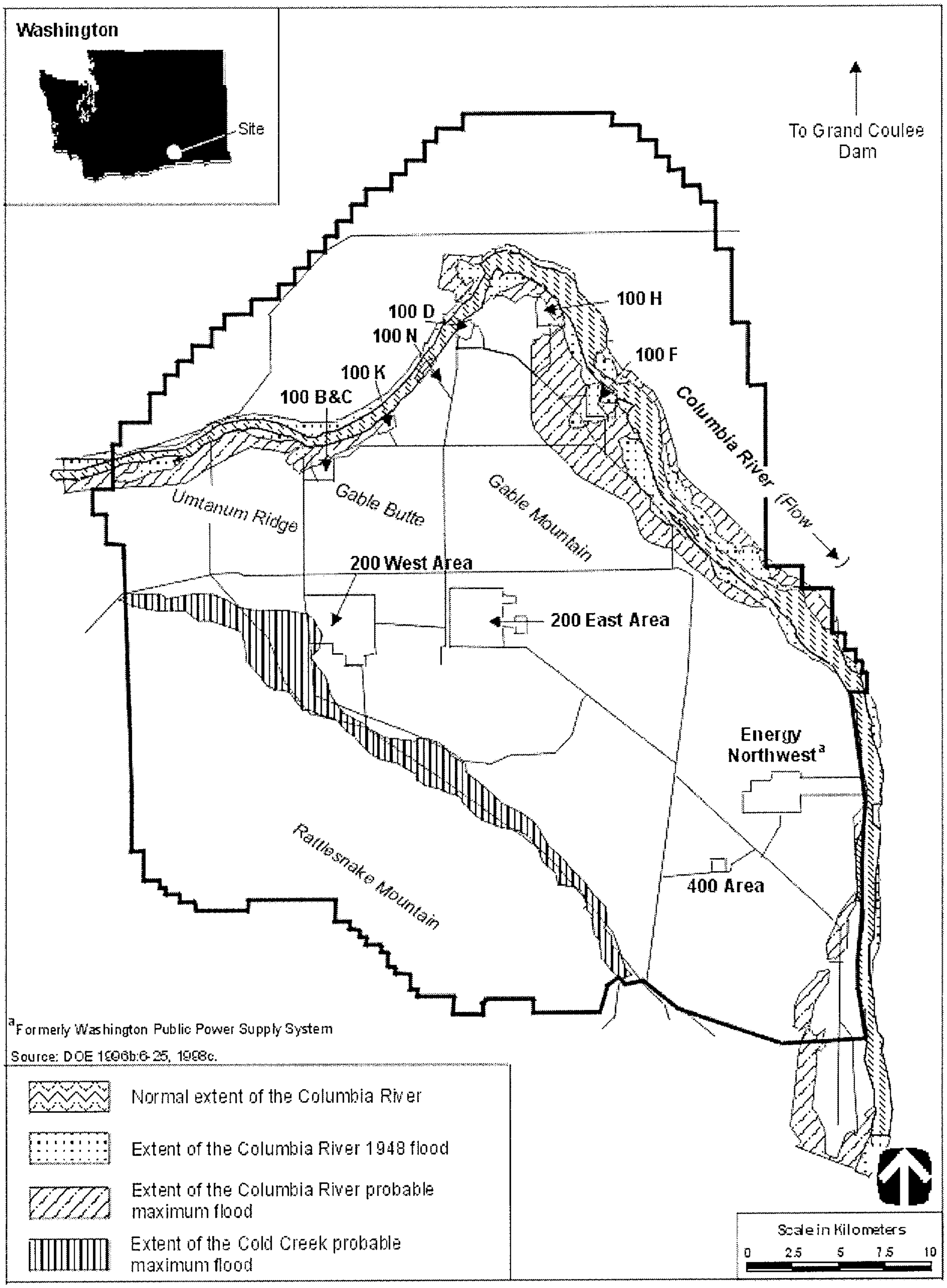


Figure 3–6. Flood Area for the Probable Maximum Flood and Columbia River 1948 Flood

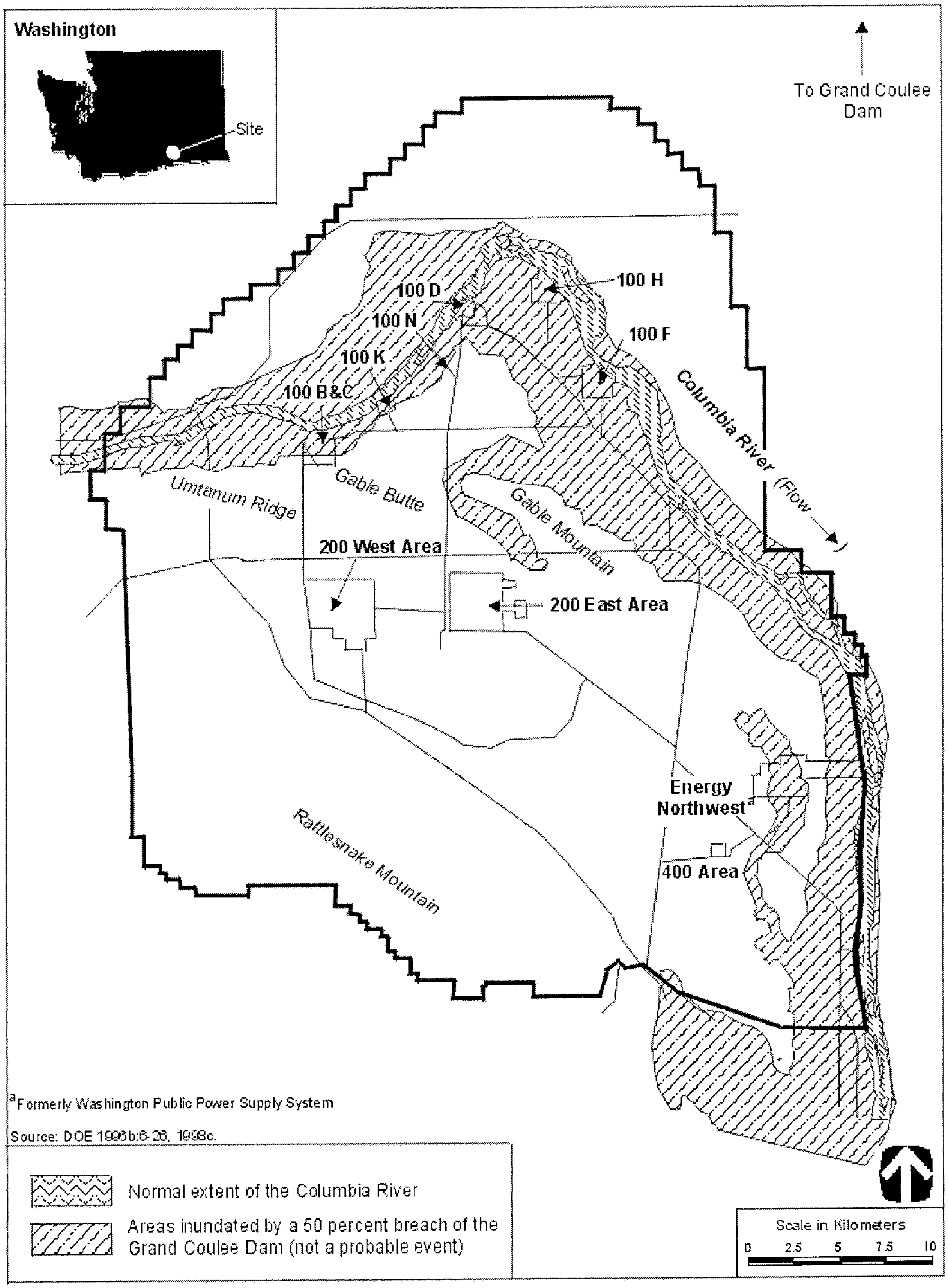


Figure 3–7. Flood Area of a 50 Percent Breach of the Grand Coulee Dam

The possibility of a landslide resulting in river blockage has also been evaluated for White Bluffs. Calculations were made for a landslide volume of 765,000 m^3 (1 million yd^3) with a concurrent flow of about 17,000 m^3/s (600,000 ft^3/s) in the river, which is the 200-year flood. This combination resulted in a flood wave crest elevation of 122 m (400 ft) above mean sea level, similar to that from the 50 percent breach of the Grand Coulee Dam (DOE 1996b:4-24).

The Hanford Reach has been classified Class A: excellent drinking water, a recreation area, and wildlife habitat (DOE 1996a:3-32; Dirkes and Hanf 1996:113). The river currently meets applicable drinking water and water quality standards. No federally designated Wild and Scenic Rivers exist on Hanford, although consideration is being given to so designating the Hanford Reach (Barghusen and Feit 1995:2.2-17–2.2-19).

DOE continues to assert a federally reserved water withdrawal right for the Columbia River. Currently, Hanford withdraws approximately 13.5 billion l/yr (3.6 billion gal/yr) from the Columbia River (DOE 1996a:3-34).

Hanford has six NPDES-permitted discharges and two NPDES permits for these discharges. One permit, WA-000374-3, includes five discharges in the 100 and 300 Areas. A request for a minor permit modification to delete two inactive outfalls from the 100 N-Area was submitted to EPA in August 1995. No effluent noncompliance issues were associated with any of these outfalls in 1995 (Dirkes and Hanf 1996:31, 32).

Permit #WA-002592-7 was issued for the 300 Area Treated Effluent Disposal Facility, which had 10 permit exceedances in 1996. This disposal facility was in normal operations and meeting design specifications at the time of these events. All indications suggest that the facility is unable to consistently meet the restrictions of the facility's NPDES permit despite the use of the best available technology (Dirkes and Hanf 1997:36). An application for a permit modification was submitted to the EPA in November 1997. A revised permit is expected to be issued in 1998 (Sandberg 1998b).

Hanford received a general storm-water permit in February 1994. The *Annual Site Compliance Evaluation and the Pollution Prevention Plan* was updated as required by the permit. No noncompliances were associated with this permit in 1995 (Dirkes and Hanf 1996:32).

All radiological contaminant concentrations measured in the Columbia River in 1995 were lower than the DOE-derived concentration guides and Washington State ambient surface water quality criteria (Dirkes and Hanf 1996:114). For nonradiological parameters, applicable standards for Class A–designated surface water were met; however, the minimum detectable concentration of silver exceeded the Washington State toxicity standard. During 1995, there was no evidence of deterioration in water quality attributable to Hanford operations along the Hanford Reach (Dirkes and Hanf 1996:119).

The Columbia River is also the primary discharge area for the unconfined aquifer underlying Hanford. The site conducts sampling of these discharges and refers to them as riverbank springs. Hanford-origin contaminants continued to be detected in riverbank spring water during 1995. The location and extent of the contaminated discharges were consistent with recent groundwater surveys. Tritium; strontium 90; technetium 99; uranium 234, 235, and 238; cadmium; chloroform; chromium; copper; nitrate; trichloroethylene (TCE); and zinc entered the river along the 100 Area shoreline. Tritium; technetium 99; iodine 129; uranium 234, 235, and 238; chromium; nitrate; and zinc entered the river along the portion extending from the old Hanford Townsite to below the 300 Area. All radiological contaminants in these discharges were below DOE-derived concentration guides. With the exception of TCE, the concentrations of all anion and volatile organic compounds measured in riverbank spring water collected from the Hanford shoreline were below Washington State ambient surface water quality criteria. The concentration of TCE exceeded the EPA standard for protection of human health for the consumption of water and organisms in the 100 K-Area riverbank spring (Dirkes and Hanf 1996:124–126, 132).

3.2.7.1.2 Proposed Facility Locations

The water source in the 200 Area is the Hanford export water system that withdraws Columbia River water at the 100 B-Area pumphouse (Mecca 1997a:5, 7). Most of the Hanford Site is supplied with water from this system. Water is withdrawn at a rate of about 36.2 million l/day (9.6 million gal/day). This system provides water to other areas of the site, but since the shutdown of the reactors its primary function is to provide water to the 200 Area (Mecca 1997a:145–147). More detailed information on this water system may be found in Section 3.2.11.

The 200 East Area sits on a plateau about 11 km (6.8 mi) south of the Columbia River (Mecca 1997a:120; Barghusen and Feit 1995:2.2-8). In this area, only the East Powerhouse Ditch and the 216-B-3C Pond are active. The pond was originally excavated in the mid-1950s for disposal of process cooling water and other liquid waste occasionally containing low levels of radionuclides. West Lake, north of the 200 East Area, is predominantly recharged from groundwater. The lake has not received direct effluent discharges from site facilities; it owes its existence to the intersection of the elevated water table with the land surface in the topographically low area south of Gable Mountain and north of the 200 East Area (Neitzel 1996:4.61).

Analyses of maximum flooding scenarios have indicated that the 200 East Area would not be flooded, even in the worst-case scenario of a failure of the Grand Coulee Dam (Neitzel 1996:4.55–4.61; ERDA 1976:1–11). Similar results have been produced by landslide analyses—specifically, analysis of a landslide-induced blockage of the Columbia River at White Bluffs. Such a blockage would cause flooding, but it would not impact the 200 East Area facilities (Neitzel 1996:4-58).

The 400 Area receives its water from three wells that have a total capacity of about 397 million l/yr (105 million gal/yr) (Mecca 1997a:780). Two other wells would provide emergency service if these wells failed, and another, dire emergency service if all other wells failed. Chlorination is the only treatment provided to these wells (Dirkes and Hanf 1996:140).

No specific flooding analyses have been completed for the 400 Area, but analyses have been completed for the site as a whole. According to the sitewide data, the elevation of the ground surface in the 400 Area is about 30 m (100 ft) above that of the maximum calculated flood from a 50 percent breach in the Grand Coulee Dam (Mecca 1997a:4). Also, the 400 Area is above the elevation of the maximum historical flood of 1894 (Neitzel 1996:4.56).

3.2.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.2.7.2.1 General Site Description

Groundwater under Hanford occurs in confined and unconfined aquifers. The unconfined aquifer lies within the glacioalluvial sands and gravels of the Hanford Formation and the fluvial and lacustrine sediments of the Ringold Formation. Groundwater generally flows eastward across the site; because of local water disposal practices, however, the water table has risen as much as 27 m (89 ft) in the 200 West Area. This has caused groundwater mounding with radial and northward flow components in the 200 Area. Depth to groundwater across the site ranges from 24 to 80 m (79 to 262 ft) (DOE 1996a:3-34).

The unconfined aquifer is recharged mainly from rainfall and runoff from the higher elevation on the western border and from artificial recharge from irrigation and wastewater disposal practices at Hanford. In the vicinity of Hanford, groundwater is discharged along the Columbia River, and some lesser amounts along the Yakima River (DOE 1996a:3-34).

The confined aquifers at Hanford consist of sedimentary interbeds and interflow zones that occur between basalt flows in the Columbia River Basalt Group. Aquifer thickness varies from several centimeters to at least 52 m (171 ft). Recharge of the confined aquifer occurs where the basalt formations are near ground level, and thus surface water is allowed to infiltrate them. Groundwater from the confined aquifers discharges to the Columbia River (DOE 1996a:3-34).

Water use in the Pasco Basin, which includes Hanford, is primarily via surface water diversion; groundwater accounts for less than 10 percent of water use. While most of the water used by Hanford is surface water withdrawn from the Columbia River, some groundwater is used. One of the principal users of groundwater was FFTF, which used about 697,000 l/day (184,000 gal/day) when it operated. The other facilities that use groundwater are the Yakima Barricade and the Patrol Training Academy (Dirkes and Hanf 1996:139–144; Barghusen and Feit 1995:2.2-21–2.2-24). DOE currently asserts an unlimited federally reserved groundwater withdrawal right with respect to the existing Hanford operations and withdraws about 195 million l/yr (52 million gal/yr) (DOE 1996a:3-37).

Groundwater quality beneath portions of the Hanford Site from the 200 Areas north and east to the Columbia River has been affected by past liquid waste disposal practices and as a result of spills and leaks from single-shell radioactive waste storage tanks (Dirkes and Hanf 1997:95). The unconfined aquifer contains radiological and nonradiological contaminants at levels exceeding water quality criteria and standards. Contamination in the confined aquifer is typically limited to areas of exchange with the unconfined aquifer. Tritium and nitrate plumes have moved steadily eastward across the site and seeped into the Columbia River. No aquifers have been designated sole-source aquifers (Barghusen and Feit 1995:2.2-22).

3.2.7.2.2 Proposed Facility Locations

Two major groundwater mounds have been formed in the 200 Area, both in response to wastewater discharges. The first was created by disposal at U Pond in the 200 West Area. This mound has been slowly dissipating since the pond was decommissioned in 1984. The second major mound was created by discharges to B Pond east of the 200 East Area. The water table near B Pond increased to a maximum of about 9 m (30 ft) above preoperational conditions in 1990, and has dropped slightly over the last few years because of the reduced volume of discharges. These mounds have altered the unconfined flow patterns that generally recharge from the west and flow to the east. Water levels in the unconfined aquifer continually change as a result of variations in the volume and location of wastewater discharges. Consequently, the movement of groundwater and its associated constituents has also changed with time (Dirkes and Hanf 1996:185).

The radiological contaminants in two 200 East Area groundwater plumes include cesium 137, cobalt 60, plutonium, strontium 90, technetium 99, and tritium. They are the result of historical reprocessing operations at B Plant. Two pump-and-treat test systems used in treatability testing of these plumes were discontinued in May 1995 after about 5 million l (1.3 million gal) of water were treated. Decisions concerning further actions have been deferred until the data are evaluated. A RCRA Field Investigation/Corrective Measures Study addressing contaminants associated with PUREX Plant discharges is being prepared (Dirkes and Hanf 1996:197–219).

In the 400 Area, groundwater flows to the east. The flow direction at the Nonradioactive Dangerous Waste Landfill and the Solid Waste Landfill, which are nearby, is east-southeast. Because of their rather high permeabilities, Hanford Formation sediments dominate groundwater flows in these areas. Transmissivity of the unconfined aquifer system in the landfill areas is particularly high, because the system is within the main flow channel of the catastrophic floods that deposited the Hanford Formation gravels. In the 400 Area, the Hanford Formation consists mainly of the sand-dominated facies, and the water table is near the point of contact between the Hanford and Ringold Formations. Transmissivity of the aquifer in the 400 Area is an order of magnitude lower than that in the landfill areas (Hartman and Dresel:1997:3.11, 3.12). Water for the 400 Area is supplied by three wells in the unconfined aquifer. Each well has a pumping capacity of 83.3 l/min (22 gal/min). The water is distributed throughout the 400 Area for potable, process, and fire protection use (Dirkes and Hanf 1997:193; Rohl 1994:2-7).

Nitrate is the only significant contaminant attributable to 400 Area operations. Elevated levels have been attributed to the sanitary sewage lagoon, a source of groundwater contamination that should be eliminated by a recently constructed sewage treatment system. Other contamination found in well samples is believed not to emanate from the 400 Area (Hartman and Dresel 1997:6.90).

3.2.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special-status species—that is, "nonsensitive" versus "sensitive" habitat.

3.2.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.2.8.1.1 General Site Description

Hanford is made up of large, undisturbed expanses of shrub-steppe habitat that supports nearly 600 plant species and numerous animal species suited to the region's semiarid environment (DOE 1996d:3-89, 3-90). Present site development consists of clusters of large buildings at widely spaced locations, occupying about 6 percent of the total available area. The remaining site area can be divided into 10 major plant communities (see Figure 3–8). The dominant plants are cheatgrass, big sagebrush, rabbitbrush, and Sandberg's bluegrass, with cheatgrass providing at least half of the total plant coverage. Shrub-steppe is considered a priority habitat by the State of Washington because of its significant value to sensitive wildlife. Trees that were originally planted on farmland to provide windbreaks and shade serve as nesting platforms for several species of birds, including hawks, owls, ravens, magpies, and great blue herons, and as night roosts for wintering bald eagles (DOE 1996a:3-42; DOE 1996b:4-51).

Animal species at Hanford include over 1,000 species of insects, 12 species of amphibians and reptiles, 214 species of birds, 44 species of fish, and 39 species of mammals (Dirkes and Hanf 1997:275). Grasshoppers and darkling beetles are among the more conspicuous groups, and along with other species, are important in the food web of the local birds and mammals. The most abundant reptile is the side-blotched lizard, although short-horned and sagebrush lizards, gopher snakes, yellow-bellied racers, and Pacific rattlesnakes are also seen frequently. The horned lark and western meadowlark are the most abundant nesting birds, but the site also supports populations of chukar partridge, gray partridge, and sage grouse (DOE 1996d:3-90). The Hanford Reach, including several sparsely vegetated islands, provides nesting habitat for the Canadian goose, ring-billed gull, Forster's tern, and great blue heron. Numerous raptors, such as the northern harrier, ferruginous hawk, Swainson's hawk, red-tailed hawk, prairie falcon, American kestrel, and owls, use the site as a refuge, especially during nesting (DOE 1996a:3-42; DOE 1996b:4-56; DOE 1996e:3-90). Mammals on the site are generally small

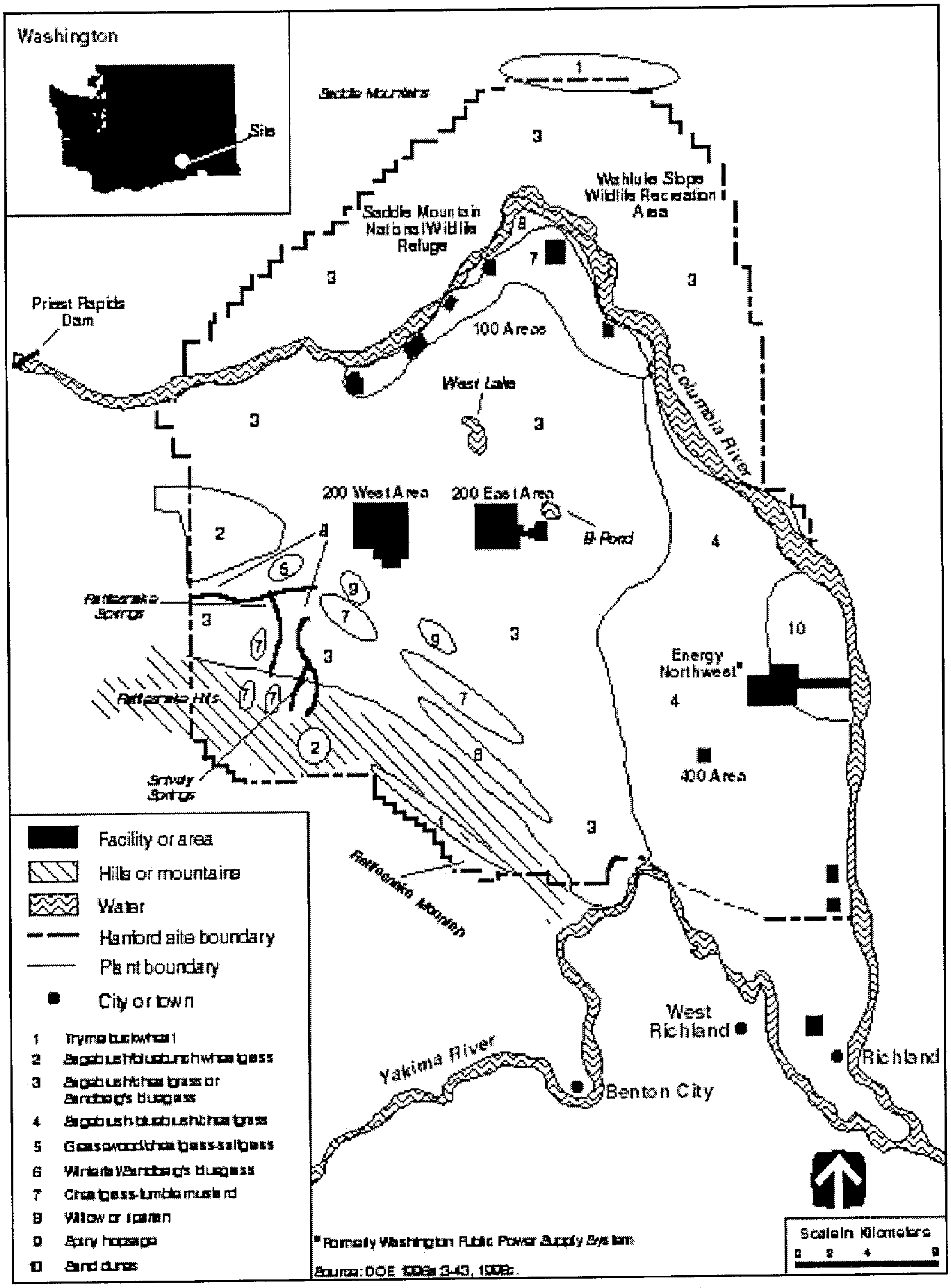


Figure 3–8. Major Plant Communities at Hanford

and nocturnal, the Great Basin pocket mouse being the most abundant. Other small mammals include the deer mouse, Townsend ground squirrel,pocket gopher, harvest mouse, Norway rat, sagebrush vole, grasshopper mouse, montane vole, vagrant shrew, Leasts chipmunk, and Merriam's shrew. Larger mammals include the mule deer and elk. Small numbers of bobcats and badgers also inhabit the site. The largest predator, which ranges all across the site, is the coyote. Bat species include the pallid bat, which frequents deserted buildings and is thought to be the most abundant. Other species include the hoary bat, silver-haired bat, California brown bat, little brown bat, Yuma brown bat, and Pacific western big-eared bat (DOE 1996b:4-55; DOE 1996d:3-90).

There are two types of natural aquatic habitats on the Hanford Site. The dominant one, the Columbia River, flows along the northern and eastern edges; the other is the small spring-streams and seeps in the Rattlesnake Hills. Several artificial water bodies, primarily ponds and ditches, have been formed as a result of wastewater disposal practices associated with the operation of reactors and separation facilities. Although they are temporary and will vanish with cessation of activities, all except West Lake form established aquatic ecosystems when present. West Lake is created by a rise in the water table in the 200 Areas, and because it is not fed by surface flow, it is alkaline and has limited plant and animal species (DOE 1996b:4-63).

The Columbia River supports a large and diverse community of plankton, benthic invertebrates, fish, and other aquatic organisms. The Hanford Reach supports transient phytoplankton and zooplankton populations and 44 anadromous and resident species of fish (DOE 1996d:3-90). Of these species, the chinook salmon, sockeye salmon, coho salmon, and steelhead trout use the river as a migration route to upstream spawning areas. Principal resident fish species sought by anglers include whitefish, sturgeon, smallmouth bass, catfish, walleye, and perch. There are also large populations of rough fish present, including carp, shiners, suckers, and squawfish. Small spring-streams, such as Rattlesnake and Snively Springs, support diverse biotic communities and are extremely productive, consisting of dense blooms of watercress and aquatic insects (DOE 1996b:4-63, 4-64). Temporary wastewater ponds and ditches develop riparian communities and are attractive to migrating birds in autumn and spring (DOE 1996e:3-90).

3.2.8.1.2 Proposed Facility Locations

Biological surveys in the 200 East Area and immediately surrounding areas show that approximately 40 percent of the area is big sagebrush and grey rabbitbrush, both native species characteristic of shrub-steppe communities. Roughly 20 percent is Russian thistle, the remainder being either disturbed vegetation or bare gravel (DOE 1996c:4-32). Because of past disturbances and human occupancy in the 200 Areas, wildlife associated with shrub-steppe habitat is somewhat limited (DOE 1996c:S-7). Several animal species may be found in this area. Bird species include the burrowing owl, ferruginous hawk, great blue heron, loggerhead shrike, long-billed curlew, northern harrier, sage sparrow, Swainson's hawk, western meadowlark, vesper sparrow, and horned lark. Potential mammal species include the black-tailed jackrabbit, coyote, Great Basin pocket mouse, house mouse, deer mouse, mule deer, Nuttall's cottontail, raccoon, and badger. Reptiles likely to be seen include the gopher snake, northern Pacific rattlesnake, western yellow-bellied racer, and side-blotched lizard (Mecca 1997b:Poston memo to Teal).

The 400 Area is characterized as postfire shrub-steppe habitat dominated by cheatgrass and small shrubs, including gray and green rabbitbrush. Generally, the same animal species listed above as potentially located in the 200 Area may be found in the 400 Area, with the following exceptions: great blue heron, raccoon, and badger. Species that may be infrequently seen due to limited habitat as a result of fire include loggerhead shrike and sage sparrow (Mecca 1997b:Poston memo to Teal). No surface water flows within 1.6 km (1 mi) of the proposed facility locations in the 200 East and 400 Areas (Mecca 1997b).

3.2.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special-status plant and animal species.[3]

3.2.8.2.1 General Site Description

The primary jurisdictional wetlands on the Hanford Site are found along the Hanford Reach and include the riparian and riverine habitats associated with the river shoreline (DOE 1996b:4-64). The riparian zone varies with seasonal water-level fluctuations and daily variations related to power generation at Priest Rapids Dam, but is known to support extensive stands of willows, grasses, various macrophytes, and other plants. Other large areas of wetlands can be found within the Saddle Mountain National Wildlife Refuge and the Wahluke Slope Wildlife Recreation Area. Wetland habitat in these areas consists of large ponds resulting from irrigation runoff. The ponds support extensive stands of cattails and other emergent aquatic vegetation that are frequently used as nesting sites by waterfowl (DOE 1996a:3-42).

Sixty-five threatened, endangered, and other special-status species listed by the Federal Government or the State of Washington may be found in the vicinity of Hanford, as shown in Table 3.2.6–1 of the *Storage and Disposition PEIS* (DOE 1996a:3-45).

3.2.8.2.2 Proposed Facility Locations

Riparian habitats are associated with the B Pond Complex near the 200 East Area and a small cooling and wastewater pond in the 400 Area (DOE 1996b:4-64). Wetland plants occurring along the shoreline of B Pond include herbaceous and woody species such as showy milkweed, western goldenrod, three square bulrush, horsetail rush, common cattail, and mulberry. Wildlife species observed include a variety of mammals and waterfowl (DOE 1996c:4-33). Similar representative plants and animals may be found in the 400 Area, with the exception of bulrushes, cattails, horsetails, and mulberry (Mecca 1997a:Poston memo to Teal).

No animals or plants on the Federal list of threatened and endangered species are known to occur on or around the 400 Area and 200 East Area. As indicated in Table 3–11, the State of Washington has classified eight bird, one mammal, four plant, and two reptile species as threatened, endangered, or species of concern. Loggerhead shrike and sage sparrow nest in undisturbed sagebrush habitat. Other bird species of concern that may occur in shrub-steppe habitat are the burrowing owl, ferruginous hawk, golden eagle, long-billed curlew, sage thrasher and Swainson's hawk. The only mammal species is the State-listed endangered pygmy rabbit which have only rarely been observed at Hanford. Pipers daisy has been found at B Pond near the 200 East Area and crouching milkvetch, stalked-pod milkvetch, and squill onion are also found in the vicinity. The reptile species of concern are the desert night snake and striped whipsnake (Dirkes and Hanf 1997:F.1–F.3; DOE 1996a:3-44; DOE 1996c:4-34).

3.2.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Hanford has a well-documented record of cultural and paleontological resources. The *Hanford Cultural Resources Management Plan*, approved by the State Historic Preservation Officer (Battelle 1989), establishes guidance for the identification, evaluation, recordation, curation, and management of

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[3] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

these resources. There are 645 cultural resource sites and isolated finds recorded. Forty-eight archaeological sites and one building are included on the National Register of Historic Places. Nominations have been prepared

Table 3–11. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in the Vicinity of 200 East Area and 400 Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Burrowing owl	*Athene cunicularia*	Species of Concern	Candidate Species
Ferruginous hawk	*Buteo regalis*	Species of Concern	Threatened
Golden eagle	*Aquila chrysaetos*	Not listed	Candidate Species
Loggerhead shrike	*Lanius ladovicianus*	Species of Concern	Candidate Species
Long-billed curlew	*Numenius americanus*	Not listed	Candidate Species
Sage sparrow	*Amphispiza belli*	Not listed	Candidate Species
Sage thrasher	*Oreoscoptes montanus*	Not listed	Candidate Species
Swainson's hawk	*Buteo swainsoni*	Not listed	Candidate Species
Mammals			
Pygmy rabbit	*Brachylagus idahoenis*	Species of Concern	Endangered
Plants			
Crouching milkvetch	*Astragalus succumbens*	Not listed	Monitor Group 3[a]
Piper's daisy	*Erigeron piperianus*	Not listed	Sensitive
Squill onion	*Allium scillioides*	Not listed	Monitor Group 3[a]
Stalked-pod milkvetch	*Astragalus sclerocarpus*	Not listed	Monitor Group 3[a]
Reptiles			
Desert night snake	*Hypsiglena torquata*	Not listed	Monitor Group
Striped whipsnake	*Masticophis taeniatus*	Not listed	Candidate Species

[a] Taxa that are more abundant or less threatened than previously assumed.

Source: Dirkes and Hanf 1997:F.1–F.3; DOE 1996c:4-34; McConnaughey 1998; Roy 1998.

for several archaeological districts and sites considered to be eligible for listing on the National Register. While many significant cultural resources have been identified, only about 6 percent of Hanford has been surveyed, and few of the known sites have been evaluated for their eligibility for listing on the National Register. Cultural resource reviews are conducted whenever projects are proposed in previously unsurveyed areas. In recent years, reviews have exceeded 500 per year (DOE 1996b:4-68, 4-69).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

3.2.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.2.9.1.1 General Site Description

Currently, 283 prehistoric sites have been identified, 17 of which contain historic components. Of 48 sites included on the National Register, 2 are individual sites (Hanford Island Site and Paris Site), and the remainder are located in seven archaeological districts. In addition, four other archaeological districts have been nominated or are planned to be nominated for the National Register. A number of sites have been identified along the Middle Columbia River and in inland areas away from the river, but near other water sources. Some evidence of human occupation has been found in the arid lowlands. Sites include remains of numerous pithouse villages, various types of open campsites, graves along the riverbanks, spirit quest monuments (rock cairns), hunting camps, game drive complexes, quarries in mountains and rocky bluffs, hunting and kill sites in lowland stabilized dunes, and small temporary camps near perennial sources of water away from the river (DOE 1996b:4-69, 4-70).

More than 10,000 years of prehistoric human activity in the largely arid environment of the Middle Columbia River region have left extensive archaeological deposits. Archaeological surveys have been conducted at Hanford since 1926; however, little excavation has been conducted at any of the sites. Surveys have included studies of Gable Mountain, Gable Butte, Snively Canyon, Rattlesnake Mountain, Rattlesnake Springs, and a portion of the Basalt Waste Isolation Project Reference Repository location. Most of the surveys have focused on islands and on a 400-m (1,312-ft) wide area on either side of the river. From 1991 through 1995, the 100 Areas were surveyed, and new sites were identified. Excavations have been conducted at several sites on the riverbanks and islands and at two unnamed sites. Test excavations have been conducted at the Wahluke, Vernita Bridge, and Tsulim sites and at other sites in Benton County (DOE 1996a:3-48).

3.2.9.1.2 Proposed Facility Locations

An archaeological survey has been conducted for all undeveloped portions of the 200 East Area and half of the undeveloped portions of the 200 West Area. No prehistoric sites were identified. Because most of the 200 Areas are either developed or disturbed, it is unlikely that they contain intact archaeological deposits. Likewise, most of the 400 Area is disturbed and is unlikely to contain intact prehistoric or historic sites. A cultural resources survey found only 12 ha (30 acres) that were undisturbed, and no sites were identified either within the 400 Area or within 2 km (1.2 mi) of the 400 Area. The *Hanford Cultural Resources Management Plan* provides for survey work before construction and has contingency guidelines for handling the discovery of previously unknown archaeological resources encountered during construction (DOE 1996a:3-48).

3.2.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.2.9.2.1 General Site Description

There are 202 historic archaeological sites and other historic localities recorded at Hanford. Of these sites, 1 is included on the National Register as a historic site, and 56 are listed as archaeological sites. Sites and localities that predate the Hanford era include homesteads, ranches, trash scatters, dumps, gold mine tailings, roads, and townsites, including the Hanford townsite and the East White Bluffs townsite and ferry landing. More recent historic structures include the defense reactors and associated materials-processing facilities that played an important role in the Manhattan Project and the Cold War era (DOE 1996a:3-48, 3-49).

Lewis and Clark were the first European Americans to visit this region, during their 1804 to 1806 expedition. They were followed by fur trappers, military units, and miners. It was not until the 1860s that merchants set up stores, a freight depot, and the White Bluffs Ferry on the Hanford Reach, and Chinese gold miners began to work the gravel bars. Cattle ranches opened in the 1880s, and farmers soon followed. Several small thriving towns, including Hanford, White Bluffs, and Ringold, grew up along the riverbanks in the early 20th century.

Other ferries were established at Wahluke and Richmond. These towns and nearly all other structures were razed after the U.S. Government acquired the land for the original Hanford Engineer Works in the early 1940s (part of the Manhattan Project). Plutonium produced at the 100 B-Reactor was used in the first nuclear explosion at the White Sands Missile Range in New Mexico, and later in the bomb that destroyed Nagasaki, Japan, to help end World War II. The Hanford 100 B-Reactor is listed on the National Register and is designated a National Mechanical Engineering Landmark, a National Historic Civil Engineering Landmark, and a National Nuclear Engineering Landmark (DOE 1996a:3-48).

3.2.9.2.2 Proposed Facility Locations

Within the 200 Area, the only National Register–evaluated historic site is the old White Bluffs freight road that crosses diagonally through the 200 West Area. The road, which was originally a Native American trail, has been in continuous use as a transportation route since prehistoric times and has played a role in European-American immigration, regional development, agriculture, and the recent Hanford operations. The road has been determined eligible for inclusion on the National Register by the State Historic Preservation Officer, but the segment in the 200 West Area is considered a noncontributing element (i.e., lacking sufficient integrity to be a significant element of the road). A 100-m (328-ft) restricted zone protects the road from uncontrolled disturbance. Buildings in the 200 Area associated with the Manhattan Project and Cold War era have been evaluated for eligibility for nomination to the National Register and are under review by the State Historic Preservation Officer. No known historic resources have been identified in the 400 Area (DOE 1996b:3-49).

3.2.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.2.9.3.1 General Site Description

In prehistoric and early historic times, the Hanford Reach was heavily populated by Native Americans of various tribal affiliations. The Wanapum and the Chamnapum bands of the Yakama Tribe lived along the Columbia River at what is now Hanford. Some of their descendants still live nearby at Priest Rapids, northwest of Hanford. Palus People, who lived on the lower Snake River, joined the Wanapum and Chamnapum to fish the Hanford Reach, and some inhabited the east bank of the river. Walla Walla and Umatilla People also made periodic visits to fish in the area. These people retain traditional secular and religious ties to the region, and many have knowledge of the ceremonies and lifeways of their culture. The Washani, or Seven Drums religion, which has ancient roots and originated among the Wanapum, is still practiced by many people on the Yakama, Umatilla, Warm Springs, and Nez Perce Reservations. Native plant and animal foods, some of which can be found at Hanford, are used in the ceremonies performed by tribal members (DOE 1996b:4-71).

Consultation is required to identify the traditional cultural properties that are important in maintaining the cultural heritage of Native American tribes. Under separate treaties signed in 1855, the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation ceded lands to the United States that include the present Hanford Site. Under the treaties, the tribes reserved the right to fish at usual and accustomed places in common with the citizens of the territory, and retained the privilege of hunting, gathering roots and berries, and pasturing horses and cattle upon open, unclaimed land. The Treaty of 1855 with the Nez Perce Tribe includes similar reservations of rights, and the Nez Perce have identified the Hanford Reach as the location of usual and accustomed places for fishing. The Wanapum People are not signatory to any treaty with the United States and are not a federally recognized tribe; however, they live about 8 km (5 mi) west of the

Hanford boundary, they were historical residents of Hanford, and their interests in the area have been acknowledged (DOE 1996b:4-71, 4-72).

All these tribes are active participants in decisions regarding Hanford and have expressed concerns about hunting, fishing, pasture rights, and access to plant and animal communities and important sites. Sites sacred to Native Americans at Hanford include remains of prehistoric villages, burial grounds, ceremonial longhouses or lodges, rock art, fishing stations, and vision quest sites. Culturally important localities and geographic features include Rattlesnake Mountain, Gable Mountain, Gable Butte, Goose Egg Hill, Coyote Rapids, and the White Bluffs portion of the Columbia River (DOE 1996a:3-49).

Consultations (see Chapter 5 and Appendix O) were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in this SPD EIS.

3.2.9.3.2 Proposed Facility Locations

Neither the 200 East Area nor the 400 Area is known to contain any Native American resources.

3.2.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.2.9.4.1 General Site Description

Remains from the Pliocene and Pleistocene Ages have been identified at Hanford. The Upper Ringold Formation dates to the Late Pliocene Age and contains fish, reptile, amphibian, and mammal fossil remains. Late Pleistocene Touchet beds have yielded mammoth bones. These beds are composed of fluvial sediments deposited along ridge slopes that surround Hanford at distances greater than 5 km (3.1 mi) from the 200 and 400 Areas (DOE 1996a:3-49).

3.2.9.4.2 Proposed Facility Locations

No paleontological resources have been reported near the 200 and 400 Areas.

3.2.10 Land Use and Visual Resources

3.2.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Hanford covers approximately 1,450 km^2 (560 mi^2) of the southeastern part of the State of Washington and extends over parts of Benton, Grant, and Franklin Counties. The site is owned entirely by the Federal Government and is administered and controlled by DOE (DOE 1996a:3-23).

3.2.10.1.1 General Site Description

The Tri-Cities area southeast of Hanford includes residential, commercial, and industrial land use. This area, encompassing the cities of Richland, Kennewick, and Pasco, is the population center closest to Hanford. Additional cities near the southern boundary of Hanford include Benton City, Prosser, and West Richland (DOE 1996b:4-81). Agriculture is a major land use in the remaining areas surrounding Hanford. In 1996, wheat was the largest crop in terms of area planted in Benton, Franklin, and Grant Counties. Alfalfa, apples, asparagus, cherries, corn, grapes, and potatoes are the other major crops in Benton, Franklin, and Grant Counties (DOE 1996b:4-106). Hanford is a Superfund site, listed on the National Priorities List. Public access to most facility areas is restricted.

DOE has designated the entire Hanford Site as a National Environmental Research Park, an outdoor laboratory for ecological research to study the environmental effects of energy development. The Hanford National Environmental Research Park is a shrub-steppe habitat that contains a wide range of semiarid land ecosystems and offers the opportunity to examine linkages between terrestrial, subsurface, and aquatic environments (DOE 1996a:3-23).

Land-use categories at Hanford include reactor operations, waste operations, administrative support, operations support, sensitive areas (including environmentally or culturally important areas), R&D and engineering development, and undeveloped areas. Generalized land uses at Hanford and vicinity are shown in Figure 3–9. Approximately 6 percent of Hanford has been disturbed and is occupied by operational facilities (DOE 1995b:4-1). Hanford contains a variety of widely dispersed facilities, including old reactors, R&D facilities, and various production and processing plants. The largest category of existing Hanford land use is sensitive areas. Approximately 665 km^2 (257 mi^2), nearly half the site, have been designated as ecological study areas or refuges. Sensitive open-space areas include the Fitzner-Eberhardt Arid Lands Ecology Reserve near Rattlesnake Mountain and two areas north of the Columbia River: the Saddle Mountain National Wildlife Refuge, administered by the USFWS, and the Wahluke Slope Wildlife Recreation Area, managed by the Washington State Department of Fish and Wildlife (DOE 1996b:4-109). Other special-status lands in the vicinity include McNary National Wildlife Refuge, administered by the USFWS, and the Columbia River Islands Area of Critical Environmental Concern and McCoy Canyon, both administered by the Bureau of Land Management (BLM).

The Fitzner-Eberhardt Arid Lands Ecology Reserve, encompassing approximately 315 km^2 (122 mi^2) in the southwestern portion of Hanford, is managed as a habitat and wildlife reserve and environmental research center by the USFWS (DOE 1996b:4-109, Sandberg 1998a). The Rattlesnake Hills Research Natural Area of the Arid Lands Ecology Reserve remains the largest Research Natural Area in the State of Washington. Because public access to the Arid Lands Ecology Reserve has been restricted since 1943, the shrub-steppe habitat is virtually undisturbed. This geographic area contains a number of small, contaminated sites that were remediated in 1994 and 1995 and have been revegetated (DOE 1996b:4-109).

The Columbia River, which is adjacent to and runs through the Hanford Site, is used for public boating, water skiing, fishing, and hunting of upland game birds and migratory fowl. Public access is allowed on certain islands, while other areas are considered sensitive because of unique habitats and the presence of cultural resources (DOE 1996b:4-109). The area known as the Hanford Reach includes the quarter-mile strip of public land on either side of the last free-flowing, nontidal segment of the Columbia River. In 1988, Congress passed Public Law 100-605, known as the *Comprehensive Conservation Study of the Hanford Reach of the Columbia River*, which required the Secretary of the Interior to prepare a study in consultation with the Secretary of Energy to evaluate outstanding features of the Hanford Reach (DOE 1996b:4-109). The results of this study can be found in the *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (NPS 1994). The study recommends that Congress designate an 80-km (50-mi) segment of the Columbia River extending downstream from below Priest Rapids Dam to near Johnson Island (river mile 346.5 to river mile 396) as a National Wildlife Refuge and Wild and Scenic River.

About 2,400 ha (5,930 acres) or 1.7 percent of the total acreage at Hanford is available for radioactive waste management facilities (DOE 1997a:4-20). Onsite programmatic and general purpose space totals approximately 799,000 m^2 (8.6 million ft^2). Fifty-one percent or approximately 408,000 m^2 (4.4 million ft^2) is general purpose space, including offices, laboratories, shops, warehouses, and other support facilities. The remaining 392,000 m^2 (4.2 million ft^2) of space is devoted to programmatic facilities, including processing, evaporation, filtration, waste recovery, waste treatment, waste storage facilities, and R&D laboratories (Mecca 1997a:120).

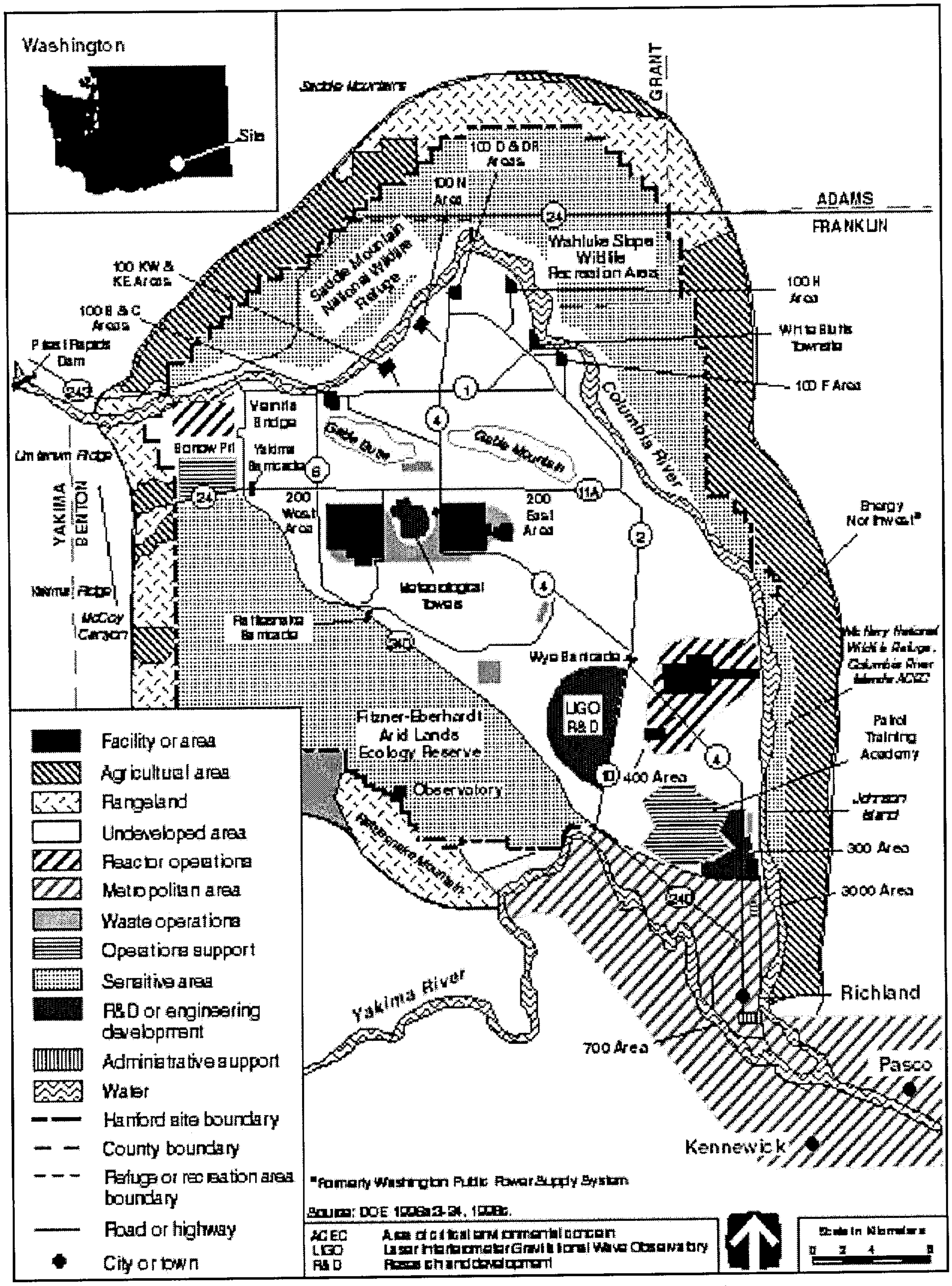


Figure 3–9. Generalized Land Use at Hanford and Vicinity

The 200 East Area is on the Central Plateau. This areas occupies about 11 km^2 (4.2 mi^2) and is dedicated to fuel reprocessing, waste-processing management, and disposal activities. Waste operations and operations support are the primary land uses. The Environmental Restoration Disposal Facility provides disposal capacity for environmental remediation waste generated during remediation of the Hanford Site (DOE 1996b:4-110).

The 400 Area occupies 0.6 km^2 (0.2 mi^2) and is about 8 km (5 mi) northwest of the 300 Area (DOE 1995b:4-2). It is the site of FFTF used in the testing of breeder reactor systems. Also in this area is FMEF, an unused building designed to fabricate fast breeder reactor fuel.

The *Hanford Site Development Plan* provides an overview of land use, infrastructure, and facility requirements to support the DOE missions at Hanford (DOE 1996b:4-109). Included in the plan is a Master Plan section that outlines the relationship of the land and the infrastructure required to support Hanford Site missions (DOE 1996b:4-109). The DOE Richland Operations Office has undertaken new comprehensive land-use planning to define how to best use the land at Hanford for the next 30 to 40 years (DOE 1996a:3-23). Its *Comprehensive Land-Use Plan* identifies existing and planned land uses, with accompanying restrictions; covers a specific timeframe; and will be updated as necessary.

Private lands bordering Hanford are subject to the planning regulations of Benton, Franklin, and Grant Counties and the city of Richland. Most of the land at Hanford is situated in Benton County. Benton County and the city of Richland have a comprehensive land-use planning process under way, with deadlines mandated under the State of Washington Growth Management Act of 1990 (DOE 1996a:3-23).

Under separate treaties signed in 1855, lands occupied by the present Hanford Site were ceded to the United States by the Confederated Tribes and Bands of the Yakama Indian Nation and by the Confederated Tribes of the Umatilla Indian Reservation (DOE 1996b:4-115). Under these treaties, the tribes retained the right to fish in their usual and accustomed places, and to hunt, gather roots and berries, and pasture horses and cattle on open, unclaimed lands. Tribal fishing rights have been recognized as effective within the Hanford Reach. DOE considers Hanford's past nuclear materials production mission and its current mission of waste management inconsistent with the continued exercise of these treaty-reserved privileges (DOE 1996b:4-115, 4-116).

3.2.10.1.2 Proposed Facility Locations

The 200 East Area is on a plateau about 11 km (6.8 mi) from the Columbia River. The 200 East and West Areas cover about 16 km^2 (6.2 mi^2) and have been dedicated for some time to fuel-reprocessing and waste management and disposal activities (DOE 1995b:4-2). Waste operations are confined primarily to the 200 Areas. The 200 East Area had previously been used to reprocess irradiated nuclear fuel and to store the resulting waste (DOE 1996c:4-50). The land is currently disturbed and is designated for waste operations. The distance from the 200 East Area to the nearest site boundary is approximately 10 km (6.2 mi).

The land in the 400 Area is currently disturbed and is designated for reactor operations. The distance from the 400 Area to the nearest site boundary is 7 km (4.3 mi).

3.2.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.2.10.2.1 General Site Description

Hanford is in the Pasco Basin of the Columbia Plateau north of the city of Richland, which is at the confluence of the Yakima and Columbia Rivers. The topography of land in the vicinity of Hanford ranges from generally flat to gently rolling. Rattlesnake Mountain, rising to 1,060 m (3,480 ft) above mean sea level, forms the southwestern boundary of the site (DOE 1995a:4-33). Gable Mountain and Gable Butte are the highest land forms within the site, rising approximately 60 m (200 ft) and 180 m (590 ft), respectively. The Columbia River flows through the northern part of the site and, turning south, forms part of the eastern site boundary. White Bluffs, steep whitish-brown bluffs adjacent to the Columbia River and above the northern boundary of the river in this region, are a striking feature of the landscape (Neitzel 1996:4.125).

Typical of the regional shrub-steppe desert, the site is dominated by widely spaced, low-brush grasslands. A large area of unvegetated, mobile sand dunes extends along the east boundary, and unvegetated blowouts are scattered throughout the site. Hanford is characterized by mostly undeveloped land, with widely spaced clusters of industrial buildings along the southern and western banks of the Columbia River and at several interior locations.

The adjacent visual landscape consists primarily of rural rangeland and farms; the city of Richland, part of the Tri-Cities area, is the only adjoining urban area. Viewpoints affected by DOE facilities are primarily associated with the public access roadways (including State Routes 24 and 240, Hanford Road, Horn Rapids Road, Route 4 South, and Steven Drive), the bluffs, and the northern edge of the city of Richland. The Energy Northwest (formerly WPPSS) nuclear reactors and DOE facilities are brightly lit at night and are highly visible from many areas. Developed areas are consistent with a Visual Resource Management (VRM) Class IV designation, while the remainder of the Hanford Site ranges from VRM Class III to Class IV (DOI 1986a, 1986b).

Site facilities across Hanford can be seen from elevated locations (e.g., Gable Mountain), a few public roadways (State Routes 24 and 240), and the Columbia River. State Route 24 provides public access to the northern portion of the site. The height of structures ranges from about 3 to 30 m (10 to 100 ft), with a few stacks and towers that reach 60 m (200 ft). Viewsheds along this highway include limited views of the Columbia River where the road drops down into the river valley. A turnout on State Route 24 along the north side of the river offers views of the river and B- and C-Reactors. A rest stop along the road to the south of the river provides views of the Umtanum Ridge to the west, the Saddle Mountains to the north, and the Columbia River valley to the east and west (DOE 1996b:4-96). State Route 240 provides public access to the southwestern portion of the Hanford Site. Viewsheds along this highway include the flat, open lands of the Arid Lands Ecology Reserve in the foreground to the west, with the prominent peaks of Rattlesnake Mountain and the extended ridgelines of the Rattlesnake Hills in the background. From the highway, views are expansive due to the flat terrain, with Saddle Mountain in the distance to the north and steam plumes from the Energy Northwest reactor cooling towers often visible in the distance to the east. Views of DOE facilities from the surface of the Columbia River are generally blocked by high riverbanks; however, steam plumes from the Energy Northwest facility are visible.

3.2.10.2.2 Proposed Facility Locations

Facilities in the 200 East Area are in the interior of the Hanford Site and cannot be seen from the Columbia River or State Route 24. Views to the east from State Route 240 include fairly flat terrain, with the structures of the 200 East and 200 West Areas in the middle ground with Gable Butte and Gable Mountain visible in the background. Developed areas within the 200 East Area are consistent with a VRM Class IV designation. Natural features of visual interest within a 40-km (25-mi) radius include the Columbia River at 10 km (6.2 mi), Gable Butte at 10 km (6.2 mi), Rattlesnake Mountain at 14 km (8.7 mi), and Gable Mountain at 5.3 km (3.3 mi).

FMEF, the tallest building in the 400 Area, is 30 m (100 ft) tall and can be seen from State Route 240. Developed areas within the 400 Area are consistent with a VRM Class IV designation (DOI 1986a, 1986b). Natural features of visual interest within a 40-km (25-mi) radius include the Columbia River at 6.8 km (4.2 mi), Gable Butte at 27 km (17 mi), Rattlesnake Mountain at 17 km (11 mi), and Gable Mountain at 19 km (12 mi) (Mecca 1997a:18).

3.2.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.2.11.1 General Site Description

Hanford has numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in Table 3–12.

Table 3–12. Hanford Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	420	420
Railroads (km)	204[a]	204[a]
Electricity		
Energy consumption (MWh/yr)	323,128	2,484,336
Peak load (MW)	60.7	283.6
Fuel		
Natural gas (m^3/yr)	459,200	20,804,000
Oil (l/yr)	9,334,800	14,775,000[b]
Coal (t/yr)	NA[c]	NA[c]
Water (l/yr)	2,754,000,000	8,263,000,000

[a] DOE is in the process of discontinuing rail service to most of Hanford (see Section 3.2.11.1.1).
[b] As supplies get low, more can be supplied by truck or rail.
[c] See Section 3.2.1.1.1.
Key: NA, not applicable.
Source: Teal 1997:4.

3.2.11.1.1 Transportation

Hanford has a network of paved roads, with 104 km (65 mi) of the 420 km (261 mi) of these roads accessible to the public. The site is crossed by State Route 240, which is the main route traveled by the public. Most onsite employees travel Route 4, the primary highway from the Tri-Cities area to most Hanford outer work locations. A recently constructed access road between State Route 240 and the 200 West Area has alleviated peak traffic congestion on Route 4. Access to the outer areas (100 and 200 Areas) is controlled by DOE at the Yakima, Wye, and Rattlesnake barricades (DOE 1996a:3-26; Mecca 1997a:126).

Onsite rail transport to Hanford is provided by a short-line railroad. Hanford's railroad is a Class III Railroad System, as defined by the Federal Railroad Administration. Its common carrier tie is with the Union Pacific Railroad in Richland (DOE 1996a:3-26; Mecca 1997a:126). The site railroad is in transition from DOE ownership to the Port of Benton with a planned date of October 1, 1998. At that time only the southern portion of the rail line that is connected to and serviced by Union Pacific would be transferred. It is expected that the Port of Benton will also have track rights as far north as the Energy Northwest (formerly WPPSS) reactors. By September 30, 1998, DOE rail operations will be discontinued. There are no current plans for service north of the Energy Northwest reactor site (Sandberg 1998a).

3.2.11.1.2 Electricity

Most site electric power is purchased from the Bonneville Power Administration and routed through substations and switching stations in a manner that provides supply redundancy on the electrical transmission and distribution systems. Bonneville Power Administration electric power is provided to three distinct systems on the Hanford Site, the 100/200 Area System, the 300 Area System, and the 400 Area System (Mecca 1997a:137). Power for the 700, 1100, and 3000 Areas is provided by the city of Richland (DOE 1996b:4-93).

3.2.11.1.3 Fuel

Natural gas, provided by the Cascade Natural Gas Corporation, is used in a few locations at Hanford. Fuel oil and propane are also used in some areas. Oil capacity is only limited by the number of deliveries by truck (DOE 1996a:3-27).

3.2.11.1.4 Water

The Columbia River is the primary source of raw water for Hanford. Average annual river flow through the site is approximately 203 million l/min (54 million gal/min) (Mecca 1997a:126). The Export Water System supplies raw river water to the 100-B, 100-D, 200 East, 200 West, and 251-W potable water filtration and treatment systems. Daily pumping averages about 72 million l/day (19 million gal/day) (Rohl 1994:2-2). Wells supply water to the 400 Area and a variety of low-use facilities at remote locations (Mecca 1997a:126).

3.2.11.1.5 Site Safety Services

The Hanford fire department operates four fire stations within the Hanford Site. The stations are strategically located to ensure minimum response time to all facilities. The fire department also provides the site with ambulance, emergency medical technicians, and advanced first aid-certified firefighters (Mecca 1997a:154).

3.2.11.2 Proposed Facility Locations

A summary of the infrastructure characteristics of the 200 East Area and the 400 Area's FMEF is shown in Table 3–13.

Table 3–13. Hanford Infrastructure Characteristics for 200 East Area and FMEF

	200 East Area		FMEF	
Resource	**Current Usage**	**Capacity**	**Current Usage**	**Capacity**
Electricity				
Energy consumption (MWh/yr)	66,671	345,000	7,300	61,000
Peak load (MW)	16.6	40.0	4.1	26.6
Fuel				
Natural gas (m^3/yr)	NA	NA	NA	NA
Oil (l/yr)	7,294,220[a]	NA[b]	760	18,900[b]
Coal (t/yr)	NA	NA	NA	NA
Water (l/yr)	688,600,000	2,596,000,000	41,690,000	397,950,000

[a] See Sandberg 1998c.

[b] As supplies get low, more can be supplied by truck or rail.

Key: FMEF, Fuels and Materials Examination Facility; NA, not applicable.

Source: Teal 1997:4.

3.2.11.2.1 Electricity

Power to the 100/200 Area electrical system is provided from two sources, the Bonneville Power Administration Midway substation at the northwestern site boundary, and a transmission line from the Bonneville Power Administration Ashe substation. The 100/200 Area electrical system consists of about 80 km (50 mi) of 230-kV transmission lines, six primary substations, about 217 km (135 mi) of 13.8-kV distribution lines, and 124 secondary substations. The 100/200 Area transmission and distribution systems, as with the Bonneville Power Administration source lines, have redundant routings to ensure electrical service to individual areas and designated facilities within those areas (Mecca 1997a:137). The substation providing power to the 200 Area has a peak load capacity of 40 MW (Teal 1997:4).

Primary electric power to the 400 Area is provided by two 115-kV Bonneville Power Administration transmission lines, one from the Bonneville Power Administration Benton substation and the second from the Bonneville Power Administration White Bluffs substation. There is one 13.8-kV tie line from the 300 Area to the 400 Area emergency power system that also provides alternate power for maintenance outages. Redundancy in the distribution lines to designated facilities ensures continuity of service and rerouting of power for maintenance of system components. The approximate lengths of distribution lines in the 400 Area are as follows: 13.8-kV lines, 7.3 km (4.5 mi); 2.4-kV lines, 518 m (1,700 ft); and 480-V lines, 14.6 km (9.1 mi). There are two substations in the 400 Area: 451A, which serves FFTF reactor and associated buildings, and 451B, which serves FMEF and associated buildings (Mecca 1997a:168, 169). The peak load capacity for FMEF is 26.6 MW and the current usage is 4.1 MW (Teal 1997:4).

3.2.11.2.2 Fuel

Coal-fire steam generation facilities have been shut down at Hanford. The conversion to oil-fired sources was completed in 1998 (see Section 3.2.1.1.1). Fuel usage at 200 Area would be about 7,294,220 l/yr (1,926,935 gal/yr) (Sandberg 1998c). Fuel usage and capacity at FMEF are 760 l/yr (201 gal/yr) and 18,900 l/yr (4,993 gal/yr), respectively (Teal 1997:4).

3.2.11.2.3 Water

The 200 East Area is the major consumer of raw water delivered via the Export Water System. That water is received at the 11.4-million-l (3-million-gal) 282-E Reservoir at a capacity of 9,842 l/min (2,600 gal/min). Monthly average potable water flow in the 200 East Area ranges between 3,028 and 3,312 l/min (800 and 875 gal/min). Daily average flow can vary widely, depending primarily on area activity (Rohl 1994:2-5, 2-6).

The 400 Area receives water from three underground deep-water wells. Each of these wells has a pumping capacity of 833 l/min (220 gal/min). Water is pumped to three aboveground storage tanks that have a combined capacity of 3,028,320 l (800,000 gal). The observed flow ranges from 681 l/min (180 gal/min) during the summer months to 284 l/min (75 gal/min) during the winter months (Rohl 1994:2-7).

3.3 INEEL

INEEL is in southeastern Idaho and is 55 km (34 mi) west of Idaho Falls, 61 km (38 mi) northwest of Blackfoot, and 35 km (22 mi) east of Arco (see Figure 2–3). The site has about 445 km (277 mi) of roads, both paved and unpaved, and 48 km (30 mi) of railroad track (DOE 1996a:3-104).

There are 450 buildings and 2,000 support structures at INEEL with more than 279,000 m^2 (3 million ft^2) of floor space in varying conditions of utility. INEEL has approximately 25,100 m^2 (270,000 ft^2) of covered warehouse space and an additional 18,600 m^2 (200,000 ft^2) of fenced yard space. The total area of the various machine shops is 3,035 m^2 (32,665 ft^2) (DOE 1996a:3-104).

There have been 52 research and test reactors at INEEL used over the years to test reactor systems, fuel and target design, and overall safety. In addition to its nuclear reactor research, other INEEL facilities are operated to support reactor operations. These facilities include HLW and LLW processing and storage sites, hot cells, analytical laboratories, machine shops, laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for LLW and TRU waste. Until 1992, spent reactor fuels were reprocessed at INTEC to recover enriched uranium and other isotopes. Due to a DOE decision to terminate spent fuel reprocessing, INTEC was transferred to the DOE Office of Environmental Management program for disposition. INTEC contains the new Waste Calcining Facility, which processes liquid HLW streams to a calcined solid (granular form). Beginning in the early part of the next century, a waste immobilization facility will convert the calcined solids into a glass or ceramic for disposal in a Federal repository. Additionally, miscellaneous spent fuel from both DOE and commercial sources is scheduled for interim storage at INTEC. Within the existing security perimeter, the Fuel Processing Facility (FPF) is a special nuclear material storage and processing facility that is 95 percent complete and has never been operated (DOE 1996a:3-104).

DOE activities at INEEL have been divided among eight distinct and geographically separate function areas as listed in Table 3–14.

DOE Activities. Environmental management activities include R&D for waste processing at the Power Burst Facility and providing waste management expertise to the Radioactive Waste Management Complex. The Power Burst Facility performs R&D for waste reduction programs and the Boron Neutron Capture Therapy Program. Waste management efforts at INEEL are directed toward safe and environmentally sound treatment, storage, and disposal of radioactive, hazardous, and sanitary waste. Major waste reduction facilities include the Waste Engineering Development Facility, the Waste Experimental Reduction Facility, and the Mixed Waste Storage Facility (DOE 1996a:3-104).

The following additional DOE activities are at INEEL:

- The Test Area North complex consists of several experimental reactors and support facilities conducting R&D activities on reactor performance. These facilities include the technical support facility, the containment test facility, the water reactor research test facility, and the inertial engine test facility. The inertial engine test facility has been abandoned, and no future activities are planned. The remaining facilities support ongoing programs.

- Materials testing and environmental monitoring activities were conducted in the Auxiliary Reactor Area. The facilities in this area are scheduled for decontamination and decommissioning.

Table 3–14. Current Missions at INEEL

Mission	Description	Sponsor
Argonne National Laboratory–West	Conduct research and develop technology to deal with nuclear issues such as stabilization of spent nuclear fuel; development and qualification of high-level nuclear waste forms; characterization, treating and stabilization of mixed waste to allow disposal; nuclear facility decommissioning; and similar activities.	Office of Nuclear Energy; Assistant Secretary for Environmental Management
Radioactive Waste Management Complex	Provide waste management functions for present and future site and DOE needs.	Assistant Secretary for Environmental Management
Power Burst Area	Perform waste processing, technology research, and development; provide interim storage for hazardous wastes.	Assistant Secretary for Environmental Management
Test Area North	Perform research on spent nuclear fuel casks, and spent nuclear fuel handling systems. Perform disassembly and decommissioning of large radioactive equipment. House a project to manufacture armor packages for Army tanks.	Office of Nuclear Energy
Test Reactor Area	Perform irradiation service, develop nuclear instruments, and conduct safety programs; develop methods to meet radioactive release limits.	Office of Nuclear Energy; Office of Naval Reactors
Idaho Nuclear Technology and Engineering Center	Provide spent fuel storage and high-level waste processing.	Assistant Secretary for Environmental Management
Naval Reactors Facility	Standby facility for conducting ship propulsion reactor research and training.	Office of Naval Reactors
Central Facilities Area	Provide centralized support services for the site.	Idaho Operations Office

Source: DOE 1996a:3-105.

- The ANL–W facility area consists of several major complexes, including the Experimental Breeder Reactor II, Transient Reactor Test Facility, Zero Power Physics Reactor, Hot Fuel Examination Facility, Fuel Cycle Facility, and Fuel Manufacturing Facility. The Experimental Breeder Reactor II was used to demonstrate the integral fast reactor concept. The Transient Reactor Test Facility and the Zero Power Physics Reactor are used to conduct reactor analysis and safety experiments. The Hot Fuel Examination Facility provides inert-atmosphere containment for handling and examining irradiated reactor fuel. The Fuel Cycle Facility has been modified for the integral fast reactor program to demonstrate remote reprocessing and refabrication. The Fuel Manufacturing Facility is used to manufacture metallic fuel elements and store plutonium material.

- The Test Reactor Area contains the Advanced Test Reactor. This reactor is used for irradiation testing of reactor fuels and material properties; instrumentation for naval reactors; and production of radioisotopes in support of nuclear medicine, industrial applications, research, and product sterilization.

- The Naval Reactors Facility is operated under jurisdiction of DOE's Pittsburgh Naval Reactors Office. Included at this facility are the submarine prototypes and the expended core facility. Activities include testing of advanced design equipment and new systems for current naval nuclear propulsion plants and obtaining data for future designs.

- The Central Facilities Area provides sitewide support services, including transportation, shop services, health services, radiation monitoring, and administrative offices.

Non-DOE Activities. Non-DOE activities at INEEL include research being conducted by the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey, and various institutions of higher learning. These activities support the designation of INEEL as a National Environmental Research Park (DOE 1996a:3-106).

3.3.1 Air Quality and Noise

3.3.1.1 Air Quality

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. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.3.1.1.1 General Site Description

The climate at INEEL and the surrounding region is characterized as that of a semiarid steppe. The average annual temperature at INEEL is 5.6 EC (42 EF); average monthly temperatures range from a minimum of -8.8 EC (16.1 EF) in January to a maximum of 20 EC (68 EF) in July. The average annual precipitation at INEEL is 22 cm (8.7 in) (Clawson, Start, and Ricks 1989:55, 77). Prevailing winds at INEEL are southwest to west-northwest with a secondary maximum frequency from the north-northeast to northeast. The average annual windspeed is 3.4 m/s (7.5 mph) (DOE 1996a:3-112). Additional information related to meteorology and climatology at INEEL is presented in Appendix F of the *Storage and Disposition PEIS* (DOE 1996a:F-8–F-11).

INEEL is within the Eastern Idaho Intrastate AQCR #61. None of the areas within INEEL and its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997d). The nearest nonattainment area for particulate matter is in Pocatello, about 80 km (50 mi) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in Table 3–15.

The nearest PSD Class I area to INEEL is Craters of the Moon National Monument, Idaho, about 53 km (33 mi) west-southwest from the center of the site. There are no other Class I areas within 100 km (62 mi) of INEEL. PSD permits have been obtained for the coal-fired steam-generating facility next to INTEC and FPF, which is not expected to be operated (DOE 1996a:3-112).

The primary sources of air pollutants at INEEL include calcination of high-level radioactive liquid waste, combustion of coal for steam, and combustion of fuel oil for heating. Other emission sources include waste burning, coal piles, industrial processes, vehicles, and fugitive dust from burial and construction activities. Table 3–15 presents the existing ambient air concentrations attributable to sources at INEEL, which are based on maximum emissions for the year 1990. These emissions were modeled using meteorological data from 1992 (DOE 1996a:3-112–3-114). Actual annual emissions from sources at INEEL are less than these levels, and the estimated concentrations bound the actual INEEL contribution to ambient levels. Only those pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Concentrations shown in Table 3–15 attributable to INEEL are in compliance with applicable guidelines and regulations.

Measured air pollutant concentrations at INEEL air-monitoring locations during 1995 indicates an annual average nitrogen dioxide concentration of 3.8 Fg/m^3; sulfur dioxide concentrations of 15 Fg/m^3 for

Table 3–15. Comparison of Ambient Air Concentrations From INEEL Sources With Most Stringent Applicable Standards or Guidelines, 1990

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	Concentration (Fg/m^3)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	284
	1 hour	40,000[b]	614
Nitrogen dioxide	Annual	100[b]	4
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	3
	24 hours	150[b]	33
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	6
	24 hours	365[b]	135
	3 hours	1,300[b]	579
Hazardous and other toxic compounds			
Benzene	Annual	0.12[f]	0.029
[Text deleted.]			

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997a), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is #1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 Fg/m^3. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is #1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[c] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] Acceptable ambient concentration listed in *Rules for the Control of Air Pollution in Idaho*. The concentration applies only to new (not existing) sources and is used here as a reference level.

[Text deleted.]

Note: The NAAQS also include standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at INEEL, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition PEIS* (DOE 1996a). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 Fg/m^3 (0.12 ppm) to an 8-hr concentration of 157 Fg/m^3 (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997b:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-Fg/m^3 3-year annual arithmetic mean based on community-oriented monitors and a 65-Fg/m^3 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997c:38652).

Source: Abbott, Crockett, and Moor 1997:7; EPA 1997a; ID DHW 1995.

3-hr averaging, 10 Fg/m^3 for 24-hr averaging, and 2.1 Fg/m^3 for the annual average; and an annual average total suspended particulate concentration of 15 Fg/m^3 (Abbott, Crockett, and Moor 1997:7). Measured concentrations attributable to INEEL are in compliance with applicable guidelines and regulations. Additional information on ambient air quality at INEEL and detailed information on emissions of other pollutants at INEEL are provided in the *INEEL Site Environmental Report for 1995* (Mitchell, Peterson, and Hoff 1996:6-4–6-6).

3.3.1.1.2 Proposed Facility Location

The meteorological conditions for INEEL are considered to be representative of the INTEC area. Primary sources of pollutants at INTEC include the New Waste Calcining Facility and coal-fired steam-generating facilities (Mitchell, Peterson, and Hoff 1996:6-4, 6-5). These facilities are sources of carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM_{10}. The Waste Calcining Facility is a large source of nitrogen dioxide at INEEL.

3.3.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.3.1.2.1 General Site Description

Major noise emission sources within INEEL include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Most INEEL industrial facilities are far enough from the site boundary that noise levels at the boundary would not be measurable or would be barely distinguishable from background levels (DOE 1996a:3-112).

Existing INEEL-related noises of public significance are from the transportation of people and materials to and from the site and in-town facilities via buses, trucks, private vehicles, helicopters, and freight trains. Noise measurements along U.S. Route 20 about 15 m (50 ft) from the roadway indicate that the sound levels from traffic range from 64 to 86 dBA and that the primary source is buses (71 to 80 dBA) (Abbott, Brooks, and Martin 1991:64). While few people reside within 15 m (50 ft) of the roadway, the results indicate that INEEL traffic noise might be objectionable to members of the public residing near principal highways or busy bus routes. Noise levels along these routes may have decreased somewhat due to reductions in employment and bus service at INEEL in the last few years. The acoustic environment along the INEEL site boundary in rural areas and at nearby areas away from traffic noise is typical of a rural location: the average day-night average sound level is in the range of 35 to 50 dBA (EPA 1974:B-4). Except for the prohibition of nuisance noise, neither the State of Idaho nor local governments have established any regulations that specify acceptable community noise levels applicable to INEEL (DOE 1996a:F-32).

The EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near INEEL, the day-night average sound levels are compatible with the residential land use, although for some residences along major roadways noise levels may be higher than 65 dBA.

3.3.1.2.2 Proposed Facility Location

No distinguishing noise characteristics have been identified at the INTEC area. INTEC is far enough—about 12 km (7.5 mi)—from the site boundary that noise levels from the facilities are not measurable or are barely distinguishable from background levels.

3.3.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.3.2.1 Waste Inventories and Activities

INEEL manages the following types of waste: HLW, TRU, mixed TRU, LLW, mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at INEEL, and therefore, will not be discussed further. Waste generation rates and the inventory of stored waste from activities at INEEL are provided in Table 3–16. Table 3–17 summarizes the INEEL waste management capabilities. More detailed descriptions of the waste management system capabilities at INEEL are included in the *Storage and Disposition PEIS* (DOE 1996a:3-141–145, E-33–E-48) and the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995b:2.2-30).

Table 3–16. Waste Generation Rates and Inventories at INEEL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	0	39,300
Remotely handled	0	200
LLW	2,624	18,634
Mixed LLW		
RCRA	180	25,734
TSCA	<1	2
Hazardous	835[b]	NA[c]
Nonhazardous		
Liquid	2,000,000[d]	NA[c]
Solid	62,000	NA[c]

[a] Includes mixed TRU waste.
[b] Includes 760 m^3 that is recyclable.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
[d] Projected annual average generation for 1997–2006.
Key: LLW, low-level waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.
Source: DOE 1996d:15, 16, except hazardous and nonhazardous solid waste (DOE 1996a:3-142, 3-143) and nonhazardous liquid waste (Werner 1997).

EPA placed INEEL on the National Priorities List on December 21, 1989. In accordance with CERCLA, DOE entered into a consent order with EPA and the State of Idaho to coordinate cleanup activities at INEEL under one comprehensive strategy. This agreement integrates DOE's CERCLA response obligations with RCRA corrective action obligations. Aggressive plans are in place to achieve early remediation of sites that represent the greatest risk to workers and the public. The goal is to complete remediation of contaminated sites at INEEL to support delisting from the National Priorities List by 2019 (DOE 1996a:3-141). More information on regulatory requirements for waste disposal is provided in Chapter 5.

Table 3–17. Waste Management Capabilities at INEEL

Facility Name/Description	Capacity	Status	Applicable Waste Type					
			TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m^3/yr except as otherwise specified)								
INTEC HEPA Filter Leach, m^3/day	0.21	Online		X		X		
INTEC Debris Treatment and Containment, m^3/day	88	Part B permit pending		X		X		
Advanced Mixed Waste Treatment Project	6,500	Planned for 2003		X		X		
[Text deleted.]								
ANL–W Remote Treatment Facility	42	Planned for 2000	X	X	X	X		
ANL–W HFEF Waste Characterization Area	37	Online	X	X				
INTEC Waste Immobilization Facility	48	Planned for 2020		X	X	X		
INTEC Liquid Effluent Treatment and Disposal Facility	11,365	Online				X		
INTEC HLW Evaporator	6,138	Online		X	X	X		
INTEC Process Equipment Waste Evaporator	13,000	Online		X	X	X		
ANL–W Sodium Processing Facility	698	Online				X		
Test Area North Cask Dismantlement	11	Online				X		
WROC - Debris Sizing, kg/hr	1,149	Planned for 2000			X	X		
WROC - Macroencapsulation, kg/hr	2,257	Planned for 1999				X		
WROC - Stabilization, m^3/day	7.6	Online				X		
WERF	49,610	Online			X	X	X	
INTEC Cold Waste Handling Facility	3,700	Online						X
INTEC Sewage Treatment Plant	3,200,000	Online						X
Storage Facility (m^3)								
ANL–W Radioactive Sodium Storage	75	Online		X		X		
ANL–W Sodium Components Maintenance Shop	200	Online				X		
ANL–W Radioactive Scrap and Waste Storage	193	Online	X	X	X	X		

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
ANL–W EBR II Sodium Boiler Drain Tank	64	Online				X		
ANL–W HFEF Waste Characterization Area	37	Online	X	X				
INTEC Tank Farm	12,533	Online		X		X		

Table 3–17. Waste Management Capabilities at INEEL (Continued)

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
INTEC FDP HEPA Storage	25	Online		X		X		
INTEC NWCF HEPA Storage	56	Online		X		X		
INTEC CPP-1619 Storage	45	Online				X	X	
INTEC CPP-1617 Staging	8,523	Online				X	X	
[Text deleted.]								
RWMC Storage Area-1, 2, and R	64,900	Online	X	X	X[a]	X[a]		
RWMC Waste Storage	112,400	Online	X	X	X[a]	X[a]		
RWMC Intermediate-Level Storage	100	Online	X					
[Text deleted.]								
WROC PBF Mixed LLW Storage	129	Online				X	X	
Portable Storage at SPERT IV	237	Online				X	X	
PBF WERF Waste Storage Building	685	Online				X	X	
Test Area North 647 Waste Storage	104	Online				X	X	
Test Area North 628 SMC Container Storage	125	Online				X	X	
Disposal Facility(m^3/yr)								
RWMC Disposal Facility	37,700	Online			X			
CFA Landfill Complex	48,000	Online						X
Percolation Ponds	2,000,000	Online						X

[a] Waste with alpha contamination greater than 10 but less than 100 nCi/g.

Key: ANL–W, Argonne National Laboratory–West; CFA, Central Facilities Area; CPP, Chemical Processing Plant; EBR, Experimental Breeder Reactor; FDP, Fluorinel Dissolution Process; Haz, hazardous; HEPA, high-efficiency particulate air; HFEF, Hot Fuel Examination Facility; HLW, high-level waste; INTEC, Idaho Nuclear Technology and Engineering Center; LLW, low-level waste; NWCF, New Waste Calcining Facility; PBF, Power Burst Facility; RWMC, Radioactive Waste Management Complex; SMC, Specific Manufacturing Complex; SPERT, Special Power Excursion Reactor Test; TRU, transuranic; WERF, Waste Experimental Reduction Facility; WROC, Waste Reduction Operations Complex.

Source: Abbott 1998; Abbott, Crockett, and Moor 1997:20; Depperschmidt 1999; Moor 1998; Werner 1997.

3.3.2.2 Transuranic and Mixed Transuranic Waste

TRU waste generated since 1972 is segregated into contact-handled and remotely handled categories and stored at the Radioactive Waste Management Complex in a form designed for eventual retrieval (DOE 1996a:3-144). Some TRU waste is also stored at the Radioactive Scrap and Waste Facility at ANL–W (DOE 1995b:2.2-36). There is very little TRU waste generated at INEEL. Most of the TRU waste in storage was received from the Rocky Flats Environmental Technology Site (DOE 1996a:3-144). TRU waste will be treated to meet WIPP waste acceptance criteria, packaged in accordance with DOE and DOT requirements, and transported to WIPP for disposal (DOE 1996a:3-144). The first shipment of TRU waste to WIPP was made in April 1999 (DOE 1999c).

The existing treatment facilities for TRU waste at INEEL are limited to testing, characterization, and repackaging. The planned Waste Characterization Facility will characterize TRU waste and either reclassify it (if it is found to be LLW) for disposal on the site, or prepare it so that it meets WIPP waste acceptance criteria (DOE 1996a:E-35).

The Advanced Mixed Waste Treatment Project will be a private sector treatment facility. This facility shall (1) treat waste to meet WIPP waste acceptance criteria, RCRA Land Disposal Restrictions (LDR), and required Toxic Substances Control Act standards; (2) reduce waste volume and life-cycle cost to DOE; and (3) perform tasks in a safe and environmentally compliant manner (Mitchell, Peterson, and Hoff 1996:3-16). Construction of a mixed LLW Disposal Facility and Plasma Hearth Treatment Facility are being considered to support commercial treatment of mixed TRU waste and alpha-contaminated mixed LLW subject to funding restraints and additional NEPA review (DOE 1996a:E-35).

Waste containing between 10 and 100 nCi/g of transuranic radionuclides is called alpha LLW. Although this waste is technically considered LLW rather than TRU waste, it cannot be disposed of at INEEL because it does not meet all INEEL LLW disposal facility acceptance criteria. Alpha LLW and alpha mixed LLW are managed together as part of the TRU waste program. It is expected that these wastes will be treated by the Advanced Mixed Waste Treatment Project and then disposed of at WIPP (DOE 1995b:2.2-34, 2.2-35).

3.3.2.3 Low-Level Waste

Liquid LLW is either evaporated and processed to calcine or solidified before disposal (DOE 1996a:E-35). INTEC has the capability to treat aqueous LLW. Liquid LLW is concentrated at the INTEC process equipment waste evaporator, with the condensed vapor processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated materials remaining after evaporation are pumped to the INTEC tank farm (DOE 1995b:2.2-39). Some small volumes of liquid LLW are solidified at the Waste Experimental Reduction Facility for disposal at the Radioactive Waste Management Complex. In addition, small volumes of aqueous LLW are discharged to the double-lined pond at the Test Reactor Area for evaporation (DOE 1995b:2.2-39).

Most solid LLW at INEEL is sent to the Waste Experimental Reduction Facility for treatment by incineration, compaction, size reduction, or stabilization before shipment for disposal at the Radioactive Waste Management Complex or offsite disposal facilities (Werner 1997). Disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex (DOE 1995b:2.2-39). About 40 percent of the LLW generated at INEEL (that contain less than 10 nCi/g of radioactivity) is buried in shallow trenches; the remaining 60 percent at the Radioactive Waste Management Complex following treatment for volume reduction. Additionally, some LLW is shipped off the site to be incinerated, and the residual ash is returned to INEEL for disposal. The Radioactive Waste Management Complex is expected to be filled to capacity by the year 2030 (Mitchell, Peterson, and Hoff 1996:3-26), although some proposals would close the LLW Disposal Facility by 2006 (DOE 1998d:B-4).

3.3.2.4 Mixed Low-Level Waste

Mixed LLW is divided into two categories for management purposes: alpha mixed LLW and beta-gamma mixed LLW. Most of the alpha mixed LLW stored at INEEL is waste that has been reclassified from mixed TRU waste and is managed as part of the TRU waste program. Therefore, this section deals only with beta-gamma mixed LLW (DOE 1995b:2.2-39, 2.2-40).

Mixed LLW, including polychlorinated biphenyls–contaminated LLW, is stored in several onsite areas awaiting the development of treatment methods (DOE 1996a:3-144). Mixed LLW is stored at the Mixed Waste Storage Facility (or Waste Experimental Reduction Facility Waste Storage Building) and portable storage units at the Power Burst Facility area. In addition, smaller quantities of mixed LLW are stored in various facilities at INEEL including the Hazardous Chemical/Radioactive Waste Facility at INTEC, and the Radioactive Sodium Storage Facility and Radioactive Scrap and Waste Storage Facility at ANL–W (DOE 1995b:2.2-41). Although mixed wastes are stored in many locations at INEEL, the bulk of that volume is solid waste stored at the Radioactive Waste Management Complex (DOE 1996a:E-39).

Aqueous mixed LLW is concentrated at INTEC. The condensate from the waste evaporator is then processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated material remaining after evaporation (mixed LLW) is pumped to the INTEC tank farm for storage (DOE 1995a:2.2-42, 2.2-43).

As part of the site treatment plans required by the FFCA, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed LLW (DOE 1995b:2.2-42). Mixed LLW is or will be processed to RCRA LDR treatment standards through several treatment facilities. Those treatment facilities and operational status are: (1) Waste Experimental Reduction Facility Incinerator (operational), (2) Waste Experimental Reduction Facility Stabilization (operational), (3) Test Area North cask dismantlement (operational), (4) Sodium Process Facility (operational), (5) High-Efficiency Particulate Air (HEPA) Filter Leach (operational), (6) Waste Reductions Operations Complex Macroencapsulation (October 1999), (7) Waste Reduction Operations Complex Mercury Retort (March 2000), (8) Debris Treatment (September 2000), and (9) Advanced Mixed Waste Treatment Project (March 2003). Commercial treatment facilities are also being considered, as appropriate (Werner 1997). Currently, limited amounts of mixed LLW are disposed of at Envirocare of Utah (Werner 1997).

3.3.2.5 Hazardous Waste

About 1 percent of the total waste generated at INEEL is hazardous waste. Most of the hazardous waste generated annually at INEEL is transported off the site for treatment and disposal (DOE 1995b:2.2-45). Offsite shipments are surveyed to determine that the wastes have no radioactive content (are not mixed waste) (DOE 1996a:3-145). Highly reactive or unstable materials, such as waste explosives, are addressed on a case-by-case basis and are either stored, burned, or detonated as appropriate (DOE 1995b:2.2-46).

3.3.2.6 Nonhazardous Waste

More than 94 percent of the waste generated at INEEL is classified as industrial waste and is disposed of on the site in a landfill complex in the Central Facilities Area and at the Bonneville County landfill (DOE 1995b:2.2-47). The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste (Werner 1997). The onsite landfill is 4.8 ha (12 acres) and is being expanded by 91 ha (225 acres) to provide capacity for at least 30 years (DOE 1996a:3-145).

The Cold Waste Handling Facility was recently put into operation at INTEC. This system allows increased volumes of nonhazardous waste to be inspected, recycled, shredded, compacted, and segregated, thereby reducing the amount of material sent to disposal (Mitchell, Peterson, and Hoff 1996:3-24).

Sewage is disposed of in surface impoundments in accordance with terms of the October 7, 1992, consent order. Waste in the impoundments is allowed to evaporate; the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible (DOE 1996a:3-145). Nonhazardous service wastewater generated at INTEC is disposed to percolation ponds at a flow rate of 3.8 million to 7.6 million l/day (1 million to 2 million gal/day) (Werner 1997). The INTEC sanitary sewer system collects and transfers sanitary waste to the sewage treatment lagoons east of INTEC for treatment and disposal. This system has a capacity of 3,200,000 m^3/yr (4,190,000 yd^3/yr) (Abbott, Crockett, and Moor 1997:20).

3.3.2.7 Waste Minimization

The DOE Idaho Operations Office has an active waste minimization and pollution prevention program to reduce the total amount of waste generated and disposed of at INEEL. This is accomplished by eliminating waste through source reduction or material substitution; by recycling potential waste materials that cannot be minimized or eliminated; and by treating all waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The DOE Idaho Operations Office published its first waste minimization plan in 1990, which defined specific goals, methodology, responsibility, and achievements of programs and organizations. The achievements and progress have been updated at least annually (DOE 1996a:E-33).

The INEEL waste minimization program has significantly reduced the quantities of hazardous waste generated at INEEL. For example, in 1992, 760 m^3 (994 yd^3) of hazardous waste was recycled. Recyclable hazardous materials include metals (such as bulk lead, mercury, chromium), solvents, fuel, and other waste materials (DOE 1995b:2.2-45). Soon the use of nonhazardous chemicals and the recycling of those for which there is no substitute should nearly eliminate the generation of hazardous waste (DOE 1996a:E-39).

Another goal of the INEEL waste minimization program is to reduce nonhazardous waste generation by 50 percent over the next 5 years (DOE 1996a:3-145). During 1993–1995, INEEL recycled more than 680,400 kg (1.5 million lb) of paper and cardboard (Mitchell, Peterson, and Hoff 1996:3-26). Efforts are also under way to expand the recycling program to include asphalt and metals and to convert scrap wood into mulch (DOE 1995b:2.2-48).

3.3.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 97) are shown in Table 3–18 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at INEEL and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a), with the hazardous waste ROD issued on August 5, 1998 (DOE 1998b). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at WIPP. Each DOE site that has, or will generate, TRU waste will, as needed, prepare and store its TRU waste on the site. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own hazardous waste on the site in existing facilities where this is economically favorable. More detailed information and DOE's alternatives for the future configuration of waste management facilities at INEEL is presented in the WM PEIS, and the hazardous waste and TRU waste RODs.

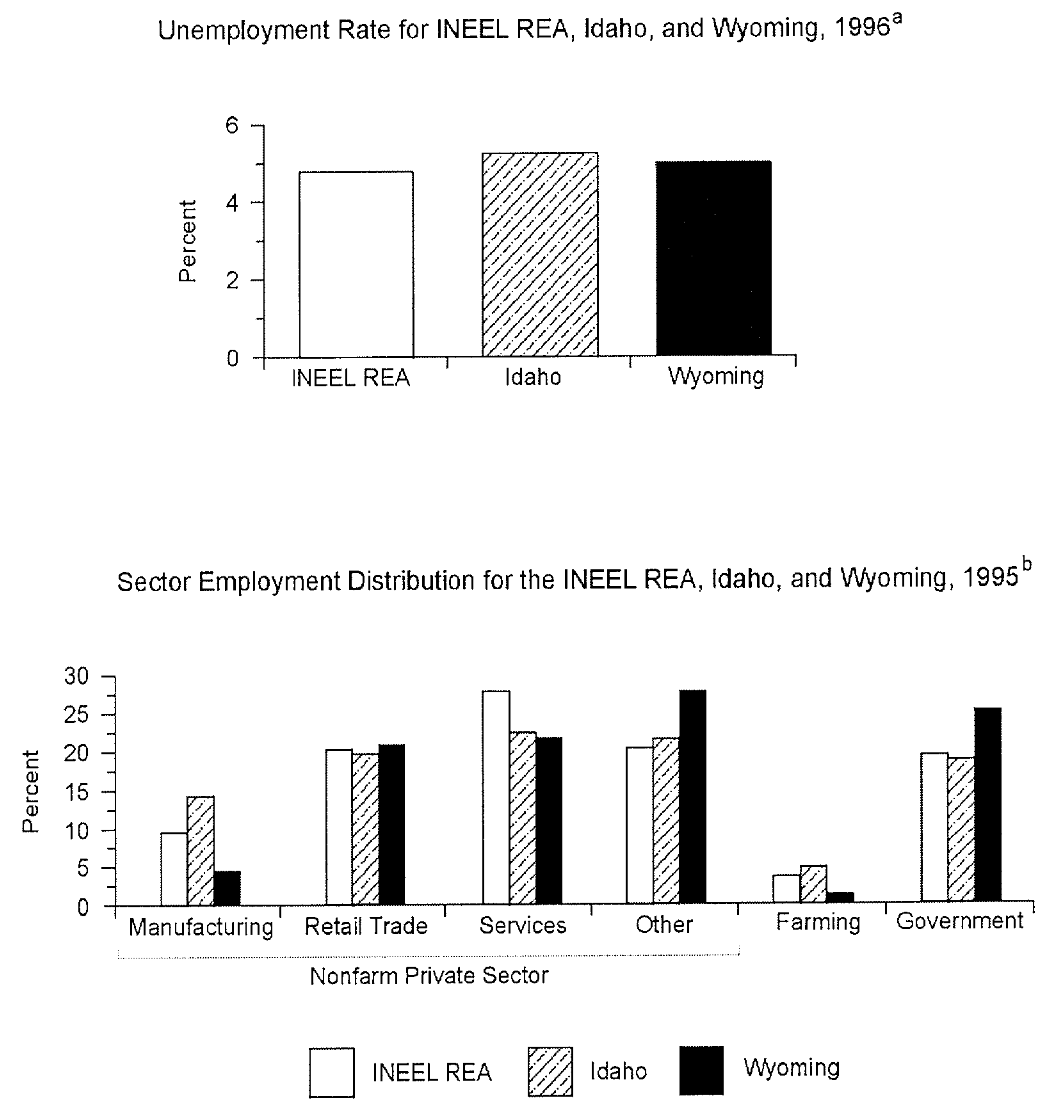
3.3.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA as defined in Appendix F.9, which encompasses 13 counties around INEEL located in Idaho and Wyoming. Statistics for population, housing, community services, and local transportation are presented for the ROI, a four-county area (in Idaho) in which 94.4 percent of all INEEL employees reside as shown in Table 3–19. In 1997, INEEL employed 8,291 persons (about 5.5 percent of the REA civilian labor force) (Werner 1997).

3.3.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the INEEL REA, Idaho, and Wyoming are summarized in Figure 3–10. Between 1990 and 1996, the civilian labor force in the REA increased 26 percent to the 1996 level of 150,403. In 1996, the annual unemployment average in the REA was 4.8 percent, which was slightly less than the annual unemployment average for Idaho (5.2 percent) and Wyoming (5 percent) (DOL 1999).

In 1995, service activities represented the largest sector of employment in the REA (27.1 percent). This was followed by retail trade (20.4 percent), and government (19.5 percent). The totals for these employment sectors



[a]DOL 1999.
[b]DOL 1997.

REA Regional economic area

Figure 3–10. Employment and Local Economy for the INEEL Regional Economic Area and the States of Idaho and Wyoming

Table 3–18. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers the regionalized alternative for treatment and storage of INEEL's TRU waste. Under this alternative, some TRU waste could be received from RFETS for treatment.[a]
LLW	DOE prefers to treat INEEL's LLW on the site. INEEL could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at INEEL. This includes the onsite treatment of INEEL's wastes and could include treatment of some mixed LLW generated at other sites. INEEL could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.[b]

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ."

[b] ROD for hazardous waste (DOE 1998b) selected the preferred alternative at INEEL.

Key: LLW, low-level waste; RFETS, Rocky Flats Environmental Technology Site; TRU, transuranic.

Source: DOE 1997a:summary, 97.

Table 3–19. Distribution of Employees by Place of Residence in the INEEL Region of Influence, 1997

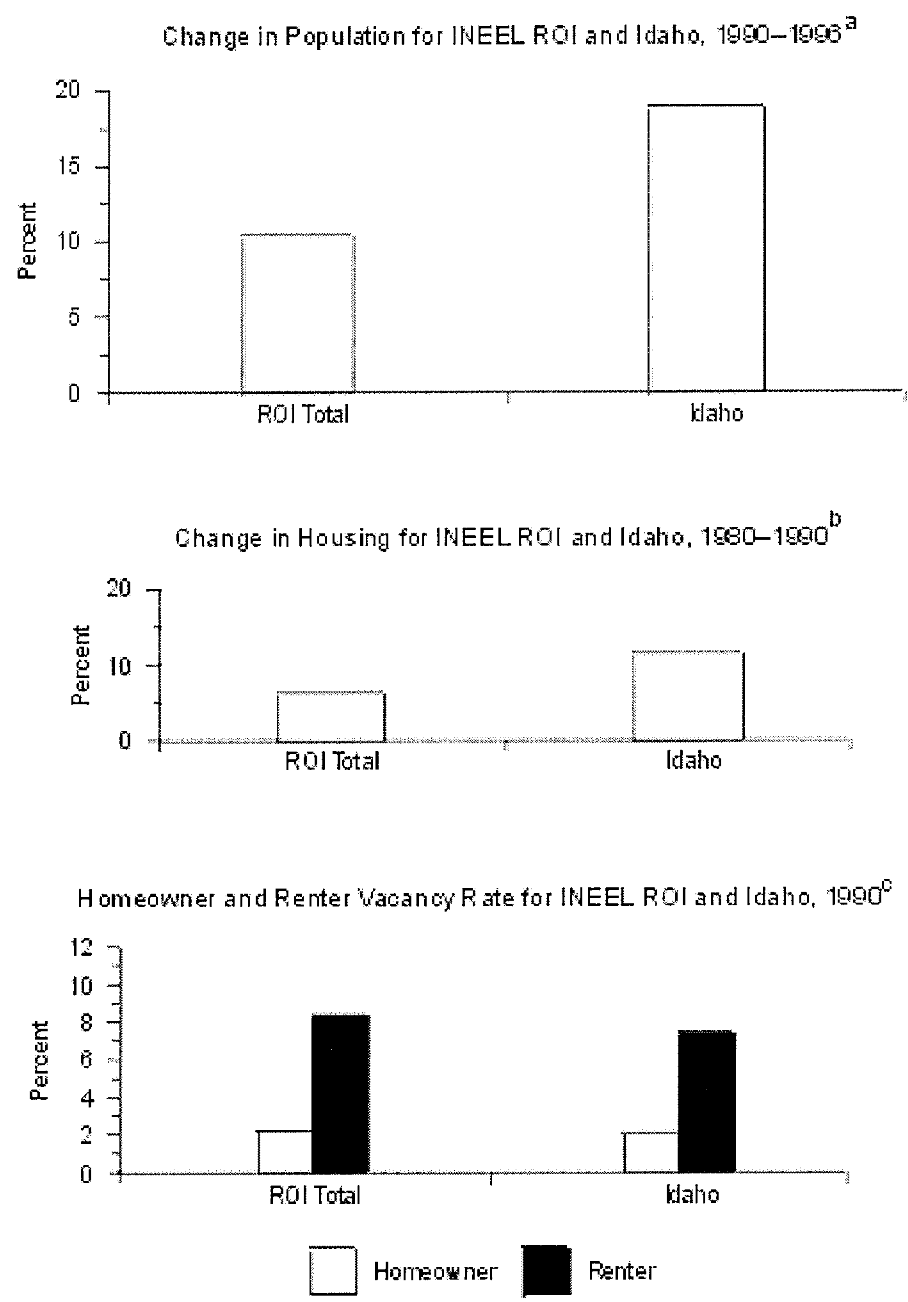
County	Number of Employees	Total Site Employment (Percent)
Bonneville	5,553	67
Bingham	1,077	13
Bannock	615	7.4
Jefferson	583	7
ROI total	7,828	94.4

Source: Werner 1997.

in Idaho were 21.5 percent, 19.6 percent, and 18.7 percent, respectively. The totals for these employment sectors in Wyoming were 21.1 percent, 20.8 percent, and 25 percent, respectively (DOL 1997).

3.3.3.2 Population and Housing

In 1996, the ROI population totaled 213,547. Between 1990 and 1996, the ROI population increased by 10.6 percent, compared with an 17.5 percent increase in Idaho's population (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by 6.7 percent, compared with the 10.2 percent increase in Idaho. The total number of housing units in the ROI for 1990 was 69,760 (DOC 1994). The 1990 ROI homeowner vacancy rate was 2.1 percent compared with the Idaho's rate of 2.0 percent. The ROI renter vacancy rate was 8.3 percent compared with the Idaho's rate of 7.3 percent (DOC 1990a). Population and housing trends are displayed in Figure 3–11.



[a] DOC 1997.
[b] DOC 1994.
[c] DOC 1990a.

ROI Region of Influence

Figure 3–11. Population and Housing for the INEEL Region of Influence and the State of Idaho

3.3.3.3 Community Services

3.3.3.3.1 Education

Thirteen school districts provide public education services and facilities in the INEEL ROI. As shown in Figure 3–12, they operated at between 50 percent (Swan Valley District) and 100 percent (Shelley District) capacity in 1997. In 1997, the average student-to-teacher ratio for the INEEL ROI was 18.8:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Idaho was 12.8:1 (DOC 1990b, 1994).

3.3.3.3.2 Public Safety

In 1997, a total of 475 sworn police officers were serving the four-county ROI. In 1997, the average ROI officer-to-population ratio was 2.2 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.6 officers per 1,000 persons (DOC 1990b). In 1997, 560 paid and volunteer firefighters provided fire protection services in the INEEL ROI. The average firefighter-to-population ratio in the ROI in 1997 was 2.6 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 1.2 firefighters per 1,000 persons (DOC 1990b). Figure 3–13 displays the ratio of sworn police officers and firefighters to the population for the INEEL ROI.

3.3.3.3.3 Health Care

In 1996, a total of 329 physicians served the ROI. The average ROI physician-to-population ratio was 1.5 physicians per 1,000 persons as compared with a 1996 State average of 1.7 physicians per 1,000 persons (Randolph 1997). In 1997, there were five hospitals serving the four-county ROI. The hospital bed-to-population ratio averaged 4.6 hospital beds per 1,000 persons (Nemeth 1997c). This compares with the 1990 State average of 3.3 beds per 1,000 persons (DOC 1996:128). Figure 3–13 displays the ratio of hospital beds and physicians to the population for all the counties in the INEEL ROI.

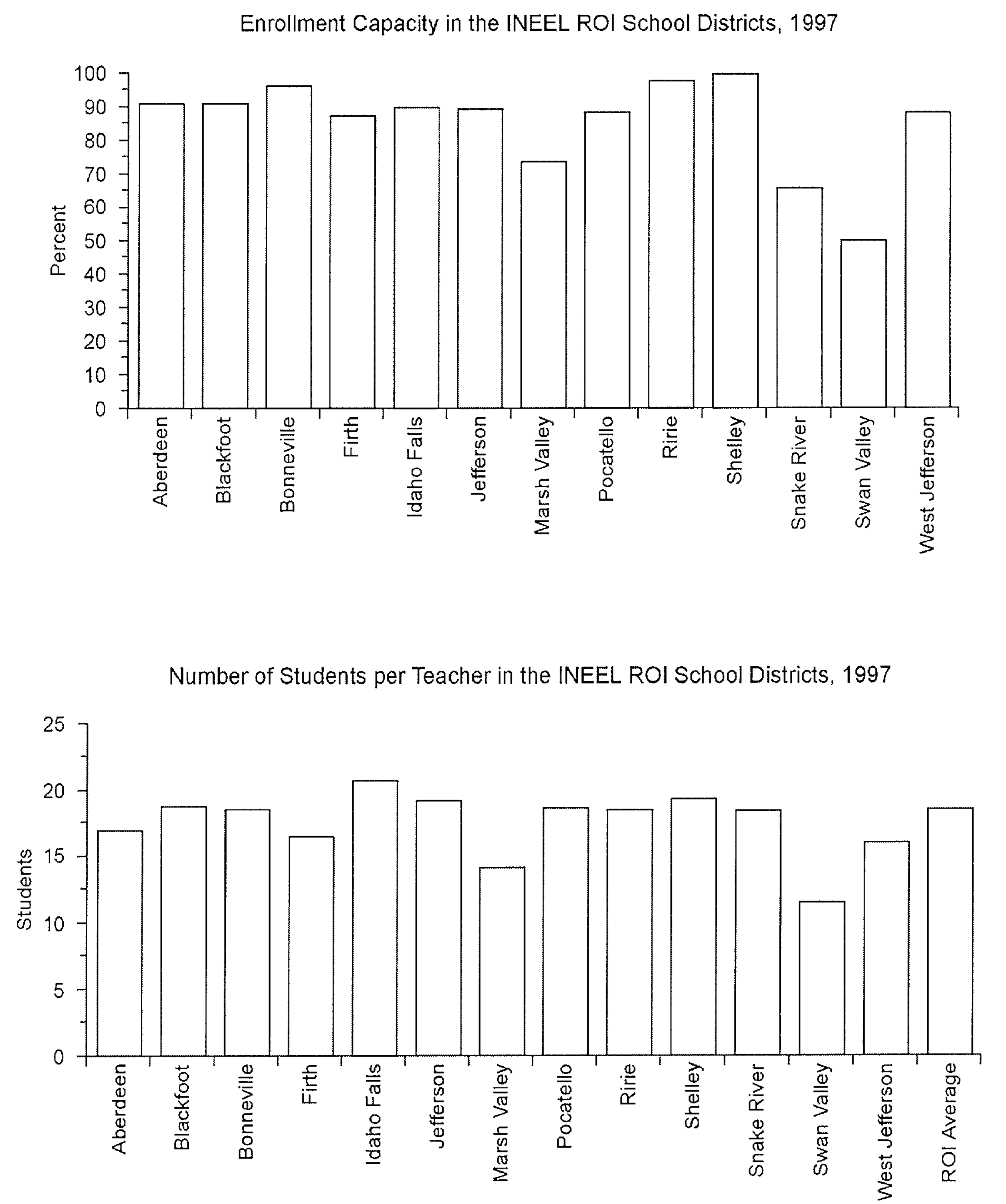
3.3.3.4 Local Transportation

Vehicular access to INEEL is provided by U.S. Routes 20 and 26 to the south and State Routes 22 and 33 to the north. U.S. Routes 20 and 26 and State Routes 22 and 33 all share rights-of-way west of INEEL (see Figure 2–3).

There are two road segments that could be affected by the disposition alternatives: U.S. Route 20 from U.S. Routes 26 and 91 at Idaho Falls to U.S. Route 26 East and U.S. Routes 20 and 26 from U.S. Route 26 East to State Routes 22 and 33.

There are no current road improvement projects affecting access to INEEL; however, there are two planned road improvement projects that could affect future access to INEEL. There are plans to resurface State Route 33 from the intersection of State Routes 28 and 33 to 13 km (8.1 mi) east of this intersection. There are also plans for routine paving of segments along State Route 28 from now until the year 2000 (Bala 1997).

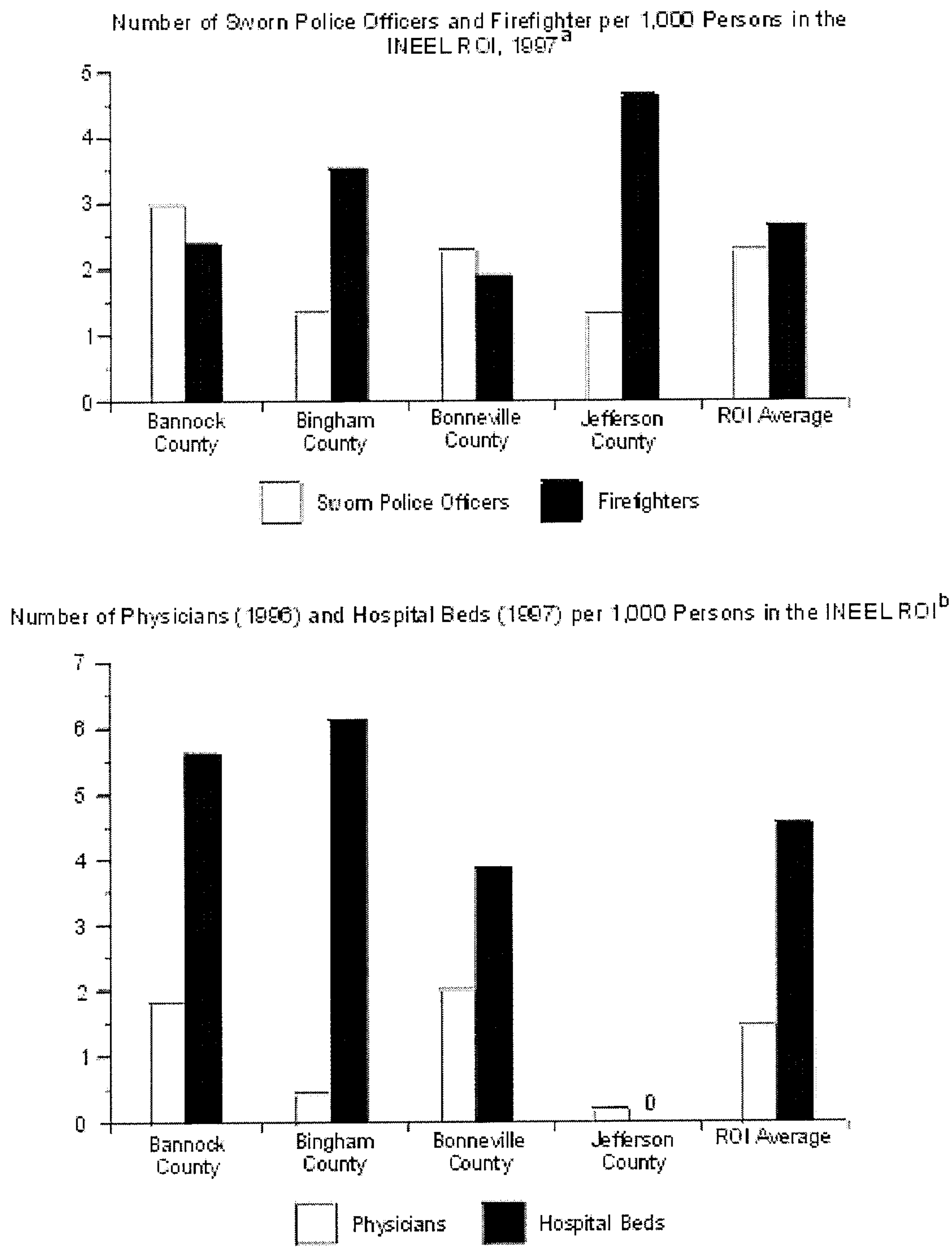
DOE shuttle vans provide transportation between INEEL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the ROI is the Union Pacific Railroad. The railroad's Blackfoot-to-Arco Branch provides rail service to the southern portion of INEEL. A DOE-owned spur connects the Union Pacific Railroad to INEEL by a junction at Scovill Siding. There are no navigable waterways within the ROI capable of accommodating waterborne transportation of material shipments to INEEL. Fanning Field in Idaho Falls



Source: Nemeth 1997a.

ROI Region of influence

Figure 3–12. School District Characteristics for the INEEL Region of Influence



[a] Kemeh 1997b.
[b] Kemeh 1997c; Randolph 1997.

ROI Region of Influence

Figure 3–13. Public Safety and Health Care Characteristics for the INEEL Region of Influence

and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service for both national and local carriers. Numerous smaller private airports are located throughout the ROI (DOE 1996a).

3.3.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.3.4.1 Radiation Exposure and Risk

3.3.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of INEEL are shown in Table 3–20. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to INEEL operations.

Table 3–20. Sources of Radiation Exposure to Individuals in the INEEL Vicinity Unrelated to INEEL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation[a]	
Cosmic radiation	48
External terrestrial radiation	73
Internal terrestrial/cosmogenic radiation	40
Radon in homes (inhaled)	200[b]
Other background radiation[c]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	426

[a] Mitchell et al. 1997:4-21.

[b] An average for the United States.

[c] NCRP 1987:11, 40, 53.

Releases of radionuclides to the environment from INEEL operations provide another source of radiation exposure to individuals in the vicinity of INEEL. Types and quantities of radionuclides released from INEEL operations in 1996 are listed in *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996* (Mitchell et al. 1997:7-4, 7-5). The doses to the public resulting from these releases are presented in Table 3–21. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEEL operations in 1996 is estimated to be 1.6×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of INEEL operations is less than 2 in 100 million. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

Table 3–21. Radiation Doses to the Public From Normal INEEL Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	10	0.031	4	0	100	0.031
Population within 80 km (person-rem)[b]	None	0.24	None	0	100	0.24
Average individual within 80 km (mrem)[c]	None	0.0020	None	0	None	0.0020

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.

[b] About 121,500 in 1996.

[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.

Source: Mitchell, Peterson, and Hoff 1996:4-48.

According to the same risk estimator, 1.2×10^{-4} excess fatal cancer is projected in the population living within 80 km (50 mi) of INEEL from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1996 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected during 1995 from all causes in the population living within 80 km (50 mi) of INEEL was 243. This expected number of fatal cancers is much higher than the 1.2×10^{-4} fatal cancer estimated from INEEL operations in 1996.

INEEL workers receive the same doses as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–22 presents the average dose to the individual worker and the cumulative dose to all workers at INEEL from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[4] (Appendix F.10), the number of projected fatal cancers among INEEL workers from normal operations in 1996 is 0.082.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1996* (Mitchell et al. 1997). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

3.3.4.1.2 Proposed Facility Location

External radiation doses and concentrations of gross alpha, plutonium, and americium in air have been measured in the INTEC area. In 1996, the annual average dose along the boundary of INTEC was about 180 mrem. If radiation from the "hot spots" along this boundary (e.g., the tree farm) is not included, the dose is reduced to about 150 mrem. This is about 20 mrem higher than the average dose measured at the offsite control locations. Concentrations in air of gross alpha, plutonium 239/240, and americium 241 in 1995 were 5×10^{-4} pCi/m^3, 2.1×10-

[4] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

^{5} pCi/m^3, and 6×10^{-6} pCi/m^3, respectively. The gross alpha value was about three times lower than that measured at the offsite control locations, and the plutonium 239/240 and americium 241 values were each about 50 percent higher. In 1996, the concentration of gross alpha was about 1×10^{-3} pCi/m^3 in the INTEC area. No measurements of plutonium or americium in air were reported in this area in 1996 (Mitchell, Peterson, and Hoff 1996:4-10, 4-17, 4-18, 4-28, 4-31; Mitchell et al.1997:4-4, 4-19, 4-21, 4-23).

Table 3–22. Radiation Doses to Workers From Normal INEEL Operations in 1996 (Total Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation: Standard[a]	Onsite Releases and Direct Radiation: Actual
Average radiation worker (mrem)	None[b]	125[c]
Total workers (person-rem)[d]	None	205[c]

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] Does not include doses received at the Naval Reactors Facility. The impacts associated with this facility fall under the jurisdiction of the Navy as part of the Nuclear Propulsion Program.

[d] About 1,650 (badged) in 1995.

Source: Abbott, Crockett, and Moor 1997.

3.3.4.2 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 through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.3.1.

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 NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal INEEL operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway. At INEEL, the risk to public health from water ingestion and direct exposure pathways is low because surface water is not used for drinking or as a receptor for wastewater discharges.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.3.1. These baseline 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. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to INEEL workers during normal operation may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. INEEL workers are also protected by adherence to OSHA 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 requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at INEEL are substantially better than required by standards.

3.3.4.3 Health Effects Studies

Epidemiological studies were conducted on communities surrounding INEEL to determine whether there are excess cancers in the general population. Two of these are described in more detail in Appendix M.4.4 of the *Storage and Disposition PEIS* (DOE 1996a:M-233, M-234). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association thereof with INEEL was established. A study by the State of Idaho completed in June 1996 found excess brain cancer incidence in the six counties surrounding INEEL, but a follow-up survey concluded that "there was nothing that clearly linked all these cases to one another or any one thing."

No occupational epidemiological studies have been completed at INEEL to date, but several worker health studies were initiated recently at INEEL and another is almost complete. Researchers from the Boston University School of Public Health in cooperation with the National Institute of Occupational Safety and Health (NIOSH), are investigating the effects of workforce restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a NIOSH cooperative agreement, the epidemiologic evaluation of childhood leukemia and paternal exposure to ionizing radiation now includes INEEL as well as other DOE sites. Another study began in October 1997, *Medical Surveillance for Former Workers at INEEL*, is being carried out by a group of investigators consisting of the Oil, Chemical, and Atomic Workers International Union, Mt. Sinai School of Medicine, the University of Massachusetts at Lowell, and the Alice Hamilton College. A cohort mortality study of the workforce at INEEL being conducted by NIOSH is not expected to be released until December 1998. DOE has implemented an epidemiologic surveillance program to monitor the health of current INEEL workers. A discussion of this program is given in Appendix M.4.4 of the *Storage and Disposition PEIS* (DOE 1996a:M-233, M-234).

3.3.4.4 Accident History

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation* (DOE/ID-12119), to estimate the potential offsite radiation doses for the entire operating history of INEEL (DOE 1996a:3-139). Releases resulted from a variety of tests and experiments as well as a few accidents at INEEL. The study concluded that these releases contributed to the total radiation dose during test programs of the 1950s and early 1960s. The frequency and size of releases has declined since that time. There have been no serious unplanned or accidental releases of radioactivity or other hazardous substance at INEEL facilities in the last 10 years of operation.

3.3.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

Government agencies whose plans are interrelated with the INEEL emergency plan for action include the State of Idaho, Bingham County, Bonneville County, Butte County, Clark County, Jefferson County, the Bureau of Indian Affairs, and the Fort Hall Indian Reservation. INEEL contractors are responsible for responding to emergencies at their facilities. Specifically, the emergency action director is responsible for recognition, classification, notifications, and protective action recommendations. At INEEL, emergency preparedness resources include fire protection from onsite and offsite locations and radiological and hazardous chemical material response. Emergency response facilities include an emergency control center at each facility, at the INEEL warning communication center, and at the INEEL site emergency operations center. Seven INEEL medical facilities are also available to provide routine and emergency service.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

3.3.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of INEEL, the potentially affected area includes only parts of central Idaho.

The potentially affected area surrounding INTEC is defined by a circle with an 80-km (50-mi) radius centered at FPF (lat. 43E34'12.5" N, long. 112E55' 55.4" W). The total population residing within that area in 1990 was 119,138. The proportion of the population there that was considered minority was 9.9 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and for the State of Idaho, 7.8 (DOC 1992).

Figure 3–14 illustrates the racial and ethnic composition of the minority population in the potentially affected area centered at FPF. At the time of the 1990 census, Hispanics and Native Americans were the largest minority groups within that area, constituting 6 percent and 2.6 percent of the total population, respectively, during the 1990 census. Asians constituted about 1 percent, and blacks, about 0.3 percent (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 14,386 persons (12.2 percent of the total population) residing within the potentially affected area around INTEC reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Idaho reported 13.3 percent.

3.3.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.3.6.1 General Site Description

The upper 1 to 2 km (0.6 to 1.2 mi) of the crust beneath INEEL is composed of interlayered basalt and sediment. The sediments are composed of fine-grained silts that were deposited by wind; silts, sands, and

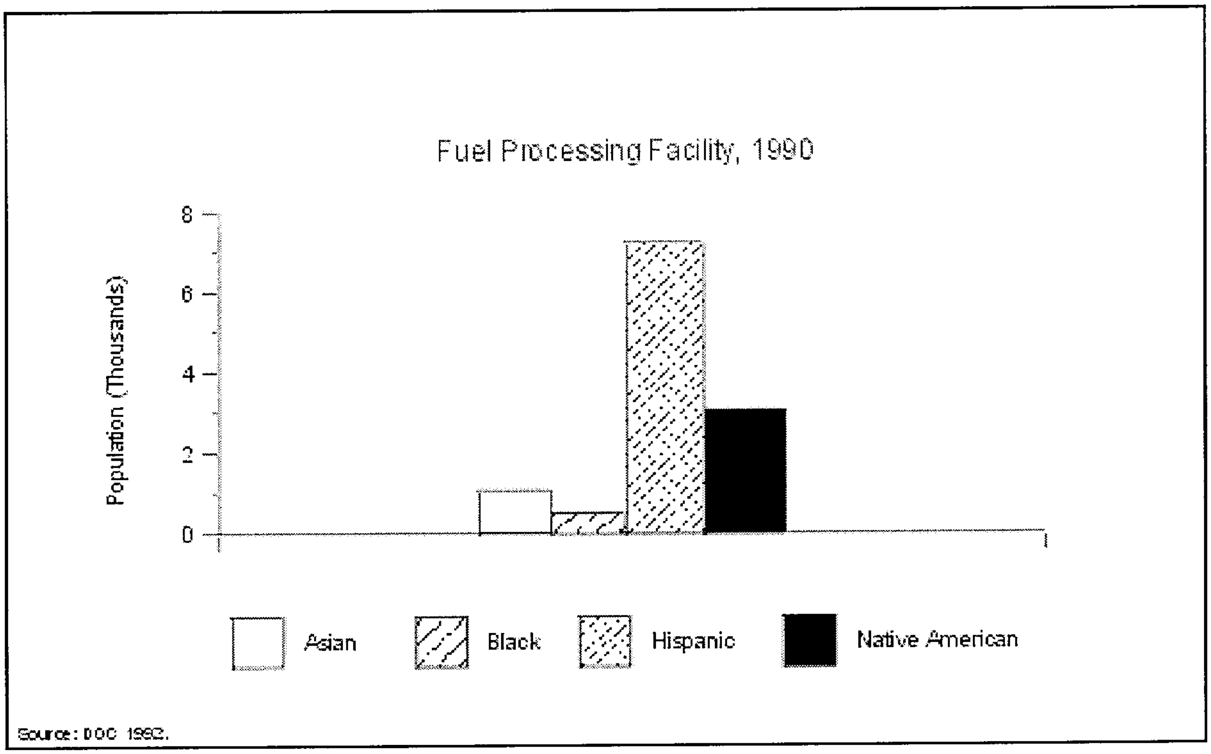


Figure 3–14. Racial and Ethnic Composition of Minorities Around the Fuel Processing Facility at INEEL

gravels deposited by streams; and clays, silts, and sands deposited in lakes. Rhyolitic (granite-like) volcanic rocks of unknown thickness lie beneath the basalt sediment sequence. The rhyolitic volcanic rocks were erupted between 6.5 and 4.3 million years ago (Barghusen and Feit 1995:2.3-17).

Within INEEL, economically viable sand, gravel, and pumice resources have been identified. Several quarries have supplied these materials to various onsite construction projects (DOE 1996a:3-121). Geothermal resources are potentially available in parts of the Eastern Snake River Plain, but neither of two boreholes—INEEL–1 (drilled to a depth of 3,048 m [10,000 ft] to explore for geothermal resources 8 km [5 mi] north of INTEC) and WO–2 (drilled to a depth of 1,524 km [5,000 ft] 4.8 km [3 mi] east of INTEC)—encountered rocks with significant geothermal potential (Abbott, Crockett, and Moor 1997:11).

There is no potential for sinkholes or unstable conditions at INTEC. Lava tubes, which could have adverse effects similar to those of sinkholes, do occur in the INEEL area, but extensive drilling and foundation excavation in the INTEC area over the past few decades has revealed no lava tubes beneath the site. Drilling for foundation engineering investigations at FPF has also revealed no lava tubes (Abbott, Crockett, and Moor 1997:10).

The Arco Segment of the Lost River Fault and the Howe Segment of the Lemhi Fault terminate about 30 km (19 mi) from the INEEL boundary and are considered capable. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years (DOE 1996a:3-121).

According to the Uniform Building Code, INEEL, located on the Eastern Snake River Plain, is in Seismic Zone 2B, meaning that moderate damage could occur as a result of an earthquake. Historic and recent seismic data cataloged by NOAA, the National Earthquake Information Center, the University of Utah, and the INEEL Seismic Network indicate that earthquakes in the region occur primarily in the Intermountain Seismic Belt and the

Centennial Tectonic Belt. The seismic characteristics of the Eastern Snake River Plain and the adjacent Basin and Range Province are different; the plain has historically experienced few and small earthquakes. No earthquakes have been recorded within about 48 km (30 mi) of the site (DOE 1996a:3-121). An earthquake with a maximum horizontal acceleration of 0.15g is calculated to have an annual probability of occurrence of 1 in 5,000 at a central INEEL location (Barghusen and Feit 1995:2.3-17).

The largest historic earthquake near INEEL took place in 1983 about 107 km (66 mi) to the northwest, near Borah Peak in the Lost River Range. The earthquake had a surface wave magnitude of 7.3 with a resulting peak horizontal ground acceleration of 0.022g to 0.078g at INEEL (Jackson 1985:385). An earthquake of greater than 5.5 magnitude can be expected about every 10 years within a 322-km (200-mi) radius of INEEL (DOE 1996a:3-121).

Volcanic hazards at INEEL can come from sources inside or outside the Snake River Plain. Most of the basaltic volcanic activity occurred at the Craters of the Moon National Monument 20 km (12 mi) southwest of INEEL between 4 million and 2,100 years ago. The probability of volcanic activity affecting facilities at INEEL is very low. In fact, the Volcanism Working Group for the *Storage and Disposition PEIS* (DOE 1996a) estimated that the conditional probability of basaltic volcanism affecting a south-central INEEL location is at most once per 40,000 years. The rhyolite domes along the Axial Volcanic Zone formed between 1.2 million and 300,000 years ago and have a recurrence interval of about 200,000 years. Therefore, the probability of future dome formation affecting INEEL facilities is also very low (DOE 1996a:3-121–3-123).

INEEL soils are derived from volcanic and clastic rocks from nearby highlands. In the southern part of the site, the soils are gravelly to rocky and generally shallow. The northern portion is composed mostly of unconsolidated clay, silt, and sand. No prime farmland lies within the INEEL boundaries. Generally, the soils are acceptable for standard construction techniques (DOE 1996a:3-107, 3-123). More detailed descriptions of the geology and the soil conditions at INEEL are included in the *Storage and Disposition PEIS* (DOE 1996a:3-121–3-123).

3.3.6.2 Proposed Facility Location

The nearest capable fault is in the South Creek Segment of the Lemhi Fault, about 26 km (16 mi) north of INTEC. All soil near INTEC was originally fine loam over a sand or sand-cobble mix deposited in the floodplain of the Big Lost River. However, all soils within the INTEC fences have been disturbed. The soils beneath the INTEC area are not subject to liquefaction because of the high content of gravel mixed with the alluvial sands and silts. In addition, the sediments are not saturated (Abbott, Crockett, and Moor 1997:10).

3.3.7 Water Resources

3.3.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.3.7.1.1 General Site Description

Three intermittent streams drain the mountains near INEEL: Big Lost River, Little Lost River, and Birch Creek. These intermittent streams carry snowmelt in the spring and are usually dry by midsummer. Several years can pass before any offsite waters enter DOE property. Big Lost River and Birch Creek are the only streams that regularly flow onto INEEL. Little Lost River is usually dry by the time it reaches the site because of upstream use of the flow for irrigation. None of the rivers flow from the site to offsite areas. Big Lost River discharges into the Big Lost River sinks, and there is no surface discharge from these sinks (Barghusen and Feit 1995:2.3-2, 2.3-21; DOE 1996a:3-115).

Big Lost River has been classified by the State of Idaho for domestic and agricultural use, cold water biota development, salmon spawning, primary and secondary recreation, and other special resource uses. Surface waters, however, are not used for drinking water on the site, nor is any wastewater discharged directly to them. Moreover, there are no surface water rights issues at INEEL, because INEEL facilities currently neither discharge directly to, nor make withdrawals from, these water bodies. None of the rivers have been classified as a Wild and Scenic River. Flood diversion facilities constructed in 1958 secured INEEL from the 300-year flood (DOE 1995b:4.8-1–4.8-5; 1996a:3-115).

3.3.7.1.2 Proposed Facility Location

There are no named streams within INTEC—only unnamed drainage ditches to carry storm flows away from buildings and facilities at the site. Outside INTEC, the only surface water is a stretch of Big Lost River. This is an intermittent stream that flows only after rainfall events or in the spring, when it carries snowmelt from the nearby mountains (Abbott, Crockett, and Moor 1997:5). A summary of water quality data for Big Lost River in the vicinity of INEEL is provided in the *Storage and Disposition PEIS* and shows no unusual concentrations of the parameters analyzed (DOE 1996a:3-115–3-117).

Flooding scenarios that involve the failure of McKay Dam and high flows in the Big Lost River have been evaluated. The results indicate that in the event of a failure of this dam, flooding would occur at INTEC and other facilities at INEEL. The low velocity and shallow depth of the water, however, would not pose a threat of structural damage to the facilities. Localized flooding can occur due to rapid snowmelt and frozen ground conditions, but none has been reported at INTEC (Barghusen and Feit 1995:2.3-21, 2.3-23). A study of the 100-year flood has been completed by the U.S. Geological Survey. The study indicates that the only INEEL facility that would be flooded is the northern part of INTEC and its entrance road. The depth of water over Lincoln Boulevard near its intersection with Monroe Boulevard is estimated at 0.12 to 0.70 m (0.4 to 2.3 ft) (Berenbrock and Kjelstrom 1998:11, 12). The 500-year flood has not been studied (Abbott, Crockett, and Moor 1997:7). However, the probable maximum flood has been calculated, as shown on Figure 3–15 (DOE 1997b).

Purgeable organics such as 1,1-dichloroethylene, toluene, and 1,1,1-trichloroethane have been detected in wells near INTEC. Metals, including arsenic, barium, lead, mercury, selenium, and silver, were also found in samples from wells. Inorganic chemicals such as sodium and chloride have been found in these samples. Maximum values for tritium in samples from three wells averaged 23,700 pCi/l; and maximum strontium 90 values averaged 53 pCi/l (Abbott, Crockett, and Moor 1997:11, 12). These values exceed the drinking water standards for tritium and strontium 90 of 20,000 pCi/l and 8 pCi/l, respectively. The results of groundwater modeling and baseline risk assessment will be used to identify the release sites requiring further evaluation. If necessary, removal actions may be taken to prevent further migration of contaminants to the Snake River Plain Aquifer (Mitchell et al. 1997:3-5). Sanitary waste with no potential for radioactive contamination is treated in the INTEC Sewage Treatment Facility (CPP–615). This facility has a Wastewater Land Application Permit from the State of Idaho and does not discharge to surface waters, but allows land application of treated sanitary sewage. The only effluent criteria associated with flows to the sewage ponds are the amounts of total suspended solids and nitrogen released to the ponds. All compliance points for the ponds are in wells downgradient from the ponds, and the maximum allowable concentrations are similar to those in the National Primary and Secondary Drinking Water Standards (Abbott, Crockett, and Moor 1997:9, 10). Drainage from corridors, roof and floor drains, and condensate from process heating, and heating, ventilation, and air

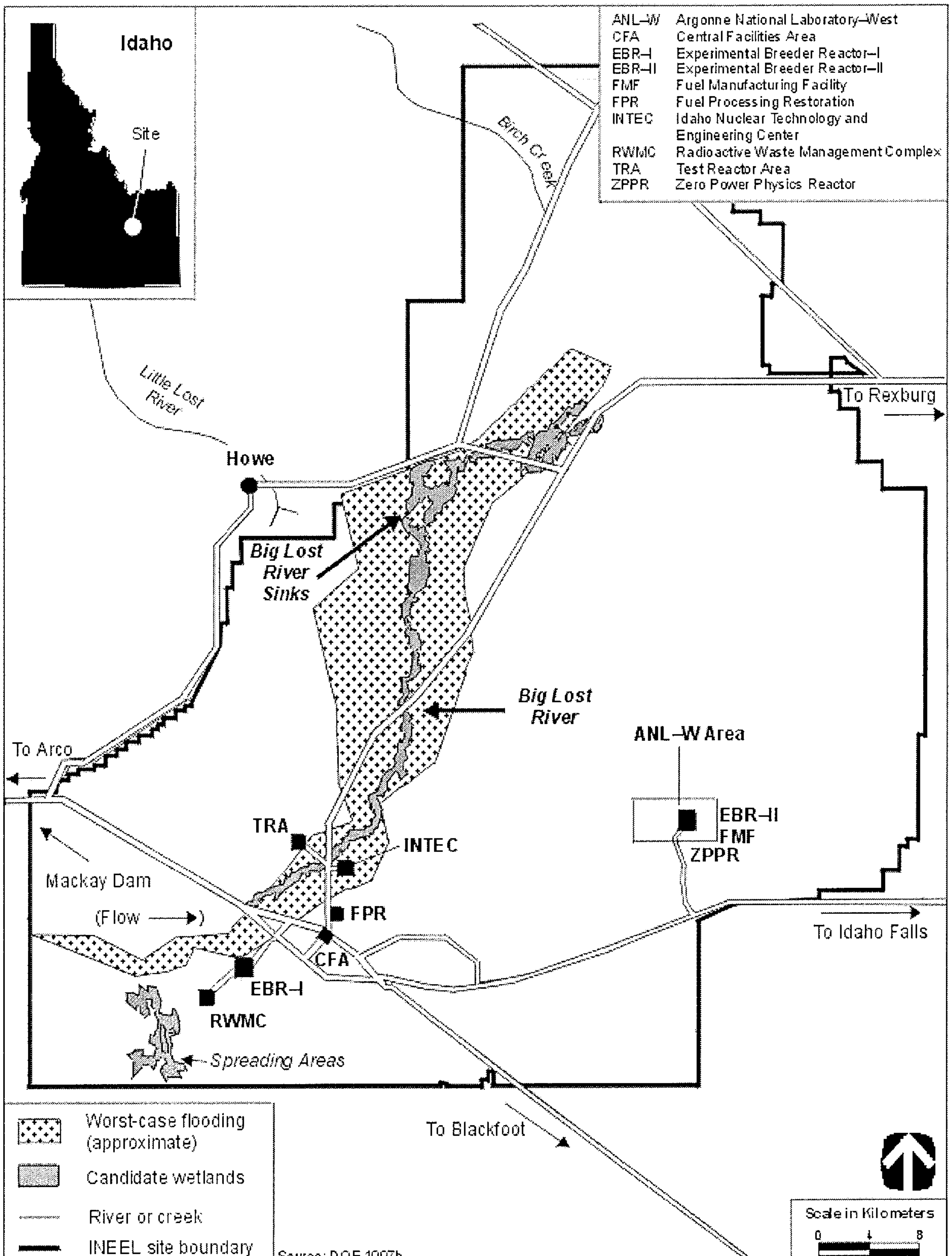


Figure 3–15. Flood Area for the Probable Maximum Flood–Induced Overtopping Failure of the Mackay Dam

conditioning systems with very low potential for radiological contamination are routed to the INTEC service waste system. Service Waste Percolation Pond 1 (SWP–1), southeast of Building CPP–603, has a surface area about of 18,400 m^2 (198,000 ft^2) and is 4.9 m (16 ft) deep. Service Waste Pond 2, immediately west of SWP–1, has a surface area of 46 m^2 (495 ft^2). Both ponds are fenced to keep out wildlife (Abbott, Crockett, and Moor 1997:9).

Consideration is being given to relocating the percolation pond to reduce the potential impacts on a contaminated perched water zone. Consideration is also being given to obtaining an NPDES permit to allow direct discharge into Big Lost River. These actions are independent of the proposed action analyzed in this SPD EIS and would be preceded by appropriate NEPA documentation (Abbott, Crockett, and Moor 1997:10).

3.3.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.3.7.2.1 General Site Description

The Snake River Plain aquifer is classified by EPA as a Class I sole source aquifer. It lies below the INEEL site and covers about 24,860 km^2 (9,600 mi^2) in southeastern Idaho. This aquifer serves as the primary drinking water source in the Snake River Basin and is believed to contain 1.2 quadrillion to 2.5 quadrillion l (317 trillion to 660 trillion gal) of water. Recharge of the groundwater comes from Henry's Fork of the Snake River, Big Lost River, Little Lost River, and Birch Creek. Rainfall and snowmelt also contribute to the aquifer's recharge (DOE 1996a:3-115–3-117).

Groundwater generally flows laterally at a rate of 1.5 to 6.1 m/day (5 to 20 ft/day). It emerges in springs along the Snake River from Milner to Bliss, Idaho. Depth to the groundwater table ranges from about 60 m (200 ft) below ground in the northeast corner of the site to about 300 m (1,000 ft) in the southeast corner (DOE 1995b:4.8-5; 1996a:3-117).

Perched water tables occur below the site. These perched water tables tend to slow the migration of pollutants that might otherwise reach the Snake River Plain aquifer (DOE 1996a:3-117).

INEEL has a large network of monitoring wells—about 120 in the Snake River Plain aquifer and another 100 drilled in the perched zone. The wells are used for monitoring to determine the compliance of specific actions with requirements of RCRA and CERCLA, as well as routine monitoring to evaluate the quality of the water in the aquifer. The aquifer is known to have been contaminated with tritium; however, the concentration dropped 93 percent between 1961 and 1994, possibly due to the elimination of tritium disposal, radioactive decay, and dispersion throughout the aquifer. Other known contaminants include cesium 137, iodine 129, strontium 90, and nonradioactive compounds such as TCE. Components of nonradioactive waste entered the aquifer as a result of past waste disposal practices. Elimination of groundwater injection exemplifies a change in disposal practices that has reduced the amount of these constituents in the groundwater (DOE 1996a:3-117, 3-119).

From 1982 to 1985, INEEL used about 7.9 billion l/yr (2.1 billion gal/yr) from the Snake River Plain aquifer, the only source of water at INEEL. This represents less than 0.3 percent of the groundwater withdrawn from that aquifer. DOE holds a Federal Reserved Water Right for the INEEL site that permits a pumping capacity of approximately 2.3 m^3/s (80 ft^3/s) with a maximum water consumption of 43 billion l/yr (11 billion gal/yr). INEEL's priority on water rights dates back to its establishment in 1950 (DOE 1996a:3-119).

3.3.7.2.2 Proposed Facility Location

Generally, the groundwater near INEEL, including INTEC, flows from the north and northeast to the south and southwest (Barghusen and Feit 1995:2.3-23).

Water for the INTEC is supplied by two deep wells located in the northwest corner of the INTEC. The wells are about 180 m (590 ft) deep and about 36 cm (14 in) in diameter (Abbott, Crockett, and Moor 1997:9). These wells can each supply up to approximately 11,000 l/min (3,000 gal/min) of water for use in the INTEC fire water, potable water, treated water, and demineralized water systems (Werner 1997). Pumping has little effect on the level of the groundwater, because the withdrawals are so small relative to the volume of water in the aquifer and the amount of recharge available. The production wells at INTEC have historically contained measurable quantities of strontium 90. In 1992, the highest concentration was 1 pCi/l, compared with the EPA maximum Primary Drinking Water Standard of 8 pCi/l. Sampling has yielded similar results over time (Barghusen and Feit 1995:2.3-23–2.3-29).

3.3.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special-status species—that is, "nonsensitive" versus "sensitive" habitat.

3.3.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.3.8.1.1 General Site Description

INEEL is dominated by fairly undisturbed shrub-steppe vegetation that provides important habitat for nearly 400 plant species and numerous animal species native to the region's cool desert environment. Facilities and operating areas occupy 2 percent of INEEL, and approximately 60 percent of the surrounding area is used by sheep and cattle for grazing (DOE 1996a:3-125). Six broad vegetative categories representing nearly 20 distinct habitats have been identified on the INEEL site. Approximately 90 percent of INEEL is covered by shrub-steppe vegetation, which is dominated by big sagebrush, saltbrush, rabbitbrush, and native grasses, and contains a diversity of forbs (Figure 3–16) (DOE 1997b:44).

The large, undeveloped tracts of land used by INEEL for safety and security buffers also provide important habitat for plants and animals. Because INEEL is at the mouth of several mountain valleys, large numbers of mammals and migratory birds of prey are funneled onto the site. During some winters, thousands of pronghorn antelope and sage grouse can be found in the low and big sagebrush communities in the northern region. The juniper communities in the northwestern and southwestern regions provide important nesting areas for raptors and songbirds (DOE 1996a:3-125; 1997b:42).

Animal species found at INEEL include 2 species of amphibians, more than 225 species of birds, 6 species of fish, 44 species of mammals, and 11 species of reptiles (Reynolds 1999). Commonly observed animals include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed

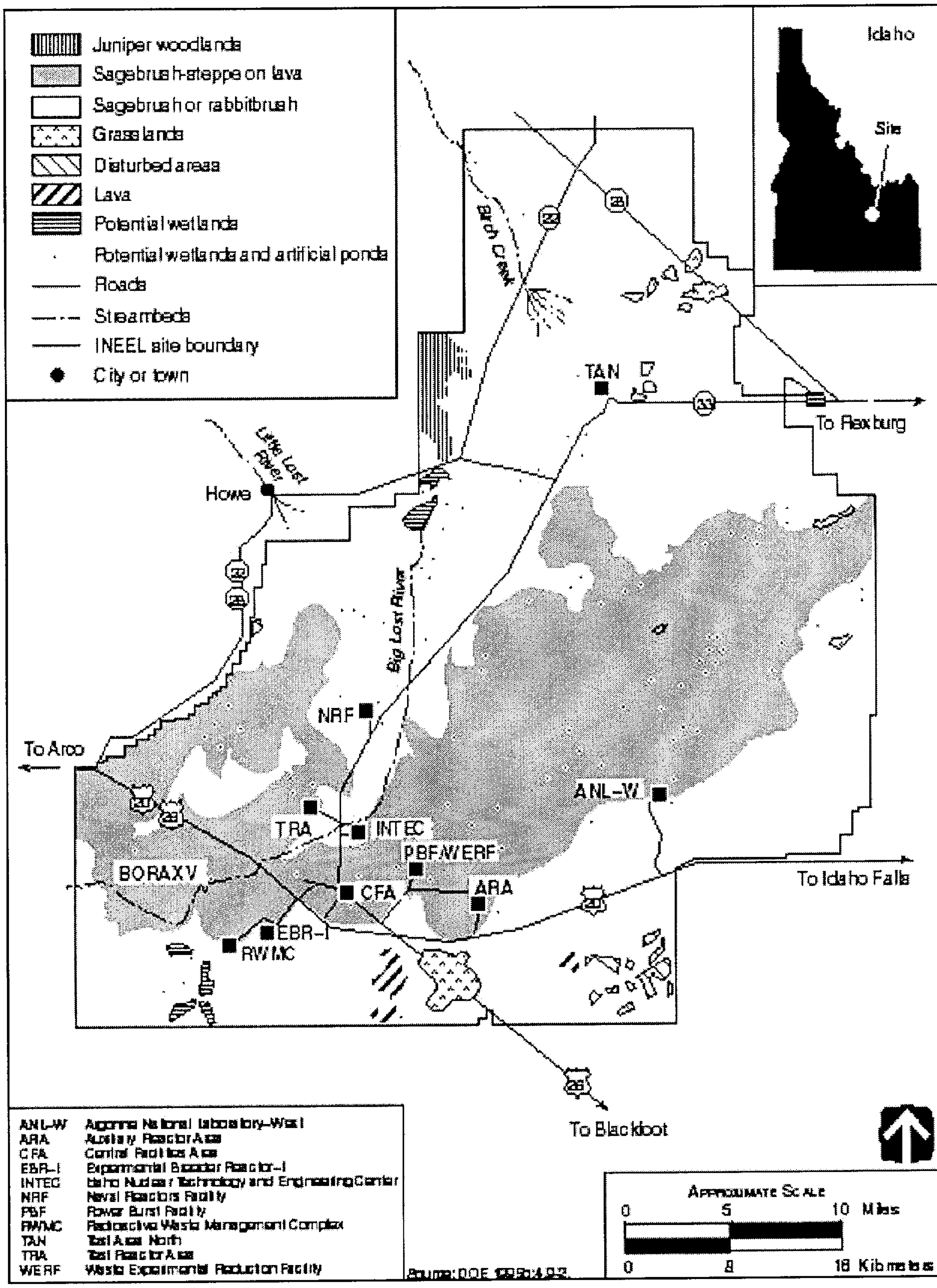


Figure 3–16. Generalized Habitat Types at INEEL

jackrabbit (DOE 1996a:3-125). Important game animals that reside at INEEL include sage grouse, mule deer, and elk. Roughly 30 percent of Idaho's pronghorn antelope population uses INEEL as winter range. Hunting of pronghorn antelope and elk is permitted under controlled conditions to reduce damage to crops on private lands and is restricted to within about 0.8 km (0.5 mi) inside the property boundary of INEEL (DOE 1995b:4.2-1; 1996a:3-125). Predators observed on the INEEL site include bobcats, mountain lions, badgers, and coyotes (DOE 1997b:42).

Aquatic habitat is limited to three intermittent streams (Big Lost River, Little Lost River, and Birch Creek) that drain into four sinks in the north-central portion of INEEL and to a number of liquid-waste disposal ponds. When water from the Big Lost River does flow on the site, several species of fish are observed: brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon (DOE 1996a:3-125).

3.3.8.1.2 Proposed Facility Location

INTEC is an industrial facility with most land surfaces being disturbed, bare ground (85 percent) or facilities and pavement (13 percent). Natural areas are limited to those areas outside the fenced boundary, mainly sagebrush-steppe on lava, sagebrush, rabbitbrush, and grasslands. The onsite areas are not vegetated except for grasses, shrubs, and trees associated with lawns and landscaping, and weedy annuals and grasses commonly found in disturbed areas. These areas, as well as buildings and wastewater treatment ponds, are used by a number of species. Accordingly, animal species potentially present in the immediate area surrounding FPF are primarily limited to those species adapted to disturbed industrial areas, such as small mammals (e.g., mice, rabbits, and ground squirrels), birds (e.g., sparrows and finches), and reptiles (e.g., lizards). A comprehensive list of species potentially present within INTEC and the surrounding area is presented in the Waste Area Grouping 3 (WAG3) risk assessment work plan developed by Rodriguez et al. (1997) (Werner 1997:WAG3 Report Summary). There are no known aquatic species or habitat within the immediate environs of FPF (Abbott, Crockett, and Moor 1997:15).

3.3.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special-status plant and animal species.[5]

3.3.8.2.1 General Site Description

Nearly all INEEL wetland habitats, with the exception of playa wetlands, are impacted by water management and diversion activities on and off the site. Agricultural demands and flood control diversions, combined with low regional precipitation, prevent permanent water in the Big Lost River and Birch Creek drainages, thus limiting the "classic" wetlands to inordinately wet periods. The Big Lost River and Birch Creek drainages support unique riparian habitats that are important to a diversity of desert animals and breeding birds (DOE 1997b:43, 44). Riparian vegetation, primarily willow and cottonwood, provides nesting habitat for hawks, owls, and songbirds (DOE 1996a:3-125). The only permanent source of surface water on INEEL is manmade ponds where flows are sustained through facility operations. These ponds represent important habitat on INEEL that would not exist otherwise (DOE 1997b:43, 44).

Nineteen threatened, endangered, and other special-status species listed by the Federal Government or the State of Idaho may be found in the vicinity of INEEL, as shown in Table 3.4.6–1 in the *Storage and Disposition PEIS* (DOE 1996a:3-128).

[5] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

3.3.8.2.2 Proposed Facility Location

There are no known wetlands within the immediate environs of INTEC (Abbott, Crockett, and Moor 1997:15). Manmade percolation ponds that receive permitted facility effluent and hold water intermittently are known to support the boreal chorus frog and aquatic invertebrates when water is present. Several wetland plant species have been identified in percolation ponds south of INTEC (Werner 1997:WAG3 Report Summary). INTEC does not provide critical habitat for any of the 14 threatened, endangered, or other special-status species listed in Table 3–23 that may occur in the area (Werner 1997:WAG3 Report Summary).

Table 3–23. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in Areas Surrounding INTEC

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered
Black tern	*Chlidonias niger*	Species of Concern	Not listed
Burrowing owl	*Athene cunicularia*	Species of Concern	Not listed
Ferruginous hawk	*Buteo regalis*	Species of Concern	Protected
Loggerhead shrike	*Lanius ludovicianus*	Species of Concern	Not listed
Northern goshawk	*Accipiter gentilis*	Species of Concern	Sensitive
Peregrine falcon	*Falco peregrinus*	Endangered	Endangered
Trumpeter swan	*Cygnus buccinator*	Species of Concern	Species of Special Concern
White-faced ibis	*Plegadis chihi*	Species of Concern	Not listed
Mammals			
Long-eared myotis	*Myotis evotis*	Species of Concern	Not listed
Pygmy rabbit	*Brachylagus (Sylvilagus) idahoensis*	Species of Concern	Species of Special Concern
Small-footed myotis	*Myotis subulatus*	Species of Concern	Not listed
Townsend's western big-eared bat	*Plecotus townsendii*	Species of Concern	Species of Special Concern
Plants			
Lemhi milkvetch	*Astragalus aquilonius*	Not listed	Global (Rare) Priority 3
Sepal-tooth dodder	*Cuscuta denticulata*	Not listed	State Priority 1
Spreading gilia	*Ipomopsis polycladon*	Not listed	State Priority 2
Unknown	*Catapyrenium congestum*	Not listed	Sensitive
Winged-seed evening primrose	*Camissonia pterosperma*	Not listed	Sensitive
Reptiles			
Northern sagebrush lizard	*Sceloporus graciosus*	Species of Concern	Not listed

Key: INTEC, Idaho Nuclear Technology and Engineering Center.
Source: Ruesink 1998; Stephens 1998, 1999; Werner 1997:WAG3 Report Summary.

The northern sagebrush lizard and three bat species of special concern are believed to have the greatest potential for occurrence within the environs of INTEC. This is based on a survey conducted in 1996 to evaluate the presence of suitable habitat for threatened and endangered species and species of concern. Bat usage of the area is likely to be limited to aerial hunting activities around the INTEC sewage disposal and percolation ponds. The sewage disposal and percolation ponds are routinely used by wildlife, and these facilities and a portion of the Big

Lost River are within 1 km (0.6 mi) of FPF. The extent of potential usage of facility habitats by the northern sagebrush lizard is unknown (Werner 1997:WAG3 Report Summary).

3.3.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. INEEL has a well-documented record of cultural and paleontological resources. Guidance for the identification, evaluation, recordation, curation, and management of these resources is included in the *Final Draft Idaho National Engineering Laboratory Management Plan for Cultural Resources* (Miller 1995). There have been 1,506 cultural resource sites and isolated finds identified, including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates (DOE 1996a:3-129). While many significant cultural resources have been identified, only about 4 percent of the area within the INEEL site has been surveyed (DOE 1996a:3-129). Most surveys have been conducted near major facility areas in conjunction with major modification, demolition, or abandonment of site facilities.

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

3.3.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.3.9.1.1 General Site Description

Prehistoric resources identified at INEEL are generally reflective of Native American hunting and gathering activities. Resources appear to be concentrated along the Big Lost River and Birch Creek, atop buttes, and within craters or caves. They include residential bases, campsites, caves, hunting blinds, rock alignments, and limited-activity locations such as lithic and ceramic scatters, hearths, and concentrations of fire-affected rock. Most sites have not been formally evaluated for nomination to the National Register, but are considered to be potentially eligible. Given the rather high density of prehistoric sites at INEEL, additional sites are likely to be identified as surveys continue (DOE 1996a:3-129).

3.3.9.1.2 Proposed Facility Location

The INTEC area has been subject to a number of archaeological survey projects over the past two decades. Most of these investigations have been concentrated around the perimeter of the site and along existing roadways or power line corridors. Survey coverage in the area around Building 691 is complete. The inventory of identified resources includes campsites and isolated artifacts reflecting Native American hunting and gathering activities, as well as resources reflective of more recent attempts at homesteading and agriculture (Abbott, Crockett, and Moor 1997:16).

Most of the area near FPF has been surveyed, except for a small area east of the railroad tracks. Six archaeological resources have been identified within the surveyed area. Most of the sites are prehistoric and historic isolates that are not likely to yield additional information and are therefore not likely to be potentially eligible for National Register nomination (Abbott, Crockett, and Moor 1997:16).

3.3.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.3.9.2.1 General Site Description

Thirty-eight historic sites and 27 historic isolates have been identified at INEEL. These resources are representative of European-American activities, including fur trapping and trading, immigration, transportation, mining, agriculture, and homesteading, as well as more recent military and scientific/engineering R&D activities. Examples of historic resources include Goodale's Cutoff (a spur of the Oregon Trail), remnants of homesteads and ranches, irrigation canals, and a variety of structures from the World War II era. Experimental Breeder Reactor I, the first reactor to achieve a self-sustaining chain reaction using plutonium instead of uranium as the principal fuel component, is listed on the National Register and is designated a National Historic Landmark. Many other INEEL structures built between 1949 and 1974 are considered eligible for the National Register because of their exceptional scientific and engineering significance and their major role in the development of nuclear science and engineering since World War II. According to current studies, additional historic sites are likely to exist in unsurveyed portions of INEEL (DOE 1996a:3-129).

3.3.9.2.2 Proposed Facility Location

In the study area near INTEC are two historic sites, a homestead and nearby trash dump, that may be eligible for nomination to the National Register. These sites are potential sources of information on Carey Land Act–sponsored agricultural activities in the region (Abbott, Crockett, and Moor 1997:16).

A historic resource inventory of all buildings within INTEC is being conducted and will likely identify additional historic structures built between 1949 and 1974. Because it was constructed after 1974, FPF is not considered to be historic (Abbott, Crockett, and Moor 1997:16).

3.3.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.3.9.3.1 General Site Description

Native American resources at INEEL are associated with the two groups of nomadic hunters and gatherers that used the region at the time of European-American contact: the Shoshone and Bannock. Both of these groups used the area that now encompasses INEEL as they harvested floral and faunal resources and obsidian from Big Southern Butte or Howe Point. Because INEEL is considered part of the Shoshone-Bannock Tribes' ancestral homeland, it contains many localities that are important for traditional, cultural, educational, and religious reasons. This includes not only prehistoric archaeological sites, which are important in a religious or cultural heritage context, but also features of the natural landscape and air, plant, water, or animal resources that have special significance (DOE 1996a:3-129).

3.3.9.3.2 Proposed Facility Location

INTEC and the surrounding area may contain Native American resources. The existence and significance of any resources near INTEC would be established in direct consultation with the Shoshone and Bannock Tribes. INEEL recently initiated general consultation with the Shoshone and Bannock Tribes, and a working agreement was established (Abbott, Crockett, and Moor 1997:16, B-1, B-2). Consultations (see Chapter 5 and Appendix O) were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in this SPD EIS.

3.3.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.3.9.4.1 General Site Description

Paleontological remains consist of fossils and their associated geologic information. The region encompassing INEEL has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains from soils and lake and river sediments, and organic materials found in caves and archaeological sites (DOE 1995b:4.4-5).

3.3.9.4.2 Proposed Facility Location

Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones or teeth from large mammals of the Pleistocene or Ice Age. These fossils were discovered during excavations and well-drilling operations. A single mammoth tooth was salvaged during the excavation of a percolation pond immediately south of INTEC. Other fossils have been recorded in the vicinities of the Test Reactor Area and Naval Reactors Facility. Occasional skeletal elements of fossil mammoth, horse, and camel have been retrieved from the Big Lost River diversion dam and Radioactive Waste Management Complex on the southwestern side of INEEL, and from river and alluvial fan gravels and Lake Terreton sediments near Test Area North (Abbott, Crockett, and Moor 1997:16).

3.3.10 Land Use and Visual Resources

3.3.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

INEEL is situated on approximately 2,300 km^2 (890 mi^2) of land in southeastern Idaho (DOE 1997b). INEEL is owned by the Federal Government and administered, managed, and controlled by DOE (DOE 1996a:3-107). It is primarily within Butte County, but portions of the site are also in Bingham, Jefferson, Bonneville, and Clark Counties. The site is roughly equidistant from Salt Lake City, Utah, and Boise, Idaho.

3.3.10.1.1 General Site Description

Lands surrounding INEEL are owned by the Federal Government, the State of Idaho, and private parties. Regional land uses include grazing, wildlife management, rangeland, mineral and energy production, recreation, and crop production. Approximately 60 percent of the surrounding area is used by sheep and cattle for grazing. Small communities and towns near the INEEL boundaries include Mud Lake to the east; Arco, Butte City, and Howe to the west; and Atomic City to the south (DOE 1995b:4.2-5). Two National Natural Landmarks border INEEL: Big Southern Butte (2.4 km [1.5 mi] south) and Hell's Half Acre (2.6 km [1.6 mi] southeast) (DOE 1996a:3-107). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area is also adjacent to INEEL (DOE 1996a:3-107).

Land-use categories at INEEL include facility operations, grazing, general open space, and infrastructure such as roads. Generalized land uses at INEEL and vicinity are shown in Figure 3–17. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreation and environmental research associated with the designation of INEEL as a National Environmental Research Park. Much of INEEL is open space that has not been designated for specific use. Some of this space serves as a buffer zone between INEEL facilities and other land uses. About 2 percent of the total INEEL site area (46 km^2 [18 mi^2]) is used for facilities and operation (DOE 1995b:4.2-1). Approximately 9,000 ha (22,240 acres) or 4 percent of the total acreage at INEEL is available for radioactive waste management facilities (DOE 1997a:vol. I, 4-20). Public access to most facilities is restricted. Approximately 6 percent of the INEEL site, or 140 km^2 (54 mi^2), is public roads and utilities that cross the site. Recreational uses include public tours of general facility areas and Experimental Breeder Reactor I (a National Historic Landmark), and controlled hunting, which is generally restricted to 0.8 km (0.5 mi) within the INEEL boundary. Between 1,210 km^2 (467 mi^2) and 1,420 km^2 (548 mi^2) are used for cattle and sheep grazing. A 3.6-km^2 (1.4-mi^2) portion of this land, at the junction of Idaho State Highways 28 and 33, is used by the U.S. Sheep Experiment Station as a winter feedlot for about 6,500 sheep (DOE 1995b:4.2-1).

INTEC is about 4.8 km (3 mi) north of the Central Facilities Area. The plant is situated on approximately 85 ha (210 acres) within the perimeter fence. An additional 22 ha (54 acres) of the plant area lie outside the fence (DOE 1997b). The INTEC complex houses reprocessing facilities for Government-owned defense and research spent fuels. Facilities at INTEC include spent fuel storage and reprocessing areas, a waste solidification facility and related waste storage bins, remote analytical laboratories, and a coal-fired steam-generating plant.

DOE land-use plans and policies applicable to INEEL include the *INEL Institutional Plan for FY 1994–1999* and the *INEL Technical Site Information Report* (DOE 1995b:vol. 2, part A, 4.2-1). The *Institutional Plan* provides a general overview of INEEL facilities, strategic program descriptions, and major construction projects, and identifies specific technical programs and capital equipment needs. The *Information Report* (DOE 1995b:vol. 2, part A) presents a 20-year master plan for development activities at the site. Land-use planning for INEEL administrative and laboratory facilities located in the city of Idaho Falls is subject to Idaho Falls planning and zoning restrictions (DOE 1996a:3-107).

All county plans and policies encourage development adjacent to previously developed areas to minimize the need for infrastructure improvements and to avoid urban sprawl. Because INEEL is remote from most developed areas, INEEL lands and adjacent areas are not likely to experience residential and commercial development, and no new development is planned near the site. Recreational and agricultural uses, however, are expected to increase in the surrounding area in response to greater demand for recreational areas and the conversion of rangeland to cropland (DOE 1995b:4.2-5).

The Fort Bridger Treaty of July 3, 1868, secured the Fort Hall Reservation as the permanent homeland of the Shoshone-Bannock Peoples. According to the treaty, tribal members reserved rights to hunting, fishing, and gathering on surrounding unoccupied lands of the United States. While INEEL is considered occupied land, it was recognized that certain areas on the INEEL site have significant cultural and religious significance to

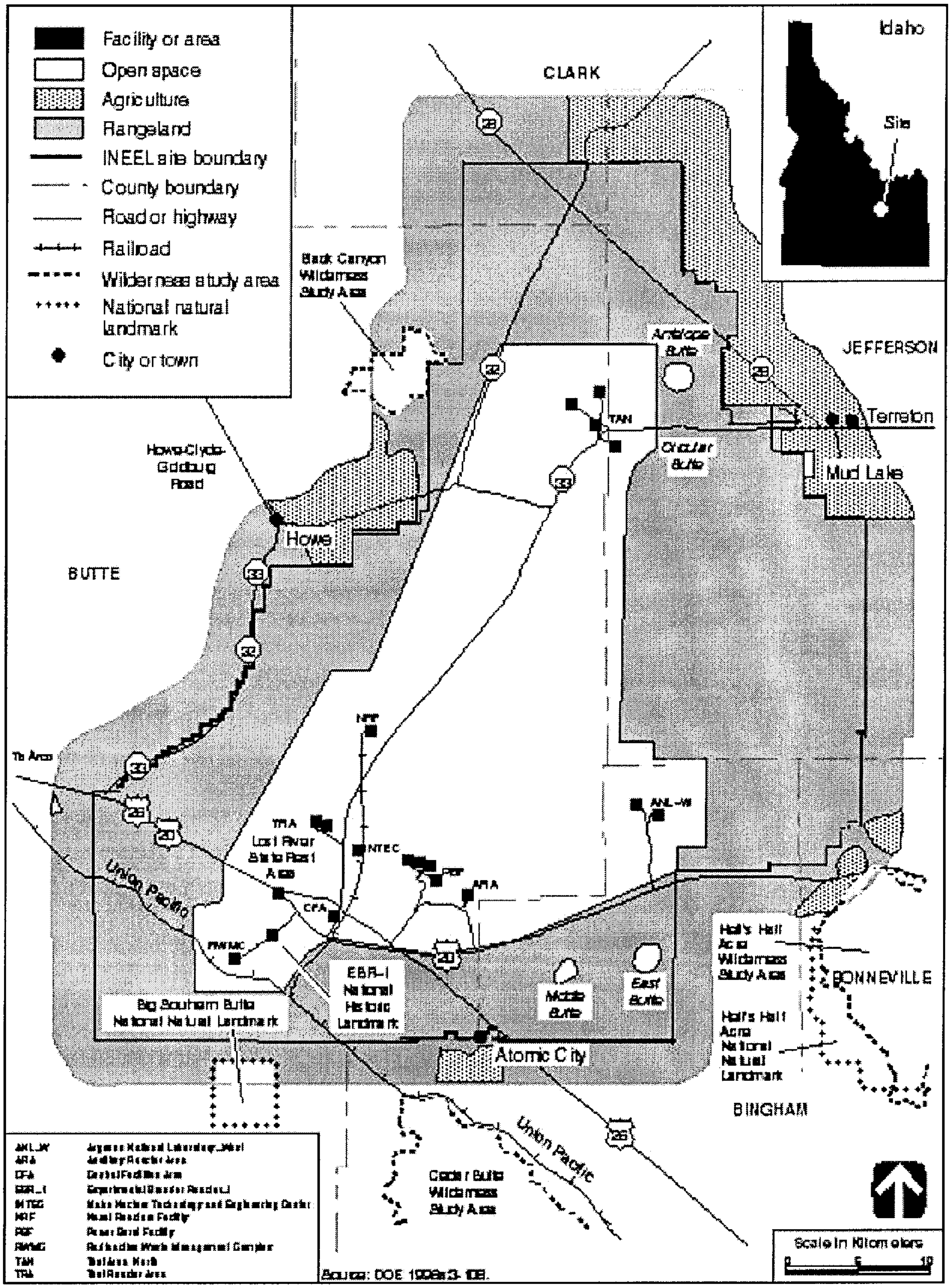


Figure 3–17. Generalized Land Use at INEEL and Vicinity

the tribes. A *1994 Memorandum of Agreement with the Shoshone-Bannock Tribes* (DOE 1994b:1) provides tribal members access to the Middle Butte to perform sacred or religious ceremonies or other educational or cultural activities.

3.3.10.1.2 Proposed Facility Location

FPF is not currently being used and is being maintained on standby. This building, the largest at INTEC, is in the middle of an area of several warehouse and administrative facilities. The land, currently disturbed, is designated for waste-processing operations. FPF is 12 km (7.5 mi) from the nearest site boundary.

3.3.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.3.10.2.1 General Site Description

The INEEL site is bordered on the north and west by the Bitterroot, Lemhi, and Lost River mountain ranges. Volcanic buttes near the southern boundary of INEEL can be seen from most locations on the site. INEEL generally consists of open desert land predominantly covered by large sagebrush and grasslands. Pasture and farmland border much of the site.

Ten facility areas are on the INEEL site. Although INEEL has a master plan, no specific visual resource standards have been established. INEEL facilities have the appearance of low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights range from about 3 to 30 m (10 to 100 ft); a few stacks and towers reach 76 m (250 ft). Although many INEEL facilities are visible from highways, most facilities are more than 0.8 km (0.5 mi) from public roads (DOE 1995b:4.5-1). The operational areas are well defined at night by the security lights.

The Craters of the Moon National Monument is about 20 km (12 mi) southwest of INEEL's western boundary. It includes a designated Wilderness Area, which must maintain Class I air quality standards. Lands adjacent to the site, under BLM jurisdiction, are designated as VRM Class II areas (DOE 1995b:4.5-2). This designation obliges preservation and retention of the existing character of the landscape. Lands within the INEEL site are designated as VRM Classes III and IV, the most lenient classes in terms of modification (DOE 1995b:4.5-2). The Black Canyon Wilderness Study Area, adjacent to INEEL, is under consideration by BLM for Wilderness Area designation, approval of which would result in an upgrade of its VRM class from Class II to Class I (DOE 1995b:4.5-2; DOI 1986a, 1986b). The Hell's Half Acre Wilderness Study Area is about 2.6 km (1.6 mi) southeast of INEEL's eastern boundary. This area, famous for its lava flows and hiking trails, is managed by BLM.

3.3.10.2.2 Proposed Facility Location

While FPF is the largest building on the site, the tallest structure is the stack connected to INTEC; it is 76 m (250 ft) tall. INTEC is visible in the middle ground from State Highways 20 and 26, with Saddle Mountain in the background. The character of INTEC is consistent with a VRM Class IV designation (DOI 1986a, 1986b). Natural features of visual interest within a 40-km (25-mi) radius include Big Lost River at 0.8 km (0.5 mi), Big Southern Butte National Natural Landmark at 20 km (12 mi), Saddle Mountain at 40 km (25 mi), Middle Butte at 18 km (11 mi), Hell's Half Acre Wilderness Study area at 35 km (22 mi) and East Butte at 23 km (14 mi) (Abbott, Crockett, and Moor 1997:4).

3.3.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.3.11.1 General Site Description

INEEL has extensive production, service, and research facilities. An extensive infrastructure supports these facilities, as shown in Table 3–24.

Table 3–24. INEEL Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	445[a]	445[a]
Railroads (km)	48	48
Electricity		
Energy consumption (MWh/yr)	232,500	394,200
Peak load (MW)	42	124
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)[b]	5,820,000	16,000,000[c]
Coal (t/yr)	11,340	11,340[c]
Water (l/yr)	6,000,000,000[d]	43,000,000,000[e]

[a] Includes paved and unpaved roads.
[b] Includes fuel oil and propane.
[c] As supplies get low, more can be supplied by truck or rail.
[d] See Werner 1997:2.
[e] See DOE 1995b:vol. II, part A, 4.13-1.
Key: NA, not applicable.
Source: DOE 1996a:3-110.

3.3.11.1.1 Transportation

The road network at INEEL provides for onsite transportation; the railroads for deliveries of large volumes of coal and oversized structural components. Commercial shipments are by truck and plane, but some bulk materials are transported by train, and waste by truck and train (DOE 1995b:vol. I, 4.11-1).

About 140 km (87 mi) of paved surface has been developed out of the 445 km (277 mi) of roads on the site, including about 29 km (18 mi) of service roads that are closed to the public. Most of the roads are adequate for the current level of normal transportation activity and could handle increased traffic volume (DOE 1995b:vol. I, 4.11-1).

Idaho Falls receives railroad freight service from Butte, Montana, to the north, and from Pocatello, Idaho, and Salt Lake City, Utah, to the south. The Union Pacific Railroad's Blackfoot-to-Arco Branch crosses the southern portion of INEEL and provides rail service to the site. This branch connects with a DOE spur line at the Scoville

Siding, then links with developed areas within INEEL. Rail shipments to and from INEEL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste (DOE 1995b:vol. I, 4.11-3).

3.3.11.1.2 Electricity

Commercial electric power is supplied to INEEL from the Antelope substation through two feeders to the federally owned Scoville substation, which supplies electric power directly to the site electric power distribution system. Electric power supplied by Idaho Power Company is generated by hydroelectric generators along the Snake River in southern Idaho and by the Bridger and Valmy coal-fired thermal electric generation plants in southwestern Wyoming and northern Nevada (DOE 1995b:vol. II, part A, 4.13-2). Characteristics of this power pool are summarized in Table 3.4.2–2 of the *Storage and Disposition PEIS* (DOE 1996a:3-111).

The average electrical availability at INEEL is about 394,200 MWh/yr; the average usage, about 232,500 MWh/yr. The peak load capacity for INEEL is 124 MW; the current peak load usage, about 42 MW (DOE 1996a:3-110).

3.3.11.1.3 Fuel

Fuels consumed at INEEL include several liquid petroleum fuels, coal, and propane gas. All fuels are transported to the site for storage and use. Fuel storage is provided for each facility, and the inventories are restocked as necessary (DOE 1995b:vol. II, part A, 4.13-2). The current site usage is about 5.8 million l/yr (1.5 million gal/yr). The current site usage of coal is about 11,340 t/yr (12,500 tons/yr) (DOE 1996a:3-110). If additional coal or fuel oil were needed during the year, it could be shipped onto the site.

3.3.11.1.4 Water

The Snake River Plain Aquifer is the source of all water at INEEL (DOE 1996a:3-119). The water is provided by a system of about 30 wells, together with pumps and storage tanks. That system is administered by DOE, which holds the Federal Reserved Water Right for the site of 43 billion l/yr (11 billion gal/yr) (DOE 1995b:vol. II, part A, 4.13-1). The current site usage is 6 billion l/yr (1.6 billion gal/yr) (Werner 1997:2).

3.3.11.1.5 Site Safety Services

DOE operates three fire stations at INEEL. These stations are at the north end of Test Area North, at ANL–W, and in the Central Facilities Area. Each station has a minimum of one engine company capable of supporting any fire emergency in its assigned area. The fire department also provides the site with ambulance, emergency medical technician, and hazardous material response services (DOE 1995b:vol. II, part A, 4.13-3).

3.3.11.2 Proposed Facility Location

A separate utility tunnel running off the main INTEC utility tunnel was completed and water, steam condensate, air, and other lines have been completed up to, and in some cases into, FPF when this facility was built. A summary of the infrastructure characteristics of INTEC is presented as Table 3–25.

3.3.11.2.1 Electricity

Electric power for INTEC is routed into the main electrical room from a 14-kV feeder in Unit Substation 2, north of the building. The current capacity available for INTEC is 262,800 MWh/yr (Abbott, Crockett, and Moor 1997:20).

Table 3–25. INEEL Infrastructure Characteristics for INTEC

Resource	Current Usage	Capacity
Electricity		
Energy consumption (MWh/yr)	60,000	262,800
Peak load (MW)	9.2[a]	31.4[b,c]
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)	757,000	1,112,720[d,e]
Coal (t/yr)	13,000	NA[e]
Water (l/yr)	45,420,000	227,100,000

[a] Demand.
[b] Equivalent to 30 MW continuous use per year.
[c] Based on a 95 percent power factor.
[d] Available capacity is INTEC tank storage capacity in liters.
[e] As supplies get low, more can be supplied by truck or rail.
Key: INTEC, Idaho Nuclear Technology and Engineering Center; NA, not applicable.
Source: Abbott, Crockett, and Moor 1997:20; Werner 1997:1.

3.3.11.2.2 Fuel

Fuel oil and propane are supplied from INTEC. The current capacity of fuel oil and propane is approximately 1.1 million l/yr (291,000 gal/yr); the usage, approximately 757,000 l/yr (200,000 gal/yr) (Abbott, Crockett, and Moor 1997:20).

3.3.11.2.3 Water

Water service is available through connection to the INTEC water supply system, which obtains its water from two deep wells located north of the INTEC main process area. The water withdrawn from the Snake River Plain Aquifer is a small fraction of the available supply (Abbott, Crockett, and Moor 1997:9). The current annual capacity of water available for FPF is about 230 million l/yr (61 million gal/yr); and the current usage for the facility is about 45 million l/yr (12 million gal/yr) (Werner 1997:1).

3.4 PANTEX PLANT

Pantex is in Carson County along U.S. Highway 60 and lies about 27 km (17 mi) northeast of downtown Amarillo, Texas (Figure 2–4). Pantex lies in the Texas Panhandle on the Llano Estacado (staked plains) portion of the Great Plains. The topography at Pantex is relatively flat, characterized by rolling grassy plains and natural playa basins. The term "playa" is used to describe the more than 17,000 ephemeral lakes in the Texas Panhandle, usually less than 1 km (0.6 mi) in diameter, that receive water runoff from the surrounding area. The region is a semiarid farming and ranching area. Pantex is surrounded by agricultural land, but several significant industrial facilities are also nearby (DOE 1996a:3-146).

Pantex was first used by the U.S. Army for loading conventional ammunition shells and bombs from 1942 to 1945. In 1951, the Atomic Energy Commission arranged to begin rehabilitating portions of the original plant and constructing new facilities for nuclear weapons operations. The current missions are shown in Table 3–26. Weapons assembly, disassembly, and stockpile surveillance activities involve handling (but not processing) of encapsulated uranium, plutonium, and tritium, as well as a variety of nonradioactive hazardous or toxic chemicals (DOE 1996a:3-146).

Table 3–26. Current Missions at Pantex

Mission	Description	Sponsor
Plutonium storage	Provide storage of pits from dismantled nuclear weapons	Assistant Secretary for Defense Programs
High explosive(s) components	Manufacture for use in nuclear weapons	Assistant Secretary for Defense Programs
Weapons assembly	Assemble new nuclear weapons for the stockpile	Assistant Secretary for Defense Programs
Weapons maintenance	Retrofit, maintain, and repair stockpile weapons	Assistant Secretary for Defense Programs
Quality assurance	Stockpile quality assurance testing and evaluation	Assistant Secretary for Defense Programs
Weapons disassembly	Disassemble stockpile weapons as required	Assistant Secretary for Defense Programs
Test and training programs	Assemble nuclear weapon-like devices for training	Assistant Secretary for Defense Programs
Weapons dismantlement	Dismantle nuclear weapons no longer required	Assistant Secretary for Defense Programs
Development support	Provide support to design agencies as requested	Assistant Secretary for Defense Programs
Waste management	Waste treatment, storage, and disposal	Assistant Secretary for Defense Programs
Environmental management	Environmental restoration activities	Assistant Secretary for Environmental Management

Source: DOE 1996a:3-146.

DOE Activities. All DOE activities at Pantex, except for environmental restoration programs, fall under the DOE Office of the Assistant Secretary for Defense Programs. Historically, DOE's mission for Pantex primarily included assembly and delivery to the U.S. Department of Defense (DoD) of a variety of nuclear weapons. Today, the primary roles of Pantex are the disassembly of U.S. nuclear weapons being returned to DOE by DoD, maintenance and repair of nuclear weapons, and storage of plutonium pits. These operations are in compliance with the negotiated downsizing of the U.S. and the former Soviet nuclear forces (DOE 1996a:3-147).

Other activities that have been, and will continue to be, conducted under DOE's national security mission include certain maintenance and monitoring activities of the remaining nuclear weapons stockpile, modification and assembly of existing nuclear weapons systems, and production of high-explosive components for nuclear weapons. DOE also conducts quality evaluation of weapons, quality assurance testing of weapons components, and R&D supporting nuclear weapons activities at the plant. DOE's national security responsibilities are mandated by statutes, Presidential directives, and congressional authorization and appropriations (DOE 1996a:3-147).

The change in mission emphasis from assembly to disassembly of nuclear weapons has caused an increase in some waste streams. Waste management operations at Pantex in the near term would add facilities to enhance capabilities to adequately handle existing waste streams. Improved facilities for hazardous waste staging, treatment, and storage would be coupled with increased use of commercial offsite facilities to treat mixed waste streams. Upon completion of the current backlog of dismantlements due to stockpile reduction, waste generation is likely to decrease (DOE 1996a:3-147).

Non-DOE Activities. Texas Tech University pursues agricultural activities on both DOE-owned and DOE-leased property (DOE 1996a:3-147).

3.4.1 Air Quality and Noise

3.4.1.1 Air Quality

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. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.4.1.1.1 General Site Description

The climate at Pantex and the surrounding region is characterized as semiarid with hot summers and rather cold winters. The average annual temperature in the Amarillo region is 13.8 EC (56.9 EF); temperatures range from an average daily minimum of -5.7 EC (21.8 EF) in January to an average daily maximum of 32.8 EC (91.1 EF) in July. The average annual precipitation is 49.8 cm (19.6 in). Prevailing winds at Pantex are from the south. The average annual windspeed is 6 m/s (13.5 mph) (NOAA 1994a). Additional information related to meteorology and climatology at Pantex is presented in Appendix F of the *Storage and Disposition PEIS* (DOE 1996a:F-11, F-12) and in the site environmental information document (M&H 1996a:6-1–6-19).

Pantex is within the Amarillo-Lubbock Intrastate AQCR #211. None of the areas within Pantex and this AQCR are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997e). Applicable NAAQS and Texas State ambient air quality standards are presented in Table 3–27.

There are no PSD Class I areas within 100 km (62 mi) of Pantex. None of the facilities at Pantex have been required to obtain a PSD permit (DOE 1996f:4-118–4-120).

The primary emission sources of criteria pollutants at Pantex are the steam plant boilers, the explosives-burning operation, and emissions from onsite vehicles. Emission sources of hazardous or toxic air pollutants include the high-explosives synthesis facility, the explosives-burning operation, paint spray booths, miscellaneous laboratories, and other small operations (DOE 1996f:4-134). The boilers and high-explosives synthesis facility operate under air permits from the Texas Natural Resource Conservation Commission (TNRCC). The paint

Table 3–27. Comparison of Ambient Air Concentrations From Pantex Sources With Most Stringent Applicable Standards or Guidelines, 1993

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	Concentration (Fg/m^3)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	161
	1 hour	40,000[b]	924
Nitrogen dioxide	Annual	100[b]	0.90
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	8.73
	24 hours	150[b]	88.5
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	<0.01
	24 hours	365[b]	<0.01
	3 hours	1,300[b]	<0.01
	30 minutes	1,048[f]	<0.01
Other regulated pollutants			
Hydrogen sulfide	30 minutes	112[f]	(g)
Total suspended particulates	3 hours	200[f]	(h)
	1 hour	400[f]	(h)
Hazardous and other toxic compounds			
Benzene	1 hour	75[i]	19.4[j]
	Annual	3[i]	0.0547
[Text deleted.]			

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997a), other than those for ozone, particulate matter, lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is #1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 Fg/m^3. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standard is #1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] No sources identified at the site.

[h] No site boundary concentrations from Pantex facilities presented in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*.

[i] TNRCC effects-screening levels are "tools" used by the Toxicology and Risk Assessment Staff to evaluate impacts of air pollutant emissions. They are not ambient air standards. If ambient levels of air contaminants exceed the screening levels, it does not necessarily indicate a problem, but would trigger a more indepth review. The levels are set where no adverse effect is expected.

[j] Concentration reported as a 30-min average.

Note: The NAAQS also includes standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at Pantex, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components* (DOE 1996f). EPA recently revised the ambient air

quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 Fg/m^3 (0.12 ppm) to an 8-hr concentration of 157 Fg/m^3 (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997b:38855). For particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-Fg/m^3 3-year annual arithmetic mean based on community-oriented monitors and a 65 Fg/m^3 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997c:38652).
Source: DOE 1996f:4-127–4-133; EPA 1997a; TNRCC 1997a, 1997b.

spray booths, miscellaneous laboratories, and other small operations are allowed under TNRCC standard exemptions. The explosive-burning operation is allowed under the TNRCC hazardous waste permit (DOE 1997c:21, 22).

With the exception of thermal treatment of high explosives at the burning ground, most stationary sources of nonradioactive atmospheric releases are fume hoods and building exhaust systems, some of which have HEPA filters for control of particulate emissions. Table 3–27 presents the ambient air concentrations attributable to sources at Pantex, which are based on emissions for the year 1993. These emissions were modeled using meteorological data from 1988 (DOE 1996f:4-123) and represent maximum output conditions. Actual annual emissions for some pollutants are somewhat less than these levels, and the estimated concentrations bound the actual Pantex contribution to ambient levels. Only those pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Additional information on ambient air quality at Pantex and detailed information on emissions of other pollutants at Pantex are discussed in the *Final EIS for the Continued Operation of Pantex* (DOE 1996f:4-117–4-135, B-3–B-61) and the 1996 *Environmental Report for Pantex Plant* (DOE 1997c:21, 22, 78–84). Concentrations of nonradiological air pollutants shown in Table 3–27 are in compliance with applicable regulations or are below applicable health effects-screening levels, the concentration of hazardous air pollutants determined by TNRCC to have minimal effect on human health and the environment.

Measurements of PM_{10} and various volatile organic compounds are made at Pantex. During 1993, only one 24-hr PM_{10} measurement exceeded the NAAQS level, while in 1994 the PM_{10} NAAQS level was exceeded 1 day in January and 1 day in June. Windblown dust is indicated as a major contributor to some of these exceedances. The concentrations of carbon monoxide, sulfur dioxide, and nitrogen dioxide from Pantex—combined with those from background (non-Pantex) sources—are expected to be in compliance with the ambient air quality standards. Measured concentrations of 1-2-dibromoethane exceeded the effects-screening levels once in 1995. However, monitoring in the last quarter of 1995 and 1996 showed that all organic compounds measured were below their respective effects-screening levels (DOE 1996f:4-121–4-123; M&H 1997:8, 12, 35–37). 1-2-dibromoethane is not emitted at Pantex. The air quality monitoring program is described in the annual site environmental monitoring reports (DOE 1997c).

Annual PM_{10} measured concentrations during 1995 were less than 24 Fg/m^3 at all monitoring locations, and except one measurement of 170 Fg/m^3 during a grass fire, 24-hr PM_{10} measured concentrations were below 129 Fg/m^3 (TNRCC 1997c:13–15).

3.4.1.1.2 Proposed Facility Location

The meteorological conditions described for Pantex are considered to be representative of the Zone 4 West area. Primary sources of pollutants in Zone 4 West include a standby diesel electric generator, drum sampling, and bulk handling of chemicals (DOE 1996f:B-10–B-29).

3.4.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.4.1.2.1 General Site Description

Major noise emission sources within Pantex include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, construction and materials-handling equipment, vehicles), as well as small arms firing, alarms, and explosives detonation. Most Pantex industrial

facilities are far enough from the site boundary that noise levels from these sources at the boundary are barely distinguishable from background noise. However, some noise from explosives detonation can be heard at residences north of the site, and small arms weapons firing can be heard at residences to the west (DOE 1996a:3-153, 1996f:4-161–4-170).

The acoustic environment along the Pantex boundary and at nearby residences away from traffic noise is typical of a rural location. The day-night average sound levels are in the range, 35 to 50 dBA, that is typical of rural areas (EPA 1974:B-4). Noise survey results in areas adjacent to Pantex indicate that ambient sound levels are generally low, with natural sounds and distant traffic being the primary sources. Traffic, aircraft, trains, and agricultural activities result in higher short-term levels (M&H 1996a:11-1–11-19). Traffic is the primary source of noise at the site boundary and at residences near roads. Traffic noise is expected to dominate sound levels along major roads in the area, such as U.S. Route 60. The residents most likely to be affected by noise from plant traffic along Pantex access routes are those living along Farm-to-Market (FM) 2373 and FM 683 (DOE 1996a:3-153).

Measurements of equivalent sound levels for traffic noise and other sources along the roads bounding Pantex are 53 to 62 dBA for FM 2373 at about 400 m (1300 ft) from the road; 51 to 58 dBA for FM 293 at about 70 m (230 ft); 44 to 65 dBA for FM 683 at about 40 m (130 ft); and 51 dBA for U.S. Route 60 at about 225 m (740 ft). These levels are based on a limited number of 30-min samples taken during peak and offpeak traffic periods; mostly at locations within the site boundary (M&H 1996a:11-11–11-15). The levels represent the range of daytime traffic noise levels at residences near the site.

Other sources of noise include aircraft, wind, insect activity, and agricultural activity. Except for the prohibition of nuisance noise, neither the State of Texas nor local governments have established any regulations that specify acceptable community noise levels applicable to Pantex (DOE 1996a:F-32).

The EPA guidelines for environmental noise protection recommend an average day-night sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near Pantex, the day-night average sound level is less than 65 dBA and is compatible with the residential land use.

3.4.1.2.2 Proposed Facility Location

No distinguishing noise characteristics of Zone 4 West have been identified. Zone 4 West is far enough—1.8 km (1.1 mi)—from the site boundary that noise levels from the facilities are barely distinguishable from background levels.

3.4.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed using appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.4.2.1 Waste Inventories and Activities

Pantex manages the following types of waste: LLW, mixed LLW, hazardous, and nonhazardous. TRU waste and mixed TRU waste are not normally generated and no HLW is currently generated at Pantex. Waste generation rates and the inventory of stored waste from activities at Pantex are provided in Table 3–28. Table 3–29 summarizes Pantex waste management capabilities. More detailed descriptions of the waste management system capabilities at Pantex are included in the *Storage and Disposition PEIS* (DOE 1996a:3-180–3-183, E-49–E-62) and the *Final EIS for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapons Components* (DOE 1996f:4-229).

Table 3–28. Waste Generation Rates and Inventories at Pantex

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	0	0[b]
Remotely handled	0	0
LLW	139	208
Mixed LLW	24[c]	135
Hazardous	486[c,d]	153[c,f]
Nonhazardous		
Liquid	473,125[g]	NA[f]
Solid	8,007[c]	311[c,f,h]

[a] Includes mixed TRU waste.
[b] DOE 1997d:1-2.
[c] DOE 1997c:19.
[d] Includes TSCA-regulated wastes.
[e] DOE 1996f:4-233.
[f] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
[g] King 1997a.
[h] Largely composed of asbestos waste.

Key: LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996e:15, 16, except as notes.

EPA placed Pantex on the National Priorities List on May 31, 1994. Currently, environmental restoration activities are conducted in compliance with CERCLA and a RCRA permit issued in April 1991, and modified in February 1996. Environmental restoration activities are expected to be completed in 2000 (DOE 1996a:3-180). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.4.2.2 Transuranic and Mixed Transuranic Waste

Pantex does not generate or manage TRU waste as a result of normal operations, although there are procedures in place to manage TRU waste if it is generated. The small quantity of TRU waste (<1 m^3) that was stored in Building 12-24 was moved to LANL pending disposal at WIPP (DOE 1997d:1-2).

3.4.2.3 Low-Level Waste

Compactible solid LLW is processed at the LLW Compactor and stored along with the noncompactible materials for shipment to the Nevada Test Site (NTS), where most LLW is disposed of, or to a commercial vendor. Some liquid LLW has been solidified, but more development is required in this area. Much liquid

Table 3–29. Waste Management Capabilities at Pantex

			Applicable Waste Type					
Facility Name/Description	**Capacity**	**Status**	**TRU**	**Mixed TRU**	**LLW**	**Mixed LLW**	**Haz**	**Non-Haz**
Treatment Facility (m^3/yr)								
11-09 South - Scintillation Vial Crusher/Segregator	Variable[a]	Online[b]			X			
11-09 South - Sort/Segregation and Decontamination Activities	Variable[a]	Online[b]			X	X		
11-09 South - Fluorescent Bulb Crusher	Variable[a]	Online[b]					X	
12-17 - Evaporator for Tritiated Water	Campaign	Online			X			
12-19 East - Rotary Evaporator Vacuum Distillation Units (2)	Campaign	Online						X
12-19 East - Fractional Distillation Unit	Campaign	Online						X
12-19 East - HE Precipitation Process	Campaign	Online						X
12-42 - Compactor/Drum Crusher	Variable[a]	Online[b]			X			
16-18 - HWTPF	750	Planned for 1999			X	X	X	
16-18 - HWTPF Waste Compacting	90	Planned for 1999			X	X	X	X
16-18 - HWTPF Drum Crushing	208	Planned for 1999			X	X	X	X
16-18 - HWTPF Wastewater Evaporation System	45	Planned for 1999			X			
16-18 - HWTPF Misc Drum Operations (including neutralization and filtration)	Various	Planned for 1999			X	X	X	
16-18 - HWTPF Drum Rinsing System	45	Planned for 1999					X	
16-18 - HWTPF Fluorescent Bulb Crusher	12	Planned for 1999					X	
16-18A - Solvent Recovery Unit	348	Planned for 1999					X	
16-18A - Scintillation Vial Crushing	90	Planned for 1999			X			X
Burning Ground Thermal Processing Units	Variable[c]	Online				X	X	
Wastewater Treatment Facility	946,250	Online						X

Facility Name/Description	Capacity	Status	TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Storage Facility (m³)								
11-07A & B Pads - Container Storage Areas	402	Online			X	X	X	X
11-07 North Pad - Container Storage Unit	125	Online			X	X	X	X

Table 3–29. Waste Management Capabilities at Pantex (Continued)

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
11-09 North Building - Container Storage Area	379	Online			X	X	X	X
16-16 Building - Hazardous Waste Staging Facility	1,047	Online			X	X	X	X
Disposal Facility (m³)								
Construction Debris Landfill (Zone 10)	21,208	Online						X

[a] Capacity included in HWTPF.
[b] Unit will move to HWTPF when operational in 1999.
[c] Permit limitations are per burning event.
Key: Haz, hazardous; HE, high explosives; HWTPF, Hazardous Waste Treatment and Processing Facility; LLW, low-level waste; TRU, transuranic.
Source: King 1997b; Lemming 1998; M&H 1997:28.

LLW is currently being evaporated. The remaining liquid LLW is being stored on the site awaiting a treatment process (Jones 1999).

Pantex is presently approved to ship seven LLW streams to NTS for disposal. Previous approvals of two waste streams were deactivated due to changes in the characterization of the wastes, but the requests for approval are being updated and reviewed and approval is expected. Requests for the approval of two additional waste streams are being prepared for submittal, and several other waste streams are being studied and considered for submittal. These wastes are currently stored on the site. Soil contaminated with depleted uranium has been disposed of at a commercial facility, and the possibility for disposal of other LLW at commercial facilities is being pursued where technically and economically advisable. Radioactively contaminated classified weapon components that cannot be demilitarized and sanitized are sent to the classified LLW repository at NTS (Jones 1999).

3.4.2.4 Mixed Low-Level Waste

Pantex treats mixed LLW in three areas: the Burning Ground, Building 11-9, and Building 12-17 (King 1997b). The Burning Ground is an open-burning area where explosives, explosive-contaminated waste, and explosive-contaminated spent solvents are burned. A large-volume reduction is attained by this treatment, and some wastes are rendered nonhazardous due to elimination of the high-explosive reactivity hazard (DOE 1996a:E-50). Building 11-9 in Zone 11 is permitted for the treatment and processing of mixed LLW and hazardous waste in tanks and containers (DOE 1996f:4-236).

Pantex has developed the *Pantex Plant Federal Facility Compliance Act Compliance Plan* to provide mixed waste treatment capability for all mixed waste streams in accordance with the FFCA of 1992 (DOE 1996a:3-180). Currently, some mixed LLW is stored on the site until it can be profiled and accepted by offsite treatment and disposal facilities, in accordance with the Pantex site treatment plan (DOE 1997c:sec. 2.3.1). The Hazardous Waste Treatment and Processing Facility is being planned to treat mixed waste (DOE 1996a:E-50).

3.4.2.5 Hazardous Waste

Pantex stores some hazardous waste on the site. Most hazardous waste generated at Pantex is shipped off the site for recycle, treatment, or disposal at commercial facilities. High explosives, high-explosive contaminated materials, and high-explosive contaminated solid wastes are burned under controlled conditions at the Burning Ground. Ash, debris, and residue resulting from this burning are transported off the site for approved disposal at a commercial RCRA-permitted facility (DOE 1996a:3-183, E-51). Polychlorinated biphenyls waste is transported to offsite permitted facilities for treatment and disposal (DOE 1996f:4-238).

3.4.2.6 Nonhazardous Waste

Management of solid waste is regulated by TNRCC. Nonhazardous waste generated at Pantex falls into Texas Class 1 or Class 2 designation. Some solid waste (inert and insoluble materials like certain scrap metals, bricks, concrete, glass, dirt, and certain plastics and rubber items that are not readily degradable) is designated as Class 2 nonhazardous waste and is disposed on the site in the Construction Debris Landfill in Zone 10. The onsite landfill is approved for both Class 2 and Class 3 wastes. The remainder of the Class 2 nonhazardous waste generated at Pantex is sanitary waste such as cafeteria and lunchroom waste, paper towels, and office waste. Most of this waste is disposed off the site at permitted landfills (such as the city of Amarillo landfill), although some goes to offsite commercial incinerators (DOE 1997c:sec. 2.3.1).

Class 1 nonhazardous waste (such as asbestos), though not hazardous by EPA's definition relative to RCRA, is handled in much the same manner as hazardous waste and is sent to offsite treatment or disposal facilities (DOE 1997c:sec. 2.3.1). Medical waste is dispositioned through a commercial vendor who picks up and transports the waste (DOE 1996f:4-238).

Sanitary sewage and some pretreated industrial wastewater are treated by the Wastewater Treatment Facility and discharged to Playa 1 (DOE 1996f:4-238). The treated effluent from the system either evaporates or infiltrates into the ground. Upgrades to the facility and associated collection/conveyance system will help to ensure that effluent limitations are met. Included in this project is the upgrade of the existing sewage treatment lagoon, repair and replacement of deteriorated sewer lines, construction of a closed system to eliminate the use of open ditches for conveyance of industrial wastewater discharges, and improvements to the plant storm-water management system (DOE 1996a:3-183, E-51). Conceptual design of the Wastewater Treatment Facility was completed on January 26, 1998, and the Title I detailed design was scheduled to be completed by June 30, 1999. Award of the actual facility construction contract is scheduled for January 31, 2001; completion of construction of all treatment facility upgrades is scheduled for November 30, 2003 (DOE 1999a).

An environmental assessment (EA) was recently completed for the wastewater treatment plant upgrade (DOE 1999d) and a FONSI was issued (DOE 1999e). As selected in the FONSI, the project to upgrade the existing Wastewater Treatment Facility will essentially involve the construction of a new, zero-discharge facility south of the current facility and outside the 100-year floodplain of Playa 1. Specifically, two new lagoons will be constructed, one serving as a facultative treatment lagoon and the second as an irrigation water storage reservoir and alternate treatment lagoon. The existing Wastewater Treatment Facility lagoon will be retained as a supplemental storage facility for treated wastewater effluent.

Beginning in 2003, instead of being discharged to Playa 1, treated effluents will be disposed of via land application for the irrigation of crops in cooperation with the Texas Tech University Research Farm. Either a subsurface flow system, a center-pivot system, or an overland flow irrigation system will be used to apply effluents (DOE 1999d, 1999e).

3.4.2.7 Waste Minimization

The goals of the Pantex pollution prevention and waste minimization program are to minimize the volume of waste generated to the extent that it is technologically and economically practical; reduce the hazard of waste through substitution or process modification; minimize contamination of real property and facilities; minimize exposure and associated risk to human health and the environment; and ensure safe, efficient, and compliant long-term management of all wastes (DOE 1996a:3-180).

Although an overall increase in waste generation of 49 percent occurred in 1996, this was largely a result of the removal of contaminated soil from ditches as part of the environmental restoration program. In fact, from 1987 to 1996, the generation of routine hazardous waste decreased by more than 99 percent. The generation of other waste types has also been reduced. The goal of reducing the generation of mixed LLW by 50 percent from 1992 levels has already been met. Another goal is to halve the generation of LLW and State-regulated (Class 1) wastes by 1999 (DOE 1997c:sec. 3.5). Pantex also participates in the Clean Texas 2000 pollution prevention program and has committed to a 50 percent reduction in 1987 chemical releases and hazardous waste generation by the year 2000 (DOE 1996f:4-232). Currently, telephone directories, paper, certain plastics, and some steel and aluminum cans are being recycled (DOE 1996a:E-51).

3.4.2.8 Preferred Alternatives From the WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 109) are shown in Table 3–30 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at Pantex, and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a), with the hazardous waste ROD issued on August 5, 1998 (DOE 1998b). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at WIPP. Each DOE site that has, or will generate, TRU waste will, as needed, prepare and store its TRU waste on the site. The hazardous waste ROD states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own hazardous waste on the site in existing facilities where this is economically favorable. More detailed information on DOE's alternatives for the future configuration of waste management facilities at Pantex is presented in the WM PEIS, and the hazardous waste and TRU waste RODs.

Table 3–30. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers treatment and storage of Pantex TRU waste at LANL.[a]
LLW	DOE prefers to treat Pantex LLW on the site. DOE prefers to ship Pantex LLW to one of two or three regional disposal sites.
Mixed LLW	DOE prefers to treat mixed LLW generated at Pantex on the site consistent with Pantex's site treatment plan. DOE prefers to ship Pantex mixed LLW to one of two or three regional disposal sites.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.[b]

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ." The ROD did not specifically address TRU waste generated at Pantex, since there is currently no TRU waste in inventory at Pantex.

[b] ROD for hazardous waste (DOE 1998b) selected the preferred alternative at Pantex.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; TRU, transuranic.

Source: DOE 1997a:summary, 26, 109.

3.4.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA as defined in Appendix F.9, which encompasses 32 counties surrounding Pantex in Texas and New Mexico. Statistics for population, housing, community services, and local transportation are presented for the ROI, a three-county area (in Texas) in which 93.8 percent of all Pantex employees reside as shown in Table 3–31. In 1997, Pantex employed 2,944 persons (about 1.3 percent of the REA civilian labor force) (King 1997a).

Table 3–31. Distribution of Employees by Place of Residence in the Pantex Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Randall	1,629	55.3
Potter	965	32.8
Carson	167	5.7
ROI total	2,761	93.8

Source: King 1997a.

3.4.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the Pantex REA are summarized in Figure 3–18. Between 1990 and 1996, the civilian labor force increased 11.6 percent to 234,072. In 1996, the unemployment rate in the REA was 4.6 percent, which was lower than the 5.6 percent unemployment rate in Texas and the 8.1 percent unemployment rate in New Mexico (DOL 1999). In 1995, government activities represented the largest sector of the employment in the REA (21.9 percent). This was followed by retail trade (19.6 percent) and services (18.8 percent). The totals for these employment sectors in Texas were 18.0 percent, 18.7 percent, and 24.7 percent, respectively. The totals for these employment sectors in New Mexico were 22 percent, 20.3 percent, and 26.7 percent, respectively (DOL 1997).

3.4.3.2 Population and Housing

In 1996, the ROI population totaled 212,729. Between 1990 and 1996, the ROI population increased 9.6 percent compared with the 12.2 percent increase in Texas (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by about 15.8 percent, compared with the 26.3 percent increase in Texas. The total number of housing units within the ROI for 1990 was 83,590 (DOC 1994). The 1990 homeowner vacancy rate for the ROI, 3.3 percent, was similar to the Texas rate of 3.2 percent. The renter vacancy rate, 14.2 percent, was also similar to Texas' 13 percent (DOC 1990a). Population and housing trends in the Pantex ROI are summarized in Figure 3–19.

3.4.3.3 Community Services

3.4.3.3.1 Education

Eight school districts provide public education in the Pantex ROI. As shown in Figure 3–20, school districts were operating between 56 and 100 percent of capacity in 1997. In 1997, the average student-to-teacher ratio for the ROI was 15:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratio for Texas was 11.3:1 (DOC 1990b; 1994).

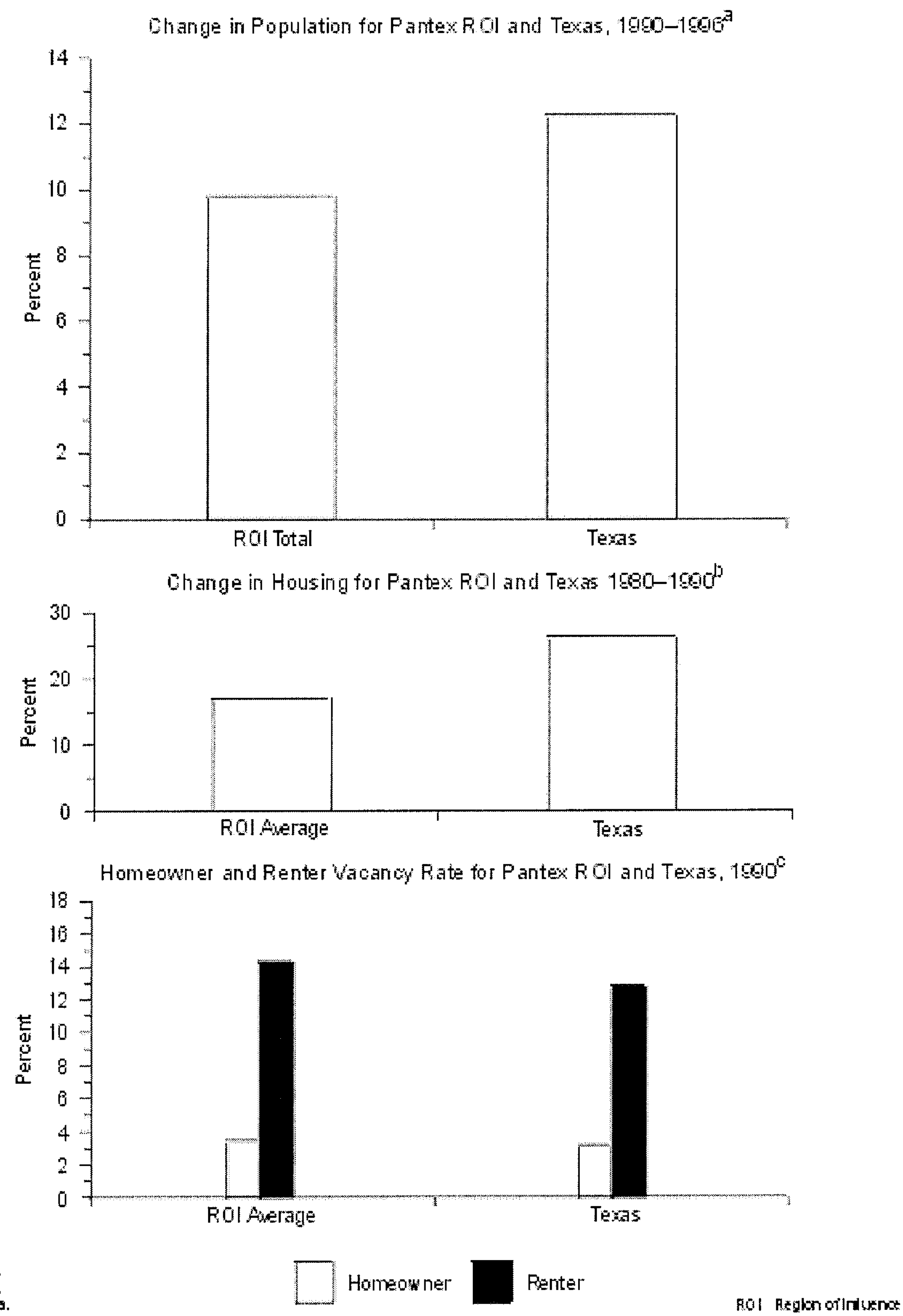
3.4.3.3.2 Public Safety

In 1997, a total of 542 sworn police officers were serving the ROI. The 1997 ROI average officer-to-population ratio was 2.5 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State average of 2.0 officers per 1,000 persons (DOC 1990b). In 1997, 487 paid and volunteer firefighters provided fire protection services to the Pantex ROI. The 1997 average ROI firefighter-to-population ratio was 2.3 firefighters per 1,000 persons (Nemeth 1997b). This compares with the1990 State average of 0.9 firefighters per

[a]DOL 1999.
[b]DOL 1997.

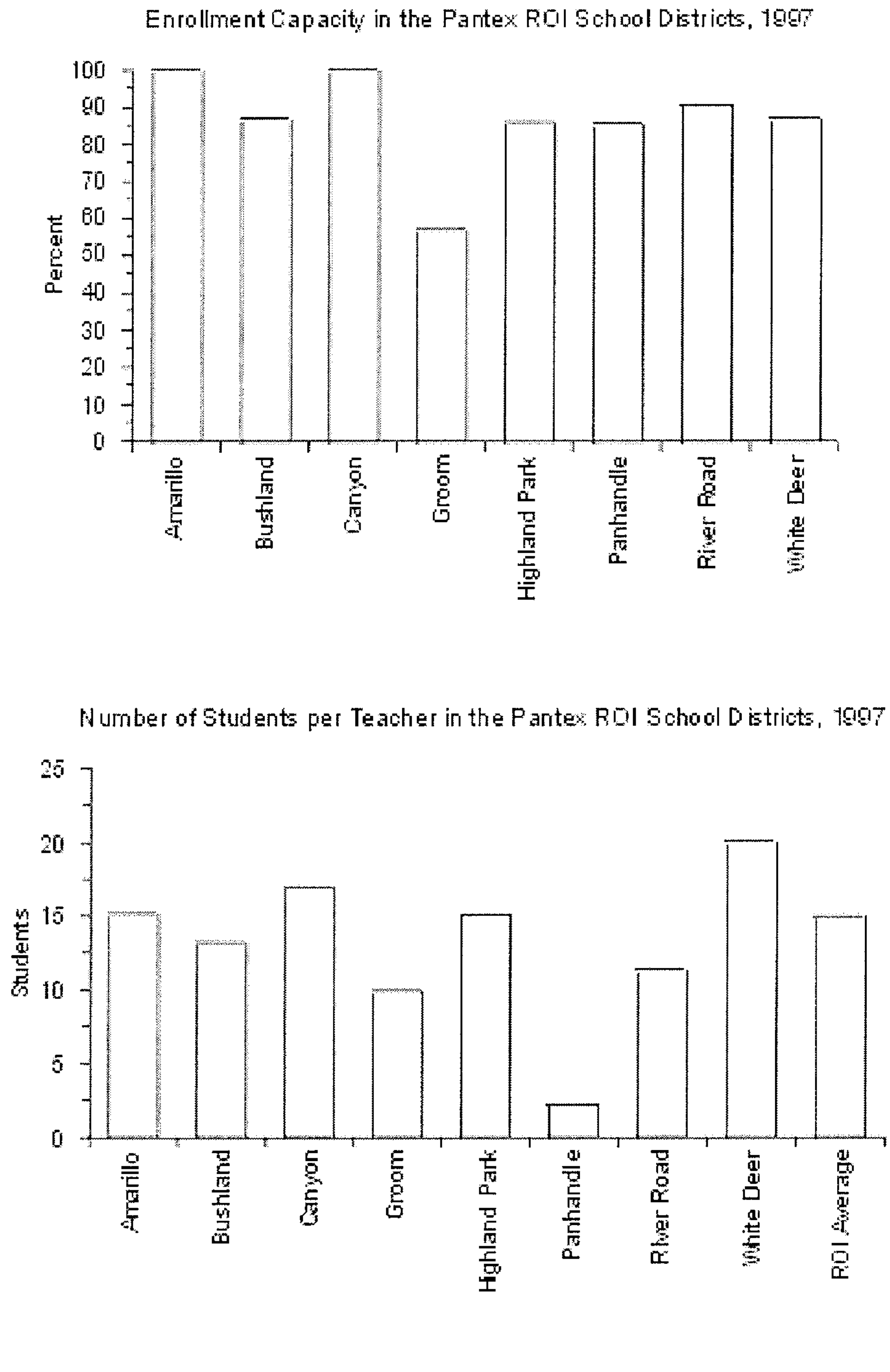
REA Regional economic area

Figure 3–18. Employment and Local Economy for the Pantex Regional Economic Area and the States of Texas and New Mexico



[a] DOC 1997.
[b] DOC 1994.
[c] DOC 1990a.

Figure 3–19. Population and Housing for the Pantex Region of Influence and the State of Texas



Source: Nemeh 1997a.

ROI Region of Influence

Figure 3–20. School District Characteristics for the Pantex Region of Influence

1,000 persons (DOC 1990b). Figure 3–21 displays the ratio of sworn police officers and firefighters to the population for the Pantex ROI.

3.4.3.3.3 Health Care

In 1996, a total of 531 physicians served the ROI. The 1996 average physician-to-population ratio in the ROI of 2.5 physicians per 1,000 persons compares with the 1996 State average of 2.2 physicians per 1,000 persons (Randolph 1997). In 1997, six hospitals served the three-county ROI. The 1997 hospital bed-to-population ratio was 5.9 beds per 1,000 persons in the ROI (Nemeth 1997c). This compares with the 1990 State average of 3.4 beds per 1,000 persons (DOC 1996:128). Figure 3–21 displays the ratio of hospital beds and physicians to the population for the Pantex ROI.

3.4.3.4 Local Transportation

Vehicular access to Pantex is provided by FM 683 to the west and FM 2373 to the east. Both roads connect with FM 293 to the north and U.S. Route 60 to the south (see Figure 2–4). Four road segments in the ROI could be affected by route disposition alternatives: I–27 from Local Route 335 at Amarillo to I–40 at Amarillo and FM 683 from U.S. Route 60 to FM 293. The third is FM 2373 from I–40 to U.S. Route 60. The fourth is FM 2373 from U.S. Route 60 to FM U.S. Route 60 (DOE 1996a).

Aside from routine minor preventive maintenance paving, there was one planned road improvement project in 1998 that could affect access onto the Pantex site. This includes the construction of a bridge along FM 1912 over U.S. Route 60. There are also long-range plans to build a bridge at the intersection of FM 2373 and U.S. Route 60. Both of these projects are not expected to be initiated until the year 2000 or beyond (Nipp 1997). Even without these improvements, the road system is more than adequate for current Pantex workloads.Amarillo City Transit provides public transport service to Amarillo, but the service does not extend to Pantex. The major railroad in the Pantex ROI is the Burlington Northern and Santa Fe Railroad, a mainline that forms the southern boundary of Pantex and provides direct access to the site. There are no navigable waterways within the ROI capable of accommodating material transports to the plant.

Amarillo International Airport provides jet air passenger and cargo service from national and local carriers. Several smaller private airports are located throughout the ROI (DOE 1996a).

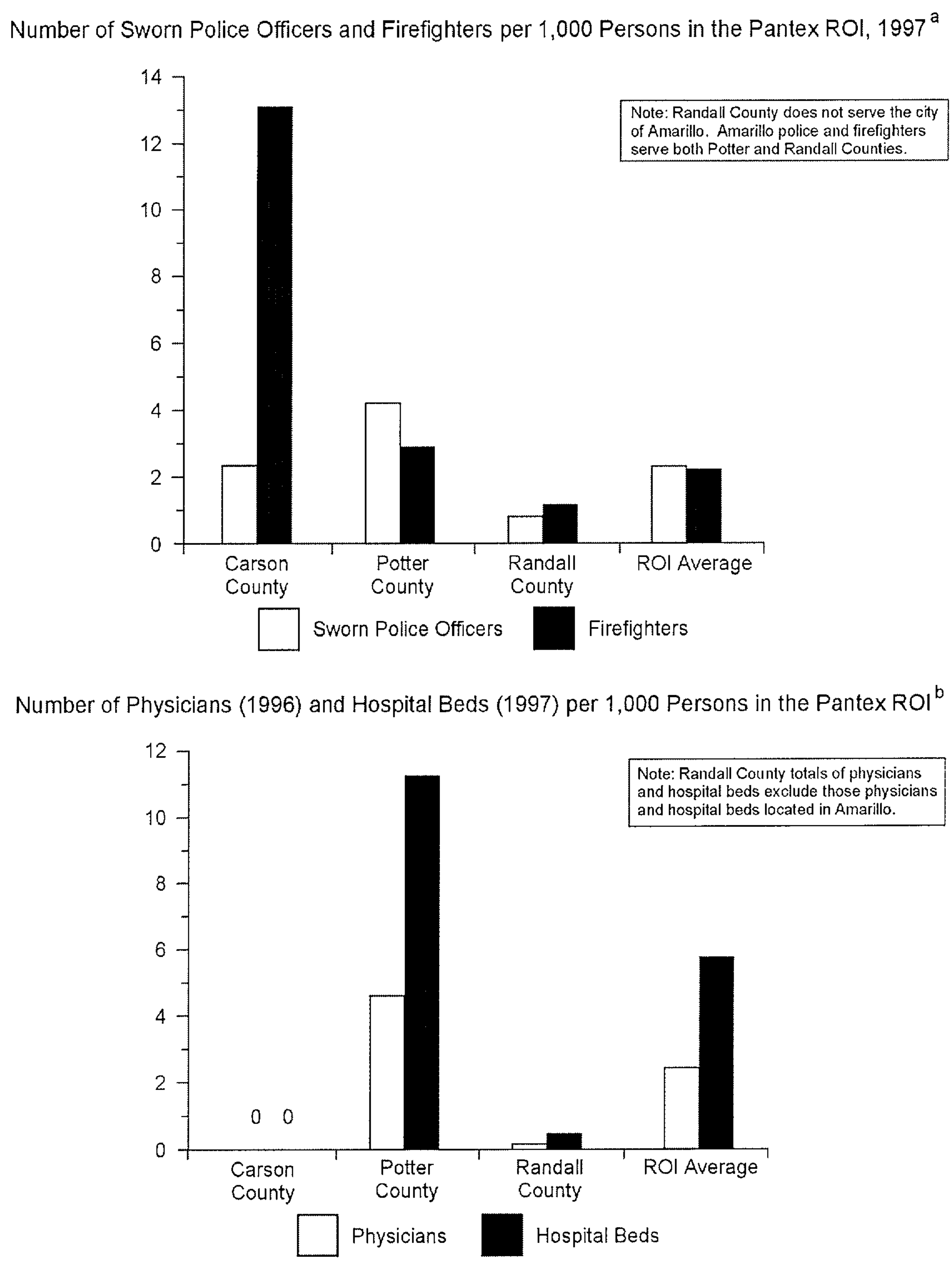
3.4.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.4.4.1 Radiation Exposure and Risk

3.4.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of Pantex are shown in Table 3–32. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to Pantex operations.



[a]Nemeth 1997b.
[b]Nemeth 1997c; Randolph 1997.

ROI Region of influence

Figure 3–21. Public Safety and Health Care Characteristics for the Pantex Region of Influence

Table 3–32. Sources of Radiation Exposure to Individuals in the Pantex Vicinity Unrelated to Pantex Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external terrestrial radiation[a]	93
Internal terrestrial radiation[b]	39
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	397

[a] DOE 1997c:65.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Releases of radionuclides to the environment from Pantex operations provide another source of radiation exposure to people in the vicinity of Pantex. Types and quantities of radionuclides released from Pantex operations in 1996 are listed in the *1996 Environmental Report for Pantex Plant* (DOE 1997c:64). Doses to the public resulting from these releases are given in Table 3–33. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Table 3–33. Radiation Doses to the Public From Normal Pantex Operations in 1996 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard**[a]	**Actual**	**Standard**[a]	**Actual**	**Standard**[a]	**Actual**
Maximally exposed individual (mrem)	10	8.8×10^{-5}	4	0	100	8.8×10^{-5}
Population within 80 km (person-rem)[b]	None	2.1×10^{-3}	None	0	100	2.1×10^{-3}
Average individual within 80 km (mrem)[c]	None	7.6×10^{-6}	None	0	None	7.6×10^{-6}

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.
[b] About 275,000 in 1996.
[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Source: DOE 1997c:65.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from Pantex operations in 1996 is estimated to be 4.4×10^{-11}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of Pantex operations is less than 5 in 100 billion. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

According to the same risk estimator, 1.1×10^{-6} excess fatal cancer is projected in the population living within 80 km (50 mi) of Pantex from normal operations in 1996. To place this number into perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1996 mortality rate associated with cancer for the U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this mortality rate, the number of fatal cancers expected to occur during 1996 from all causes in the population living within 80 km (50 mi) of Pantex was 550. This expected number of fatal cancers is much higher than the 1.1×10^{-6} fatal cancer estimated from Pantex operations in 1996.

Pantex workers receive the same dose as the general public from background radiation, but they also receive an additional dose from working in facilities with nuclear materials. Table 3–34 presents the average dose to the individual worker and the cumulative dose to all workers at Pantex from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a:para. 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[6] (Appendix F.10), the number of projected fatal cancers among Pantex workers from normal operations in 1996 is 0.011.

Table 3–34. Radiation Doses to Workers From Normal Pantex Operations in 1996 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	8.7
Total workers (person-rem)[c]	None	28

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202). However, DOE's goal is to maintain radiological exposure as low as is reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); the site must make reasonable attempts to maintain individual worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] About 3,160 in 1996 of which approximately 2,400 were badged.

Source: M&H 1997.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *1996 Environmental Report for Pantex Plant* (DOE 1997c). In addition, the concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are presented in that same report.

3.4.4.1.2 Proposed Facility Location

External radiation doses and concentrations of gross alpha and plutonium in air have been measured in Zone 4. In 1996, the annual dose in Zone 4 was about 100 mrem. This is the same as measured at the offsite control location, which indicates that there is no additional dose to workers above background. In that same year, the

[6] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

Zone 4 concentration in air of plutonium 239/240 was 3.2×10^{-7} pCi/m^3. This value was about one-third less than that measured at the offsite locations (DOE 1997c:67, 77, 79).

3.4.4.2 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 through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.4.1.

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 NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal Pantex operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or by direct exposure, are lower than those from the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.4.1. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. All annual concentrations are in compliance with applicable guidelines and regulations. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to Pantex workers during normal operations may include the inhalation of contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a meaningful estimate of impacts. However, workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to OSHA 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 requires that conditions in the workplace be as free as possible from recognized hazards that cause, or are likely to cause, illness or physical harm. Therefore, workplace conditions at Pantex are substantially better than required by standards.

3.4.4.3 Health Effects Studies

Only one cancer incidence and mortality study was conducted on the general population in communities surrounding Pantex for the period 1981 to 1992, and only one study of workers (employed between 1951 and 1978) has been done. There were no statistically significant increases in mortality among females in the general population during this period, but significant increases in prostate cancer mortality occurred among Potter County and Randall County males, and in leukemia mortality among Carson County males. No statistically significant increases in other types of cancer among males occurred during this period. Significantly fewer deaths were observed in the workforce than would be expected judging from U.S. death rates for cancer, arteriosclerotic heart disease, and digestive diseases. No specific causes of death occurred more frequently than expected. Workers were reported to show a nonstatistically significant excess of brain cancer and leukemia in the study conducted; the small number of cases could be attributed to chance alone. For a more detailed description of the studies reviewed and the findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current Pantex workers, refer to Appendix M.4.5 of the *Storage and Disposition PEIS* (DOE 1996a).

3.4.4.4 Accident History

In 1989, during a weapon disassembly and retirement operation, a release of tritium in the assembly cell occurred. Four workers received negligible doses, and a fifth, a somewhat higher, but still low dose of 1.4 mrem. No other incidents involving the accidental release of radioactivity from Pantex have taken place in more than 30 years.

3.4.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes planning, preparedness, and response.

Pantex has an emergency management plan to protect life and property within the facility, the health and welfare of surrounding areas, and the defense interests of the nation during any credible emergency situation. Formal mutual assistance agreements have been made with the Amarillo fire department, the National Guard, and St. Anthony's Hospital. Under accident conditions, an emergency coordinating team of DOE and Pantex contractor management personnel would initiate the Pantex emergency plan and coordinate all onsite actions.

If offsite areas could be affected, the Texas Department of Public Safety would be notified immediately and would make emergency announcements to the public and local governmental agencies in accordance with Annex R of the *State of Texas Emergency Management Plan*. Pantex has Radiological Assistance Teams equipped and trained to respond to an accident involving radioactive contamination on or off the site. In addition, the Joint Nuclear Accident Coordination Center in Albuquerque, New Mexico, can be called on if needed to mobilize radiation emergency response teams from DOE, DoD, and other participating Federal agencies.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

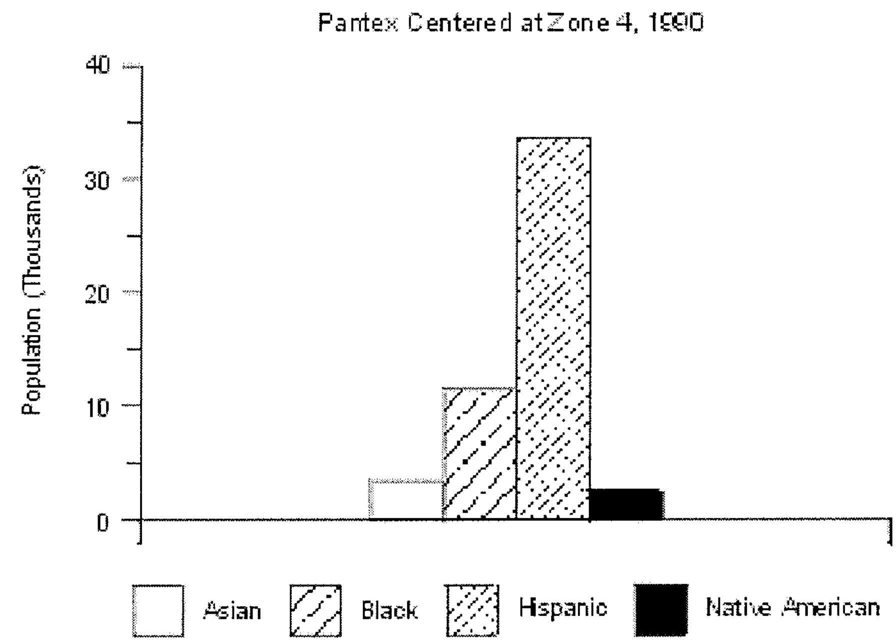
3.4.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of Pantex, the potentially affected area includes only parts of northwestern Texas.

The potentially affected area around Zone 4 West is defined by a circle with an 80-km (50-mi) radius centered at Pantex (lat. 35E20'0.4" N, long. 101E34'22.5" W). The total population residing within that area in 1990 was 266,004. The proportion of the population there that was considered minority was 19.1 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and for the State of Texas, 39.3 (DOC 1992).

Figure 3–22 illustrates the racial and ethnic composition of the minority population in the potentially affected area. At the time of the 1990 census, Hispanics were the largest minority group within that area, constituting 12.8 percent of the population. Blacks constituted about 4.2 percent, and Asians, about 1.3 percent. Native Americans were the smallest group, constituting about 0.8 percent (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 39,578 persons (15.2 percent of the total population) residing within the potentially affected area around Zone 4 West reported incomes below that threshold. Data obtained during the 1990 census also show that of



Source: DOC 1992.

Figure 3–22. Racial and Ethnic Composition of Minorities Around Pantex

the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Texas reported 18.1 percent.

3.4.6 Geology and Soils

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.4.6.1 General Site Description

Pantex is rather flat and includes four playas on DOE property and two playas on land leased from Texas Tech University (M&H 1996a:5-5). The playas are frequently dry, with clay bottoms and depths to about 9 m (30 ft)(DOE 1996a:3-165). (See Section 3.4.7.1 for additional information on these playas.) The primary surface deposits at Pantex are Pullman soils on the Southern High Plains surface and Randall soils in the playas (M&H 1996a:3-1).

The Pullman soils are the soil horizon in the uppermost section of the Quaternary-aged Blackwater Draw Formation. This formation consists of a sequence of buried soil horizons, the upper unit of mostly clay loam and caliche about 3 m (10 ft) thick and a lower unit of silty sand with caliche 10 to 24 m (30 to 80 ft) thick. The Blackwater Draw Formation overlies the Ogallala Formation (M&H 1996a:3-1).

The Ogallala Formation of Tertiary Age regionally consists of alluvial sediments partly occupying paleovalleys, with eolian sediments capping paleouplands and most fluvial deposits. More specifically, the basal, paleovalley fill materials consist of sands and gravels deposited in a high-energy fluvial environment along with fine sand and silt and laminated-to-massive clay resulting from overbank or floodplain deposition. Eolian sediments overlie and are interbedded with the fluvial deposits and consist of dune sand deposits as well as deposits ranging from fine sand to coarse silt thought to have been deposited as thin sand sheets and loess. Overall, a total of seven distinct lithofacies have been identified in the Ogallala Formation, including gravel; sand and gravel; fluvial sand; find sand and mud; laminated fine sand and silt; and laminated-to-massive clay, eolian sand, and fine sand to coarse silt (Gustavson 1996:1, 5, 17, 34, 48). The top of the formation is capped by the Caprock caliche. Depths to the base of the Ogallala vary considerably, from about 90 m (300 ft) at the southwest corner of the site to about 220 m (720 ft) at the northeast corner of the site (M&H 1996a:3-1). Underlying the Ogallala Formation are sedimentary rocks of the Triassic Dockum Group. This rock is as much as 30 m (100 ft) thick and consists of sandstone, siltstone, and mudstone. The portion of the Triassic Dockum Group near the northeastern corner of Pantex was eroded before the Ogallala was deposited directly on Permian strata (M&H 1996a:19). The Permian strata consist of deposits of salt, shale, limestone, argillaceous (clay-bearing) limestone, and dolomite. No economically viable geologic resources have been identified at Pantex (DOE 1996a:3-165).

Dissolution of salt beds within the Permian strata has resulted in sinkholes and fractures in nearby Armstrong and Hutchinson Counties in Texas. No sinkholes or fractures have been identified in Carson County, where the site is located. Recent work using shallow seismic data has determined that the structure beneath the playas at Pantex and adjacent areas shows the displacement of Ogallala strata. This displacement is attributed to the dissolution of underlying salt beds, an active geologic process in the region (DOE 1996a:3-165). In terms of the life of Pantex, the effects of that process are negligible (M&H 1997:19).

There are no capable faults in the vicinity of Pantex. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000-years (DOE 1996a:3-165). No tectonic faulting younger than late Permian is recognized at or near Pantex. An assessment of natural hazards at Pantex found three major subsurface faults and one minor surface fault. The subsurface faults range from 64 to 250 km (40 to 155 mi) in length and are 8 to 40 km (5 to 25 mi) from the plant site. The surface fault is estimated to be 6.4 km (4 mi) long and 32 km (20 mi) northwest of Pantex (M&H 1996a:3-8–3-10).

According to the Uniform Building Code, Pantex is on the boundary zone between Seismic Zones 0 and 1, meaning that little or no damage could occur as a result of an earthquake. This area is fairly free of earthquakes (DOE 1996a:3-165). Between 1906 and 1986, as few as 36 earthquakes were felt by persons in the Texas Panhandle. The strongest reported had a Modified Mercalli Intensity of VI. An earthquake of intensity VI is felt by everyone but causes little damage to competent structures. Many of the earthquake epicenters are associated with the Amarillo Uplift, about 32 km (20 mi) north of Pantex. An earthquake with a maximum horizontal acceleration of 0.17g is calculated to have an annual probability of occurrence of 1 in 5,000 at Pantex (Barghusen and Feit 1995:2.10–14).

There are no volcanic hazards at Pantex because there are no known areas of active volcanism in the Texas Panhandle (DOE 1996a:3-165). The nearest volcanic activity occurred 4,000 to 10,000 years ago in northeast New Mexico (M&H 1996a:3-8).

Pantex is underlain by soils of the Pullman-Randall association, which consists of nearly level to gently sloping, deep noncalcareous clays (i.e., clays containing no calcium carbonate [calcite]) and clay loams. Pullman soils underlie most of the Pantex area, but Randall soils occur in the vicinity of the playas and depressions (DOE 1996a:3-165). The Pullman soil is classified as prime farmland soil (M&H 1997:17). Soils at Pantex are acceptable for standard construction techniques (DOE 1996a:3-165). More detailed descriptions of the geology and the soil conditions at Pantex are included in the *Storage and Disposition PEIS* (DOE 1996a:3-165, 3-166) and the *Environmental Information Document for the Pantex Plant EIS* (M&H 1996a:3-1–3-53).

3.4.6.2 Proposed Facility Location

The soil types near Zone 4 West are Pullman clay loam (0 to 1 percent and 1 to 3 percent slopes) and Osteocyte clay loam (1 to 3 percent slopes). Neither of these soils is subject to liquefaction or is unstable (M&H 1997:17).

3.4.7 Water Resources

3.4.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.4.7.1.1 General Site Description

Pantex is situated on a flat portion of the Southern High Plains of Texas. No streams or rivers flow through Pantex. Major surface water in the vicinity includes the Canadian River, 27 km (17 mi) north of the plant, Sweetwater Creek and the Salt Fork of the Red River, respectively 80 km (50 mi) and 32 km (20 mi) to the east, and the Prairie Dog Fork of the Red River, 56 km (35 mi) to the south. The Canadian River flows into Lake Meredith about 40 km (25 mi) north of the plant. Water from Lake Meredith is mixed with water pumped from the Ogallala aquifer for use as drinking water for several Southern High Plains cities. No hydrologic connections exist to transport contaminants from Pantex into either the Canadian River or Lake Meredith (M&H 1996a:5-4, 5-5).

The only naturally occurring bodies of water on the plant site are the playas and very small, unnamed, intermittent channels and ditches that may feed storm water into them. There are three playas (Playas 1, 2, and 3) on Pantex property, two (Playas 4 and 5) on the Texas Tech University property, several adjacent to Pantex, and one, called Pantex Lake, on DOE-owned property about 4 km (2.5 mi) northeast of the main portion of Pantex. Pantex Lake received discharges from the old sewage treatment facility from 1942 until the early 1970s; however, flows from the wastewater treatment facility are now discharged to Playa 1 as permitted by the State of Texas and the EPA. Currently, there are no industrial discharges diverted to Pantex Lake, Playa 3, or Playa 5, although all of the playas receive surface water runoff from precipitation events (Barghusen and Feit 1995:2.10-17–2.10-20).

Studies have suggested that most of the recharge of the underlying Ogallala aquifer within the Southern High Plains originates from water stored in the playas. However, the playas are frequently dry because of the high, naturally occurring evaporation rate combined with a rate of infiltration that normally exceeds the rate of inflow. Playas in the area of the plant may be as large as 1,220 m (4,000 ft) in diameter and more than 9 m (30 ft) deep. Most of the playas are floored with a clay accumulation at the bottom that is lens shaped, being thickest in the middle and thinning out toward the edges. These clay floors may contain desiccation cracks up to 1.8 m (6 ft) deep when the floor is dry (Barghusen and Feit 1995:2.10-17).

The only surface waterway that flows throughout the year is the one that receives flow from the Wastewater Treatment Facility and discharges into Playa 1. In 1996, discharge to the waterway was 1,242,400 l/day (328,200 gal/day). The Wastewater Treatment Facility receives and treats sanitary waste flows and some process wastewater flows. Effluent from the Wastewater Treatment Facility is monitored pursuant to the plant's NPDES permit and TNRCC permits. The remaining channels and ditches contain flows only after storm events (DOE 1997c:112).

Industrial and storm-water discharges are authorized by State and Federal permits. Pantex is authorized to discharge wastewater into Playas 1, 2, and 4 under NPDES Permit TX0107107, issued June 1, 1996, and TNRCC Wastewater Discharge Permit 02296, issued June 14, 1996. These permits define the volume and quality of effluent flows that may be discharged to the playas. Storm water from industrial activities is permitted to be discharged into Playas 1, 2, 3, and 4 by general NPDES Permit TXR00G138, issued February 15, 1995. Pollution prevention plans are required by this permit, which establishes 10 outfalls throughout Pantex where effluent samples are to be taken (M&H 1997:15). Pantex is currently transitioning to the new Multi-Sector General Permit for Storm Water. This permit will require monitoring at 8 storm water outfalls (Weinreich 1997). Pantex is also authorized to discharge storm water from construction activities that disturb more than 2 ha (5 acres) under the "Final NPDES General Permits for Storm Water Discharges from Construction Sites" (57 Federal Register 41176). A notice of intent is filed for each individual construction project and a pollution prevention plan is prepared and implemented. No sampling requirements are associated with these permitted activities (M&H 1997:15). On September 14, 1998 (63 Federal Register 51164), the State of Texas was authorized by EPA to assume administration of the NPDES permit program. While permits already issued by EPA will remain in effect until they expire or are replaced by a TNRCC-issued permit, this will ultimately result in consolidation of the industrial and storm-water discharge permits held by Pantex under the Texas Pollutant Discharge Elimination System (EPA 1998a).

The playas are considered by the State of Texas to be "waters of the State." The Pantex playas have been designated as jurisdictional wetlands, and therefore are also waters of the United States (DOE 1996a:3-157). Including monitoring required by NPDES and TNRCC permits, surface water is monitored for radioactive and nonradioactive parameters at 37 onsite locations, including the playas (DOE 1997c:iii).

Sampling data for surface waters at the site in 1996 showed that concentrations of radionuclides were similar to historical levels and lower than the derived concentration guides for ingested water (DOE 1997c:table 10.2). Moreover, little concern emerged during the monitoring of surface waters, and discharges to them, for a variety of other parameters, including organics, metals, explosives, polychlorinated biphenyls, and pesticides. Toluene was detected twice at the wastewater treatment plant effluent outfall (Outfall 001); however, it was not detected in the plant influent 30 days prior to sampling. No noncompliances were reported at any of the other monitored outfalls or sampling points on the site. Throughout the 1996 sampling season, Pantex Lake was dry, and no samples could be collected (DOE 1997c:116).

On December 2, 1997, EPA issued Mason & Hanger Corporation at Pantex an Administrative Order regarding its NPDES Permit No. TX107107. During 1997, Pantex periodically exceeded some discharge limits set by the permit. The exceedances included ammonia, oil and grease, total suspended solids, and total metals. Although Pantex exceeded the limits set by the EPA permit, based on all available data, the levels of constituents found in the wastewater do not pose a threat to public health or the environment. The Administrative Order required correction of exceedances within 30 days, and for those exceedances that could not be corrected within 30 days, submittal of a corrective action plan. A comprehensive plan was submitted to EPA on December 22, 1997. EPA indicated that it intended to use the plan to develop a negotiated compliance agreement. The complaince agreement was signed on November 24, 1998 by DOE (Battley 1999). Pantex is proceeding with implementation of its corrective action plan. Corrective actions include upgrading the Wastewater Treatment Facility; soil stabilization and erosion control measures; and operational, maintenance, and monitoring program modifications. These engineered solutions are scheduled for completion in the year 2003 (Nava 1998; DOE 1999a).

An EA was recently completed for the wastewater treatment plant upgrade (DOE 1999d) and a FONSI was issued (DOE 1999e). As selected in the FONSI, the project to upgrade the existing Wastewater Treatment Facility will essentially involved the construction of a new, zero-discharge facility south of the current facility and outside the 100-year floodplain of Playa 1. Specifically, two new lagoons will be constructed, one serving as a facultative treatment lagoon and the second as an irrigation water storage reservoir and alternate treatment lagoon. The existing Wastewater Treatment Facility lagoon will be retained as a supplemental storage facility for treated wastewater effluent.

Beginning in 2003, instead of being discharged to Playa 1, treated effluents will be disposed of via land application for the irrigation of crops in cooperation with the Texas Tech University Research Farm. Either a subsurface flow system, a center-pivot system, or an overland flow irrigation system will be used to apply effluents (DOE 1999d, 1999e).

Water rights in Texas fall under the Doctrine of Prior Appropriations. Under this doctrine, the user who first appropriates water for a beneficial use has priority in the use of available water supplies over a user claiming rights at a later time. Courts also recognize riparian rights legally granted in Spanish-American Agreements. TNRCC is the administrator for water rights and the permit-issuing authority (DOE 1996a:3-160). Because Pantex does not use any surface water, it exerts no surface water rights.

Figure 3–23 shows the surface water drainage basins for each of the playas (DOE 1996f:4-76). Storm-water runoff from the industrialized areas of Pantex collects within the playas and the tailwater pit and does not flow offsite. Storm water that is collected in the tailwater pit at the northeast boundary of the site is pumped to a ditch that flows to Playa 1 (M&H 1996a:5-7). General flooding of some low-lying portions of Pantex could occur as a result of runoff associated with precipitation and the subsequent filling of the playas. Historically, there has been no major flooding at the Pantex site (M&H 1996a:5-17–5-24; 1996b:2-11). There are no federally designated Wild and Scenic Rivers on the site (Barghusen and Feit 1995:2.10-2).

3.4.7.1.2 Proposed Facility Location

Most surface runoff near Zone 4 West flows to Playa 1(M&H 1996b:2-11; 1997:24). However, a very small portion of this area flows to Playa 2. The distance between the proposed surplus plutonium disposition facilities and the drainage basin divide is sufficient to prevent storm-water flows from the proposed facilities from entering Playa 2. Playa 1 has a surface area of 32 ha (79 acres) and Playa 2, 30 ha (74 acres) (M&H 1996a:5-6). A review of flooding maps of the playas indicates that the 100-year flood elevation for Playa 1 is 1,073.4 m (3,522 ft) and for Playa 2 it is 1,074.7 m (3,526 ft). The elevation of the proposed facilities is 1,084 m (3,556 ft) (DOE 1996f:4-77).

Playa 3 is upgradient from the proposed surplus plutonium disposition facilities and the 100-year flood elevation is 1,086.5 m (3,565 ft). The maps indicate that water elevations above that of the 100-year flood would result in sheet overflow at shallow depths in the direction of the proposed facilities. Figure 3–23 shows the approximate extent of the floodplains at Pantex (DOE 1996b:4-76).

Results of surface water quality sampling from 1994 confirm that Pantex was in compliance with all water quality regulations for Playa 1 and that, with the exception of a high water level in Playa 1 in July 1994 attributable to a rainfall event, all permit requirements were met (DOE 1996a:3-157).

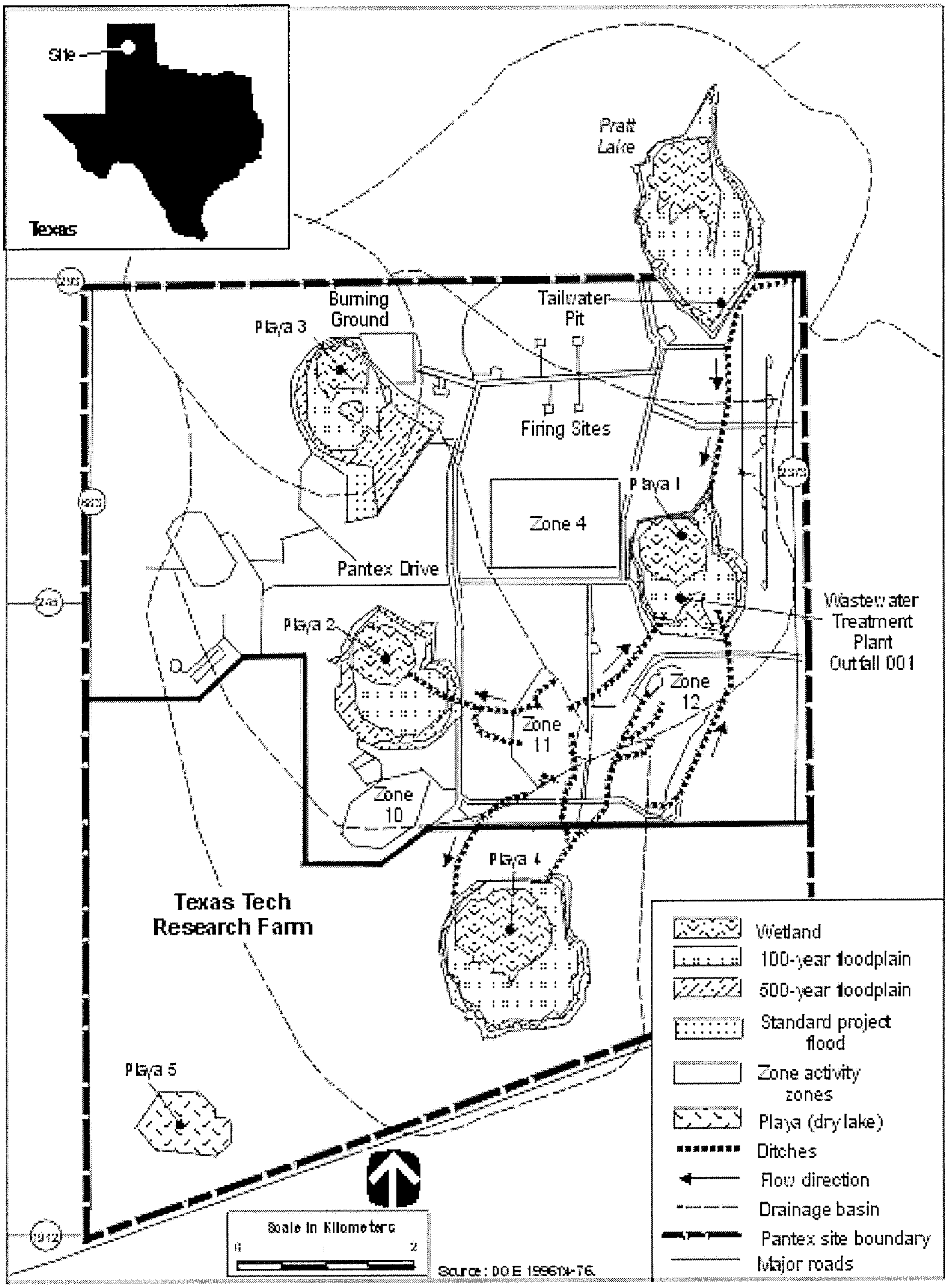


Figure 3–23. Locations of Floodplains and Playas at Pantex

3.4.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.4.7.2.1 General Site Description

The three primary hydrostratigraphic units, (i.e., separate layers of water), in the vicinity of Pantex are the Blackwater Draw Formation, the Ogallala Formation, and the Triassic Dockum Group. The units as a whole constitute the vadose (unsaturated) zone, the saturated perched aquifer zone, and the lower, saturated main aquifer below the site (M&H 1996a:4-1).

The Blackwater Draw Formation has been identified as the most widespread post-Ogallala unit throughout the Southern High Plains. It consists of modified eolian sands and silts interbedded with numerous caliches composed of variably cemented carbonate layers and nodules. The thickness of the Blackwater Draw Formation at Pantex is variable, ranging from 15 to 24 m (50 to 80 ft) (M&H 1996a:4-4).

The High Plains aquifer, commonly referred to as the Ogallala aquifer, underlies the southern part of the Great Plains physiographic province. It is the primary water source for the Texas Panhandle and eastern New Mexico. The Ogallala aquifer in the vicinity of Pantex consists primarily of the saturated lower Ogallala Formation, although water is also produced from strata as old as Permian (M&H 1996a:4-4).

The Ogallala aquifer exists in unconfined conditions. Recharge occurs from precipitation and subsequent infiltration of surface water either through surface soils or through focused recharge from the numerous playas that occur across the area. Direct recharge of the aquifer can occur in those limited areas where the aquifer formation is at the surface, but no outcrops exist at Pantex. Recent evidence supports significant recharge of the aquifer below the playas in the Southern High Plains; however, evidence of such recharge has not been determined for the Ogallala aquifer at Pantex (M&H 1996a:4-1).

Depths to the Ogallala aquifer generally run parallel to the regional land surface, which dips gently from northwest to southeast (M&H 1996a:3-36, 4-15). The depth to the Ogallala aquifer at Pantex varies from about 104 m (341 ft) at the southern boundary to 140 m (459 ft) at the northern boundary (M&H 1997:14). This south-to-north groundwater flow contrasts with the regional northwest-to-southeast trend of the remaining portion of the Southern High Plains. Localized disruption of these generalized flow patterns can occur where significant withdrawals are made, such as near the city of Amarillo Carson County well field about 3.2 km (2 mi) northeast of Pantex (M&H 1996a:4-1).

The Triassic Dockum Group underlying the Ogallala Formation is believed to be as thick as 30 m (100 ft) under Pantex. The lateral extent, thickness, and hydraulic characteristics of this group have not been established beneath Pantex, and well logs usually identify these only as Triassic or red beds (M&H 1996a:4-4, 4-5). However, limited data from regional hydrogeologic studies of the Dockum Group divide it into an upper and a lower section, with only the Lower Dockum Group inferred to exist beneath portions of Carson County, including the southwest portion where Pantex is located. The Lower Dockum Group consists predominantly of fine to coarse-grained sandstones and granular and pebble conglomerate along with mudstone sequences of alluvial, deltaic, and lacustrine origin. It has a thickness of less than 61 m (200 ft) beneath southwestern Carson County, consistent with site-specific data (Dutton and Simpkins 1986:3-4).

The water-bearing stratum of the Lower Dockum Group is the Lower Dockum aquifer. Regionally, the surface of the aquifer lies 91 to 213 m (300 to 700 ft) below the water table of the Ogallala aquifer and below the base of the Ogallala Formation (Dutton and Simpkins 1986:13). Any interconnection between the High Plains (Ogallala) aquifer system and the Lower Dockum aquifer across most of the Southern High Plains is thought to be poor at best, with little current recharge occurring (having ended during the Pleistocene epoch) (Dutton and Simpkins 1986:13, 24). Although at Pantex the upper confining layer of the Lower Dockum aquifer is absent, there are indications that it may be hydraulically connected to the overlying Ogallala aquifer. (M&H 1996a:4-7, 4-15-16).

The two main water-bearing units beneath the plant are the Tertiary Ogallala Formation and the Triassic Dockum Group. Two water-bearing zones in the Ogallala Formation are present beneath the plant. The first is a perched water zone above the main zone of saturation. One of these is present beneath Playa 1. The perched water zones consist of discontinuous perched water lenses, the lateral extent of which has not been fully determined. The second and deeper water-bearing zone is the Ogallala aquifer, which is the primary source of water for drinking, irrigation, and commercial uses (M&H 1996a:4-5). In general, factors such as well yield, depth to water, and high solids content limit production of the Lower Dockum Group aquifer for potable purposes. Irrigation water is supplied by the Dockum Group rather than the Ogallala Formation in locations to the west and south of Pantex, but Ogallala water is reportedly mixed with groundwater from the Dockum Group to meet the potable water needs of a few municipalities (Dutton and Simpkins 1986:3, 21, 22). There are no designated sole source aquifers near Pantex (Barghusen and Feit 1995:2.10-2).

Five production wells in the northeast corner of Pantex provide water for the plant's needs (DOE 1996a:3-162). Pantex water use has decreased during the period from 1991 to 1995 by 231 million l (61 million gal), from a maximum of 848 million l (224 million gal) of water in 1991, to 617 million l (163 million gal) of water in 1995 (M&H 1996a:4-33, 9-8). In 1995, the city of Amarillo produced 23.6 billion l (6.2 billion gal) of water from the Ogallala aquifer via the Carson County well fields. In addition, approximately 101 billion l (27 billion gal) of water were applied for irrigation in Carson County in 1995 (DOE 1996f:4-104).

Groundwater is controlled by the individual landowner in Texas through the Doctrine of Prior Appropriations (DOE 1996a:3-160). TNRCC and the Texas Water Development Board are the two State agencies with major involvement in groundwater fact finding, data gathering, and analysis. Groundwater management is the responsibility of local jurisdictions through Groundwater Management Districts. Pantex is in Panhandle Groundwater District 3, which has the authority to require permits and limit the quantity of water pumped. Historically, the Panhandle Groundwater Conservation District has not limited the quantity of water pumped. However, for wells drilled after July 19, 1995, that produce more than 1,300,000 l/yr (350,000 gal/yr) per acre owned, landowners will be required to obtain a High Production Permit from the Panhandle Groundwater Conservation District (DOE 1996f:4-105).

As described in Section 3.4.10.1, the DOE-owned portion of Pantex is approximately 41 km^2 (4,100 ha or 10,100 acres) in area. Therefore, a High Production Permit would be required if DOE were to exceed approximately 13 billion l/yr (3.4 billion gal/yr) of groundwater withdrawals. As shown in Table 3–36, the current usage is about 850 million l/yr (225 million gal/yr), with a system capacity of about 3.8 billion l/yr (1 billion gal/yr). Further detail on the groundwater resources at Pantex may be found in the *Storage and Disposition PEIS* (DOE 1996a) and the *Environmental Information Document: The Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components EIS* (M&H 1996a).

3.4.7.2.2 Proposed Facility Location

Given the nature and extent of the Ogallala aquifer, the general site description is believed to be representative of conditions beneath Zone 4 West. Water for the proposed facilities would be supplied from the existing site water system, which uses groundwater; no surface water would be used (M&H 1997:13).

3.4.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special-status species—that is, "sensitive" versus "nonsensitive" habitat.

3.4.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.4.8.1.1 General Site Description

Pantex is on a treeless portion of the High Plains where 229 plant species and numerous animal species thrive (DOE 1996a:3-166). Short-grass prairie grasslands were the native vegetation until the prairie was converted to agricultural use for crops, grazing, or protective vegetative cover under the Conservation Reserve Program. The few remaining native grassland areas are heavily grazed by livestock. Such grazing has transformed much of the rangeland from the native blue grama-buffalo grass to brush, forbs, or cacti. Essentially all land at Pantex has been managed or disturbed to some degree. The following five basic habitat types have been identified: operational areas, grasslands, mowed areas, agricultural croplands, and playas as shown in Figure 3–24 (Battelle and M&H 1996:8, 11).

Animal species found at Pantex include 7 species of amphibians, 43 species of birds, 19 species of mammals, and 8 species of reptiles. Common bird species known to exist in the vicinity of Pantex include the western meadowlark, mourning dove, horned lark, and several species of sparrows. Raptors on the site include the Swainson's hawk, American kestrel, and burrowing owl. Frequently sighted mammals include the black-tailed jackrabbit, black-tailed prairie dog, and hispid cotton rat. Although hunting is not permitted on the site, game animals include the desert cottontail, northern bobwhite, scaled quail, and numerous waterfowl. Predators present include the badger and coyote (DOE 1996a:3-166).

Aquatic habitats are limited to Playa 1, several wastewater treatment lagoons, and ditches, and five playas that contain water after precipitation events (Playas 2, 3, 4, and 5, and Pantex Lake). Vegetation in these areas is quite variable. Playa 1 receives treated effluent from the wastewater treatment facility, and because of this year round flow supports extensive stands of barewaist cattail, tule, or soft-stemmed bulrush. Playa 2 is nearly covered with smartweeds, while longspike spikerush is the most abundant species at Playa 3. Pantex Lake, the largest playa, supports a large number of species, longspike spikerush and wooly bursage being the most common, as is the case for Playa 4. Playa 5 is on Texas Tech University property and is not influenced by Pantex activities. The diversity of macroinvertebrates is playa-specific, and more than 80 species have been recorded (Battelle and M&H 1996:20–22).

Birds are the most conspicuous animal associated with the playas in terms of numbers, diversity, and biomass. Situated along the central flyway migratory route, the playas provide valuable habitat for migration, wintering, and nesting. The most common wintering ducks are mallards, northern pintails, green-winged teals, and

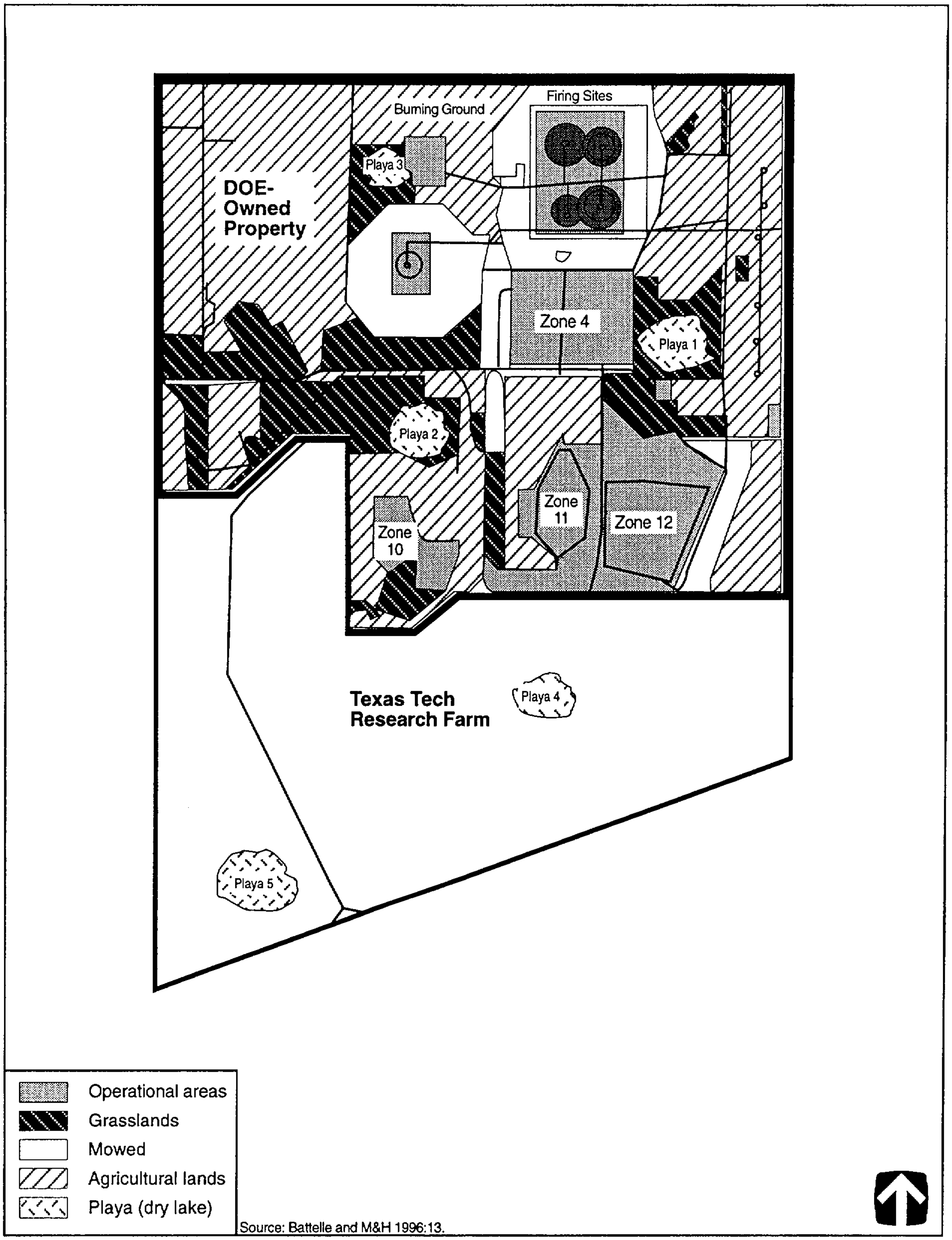


Figure 3–24. Generalized Habitat Types at Pantex (Main Plant Area)

American wigeons. Species known to breed in playas include the mallard, northern pintail, blue-winged teal, cinnamon teal, northern bobwhite, western meadowlark, yellow-headed blackbird, red-winged blackbird, and ring-necked pheasant (Battelle and M&H 1996:22).

3.4.8.1.2 Proposed Facility Location

The immediate environs of Zone 4 West are mowed for security and fire protection purposes. The security fencing system around Zone 4 West contains bare ground, whereas the interior of the zone contains areas of buffalo grass between structures (M&H 1997:20). An agricultural area northwest of Zone 4 West is regularly planted with winter wheat. South of the zone is a previously cultivated area that has been revegetated with native grass species of buffalo grass, blue grama, and sideoats grama (King 1997a:8). Several animal species could be present in and around Zone 4 West. Mammals sighted in this area include the cottontail rabbit, black-tailed jackrabbit, striped skunk, coyote, and thirteen-lined ground squirrel. Reptiles and amphibians known to inhabit the area include the prairie rattlesnake, Texas horned lizard, Great Plains skink, bull snake, Great Plains toad, plains spadefoot toad, and tiger salamander. Birds found in the area include the western burrowing owl, western meadowlark, western kingbird, eastern kingbird, American kestrel, horned lark, mourning dove, pigeon, grasshopper sparrow, and numerous waterfowl and other species associated with wetlands (King 1997a:8; M&H 1997:20).

3.4.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including designated wetlands) areas of the site that support threatened and endangered, State-protected, and other special-status plant and animal species.[7]

3.4.8.2.1 General Site Description

Playas 1, 2, 3, and 4 and Pantex Lake have been designated by USACE as jurisdictional wetlands and are therefore regulated pursuant to Section 404 of the Clean Water Act (Battelle and M&H 1996:20).

Ten threatened, endangered, or other special-status species listed by the Federal Government or the State of Texas may be found in the vicinity of Pantex, as shown in Table 3.5.6–1 in the *Storage and Disposition PEIS* (DOE 1996a:3-166).

3.4.8.2.2 Proposed Facility Location

Portions of the drainage basins for Playas 1, 2, and 3 lie in or near Zone 4 (see Figure 3-23). Some shorebirds and waterfowl (e.g., grebes, blackbirds, teals, ducks, and heron) nest or feed within the grasslands and cultivated fields associated with these playas (King 1997a; M&H 1997:21).

Although there is no critical habitat for any threatened or endangered species at Pantex, four special-status species may be found within the environs of Zone 4 West, as shown in Table 3–35. The ferruginous hawk is a common winter resident that feeds on prairie dogs and cottontail rabbits. The area west of Zone 4 West is a potential feeding location because of its prairie dog towns. The prairie dogs are removed from this area at least annually. Also associated with the prairie dog towns is the western burrowing owl. Up to 10 pairs have been identified as nesting in the area just west of Zone 4 West. Although not observed anywhere on Pantex since 1996, the swift fox (*Vulpes velox*), a candidate for Federal listing as a threatened or endangered species, may be present

[7] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

on the site, judging from the historical observation of field indicators in areas adjacent to Zone 4 and Zone 4 West. The Texas horned lizard is fairly common and is seen most frequently around the playas. Because it feeds mainly on harvester ants found throughout Pantex, there is a high probability of its occurrence in and around Zone 4 West (M&H 1997:21, 22).

Table 3–35. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in Areas Surrounding Zone 4 West

Common Name	Scientific Name	Federal Status	State Status
Birds			
Ferruginous hawk	*Buteo regalis*	Species of Concern	Not listed
Western burrowing owl	*Athene cunicularia hypugea*	Species of Concern	Not listed
Mammals			
Swift fox	*Vulpes velox*	Candidate species	Not listed
Reptiles			
Texas horned lizard	*Phrynosoma cornutum*	Species of Concern	Threatened

Source: M&H 1997:21, 22.

3.4.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Pantex has a well-documented record of cultural resources. These resources include 69 archaeological sites indicating prehistoric Native American and historic European-American occupation and use. They also include the standing structures, foundations, and other extant features once part of the Pantex Ordnance Plant (1942-1945), the World War II predecessor of Pantex. In addition, many structures and features associated with Cold War era (1951-1991) operations at the plant are included in the cultural resource inventory. Pantex also maintains valuable historic documents, records, and artifacts pertinent to interpretation of the prehistoric and historic human activities conducted on the site (M&H 1996a).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

Approximately 50 percent of Pantex, including DOE-leased and -owned property, has been surveyed for archaeological resources. Both the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation have agreed that additional archaeological surveys are not required. All World War II buildings, structures, and remains at Pantex have been surveyed and recorded. A building survey and an oral history program on the Cold War period are ongoing. By calendar year 1999, all the plant's cultural resources will be managed under a comprehensive Cultural Resource Management Plan required by the National Historic Preservation Act. Until that time, resources will be effectively managed through existing case-by-case procedures and interim agreements that comply with the act (M&H 1997:26, 27).

3.4.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.4.9.1.1 General Site Description

Prehistoric site types identified at Pantex include small temporary campsites and limited-activity locations characterized by surface scatters of artifacts. Archaeological surveys at Pantex have systematically covered about one-half of the facility. About 60 prehistoric sites have been recorded to date on DOE and Texas Tech University property. In consultation with the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation, DOE has determined that only two prehistoric archaeological sites are potentially eligible for inclusion on the National Register.

3.4.9.1.2 Proposed Facility Location

There are no National Register–eligible sites near Zone 4 West (M&H 1997:26, 27).

3.4.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.4.9.2.1 General Site Description

Historic resources at Pantex include European-American farmstead sites represented by foundations and artifact scatters; World War II era buildings, structures, and foundations; and Cold War era buildings and structures. To date, 12 European-American farmstead sites have been surveyed and recorded. In consultation with the Texas State Historic Preservation Officer and the Advisory Council on Historic Preservation, DOE has determined that these sites are not eligible for inclusion on the National Register. All remaining World War II era buildings, structures, and foundations have been surveyed and recorded. Under the terms of the programmatic agreement executed in October 1996 among DOE, the Texas State Historic Preservation Officer, and the Advisory Council on Historic Preservation (DOE 1996g), plant properties requiring modification are reviewed by plant staff, and appropriate mitigation is completed.

3.4.9.2.2 Proposed Facility Location

According to existing information, it is unlikely that unrecorded historic sites exist within Zone 4 West. If required, additional reviews by the State Historic Preservation Office are expected to be minimal (M&H 1997:27). Inadvertent discoveries will be addressed as discussed in Chapter 5.

3.4.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts. The identification of these resources is determined through consultations with potentially affected Native American groups (see Chapter 5 and Appendix O).

3.4.9.3.1 General Site Description

A treaties search has been completed, indicating that four federally recognized Native American tribes, the Kiowa, Comanche, Apache, and Cheyenne-Arapaho Tribes of Oklahoma, are culturally affiliated with the Texas Panhandle region. Pantex staff have contacted these four and six additional tribes: the Mescalero and Jicarilla Apache Tribes, the Caddo Tribe of Oklahoma, the Delaware Tribe of Western Oklahoma, the Wichita and affiliated tribes, and the Fort Sill Apache Tribe. As a result of these consultations no mortuary remains, associated artifacts, or traditional cultural properties have been identified at Pantex, nor are they likely to be (M&H 1997:27).

3.4.9.3.2 Proposed Facility Location

Zone 4 West does not contain any recognized Native American resources. Consultations (see Chapter 5 and Appendix O) were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in this SPD EIS.

3.4.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.4.9.4.1 General Site Description

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the Southern High Plains, this formation contains Late Pleistocene vertebrate remains including bison, camel, horse, mammoth, and mastodon, with occasional evidence of their use by humans (M&H 1997:27).

3.4.9.4.2 Proposed Facility Location

No paleontological resources have been reported for Zone 4 West.

3.4.10 Land Use and Visual Resources

3.4.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Pantex is in Carson County, approximately 27 km (17 mi) northeast of downtown Amarillo. The operational activities of the site are confined to 60 km^2 (23 mi^2) of land, of which approximately 37 km^2 (14 mi^2) are owned by the Federal Government. The remaining lands are leased from Texas Tech University to provide a safety and security buffer zone. In addition to the Pantex site, DOE owns a 4.4 km^2 (1.7 mi^2) portion of a large playa approximately 6.4 km (4 mi) northeast of the plant (DOE 1996a:3-148).

3.4.10.1.1 General Site Description

Regional land use within an 80-km (50-mi) radius of Pantex is predominately agricultural (DOE 1996f:4-26). Most of this expanse is devoted to rangeland along the Canadian River drainage north of Pantex and in the tributary drainage of the Red River to the south (DOE 1996f:4-26). Cropland, for both irrigated and dry-land crops, is the second largest land-use category behind rangeland. Some private property owners have enrolled their land in the Federal Conservation Reserve Program. Under terms of the program, the land cannot be cultivated or grazed for 10 years (DOE 1996f:4-22). However, most of the land is cultivated. The land surrounding Pantex is rural private property. The closest offsite residences are approximately 48 m (160 ft) from the plant boundary in the western and northeastern sectors (DOE 1996a:3-148).

Commercial, residential, industrial, institutional, and public lands constitute a small part of the total land use within an 80-km (50-mi) radius. These areas are associated mainly with the towns and cities of the region (DOE 1996f:4-26). Amarillo, which is primarily residential, is the largest urban area in the region.

Land-use categories at Pantex include industrial, agricultural, rangeland, open space, and playa areas. Generalized land uses at Pantex and the vicinity are shown in Figure 3–25. Several areas of land not actively committed to Pantex operations are used by Texas Tech University for agricultural purposes. Agricultural activities generally consist of dry farming and livestock grazing. The soil at Pantex contains several types that, according to the Natural Resources Conservation Service have been classified as prime farmland soils (DOE 1996a:3-148).

Approximately 23 percent of the Pantex site has been developed for industrial use (DOE 1996f:4-21). Pantex is divided into four major working areas: manufacturing, high-explosives development, test firing sites, and support facilities. The manufacturing area is devoted to the fabrication of high-explosives components and weapons assembly and disassembly operations. The area in which nuclear weapons operations are conducted covers approximately 80 ha (200 acres) and contains more than 100 buildings (DOE 1983:3-1). This area is surrounded by a security zone.

DOE will manage future land and facility use at Pantex through the land- and facility-use planning process. Guidance for future site development and reuse is based on long-term goals and objectives shared by DOE and stakeholders (DOE 1996f:4-24). Pantex has a *Site Development Plan* that depicts the plant upon completion of the projects outlined in the *Technical Site Information Five Year Plan*. Land resources at Pantex are expected to remain constant with continued leasing of Texas Tech University land for security and safety reasons (M&H 1996a:10-31). *The Integrated Plan for Playa Management at Pantex Plant* provides land-use guidelines for the playas and surrounding areas. This plan is being implemented as a best management plan to protect cultural and natural resources (M&H 1996c:10-41).

Within the State of Texas, land-use planning occurs only at the municipal level. The *1995 City of Amarillo Comprehensive Plan* has designated land for future growth within the city limits (DOE 1996f:4-33). Future residential development is expected to the southwest, away from the Pantex site. The East Planning Area of the city, which extends to within 3.2 km (2 mi) of Pantex, has historically been one of the slower growing residential areas. Because of the presence of the airport and industrial land use in the area, the comprehensive plan encourages compatible rather than residential use (DOE 1996a:3-148). No future land use has been projected by the city of Amarillo or county planning agencies (M&H 1996a:10-31).

No onsite areas are subject to Native American Treaty Rights.

3.4.10.1.2 Proposed Facility Location

Existing land use within Zone 4 West is designated as industrial. It contains the weapons/high-explosives magazines and interim pit storage area (DOE 1996f:4-21). It also supports various DOE nuclear weapons design agencies. The land is currently disturbed and is designated for high-explosives development. Zone 4 is 1.8 km (1.1 mi) from the nearest site boundary.

Areas immediately adjacent to the zone to the north, south, and west are designated as open space. Lands to the east are primarily designated as rangeland and agricultural land. About 0.4 km (0.2 mi) to the east of Zone 4 is the Playa 1 Management Unit. Playa 1 currently receives permitted industrial and sanitary sewage effluents from the wastewater treatment facility as well as storm-water runoff from Zones 4, 11, and 12 (M&H 1996c:4). According to the *Facility Assessment Visual Site Inspection Report* prepared under RCRA (M&H 1996c:4), previous discharges of industrial pollutants into the playa have resulted in its classification as a solid

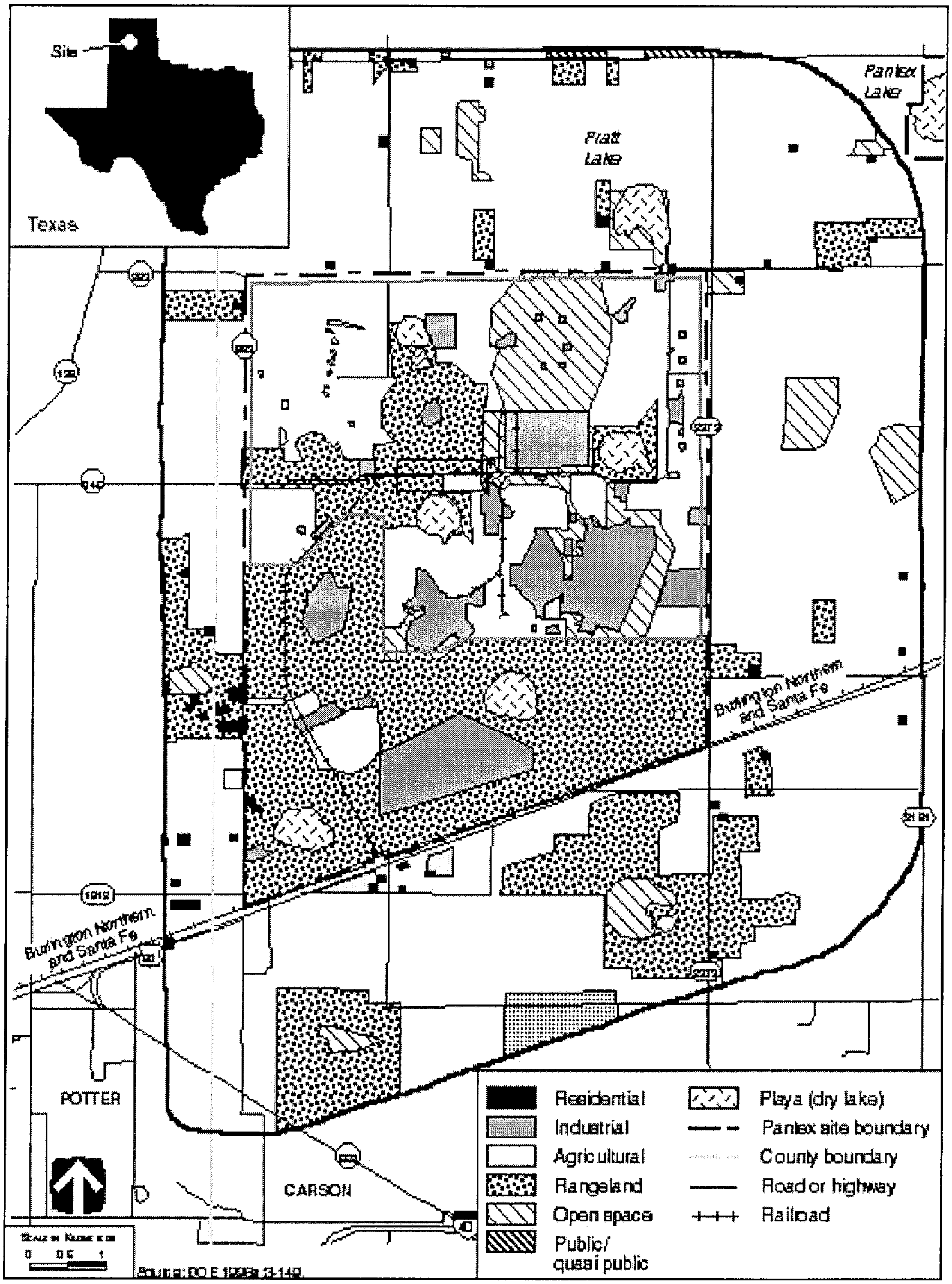


Figure 3–25. Generalized Land Use at Pantex and Vicinity

waste management unit (SWMU). Any activities disturbing the soils within an SWMU, including remedial activities, are regulated under RCRA and require additional management (M&H 1996c:4).

3.4.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.4.10.2.1 General Site Description

Pantex is in the treeless Southern High Plains of Texas. It lies in the transition zone between the North Central Plains and the Llano Estacado (staked plains) to the south. The landscape typically consists of cultivated cropland and rangeland. The plant consists of operational facilities and the inactive facilities of the former World War II ammunition plant. These industrial uses are surrounded by cropland and rangeland that blend into the offsite viewscape. The developed areas of Pantex are consistent with a VRM Class IV designation. The remainder of Pantex is consistent with VRM Class III or IV (DOE 1996a:3-148; DOI 1986a, 1986b).

Public access to the plant is strictly controlled. Access to the plant perimeter is limited to three Texas FM roads and U.S. Route 60. The most visible and sensitive vantage point for Pantex facilities is located 2.4 km (1.5 mi) southeast at the intersection of U.S. Route 60 and FM 2373. U.S. Route 60 is part of the Texas Plains Trail, a scenic road on which Pantex is a designated point of interest. From this road, parts of the plant are visible as low clusters of buildings on a flat landscape. The most visible structures include a new water tower in Zone 11, with a height of 45 m (148 ft), and the twin stacks of the steam plant, each with a height of 20 m (65 ft). The tallest structure at Pantex is a 60-m (197-ft) meteorological tower in the northeast corner of the site (Greenly 1999). This tower would normally be visible as a pencil-thin line from a distance of 1.6 km (1 mi) or less. The operations areas are well defined at night by the security lights. Plant facilities are also visible from I–40, a motorist rest area approximately 10 km (6.2 mi) away being the closest vantage point. The view from this point is similar to that described for U.S. Route 60, but because of the greater distance, the plant facilities are more obscure (DOE 1996a:3-148).

3.4.10.2.2 Proposed Facility Location

Zone 4 West, which houses existing industrial facilities, is not visible from U.S. Route 60, including the intersection of U.S. Route 60 and FM 2373. The new water tower and the twin stacks of the steam plant are the features most visible from offsite. Operations areas are well defined at night by the security lights. The closest natural feature of visual interest is Palo Duro Canyon State Park, 45 km (28 mi) to the south. Open space immediately to the west of Zone 4 West is consistent with a VRM Class III or IV designation. Zone 4 West is a developed area consistent with VRM Class IV (DOE 1996a:3-148; DOI 1986a, 1986b; Greenly 1999).

3.4.11 Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various proposed alternatives.

3.4.11.1 General Site Description

Pantex has the extensive infrastructure necessary to support operations at the plant. The key components of this infrastructure are summarized in Table 3–36.

Table 3–36. Pantex Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	76	76
Railroads (km)	27	27
Electricity		
Energy consumption (MWh/yr)	81,850	420,500
Peak load (MW)	13.6	124
Fuel		
Natural gas (m^3/yr)	12,910,000	248,000,000
Oil (l/yr)	59,960	NA[a]
Coal (t/yr)[b]	NA[b]	NA[b]
Water (l/yr)	851,600,000	3,785,000,000

[a] As supplies get low, more can be supplied by truck or rail.
[b] Coal is not used at Pantex.
Key: NA, not applicable.
Source: King 1997a:5.

3.4.11.1.1 Transportation

An onsite road system of about 76 km (47 mi) of paved surface has been developed (DOE 1996a:3-151). Roads within the plant are classified as either "primary," "secondary," or "tertiary." Primary roads are the main distribution arteries for all traffic outside and within the plant. Secondary roads supplement the primary roads and serve as collector roadways. Both the primary and secondary roads are two-lane, paved arteries. Tertiary roads are frequently single lanes, but some have two lanes when the extra width is justified by traffic volume (M&H 1996a:9-17).

Amarillo is a major rail center on the main lines of the Burlington Northern and Santa Fe, which has internodal facilities in Amarillo. Pantex is connected to the Burlington Northern and Santa Fe system via a spur that enters the plant from the southwest. This spur provides access to the entire system as well as to other railroads (M&H 1996a:9-17, 9-19).

3.4.11.1.2 Electricity

Electrical service for the nine-county region surrounding Pantex is supplied by the Southwestern Public Service Company except for Donley County which is serviced by West Texas Utilities (M&H 1996a:9-1). Generation is mainly from coal, oil, and gas (produced by gas turbines), in order of capacity. The rest comes from nuclear, hydroelectric, and other sources. Pantex draws its power from the West Central Power Pool, characteristics of which are summarized in Table 3.5.2–2 of the *Storage and Disposition PEIS* (DOE 1996a:3-151).

The average electrical availability at Pantex is about 420,500 MWh/yr; the average annual usage, about 81,850 MWh/yr. The peak load capacity for the plant is 124 MW; the current peak load usage, about 13.6 MW (King 1997a:5).

3.4.11.1.3 Fuel

Fuels consumed at Pantex include liquid petroleum fuels and natural gas. Natural gas is supplied by Energas (King 1997a:3). Oil is used as a backup for the Building 16-13 steam boiler. Oil capacity is only limited by the number of deliveries of oil by truck. There is a 89,300-l (23,600-gal) fuel oil storage tank on the site. The current annual site availability of natural gas is about 248 million m^3/yr (8.8 billion ft^3/yr); and the current usage, about 12.9 million m^3/yr (456 million ft^3/yr) (King 1997a:5).

3.4.11.1.4 Water

Water for Pantex is provided by a system of five wells, together with pumps and storage tanks. The volume used by the plant between 1989 and 1995 ranged from 689 million l (182 million gal) to 946 million l (250 million gal) (M&H 1996a:9-7). The water supply system capacity is about 3.8 billion l/yr (1 billion gal/yr); the average usage of domestic water, about 850 million l/yr (225 million gal/yr) (King 1997a:5).

3.4.11.1.5 Site Safety Services

Plant fire protection is provided by the Pantex fire department, which has one onsite fire station. Personnel in the fire department maintain a high level of readiness. A minimum of eight firefighters, three of whom are certified paramedics, are on duty at all times. The fire department maintains two advanced life-support ambulances on the site (M&H 1996a:9-25).

3.4.11.2 Proposed Facility Location

Little current utility usage occurs in Zone 4 West. Given the current usage level of each utility type at Pantex, excess capacity available for Zone 4 West would be as indicated in Table 3–37. There would be an electrical capacity of 338,634 MWh/yr, with a peak load of 110.4 MW; a natural gas capacity of about 235 million m^3/yr (8.3 billion ft^3/yr); and a water capacity of about 3 billion l/yr (775 million gal/yr), with a peak supply of about 8 million l/day (2 million gal/day) (King 1997a:6).

Table 3–37. Pantex Infrastructure Characteristics for Zone 4

Resource	Current Usage	Excess Site Capacity
Electrical		
Energy consumption (MWh/yr)	Negligible	338,634
Peak load (MW)	Negligible	110.4
Fuel		
Natural gas (m^3/yr)	Negligible	235,181,309
Oil (l/yr)	NA	NA[a]
Coal (t/yr)[b]	NA[b]	NA[b]
Water (l/yr)	Negligible	2,933,000,000

[a] As supplies get low, more can be supplied by truck or rail.
[b] Coal is not used at Pantex.
Key: NA, not applicable.
Source: King 1997a:6.

3.5 SRS

SRS is about 19 km (12 mi) south of Aiken, South Carolina (Figure 2–5). First established in 1950, SRS has been involved for more than 40 years in tritium operations and nuclear material production. Today the site includes 16 major production, service, and R&D areas, not all of which are currently in operation (DOE 1996a:3-228).

There are more than 3,000 facilities at SRS, including 740 buildings with 511,000 m^2 (5.5 million ft^2) of floor area. Major nuclear facilities at SRS include fuel and plutonium storage facilities and target fabrication facilities, nuclear material production reactors, chemical separation plants, a uranium fuel processing area, liquid HLW tank farms, a waste vitrification facility, and the Savannah River Technology Center. SRS processes nuclear materials into forms suitable for continued safe storage, use, or transportation to other DOE sites. Tritium recycling facilities at SRS empty tritium from expired reservoirs, purify it to eliminate the helium decay product, and fill replacement reservoirs for nuclear weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to DoD to replace expired reservoirs. Historically, DOE has produced tritium at SRS, but none has been produced since 1988 (DOE 1996a:3-228).

DOE Activities. The current missions at SRS are shown in Table 3–38. In the past, the SRS complex produced nuclear materials. The complex consisted of various plutonium storage facilities, five reactors (the C-, K-, L-, P-, and R-Reactors) (all inactive), a fuel and target fabrication plant, 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. SRS is still conducting tritium recycling operations in support of stockpile requirements using retired weapons as the tritium supply source. The separations facilities and F- and H-Canyons are planned to be used through the year 2002 to complete DOE's commitment to the Defense Nuclear Facilities Safety Board regarding stabilization of inventories of unstable nuclear materials (DOE 1996a:3-228).

Table 3–38. Current Missions at SRS

Mission	Description	Sponsor
Plutonium storage	Maintain F-Area plutonium storage facilities	Assistant Secretary for Environmental Management
Tritium recycling	Operate H-Area tritium facilities	Assistant Secretary for Defense Programs
Stabilize targets, spent nuclear fuels, and other nuclear materials	Operate F- and H-Canyons	Assistant Secretary for Environmental Management
Waste management	Operate waste management facilities	Assistant Secretary for Environmental Management
Environmental monitoring and restoration	Operate remediation facilities	Assistant Secretary for Environmental Management
Research and development	Savannah River Technology Center technical support of Defense Programs, Environmental Management, and Nuclear Energy programs	Assistant Secretary for Defense Programs; Assistant Secretary for Environmental Management; Office of Nuclear Energy

Source: DOE 1996a:3-229.

DOE Office of Environmental Management is pursuing a 10-year plan to achieve full compliance with all applicable laws, regulations, and agreements to treat, store, and dispose of existing wastes; reduce generation of new wastes; clean up inactive waste sites; remedied contaminated groundwater; and dispose of surplus facilities (DOE 1996a:3-228).

The Savannah River Technology Center provides technical support to all DOE operations at SRS. In this role, it provides process engineering development to reduce costs, waste generation, and radiation exposure. SRS has an expanding mission to transfer unique technologies developed at the site to industry. SRS is also an active participant in the Strategic Environmental R&D Program formulated to develop technologies to mitigate environmental hazards at DoD and DOE sites (DOE 1996a:3-228).

Non-DOE Activities. Non-DOE facilities and operations at SRS 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 acres), 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 plans and provides continual support with site layout and vegetative management. It also assists in long-term wildlife management and soil rehabilitation projects (DOE 1996a:3-228).

The Savannah River Ecology Laboratory is operated for DOE by the Institute of Ecology of the University of Georgia. It has established a center of ecological field research where faculty, staff, and students perform interdisciplinary field research and gain 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. In addition to Savannah River Ecology Laboratory studies, the Institute of Archaeology and Anthropology is operated by the University of South Carolina to survey the archaeological resources of SRS. These surveys are used by DOE when planning new facility additions or modifications (DOE 1996a:3-229).

3.5.1 Air Quality and Noise

3.5.1.1 Air Quality

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. Air pollutants are transported, dispersed, or concentrated by meteorological and topographical conditions. Air quality is affected by air pollutant emission characteristics, meteorology, and topography.

3.5.1.1.1 General Site Description

The SRS region has a temperate climate with short, mild winters and long, humid summers. Throughout the year, the climate is frequently affected by warm, moist maritime air masses. The average annual temperature at SRS is 17.3 EC (63.2 EF); temperatures vary from an average daily minimum of 0 EC (32 EF) in January to an average daily maximum of 33.2 EC (91.7 EF) in July. The average annual precipitation at SRS is about 114 cm (45 in). Precipitation is distributed fairly evenly throughout the year, with the highest in summer and the lowest in autumn. There is no predominant wind direction at SRS. The average annual wind speed at Augusta National Weather Service Station is 2.9 m/s (6.5 mph) (NOAA 1994b). Additional information related to meteorology and climatology at SRS is presented in Appendix F of the *Storage and Disposition PEIS* (DOE 1996a:F-16, F-17) and in the *Savannah River Site Waste Management Environmental Impact Statement* (DOE 1995c:3-21–3-25).

SRS is near the center of the Augusta-Aiken Interstate AQCR #53. None of the areas within SRS and its surrounding counties are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1997f; 1997g). Applicable NAAQS and the ambient air quality standards for the States of South Carolina and Georgia are presented in Table 3–39.

Table 3–39. Comparison of Ambient Air Concentrations From SRS Sources With Most Stringent Applicable Standards or Guidelines, 1994

Pollutant	Averaging Period	Most Stringent Standard or Guideline (Fg/m^3)[a]	Concentration (Fg/m^3)
Criteria pollutants			
Carbon monoxide	8 hours	10,000[b]	632
	1 hour	40,000[b]	5,010
Nitrogen dioxide	Annual	100[b]	8.8
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual	50[b]	4.8
	24 hours	150[b]	80.6
$PM_{2.5}$	3-year annual	15[c]	(e)
	24 hours (98th percentile over 3 years)	65[c]	(e)
Sulfur dioxide	Annual	80[b]	16.3
	24 hours	365[b]	215
	3 hours	1,300[b]	690
Lead	Calendar quarter	1.5[b]	<0.01
Other regulated pollutants			
Gaseous fluoride	30 days	0.8[f]	(g)
	7 days	1.6[f]	0.11
	24 hours	2.9[f]	0.60
	12 hours	3.7[f]	241
Total suspended particulates	Annual	75[f]	43.3
Hazardous and other toxic compounds			
Benzene	24 hours	150[f]	20.7
[Text deleted.]			

[a] The more stringent of the Federal and State standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (EPA 1997a), other than those for ozone, particulate matter, and lead, and those based on annual averages, are not to be exceeded more than once per year. The 1-hr ozone standard is attained when the expected number of days per year with maximum hourly average concentrations above the standard is #1. The 1-hr ozone standard applies only to nonattainment areas. The 8-hr ozone standard is attained when the 3-year average of the annual fourth-highest daily maximum 8-hr average concentration is less than or equal to 157 Fg/m^3. The 24-hr particulate matter standard is attained when the expected number of days with a 24-hr average concentration above the standards is #1. The annual arithmetic mean particulate matter standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

[b] Federal and State standard.

[c] Federal standard.

[d] Not directly emitted or monitored by the site.

[e] No data is available with which to assess $PM_{2.5}$ concentrations.

[f] State standard.

[g] No concentration reported.

Note: The NAAQS also includes standards for lead. No sources of lead emissions have been identified for any of the alternatives presented in Chapter 4. Emissions of other air pollutants not listed here have been identified at SRS, but are not associated with any of the alternatives evaluated. These other air pollutants are quantified in the *Storage and Disposition PEIS* (DOE 1996a). EPA recently revised the ambient air quality standards for particulate matter and ozone. The new standards, finalized on July 18, 1997, changed the ozone primary and secondary standards from a 1-hr concentration of 235 Fg/m^3 (0.12 ppm) to an 8-hr concentration of 157 Fg/m^3 (0.08 ppm). During a transition period while States are developing State implementation plan revisions for attaining and maintaining these standards, the 1-hr ozone standard will continue to apply in nonattainment areas (EPA 1997b:38855). For

particulate matter, the current PM_{10} annual standard is retained, and two $PM_{2.5}$ standards are added. These standards are set at a 15-Fg/m^3 3-year annual arithmetic mean based on community-oriented monitors and a 65-F g/m^3 3-year average of the 98th percentile of 24-hr concentrations at population-oriented monitors. The revised 24-hr PM_{10} standard is based on the 99th percentile of 24-hr concentrations. The existing PM_{10} standards will continue to apply in the interim period (EPA 1997c:38652). Values may differ from those of the source document due to rounding.
Source: DOE 1998e:3-14, 1998f:3-26; EPA 1997a; SCDHEC 1996.

There are no PSD Class I areas within 100 km (62 mi) of SRS. None of the facilities at SRS have been required to obtain a PSD permit (DOE 1996a:3-233).

The primary emission sources of criteria air pollutants at SRS 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 (DWPF), the In-Tank Precipitation process, groundwater air strippers, the Consolidated Incineration Facility, 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 (DOE 1996a:F-17, F-18).

Table 3–39 presents the ambient air concentrations attributable to sources at SRS. These concentrations are based on emissions for the year 1994 (DOE 1998e:3-14; DOE 1998f:3-26). Only those hazardous pollutants that would be emitted for any of the surplus plutonium disposition alternatives are presented. Additional information on ambient air quality at SRS is in the *SRS Environmental Report for 1995* (Arnett and Mamatey 1996:111–114). Concentrations shown in Table 3–39 attributable to SRS are in compliance with applicable guidelines and regulations. Data for 1995 from nearby South Carolina monitors at Beech Island, Jackson, and Barnwell indicate that the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS (SCDHEC 1995:1, 25, 28, 37–39). Air pollutant measurements at these monitoring locations during 1995 showed for nitrogen dioxide an annual average concentration of 9.4 Fg/m^3; for sulfur dioxide concentrations of 99 Fg/m^3 for 3-hr averaging, 24 Fg/m^3 for 24-hr averaging, and 5 Fg/m^3 for the annual average; for total suspended particulates an annual average concentration of 37 Fg/m^3; and for PM_{10} concentrations of 62 Fg/m^3 for 24-hr averaging and 19 Fg/m^3 for the annual average.

3.5.1.1.2 Proposed Facility Locations

The meteorological conditions described for SRS are considered representative of F-Area. Information on air pollutant emissions from F-Area is included in the overall site emissions discussed previously.

The meteorological conditions described for SRS are considered representative of S-Area. Information on air pollutant emissions from S-Area is included in the previous discussion of overall site emissions. The air pollutant sources in this area include process and diesel generator emissions.

3.5.1.2 Noise

Noise is unwanted sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities or diminish the quality of the environment.

3.5.1.2.1 General Site Description

Major noise sources at SRS are primarily in developed or active areas and include various industrial facilities, equipment, and machines (e.g., cooling systems, transformers, engines, pumps, boilers, steam vents, paging systems, construction and materials-handling equipment, and vehicles). Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations. Existing SRS-related noise sources of importance to the public are those related to transportation of people and materials to and from the site, including trucks, private vehicles, helicopters, and trains (DOE 1996a:3-233–3-235).

Another important contributor to noise levels is traffic to and from SRS operations along access highways through the nearby towns of New Ellenton, Jackson, and Aiken. Noise measurements recorded during 1989 and 1990 along State Route 125 in the town of Jackson at a point about 15 m (50 ft) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 48 to 72 dBA. The estimated day-night average sound levels along this route were 66 dBA for summer and 69 dBA for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 m (50 ft) from the roadway indicate that the 1-hr equivalent sound level from traffic ranged from 53 to 71 dBA. The estimated average day-night average sound levels along this route were 68 dBA for summer and 67 dBA for winter (NUS 1990:3-2–3-6, app. C and F).

Most industrial facilities at SRS are far enough from the site boundary that noise levels from these sources at the boundary would not be measurable or would be barely distinguishable from background levels.

The States of Georgia and South Carolina, and the counties in which SRS is located, have not established any noise regulations that specify acceptable community noise levels, with the exception of a provision in the Aiken County Zoning and Development Standards Ordinance that limits daytime and nighttime noise by frequency band (DOE 1996a:F-33).

The EPA guidelines for environmental noise protection recommend an average day-night average sound level of 55 dBA as sufficient to protect the public from the effects of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974:29). Land-use compatibility guidelines adopted by the Federal Aviation Administration and the Federal Interagency Committee on Urban Noise indicate that yearly day-night average sound levels less than 65 dBA are compatible with residential land uses and levels up to 75 dBA are compatible with residential uses if suitable noise reduction features are incorporated into structures (DOT 1995). It is expected that for most residences near SRS, the day-night average sound level is less than 65 dBA and is compatible with the residential land use, although for some residences along major roadways noise levels may be higher.

3.5.1.2.2 Proposed Facility Locations

No distinguishing noise characteristics at F-Area have been identified. F-Area is far enough—7.9 km (4.9 mi)—from the site boundary that noise levels from the facilities are not measurable or are barely distinguishable from background levels.

No distinguishing noise characteristics at S-Area have been identified. Observations of sound sources during a summer sound level survey near the fence line of S-Area indicate that typical sources include vehicles, turbines, locomotives, paging systems, and fans (NUS 1990:app. B). S-Area is far enough—9.6 km (6 mi)—from the site boundary that noise levels from these facilities are not measurable or are barely distinguishable from background levels.

3.5.2 Waste Management

Waste management includes minimization, characterization, treatment, storage, transportation, and disposal of waste generated from ongoing DOE activities. The waste is managed according to appropriate treatment, storage, and disposal technologies and in compliance with all applicable Federal and State statutes and DOE orders.

3.5.2.1 Waste Inventories and Activities

SRS manages the following types of waste: HLW, TRU, mixed TRU, LLW, mixed LLW, hazardous, and nonhazardous. HLW would not be generated by surplus plutonium disposition activities at SRS, and therefore, will not be discussed further. Waste generation rates and the inventory of stored waste from activities at SRS are provided in Table 3–40. Table 3–41 summarizes the SRS waste management capabilities. More detailed

Table 3–40. Waste Generation Rates and Inventories at SRS

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact handled	427	6,977
Remotely handled	4	0
LLW	10,043	1,616
Mixed LLW		
RCRA	1,135	6,940
TSCA	0	110
Hazardous	74	1,416[b]
Nonhazardous		
Liquid	416,100	NA[c]
Solid	6,670	NA[c]

[a] Includes mixed TRU wastes.

[b] Sessions 1997a.

[c] Generally, nonhazardous wastes are not held in long-term storage.

Key: LLW, low-level waste; NA, not applicable; RCRA, Resource Conservation and Recovery Act; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996d:15, 16, except for hazardous and nonhazardous solid waste (DOE 1996a:3-262, 3-263) and nonhazardous liquid waste (Sessions 1997a).

descriptions of the waste management system capabilities at SRS are included in the *Storage and Disposition PEIS* (DOE 1996a:3-261–3-265, E-97) and the *Savannah River Site Waste Management Final EIS* (DOE 1995c:3-66).

EPA placed SRS on the National Priorities List in December 1989. In accordance with CERCLA, DOE entered into an FFCA with EPA and the State of South Carolina to coordinate cleanup activities at SRS under one comprehensive strategy. The FFCA combines the RCRA Facility Investigation Program Plan with a CERCLA cleanup program titled the *RCRA Facility Investigation/Remedial Investigation Program Plan* (DOE 1996a:3-261). More information on regulatory requirements for waste disposal is provided in Chapter 5.

3.5.2.2 Transuranic and Mixed Transuranic Waste

TRU waste generated between 1974 and 1986 is stored on five concrete pads and one asphalt pad that have been covered with approximately 1.2 m (4 ft) of soil. TRU waste generated since 1986 is stored on 13 concrete pads that are not covered with soil. The TRU waste storage pads are in the Low-Level Radioactive Waste Disposal Facility (DOE 1995c:3-80, 3-81).

A TRU Waste Characterization and Certification Facility is planned and would provide extensive containerized waste certification capabilities. The facility is needed to prepare TRU waste for treatment and to certify TRU waste for disposal at WIPP. Drums that are certified for shipment to WIPP will be placed in interim storage on concrete pads in E-Area (DOE 1996a:3-264). LLW containing concentrations of TRU nuclides between 10 and 100 nCi (referred to as alpha-contaminated LLW) is managed like TRU waste because its physical and chemical properties are similar and similar procedures will be used to determine its final disposition (DOE 1996a:3-264). WIPP is expected to begin receiving waste from SRS in 2000 (Aragon 1999).

Table 3–41. Waste Management Capabilities at SRS

Facility Name/Description	Capacity	Status	Applicable Waste Type: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment Facility (m³/yr)								
TRU Waste Characterization/ Certification Facility	1,720	Planned for 2007	X	X				
Consolidated Incineration Facility & Ashcrete Stabilization Facility	4,630 liquid 17,830 solid	Online			X	X	X	
F- and H-Area Effluent Treatment Facility	1,930,000	Online			X	X		
M-, L-, and H-Area Compactors	3,983	Online			X			
Non-Alpha Vitrification Facility	3,090	Planned			X	X	X	
M-Area Liquid Effluent Treatment Facility	999,000	Online				X		
M-Area Vendor Treatment Facility	2,470	Planned				X		
Savannah River Technology Center Ion Exchange Treatment Probe	11,200	Online				X		
E-Area Supercompactor	5,700	Planned			X			
Z-Area Saltstone Facility	28,400	Online				X		
Central Sanitary Wastewater Treatment Facility	1,449,050	Online						X
Storage Facility (m³)								
TRU Storage Pads	34,400	Online	X	X				
DWPF Organic Waste Storage Tank	568	Online				X		
Liquid Waste Solvent Tanks	454	Planned				X		
M-Area Process Waste Interim Treatment/Storage Facility	8,300	Online				X		
Mixed Waste Storage Facilities (645-2N, -295, -43E)	1,905	Online				X		
Savannah River Technology Center Mixed Waste Storage Tanks	198	Online				X		
Long-Lived Waste Storage Building	1,064	Planned			X			
Solid Waste Storage Pads	2,657	Online				X	X	
Buildings 316-M, 710-B, 645-N, and 645-4N	2,515	Online				X	X	
M-Area Storage Pad	2,160	Online				X		
Disposal Facility (m³)								
Intermediate-Level Waste Vaults	3,665	Online			X			
Low-Activity Waste Vaults	30,500	Online			X			
LLW Disposal Facility Slit Trenches	26,000	Planned			X			
Z-Area Saltstone Vaults	1,110,000	Online			X			

Key: DWPF, Defense Waste Processing Facility; Haz, hazardous; LLW, low-level waste; TRU, transuranic.
Source: DOE 1996a:E-108–E-112; Miles 1998; Rhoderick 1998; Sessions 1997a, 1997b.

3.5.2.3 Low-Level Waste

Both liquid and solid LLW are treated at SRS. Most aqueous LLW streams are sent to the F- and H-Area Effluent Treatment Facility and treated by filtration, reverse osmosis, and ion exchange to remove the radionuclide contaminants. After treatment, the effluent is discharged to Upper Three Runs Creek. The treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility. In that facility, wastes are immobilized with grout for onsite disposal (DOE 1996a:E-98).

After completion of a series of extensive readiness tests, the Consolidated Incineration Facility began radioactive operations in 1997. The Consolidated Incineration Facility is designed to incinerate both solid and liquid LLW, mixed LLW, and hazardous waste (WSRC 1997a).

Solid LLW is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid LLW that radiates less than 200 mrem/hr at 5 cm (2 in) from the unshielded container is considered low-activity waste. If it radiates greater than 200 mrem/hr at 5 cm (2 in), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with more than 10 Ci of tritium per container. Long-lived waste is contaminated with long-lived isotopes that exceed the waste acceptance criteria for onsite disposal (DOE 1996a:E-99).

Four basic types of vaults and buildings are used for storing the different waste categories: low-activity waste vaults, intermediate-level nontritium vaults, intermediate-level tritium vaults, and the long-lived waste storage building. The vaults are below-grade concrete structures, and the storage building is a metal building on a concrete pad (DOE 1996a:E-99).

Currently, DOE places low-activity LLW in carbon steel boxes and deposits them in the low-activity waste vaults in E-Area. Intermediate-activity LLW is packaged according to waste form and disposed of in the intermediate-level waste vaults in E-Area. Long-lived wastes are stored in the Long-Lived Waste Storage Building in E-Area until treatment and disposal technologies are developed (DOE 1995c:3-75).

Saltstone generated in the solidification of LLW salts extracted from HLW is disposed of in the Z-Area Saltstone Vaults. Saltstone is solidified grout formed by mixing the LLW salt with cement, fly ash, and furnace slag. Saltstone is the highest volume of solid LLW disposed of at SRS. SRS disposal facilities are projected to meet solid LLW disposal requirements, including LLW from off the site, for the next 20 years (DOE 1996a:3-261, 3-264).

3.5.2.4 Mixed Low-Level Waste

The FFCA addresses SRS compliance with RCRA LDR. The FFCA requires DOE facilities storing mixed waste to develop site-specific treatment plans and to submit them for approval (DOE 1996a:3-264, 3-265). The site treatment plan for mixed waste specifies treatment technologies or technology development schedules for all SRS mixed waste (Arnett and Mamatey 1996:50). SRS is allowed to continue to generate and store mixed waste, subject to LDR. Schedules to provide compliance through treatment in the Consolidated Incineration Facility are included in the FFCA (DOE 1996a:3-264).

The SRS mixed waste program consists primarily of safely storing waste until treatment and disposal facilities are available. Mixed LLW is stored in the A-, E-, M-, N-, and S-Areas in various tanks and buildings. These facilities include burial ground solvent tanks, the M-Area Process Waste Interim Treatment/Storage Facility, the Savannah River Technology Center Mixed Waste Storage Tanks, and the DWPF Organic Waste Storage Tank (DOE 1995c:3-81). These South Carolina Department of Health and Environmental Control permitted facilities will remain in use until appropriate treatment and disposal is performed on the waste (DOE 1996a:E-99).

3.5.2.5 Hazardous Waste

Hazardous waste is accumulated at the generating facility for a maximum of 90 days, or stored in DOT-approved containers in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in B- and N-Areas. Most of the waste is shipped off the site to commercial RCRA-permitted treatment and disposal facilities using DOT-certified transporters. DOE plans to incinerate up to 9 percent of the hazardous waste (organic liquids, sludge, and debris) in the Consolidated Incineration Facility (DOE 1996a:3-265). In 1995, 72 m^3 (2,538 ft^3) of hazardous waste were sent to onsite storage. Of this amount, 20 m^3 (712 ft^3) were shipped off the site for commercial treatment or disposal (Arnett and Mamatey 1996:48).

3.5.2.6 Nonhazardous Waste

In 1994, the centralization and upgrading of the sanitary wastewater collection and treatment systems at SRS were completed. The program included the replacement of 14 (of 20) aging treatment facilities scattered across the site with a new 3,975 m^3/day (1.1 million gal/day) central treatment facility and connecting them with a new 29 km (18 mi) sanitary sewer system. The central treatment facility treats sanitary wastewater by the extended aeration activated sludge process. The treatment facility separates the wastewater into two forms, clarified effluent and sludge. The liquid effluent is further treated by the nonchemical method of ultraviolet (UV) light disinfection to meet NPDES discharge limitations for the outfall to Fourmile Branch. The sludge is further treated to reduce pathogen levels to meet proposed land application criteria. The remaining sanitary wastewater treatment facilities are being upgraded as necessary by replacing existing chlorination treatment systems with nonchemical UV light disinfection systems to meet NPDES limitations (DOE 1996a:3-265).

SRS has privatized the collection, hauling, and disposal of its sanitary waste (Arnett and Mamatey 1996:48). SRS-generated solid sanitary waste is sent to the Three Rivers Landfill (DOE 1998f:3-42). SRS disposes of other nonhazardous waste that consists of scrap metal, powerhouse ash, domestic sewage, scrap wood, construction debris, and used railroad ties in a variety of ways. Scrap metal is sold to salvage vendors for reclamation. Powerhouse ash and domestic sewage sludge are used for land reclamation. Scrap wood is burned on the site or chipped for mulch. Construction debris is used for erosion control. Railroad ties are shipped off the site for disposal (DOE 1996a:E-100).

3.5.2.7 Waste Minimization

The total amount of waste generated and disposed of at SRS has been and continues to be reduced through the efforts of the pollution prevention and waste minimization program at the site. This program is designed to achieve continuous reduction of waste and pollutant releases to the maximum extent feasible and in accordance with regulatory requirements while fulfilling national security missions (DOE 1996a:E-97). The program focuses mainly on source reduction, recycling, and increasing employee participation in pollution prevention. For example, 1995 nonhazardous solid waste generation was 32 percent below that of 1994, and the disposal volume of other solid waste, including radioactive and hazardous wastes, was 38 percent below 1994 levels. In 1995, SRS achieved a 9 percent reduction in its radioactive waste generation volume compared with 1994. Total solid waste volumes have declined by more than 70 percent since 1991. Radioactive solid waste volumes have declined by about 63 percent, or more than 17,000 m^3 (600,000 ft^3) from 1991 through 1995. In 1995, more than 2,990 t (3,300 tons) of nonradioactive materials were recycled at SRS, including 963 t (1,062 tons) of paper and cardboard (Arnett and Mamatey 1996:16, 41).

3.5.2.8 Preferred Alternatives From the Final WM PEIS

Preferred alternatives from the WM PEIS (DOE 1997a:summary, 117) are shown in Table 3–42 for the four waste types analyzed in this SPD EIS. A decision on the future management of these wastes could result in the construction of new waste management facilities at SRS and the closure of other facilities. Decisions on the various waste types are expected to be announced in a series of RODs to be issued on this WM PEIS. In fact, the TRU waste ROD was issued on January 20, 1998 (DOE 1998a), with the hazardous waste ROD issued on August 5, 1998 (DOE 1998b). The TRU waste ROD states that DOE will develop and operate mobile and fixed facilities to characterize and prepare TRU waste for disposal at WIPP. Each DOE site that has, or will generate, TRU waste will, as needed, prepare and store its TRU waste on the site. The hazardous waste ROD states that

Table 3–42. Preferred Alternatives From the WM PEIS

Waste Type	Preferred Action
TRU and mixed TRU	DOE prefers the regionalized alternative for onsite treatment and storage of SRS contact-handled TRU waste. Under this alternative, some contact-handled TRU waste could be received from ORR for treatment and storage.[a]
LLW	DOE prefers to treat SRS LLW on the site. SRS could be selected as one of the regional disposal sites for LLW.
Mixed LLW	DOE prefers regionalized treatment at SRS. This includes the onsite treatment of SRS waste and could include treatment of some mixed LLW generated at other sites. SRS could be selected as one of the regional disposal sites for mixed LLW.
Hazardous	DOE prefers to continue to use commercial facilities for hazardous waste treatment.[b]

[a] ROD for TRU waste (DOE 1998a) states that "each of the Department's sites that currently has or will generate TRU waste will prepare and store its TRU waste on site. . . ."

[b] ROD for hazardous waste (DOE 1998b) selected a modified preferred alternative that includes continued onsite treatment at SRS where this is economically favorable.

Key: LLW, low-level waste; ORR, Oak Ridge Reservation; TRU, transuranic.

Source: DOE 1997a:summary, 117.

most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own hazardous waste on the site in existing facilities where this is economically favorable. More detailed information and DOE's alternatives for the future configuration of waste management facilities at SRS is presented in the WM PEIS and the hazardous waste and TRU waste RODs.

3.5.3 Socioeconomics

Statistics for employment and regional economy are presented for the REA as defined in Appendix F.9, which encompasses 15 counties around SRS located in Georgia and South Carolina. Statistics for population, housing, community services, and local transportation are presented for the ROI, a five-county area in which 90.7 percent of all SRS employees reside as shown in Table 3–43. In 1997, SRS employed 15,032 persons (about 5.8 percent of the REA civilian labor force) (Knox 1997).

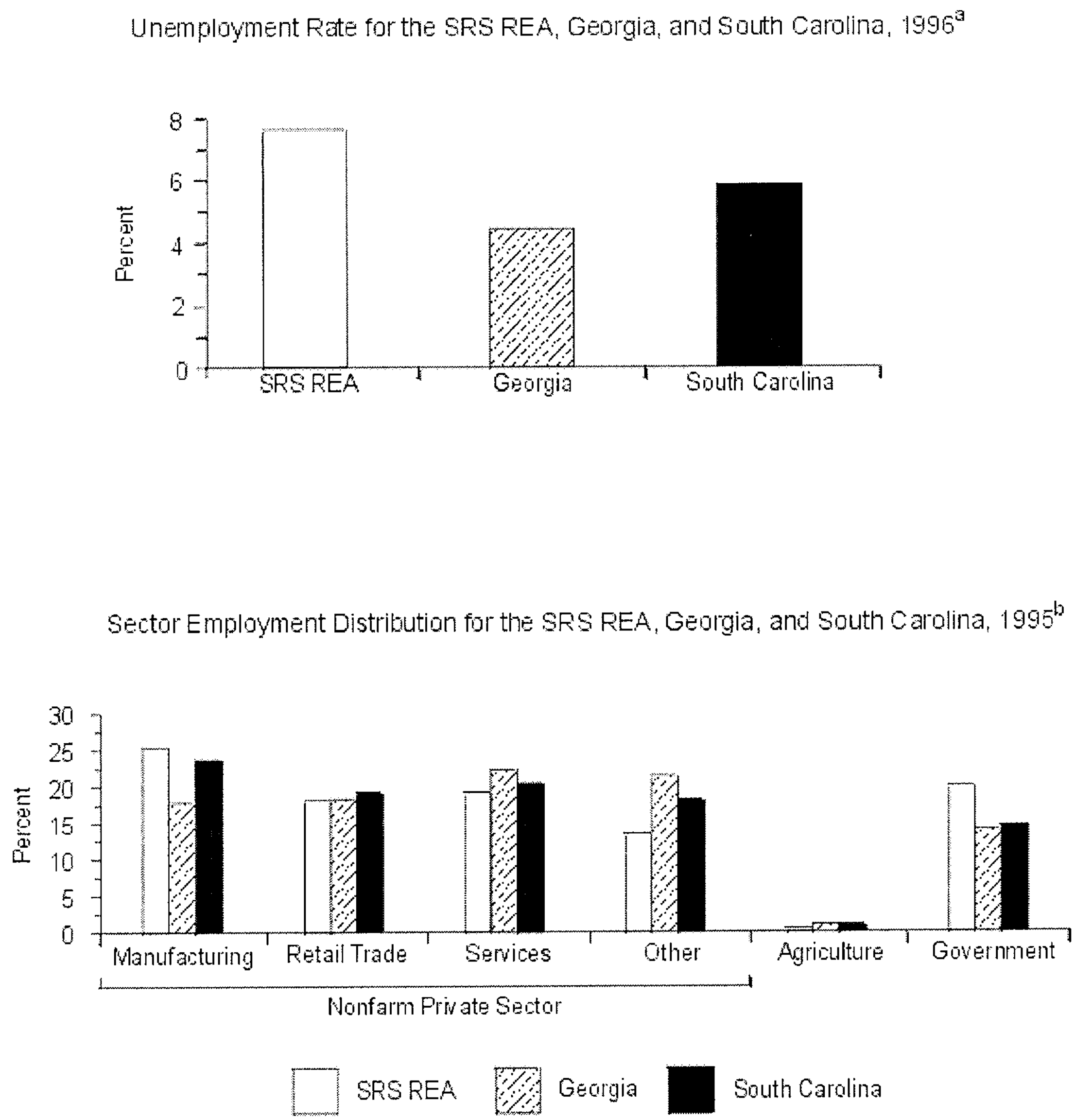
Table 3–43. Distribution of Employees by Place of Residence in the SRS Region of Influence, 1997

County	Number of Employees	Total Site Employment (Percent)
Aiken	6,981	53.9
Columbia	1,881	14.5
Richmond	1,755	13.5
Barnwell	932	7.2
Edgefield	210	1.6
ROI total	11,759	90.7

Source: Knox 1997.

3.5.3.1 Regional Economic Characteristics

Selected employment and regional economy statistics for the SRS REA are summarized in Figure 3–26. Between 1990 and 1996, the civilian labor force in the REA increased 3.6 percent to the 1996 level of 257,101. In 1996, the unemployment rate in the REA was 7.6 percent, which is greater than the unemployment rates for Georgia (4.6 percent) and South Carolina (6 percent) (DOL 1999).



[a]DOL 1999.
[b]DOL 1997.

REA Regional economic area

Figure 3–26. Employment and Local Economy for the SRS Regional Economic Area and the States of Georgia and South Carolina

In 1995, manufacturing represented the largest sector of employment in the REA (25.6 percent). This was followed by government (20.9 percent) and service (19.9 percent) activities. The total for these employment sectors in Georgia was 17.5 percent, 16.8 percent, and 23 percent, respectively. The total for these employment sectors in South Carolina was 23.3 percent, 17.3 percent, and 20.5 percent, respectively (DOL 1997).

3.5.3.2 Population and Housing

In 1996, the ROI estimated population totaled 453,778. From 1990 to 1996, the ROI population increased by 8.6 percent, compared with a 13 percent increase in Georgia's population and a 5.7 percent increase in South Carolina's population (DOC 1997). Between 1980 and 1990, the number of housing units in the ROI increased by 25.1 percent, compared with the 30.1 percent increase in Georgia and the 23.5 percent increase in South Carolina. The total number of housing units within the ROI for 1990 was 165,443 (DOC 1994). The 1990 homeowner vacancy rate for the ROI was 2.2 percent, compared with the statewide rates of 2.5 percent for Georgia and 1.7 percent for South Carolina. The renter vacancy rate for the ROI counties was 10 percent compared with the statewide rates of 12.2 percent for Georgia and 11.5 percent for South Carolina (DOC 1990a). Population and housing trends are summarized in Figure 3–27.

3.5.3.3 Community Services

3.5.3.3.1 Education

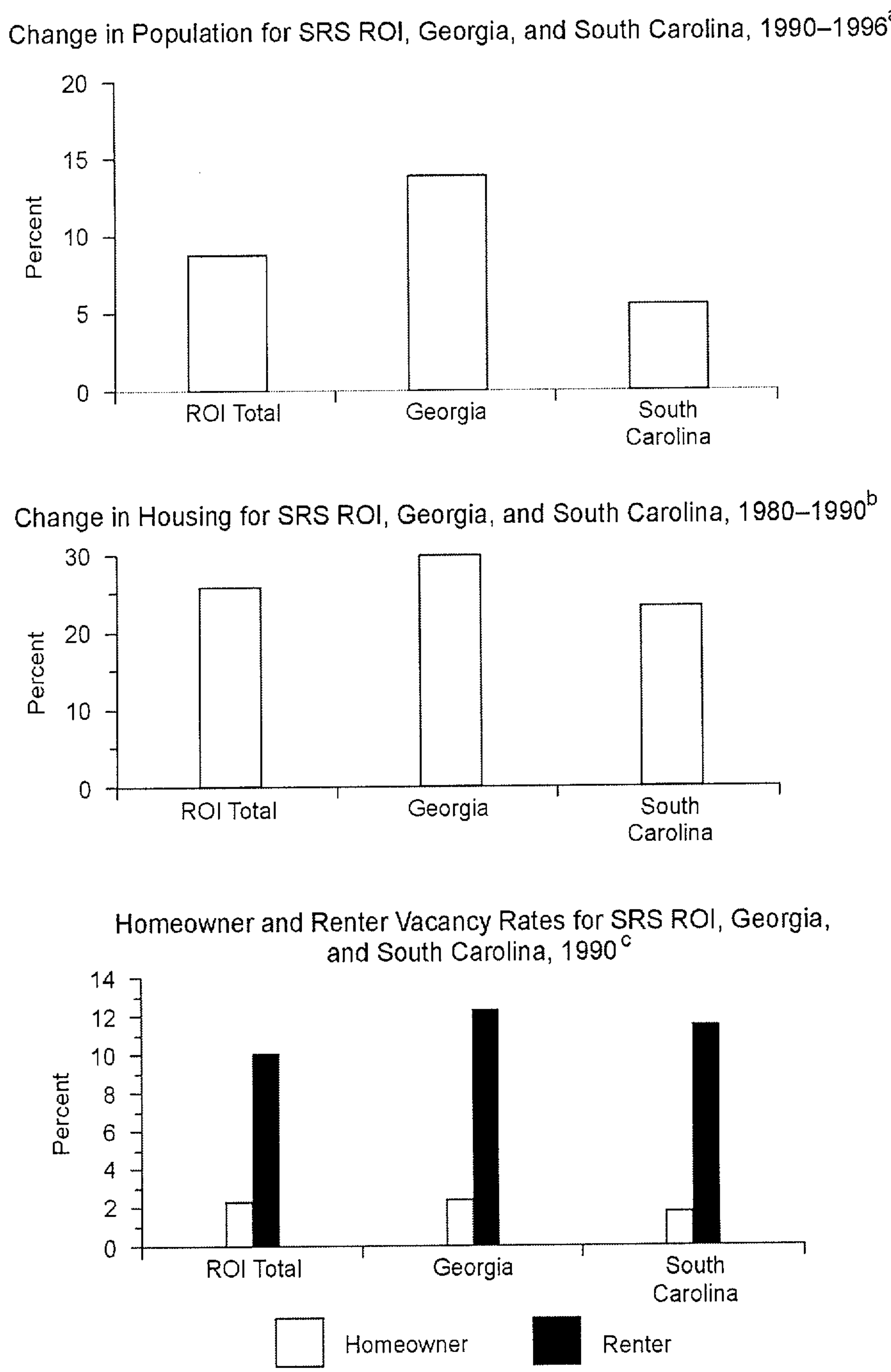
Seven school districts provided public education services and facilities in the SRS ROI. As shown in Figure 3–28, these school districts operated at between 85 percent (Barnwell County, District 19) and 125 percent (Richmond County School District) capacity in 1997. In 1997, the average student-to-teacher ratio for the SRS ROI was 17:1 (Nemeth 1997a). In 1990, the average student-to-teacher ratios were 10.8:1 for Georgia and 11.5:1 for South Carolina (DOC 1990b; 1994).

3.5.3.3.2 Public Safety

In 1997, a total of 973 sworn police officers were serving the five-county ROI. The average ROI officer-to-population ratio was 2.1 officers per 1,000 persons (Nemeth 1997b). This compares with the 1990 State averages of 2.0 officers per 1,000 persons for Georgia and 1.8 officers per 1,000 persons for South Carolina (DOC 1990b). In 1997, 1,712 paid and volunteer firefighters provided fire protection services in the SRS ROI. The average firefighter-to-population ratio in the ROI was 3.8 firefighters per 1,000 persons (Nemeth 1997b). This compares with the 1990 State averages of 1.0 firefighters per 1,000 persons for Georgia and 0.8 firefighters per 1,000 persons for South Carolina (DOC 1990b). Figure 3–29 displays the ratio of sworn police officers and firefighters to the population for all the counties in the ROI.

3.5.3.3.3 Health Care

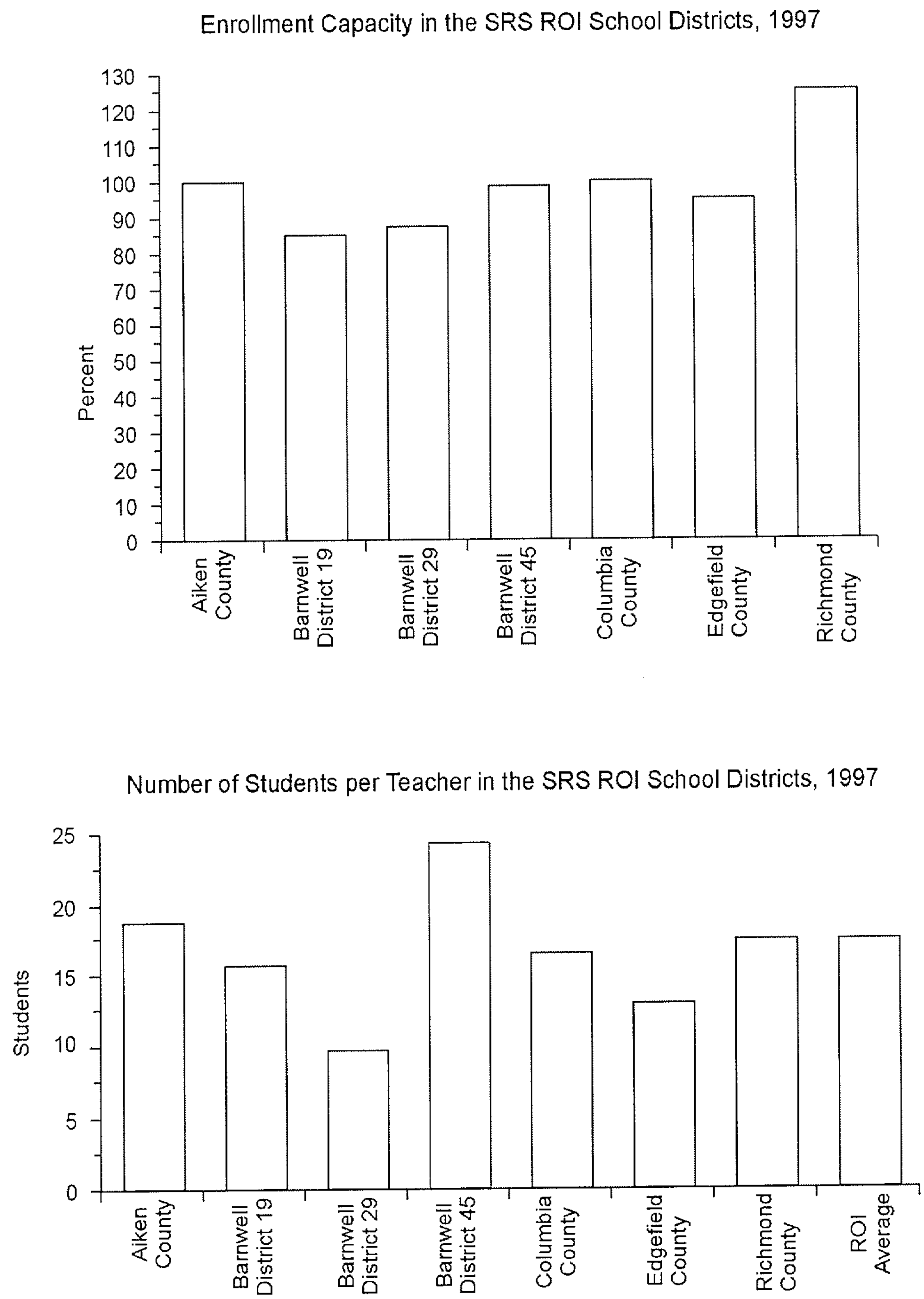
In 1996, a total of 1,722 physicians served the ROI. The average physician-to-population ratio in the ROI was 3.8 physicians per 1,000 persons. This compares with a 1996 State average of 2.3 physicians per 1,000 persons for Georgia and 2.2 physicians per 1,000 persons for South Carolina (Randolph 1997). In 1997, there were 10 hospitals serving the five-county ROI. The hospital bed-to-population ratio averaged 7.7 beds per 1,000 persons (Nemeth 1997c). This compares with a 1990 State average of 4.1 beds per 1,000 persons for Georgia and 3.3 beds per 1,000 persons for South Carolina (DOC 1996:128). Figure 3–29 displays the hospital bed-to-population and physician-to-population ratios for the SRS ROI counties.



[a]DOC 1997.
[b]DOC 1994.
[c]DOC 1990a.

ROI Region of influence

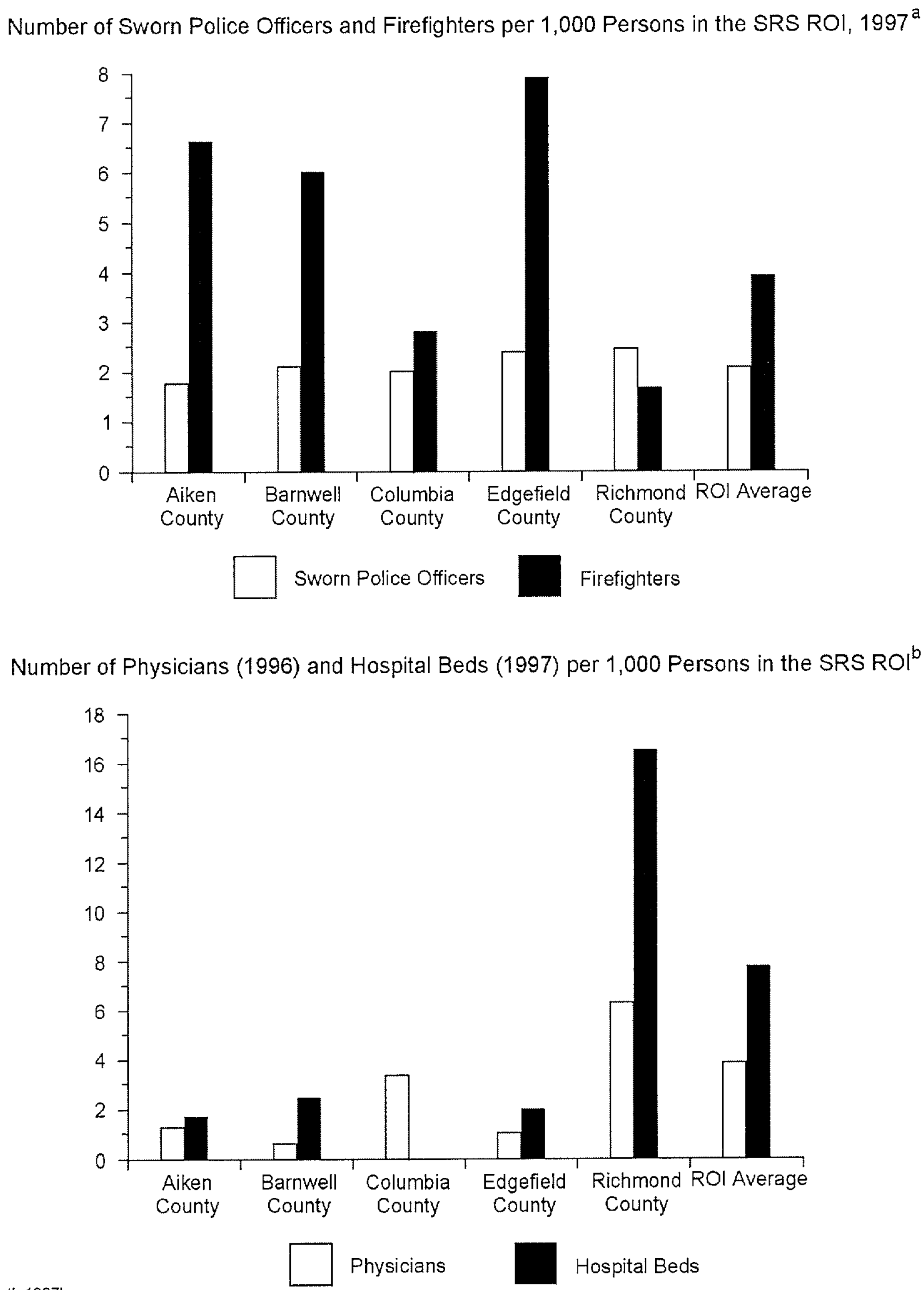
Figure 3–27. Population and Housing for the SRS Region of Influence and the States of Georgia and South Carolina



Source: Nemeth 1997a.

ROI Region of influence

Figure 3–28. School District Characteristics for the SRS Region of Influence



[a]Nemeth 1997b.
[b]Nemeth 1997c; Randolph 1997.

ROI Region of influence

Figure 3–29. Public Safety and Health Care Characteristics for the SRS Region of Influence

3.5.3.4 Local Transportation

Vehicular access to SRS is provided by South Carolina State Routes 19, 64, and 125 (see Figure 2–5). Two road segments in the ROI could be affected by the disposition alternatives: South Carolina State Route 19 from U.S. I–78 at Aiken to U.S. 278 and South Carolina State Route 230 from U.S. 25 Business at North Augusta to U.S. I–25, I–78, and I–278. Three road improvement projects are planned that would alleviate traffic congestion leading into SRS.

The first improvement project is the widening of South Carolina State Route 302, Pine Log Road, from U.S. Route 78 and the construction of new segments to extend the route to South Carolina State Route 19. U.S. Route 25 is also being widened for one-half mile south of I–20. The widening project will be in conjunction with the second improvement project, the new construction of the Bobby Jones Expressway. The expressway will head in a southwest direction crossing South Carolina State Routes 126 and 125 and U.S. Route 1 and continue over the Savannah River to connect with the Georgia portion of the Bobby Jones Expressway, which is already constructed. The third improvement project is the completion of the South Carolina State Route 118 around Aiken. South Carolina State Route 118 will be widened with the construction of new segments to complete the by-pass (Sullivan 1997).

There is no public transportation to SRS. Rail service in the ROI is provided by the Norfolk Southern Corporation and CSX Transportation. SRS is provided rail access via Robbins Station on the CSX Transportation line.

Waterborne transportation is available via the Savannah River. Currently, the Savannah River is used primarily for recreation. SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments.

Columbia Metropolitan Airport in the city of Columbia, South Carolina, and Bush Field in the city of Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers. Numerous smaller private airports are located in the ROI (DOE 1996a).

3.5.4 Existing Human Health Risk

Public and occupational health and safety issues include the determination of potentially adverse effects on human health that result from acute and chronic exposures to ionizing radiation and hazardous chemicals.

3.5.4.1 Radiation Exposure and Risk

3.5.4.1.1 General Site Description

Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in Table 3–44. Annual background radiation doses to individuals are expected to remain constant over time. The total dose to the population, in terms of person-rem, changes as the population size changes. Background radiation doses are unrelated to SRS operations.

Releases of radionuclides to the environment from SRS operations provide another source of radiation exposure to individuals in the vicinity of SRS. Types and quantities of radionuclides released from SRS operations in 1996 are listed in the *Savannah River Site Environmental Report for 1996* (Arnett and Mamatey 1997a:71–73). Doses to the public resulting from these releases are presented in Table 3–45. These doses fall within radiological limits per DOE Order 5400.5 (DOE 1993a:II-1–II-5) and are much lower than those of background radiation.

Table 3–44. Sources of Radiation Exposure to Individuals in the SRS Vicinity Unrelated to SRS 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)	200[b]
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] Arnett and Mamatey 1997a:116.
[b] An average for the United States.
[c] NCRP 1987:11, 40, 53.

Table 3–45. Radiation Doses to the Public From Normal SRS Operations in 1996 (Total Effective Dose Equivalent)

Members of the 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 (person-rem)[c]	None	6.4	None	2.2	100	8.6
Average individual within 80 km (mrem)[d]	None	1.0×10^{-2}	None	3.2×10^{-3}	None	1.4×10^{-2}

[a] The standards for individuals are given in DOE Order 5400.5 (DOE 1993a:II-1–II-5). As discussed in that order, the 10-mrem/yr limit from airborne emissions is required by the Clean Air Act, and the 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all pathways combined. The 100-person-rem value for the population is given in proposed 10 CFR 834, as published in 58 FR 16268 (DOE 1993b:para. 834.7). If the potential total dose exceeds the 100-person-rem value, it is required that the contractor operating the facility notify DOE.
[b] Conservatively includes all water pathways, not just the drinking water pathway. The population dose includes contributions to Savannah River users downstream of SRS to the Atlantic Ocean.
[c] About 620,100 in 1996. For liquid releases, an additional 70,000 water users in Port Wentworth, Georgia, and Beaufort, South Carolina (about 160 km [98 mi] downstream), are included in the assessment.
[d] 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: Arnett and Mamatey 1997a:108, 111, 112, 115.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from SRS operations in 1996 is estimated to be 1.0×10^{-7}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with 1 year of SRS operations is 1 in 10 million. (It takes several to many years from the time of radiation exposure for a cancer to manifest itself.)

According to the same risk estimator, 0.0043 excess fatal cancer is projected in the population living within 80 km (50 mi) of SRS from normal operations in 1996. To place this number in perspective, it may be compared with the number of fatal cancers expected in the same population from all causes. The 1996 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year (Famighetti 1998:964). Based on this national mortality rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of SRS was 1,240. This expected number of fatal cancers is much higher than the 0.0043 fatal cancers estimated from SRS operations in 1996.

SRS workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in facilities with nuclear materials. Table 3–46 presents the average worker and cumulative worker dose to SRS workers from operations in 1996. These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995b:paragraph 835.202). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers[8] (Appendix F.10), the number of projected fatal cancers to SRS workers from normal operations in 1996 is 0.095.

Table 3–46. Radiation Doses to Workers From Normal SRS Operations in 1996 (Total Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard[a]	Actual
Average radiation worker (mrem)	None[b]	19.0
Total workers (person-rem)[c]	None	237

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202). However, DOE's goal is to maintain radiological exposure as low as reasonably achievable. It has therefore established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.

[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."

[c] About 12,500 (badged) in 1996.

Source: Sessions 1997c.

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* (Arnett and Mamatey 1997a). The concentrations of radioactivity in various environmental media (including air, water, and soil) in the site region (on and off the site) are also presented in that report.

3.5.4.1.2 Proposed Facility Locations

External radiation doses and concentrations of gross alpha, plutonium, and americium in air have been measured in F- and S-Areas. In 1996, the annual doses in the F- and S-Areas were 106 and 111 mrem, respectively. Both are higher than the dose of 87 mrem measured at the offsite control location. In the same year, the concentrations of gross alpha were about 1.3×10^{-3} pCi/m^3 and 9.8×10^{-4} pCi/m^3 in the F- and S-Areas, respectively, compared with the approximately 9.4×10^{-4} pCi/m^3 measured at the offsite control location. The concentrations of plutonium 239 in the F- and S-Areas were about 8.4×10^{-7} and 0 pCi/m^3, respectively. Offsite controls did not detect any plutonium 239 in the air in 1996 (Arnett and Mamatey 1997a:80; 1997b:31, 33, 40, 42).

[8] The risk estimator for workers is lower than the estimator for the public because of the absence from the workforce of the more radiosensitive infant and child age groups.

3.5.4.2 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 through which people may come in contact with hazardous chemicals (e.g., surface water during swimming, soil through direct contact, or food). Hazardous chemicals can cause cancer and noncancer health effects. The baseline data for assessing potential health impacts from the chemical environment are addressed in Section 3.5.1.

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 NPDES permit requirements) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of monitoring information and inspection of mitigation measures. Health impacts on the public may occur via inhalation of air containing hazardous chemicals released to the atmosphere during normal SRS operations. Risks to public health from other possible pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those via the inhalation pathway.

Baseline air emission concentrations and applicable standards for hazardous chemicals are addressed in Section 3.5.1. The baseline 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. Information on estimating the health impacts of hazardous chemicals is presented in Appendix F.10.

Exposure pathways to SRS workers during normal operations may include inhaling contaminants in the workplace atmosphere and direct contact with hazardous materials. The potential for health impacts varies among facilities and workers, and available information is insufficient for a detailed estimate of impacts. Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, substitution, and engineering and management controls. They are also protected by adherence to OSHA 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 requires that conditions in the workplace be as free as possible from recognized hazards that cause or are likely to cause illness or physical harm. Therefore, workplace conditions at SRS are substantially better than required by standards.

3.5.4.3 Health Effects Studies

One epidemiological study on the general population in communities surrounding SRS has been conducted and published. No evidence of excess cancer mortality, congenital anomalies, birth defects, early infancy deaths, strokes, or cardiovascular deaths was reported. The epidemiological literature on the facility reflects an excess of leukemia deaths among hourly workers; no other health effects for workers are reported. For a more detailed description of the studies reviewed and their findings, and for a discussion of the epidemiologic surveillance program implemented by DOE to monitor the health of current SRS workers, refer to Appendix M.4.7 of the *Storage and Disposition PEIS* (DOE 1996a:M-242, M-243).

3.5.4.4 Accident History

Between 1974 and 1988, there were 13 inadvertent tritium releases from the SRS tritium facilities. These releases were attributed to aging equipment in the tritium-processing facility and are one of the reasons for the construction of the Replacement Tritium Facility at SRS. A detailed description and study of these incidents and the consequences thereof for the offsite population have been documented by SRS. The most significant were in 1981, 1984, and 1985, when, respectively, 32,934, 43,800, and 19,403 Ci of tritiated water vapor were released (DOE 1996a:3-259). From 1989 through 1992, there were 20 inadvertent releases, all with little or no offsite dose consequences. The largest of the recent releases occurred in 1992 when 12,000 Ci of tritium were released (Arnett, Karapatakis, and Mamatey 1993:260).

In 1993, an inadvertent release of 0.18 microcurie (mCi) of plutonium 238 and plutonium 239 took place. Westinghouse Savannah River Company emergency response models estimated an exposure of 0.0019 mrem to a hypothetical person at the site boundary (Arnett, Karapatakis, and Mamatey 1994:178).

3.5.4.5 Emergency Preparedness

Each DOE site has established an emergency management program that would be activated in the event of an accident. This program has been developed and maintained to ensure adequate response to most accident conditions and to provide response efforts for accidents not specifically considered. The emergency management program includes emergency planning, preparedness, and response.

The Emergency Preparedness Facility at SRS 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 the emergency. Emergency plans have been prepared for specific areas at SRS. Participating government agencies whose plans are interrelated with the SRS emergency plan for action include the States of South Carolina and Georgia, the City of Aiken, and the various counties in the general region of the site. Emergency response support, including firefighting and medical assistance, would be provided by these jurisdictions.

DOE has specified actions to be taken at all DOE sites to implement lessons learned from the emergency response to an accidental explosion at Hanford in May 1997. These actions and the timeframe in which they must be implemented are presented in Section 3.2.4.5.

3.5.5 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. In the case of SRS, the potentially affected area includes parts of Georgia and South Carolina.

The potentially affected area around the location of the proposed surplus plutonium disposition facilities in F-Area is defined by a circle with an 80-km (50-mi) radius centered at the Actinide Packaging and Storage Facility (APSF), if built, (lat. 33E17'32" N, long. 81E40'26" W). The total population residing within that area in 1990 was 614,095. The proportion of the population there that was considered minority was 38.0 percent.

Figure 3–30 illustrates the racial and ethnic composition of the minority population in the potentially affected area surrounding APSF, if built. At the time of the 1990 census, Blacks were the largest minority group within that area, constituting 35.7 percent of the total population. Hispanics constituted about 1.1 percent, and Asians, about 1 percent. Native Americans comprised about 0.2 percent of the population (DOC 1992).

[Text deleted.]

The potentially affected area around S-Area is defined by a circle with an 80-km (50-mi) radius centered at DWPF (lat. 33E17'43" N, long. 81E38'25" W). The total population residing within that area in 1990 was 626,317. The proportion of the population around this facility that was considered minority was 38.5 percent.

Figure 3–30 illustrates the racial and ethnic composition of the minority population in the potentially affected area around the S-Area. At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 36.3 percent of the total population. Hispanics constituted about 1.0 percent, and Asians, about 1 percent. Native Americans constituted about 0.2 percent of the population (DOC 1992). The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages for the States of Georgia and South Carolina, 29.8 and 31.4, respectively (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 107,057 persons (18.0 percent of the total population) residing within the potentially affected area around F-Area at APSF, if built, reported incomes below the poverty threshold. [Text deleted.] The low-income population around S-Area at DWPF was 109,217 (18.0 percent of the total population).

Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that Georgia and South Carolina reported 14.7 and 15.4 percent, respectively.

3.5.6 Geology and Soils

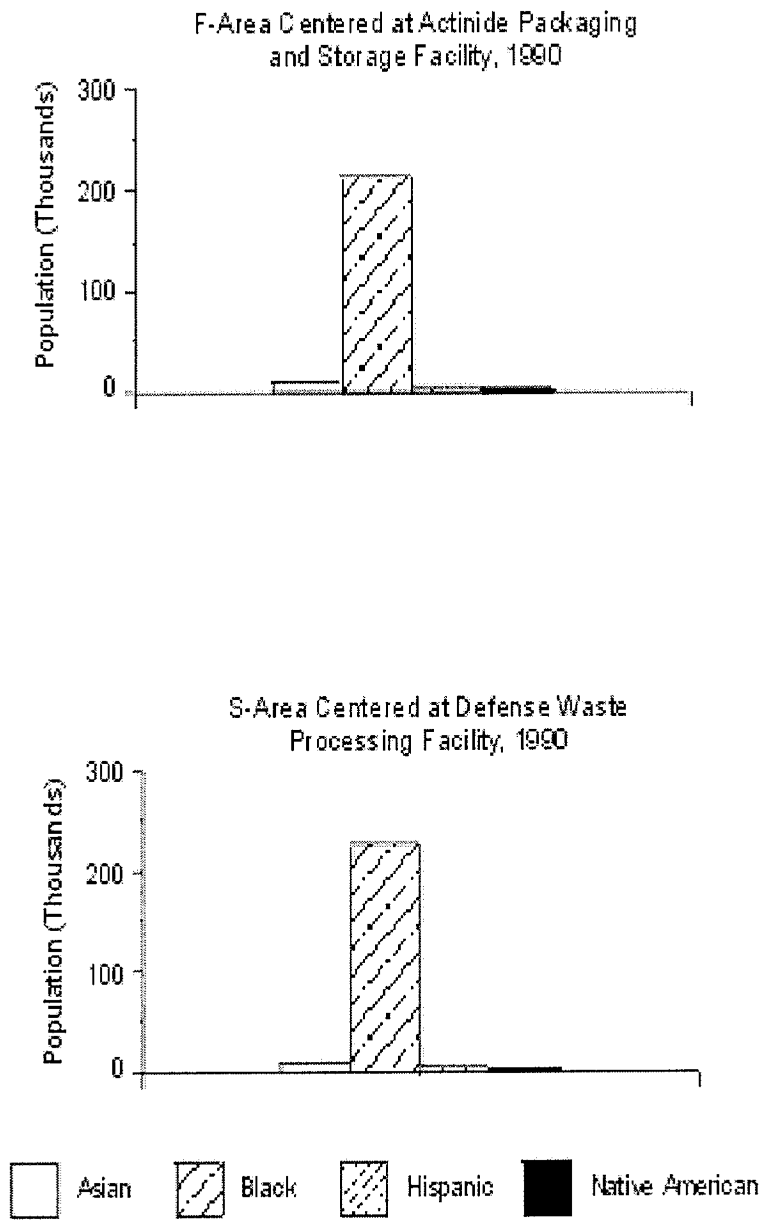
Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.5.6.1 General Site Description

Coastal Plain sediments beneath SRS overlie a basement complex composed of Paleocene crystalline and Triassic sedimentary formations of the Dunbarton Basin. Small and discontinuous zones of calcareous sand (i.e., sand containing calcium carbonate [calcite]), potentially subject to dissolution by water, are beneath some parts of SRS. If dissolution occurs in these zones, potential underground subsidence resulting in settling of the ground surface could occur. No settling as a result of dissolution of these zones has been identified. No economically viable geologic resources have been identified at SRS (DOE 1996a:3-241).

In the immediate region of SRS, there are no known capable faults. A capable fault is one that has had movement at or near the ground surface at least once within the past 35,000 years or recurrent movement within the past 500,000 years. Several faults have been identified from subsurface mapping and seismic surveys within the Paleozoic and Triassic basement beneath SRS. The largest of these is the Pen Branch Fault. There is no evidence of movement within the last 38 million years along this fault (DOE 1996a:3-241).

According to the Uniform Building Code, SRS is in Seismic Zone 2, meaning that moderate damage could occur as a result of an earthquake (DOE 1996a:3-241). Two earthquakes occurred during recent years inside the SRS boundary. On June 8, 1985, an earthquake with a local Richter scale magnitude of 2.6 and a focal depth of about 1 km (0.6 mi) occurred at SRS. Its epicenter was west of C- and K-Areas. The acceleration produced by the earthquake did not activate seismic monitoring instruments in the reactor areas. (These instruments have detection limits of 0.002g.) On August 5, 1988, another earthquake with a local Richter scale magnitude of 2.0 and a focal depth of about 2.7 km (1.7 mi) occurred at SRS. Its epicenter was northwest of K-Area. The seismic alarms in SRS facilities were not triggered. Existing information does not conclusively correlate the two earthquakes with any of the known faults on the site (DOE 1995c:3-7). Earthquakes capable of producing structural damage are not likely to occur in the vicinity of SRS (DOE 1996a:3-241).



Source: DOC 1992.

Figure 3–30. Racial and Ethnic Composition of Minorities Around SRS

Historically, two large earthquakes have occurred within 300 km (186 mi) of SRS. The largest of these, the Charleston earthquake of 1886, had an estimated Richter scale magnitude ranging from 6.5 to 7.5 (DOE 1996a:3-241). The SRS area experienced an estimated peak horizontal acceleration of 0.10g during this earthquake (DOE 1995c:3-6). An earthquake with a maximum horizontal acceleration of 0.19g is estimated to have an annual probability of occurrence of 1 in 5,000 at SRS (Barghusen and Feit 1995:2.13–16).

There are no volcanic hazards at SRS. The area has not experienced volcanic activity within the last 230 million years (DOE 1996a:3-241). Future volcanism is not expected because SRS is along the passive continental margin of North America (Barghusen and Feit 1995:2.13–16).

The soils at SRS are primarily sands and sandy loams. The somewhat excessively drained soils have a thick, sandy surface layer that extends to a depth of 2 m (6.6 ft) or more in some areas. Soil units that meet the soil requirements for prime farmland soils exist on SRS. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these lands as prime farmland due to the nature of site use; that is, the lands are not available for the production of food or fiber. The soils at SRS are considered acceptable for standard construction techniques (DOE 1996a:3-230, 3-241). Detailed descriptions of the geology and the soil conditions at SRS are included in the *Storage and Disposition PEIS* (DOE 1996a:3-241) and the *Savannah River Site Waste Management Final EIS* (DOE 1995c:3-4–3-6).

3.5.6.2 Proposed Facility Locations

Soils in F-Area are predominantly of the Fuquay-Blanton-Dothan association, consisting of nearly level to sloping, well-drained soils. Other soils include the Troup-Pickney-Lucy association, consisting of nearly level soils formed along, and parallel to, the floodplains of streams (Barghusen and Feit 1995:2.13–16).

Several subsurface investigations conducted on SRS waste management areas encountered soft sediments classified as calcareous sands. These sands were encountered in borings in S-Area between 33 and 35 m (108 to 115 ft) below ground surface. Preliminary information indicates that these calcareous zones are not continuous over large areas, nor are they very thick. No settling as a result of dissolution of these zones has been identified (DOE 1995c:3-6). Soils in S-Area are predominantly the same as those in F-Area (Barghusen and Feit 1995:2.13–16).

3.5.7 Water Resources

3.5.7.1 Surface Water

Surface water includes marine or freshwater bodies that occur above the ground surface, including rivers, streams, lakes, ponds, rainwater catchments, embayments, and oceans.

3.5.7.1.1 General Site Description

The largest river in the area of SRS is the Savannah River, which borders the site on the southwest. Six streams flow through SRS and discharge into the Savannah River: Upper Three Runs Creek, Beaver Dam Creek, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek. Upper Three Runs Creek has two tributaries, Tims Branch and Tinker Creek; Pen Branch has one, Indian Grave Branch; and Steel Creek, one, Meyers Branch (DOE 1996a:3-236).

There are two manmade lakes at SRS: L-Lake, which discharges to Steel Creek, and Par Pond, which discharges to Lower Three Runs Creek. Also, about 299 Carolina bays—i.e., closed depressions capable of holding water—occur throughout the site. While these bays receive no direct effluent discharges, they do receive storm-water runoff (DOE 1996a:3-236; WSRC 1997b:6-124).

Water has historically been withdrawn from the Savannah River for use mainly as cooling water; some, however, has been used for domestic purposes (DOE 1996a:3-236). SRS currently withdraws about 140 billion l/yr (37 billion gal/yr) from the river. Most of this water is returned to the river through discharges to various tributaries (DOE 1996a:3-236).

The average flow of the Savannah River is 283 m^3/s (10,000 ft^3/s). Three large upstream reservoirs, Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill, regulate the flow in the Savannah River, thereby lessening the impacts of drought and flooding on users downstream (DOE 1995c:3-14).

Several communities in the area use the Savannah River as a source of domestic water. The nearest downstream water intake is the Beaufort-Jasper Water Authority in South Carolina, which withdraws about 0.23 m^3/s (8.1 ft^3/s) to service about 51,000 people. Treated effluent is discharged to the Savannah River from upstream communities and from treatment facilities at SRS. The average annual volume of flow discharged by the sewage treatment facilities at SRS is about 700 million l (185 million gal) (DOE 1996a:3-236; Barghusen and Feit 1995:2.13-18).

It is clear that the surplus plutonium disposition facilities would not be located within a 100-year floodplain, but there is no information concerning 500-year floodplains (DOE 1996a:3-236). No federally designated Wild and Scenic Rivers occur within the site (Barghusen and Feit 1995:2.13-2). A map showing the 100-year floodplain is presented as Figure 3–31 (Noah 1995:52).

The Savannah River is classified as a freshwater source that is suitable for primary and secondary contact recreation; drinking, after appropriate treatment; fishing; balanced indigenous aquatic community development and propagation; and industrial and agricultural uses. A comparison of Savannah River water quality upstream (river mile 160) and downstream (river mile 120) of SRS showed no significant differences for nonradiological parameters (Arnett and Mamatey 1996:73, 119, 120). A comparison of current and historical data shows that the coliform data are within normal fluctuations for river water in this area. For the different river locations, however, there has been an increase in the number of analyses in which standards were not met. The data for the river's monitoring locations generally met the freshwater standards set by the State; a comparison of the 1995 and earlier measurements for river samples showed no abnormal deviations. As for radiological constituents, tritium is the predominant radionuclide detected above background levels in the Savannah River (Arnett and Mamatey 1996:80, 120).

Surface water rights for SRS are determined by the Doctrine of Riparian Rights, which allows owners of land adjacent to or under the water to use the water beneficially (DOE 1996a:3-239). SRS has five NPDES permits, two (SC0000175 and SC0044903) for industrial wastewater discharges, two (SCR000000 and SCR100000) for general storm-water discharges, and one (ND0072125) for land application. Permit SC0000175 regulates 76 outfalls; permit SC0044903, another 7. The 1995 compliance rate for these outfalls was 99.8 percent. The 48 storm-water–only outfalls regulated by the storm-water permits are monitored as required. A pollution prevention plan has been developed to identify where best available technology and best management practices must be used. For storm-water runoff from construction activities extending over 2 ha (5 acres), a sediment reduction and erosion plan is required (Arnett and Mamatey 1996:24, 114, 115, 226).

3.5.7.1.2 Proposed Facility Locations

The land around F-Area drains to Upper Three Runs Creek and Fourmile Branch (DOE 1995c:3-17). Upper Three Runs Creek is a large, cool blackwater stream that flows into the Savannah River. It drains about

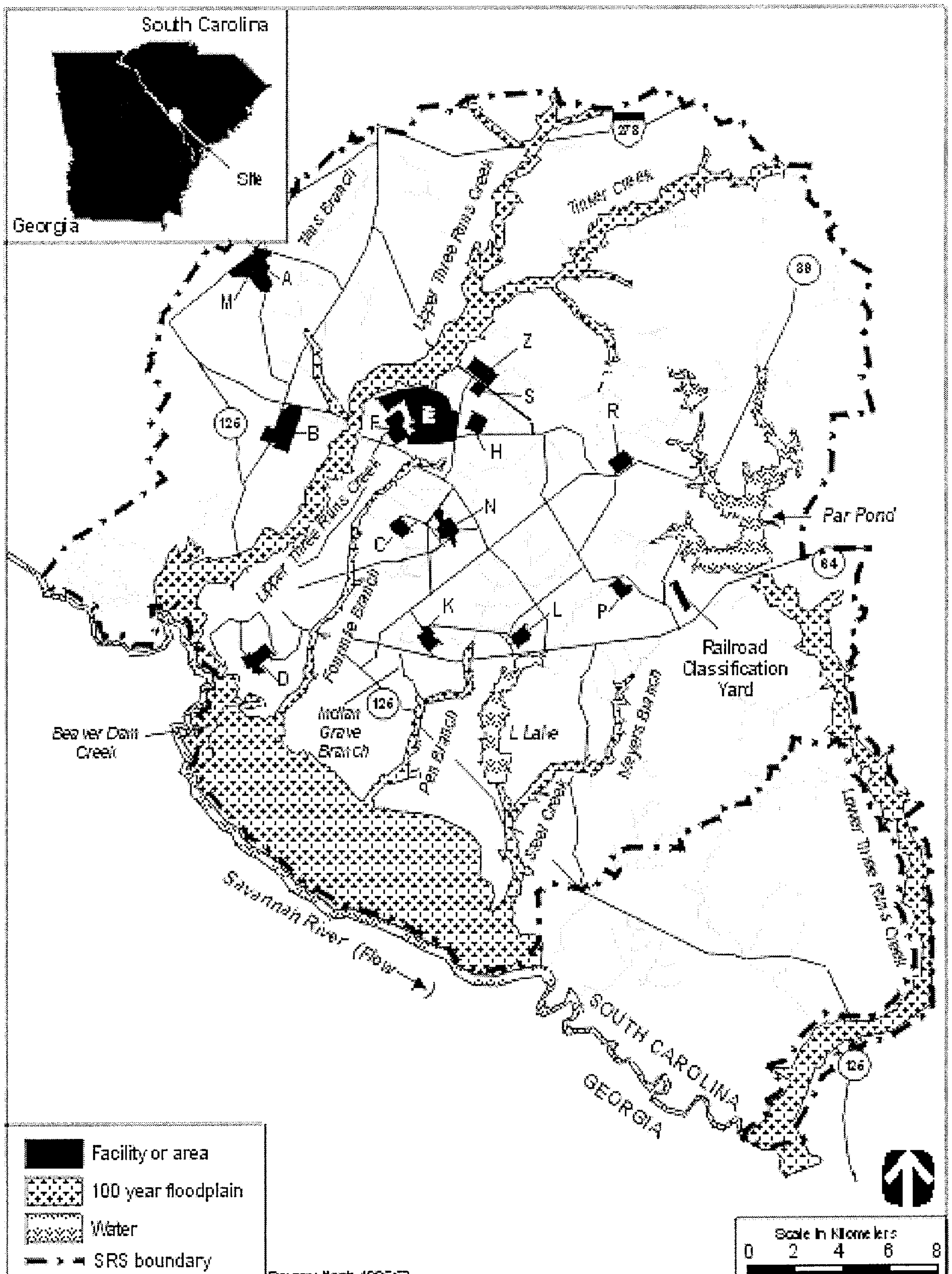


Figure 3–31. Locations of Floodplains at SRS

544 km^2 (210 mi^2), and during water year 1991, had a mean discharge of 6.8 m^3/s (240 ft^3/s) near its mouth. The 7-day, 10-year low flow, which is the lowest flow over any 7 days within any 10-year period, is about 2.8 m^3/s (100 ft^3/s). The stream is about 40 km (25 mi) long and only its lower reaches extend through SRS. It receives more water from underground sources than any other SRS stream, and therefore has lower dissolved solids, hardness, and pH values. It is the only major stream on the site that has not received thermal discharges. It receives permitted discharges from several areas at SRS, including F-Area, S-Area, S-Area sewage treatment plant, and treated industrial wastewater from the Chemical Waste Treatment Facility steam condensate. Flow from the sanitary wastewater discharge averages less than 0.001 m^3/s (0.035 ft^3/s or 16 gal/min). A comparison with the 7-day, 10-year low flow of 2.8 m^3/s (100 ft^3/s) in Upper Three Runs Creek shows that the present discharges are very small. The analytical results for the active outfalls show the constituents of concern are maintained within permit limitations (DOE 1994c:3-12–3-15; 1995c:3-15, 3-19).

Fourmile Branch is a blackwater stream affected by past operational practices at SRS. Its headwaters are near the center of the site, and it flows southwesterly before discharging into the Savannah River. The watershed is about 54 km^2 (21 mi^2) and receives permitted effluent discharges from F-Area and H-Area. This stream received cooling water discharges from C-Reactor while it was operating. Since those discharges ceased in 1985, the maximum recorded temperature in the stream has been 32 EC (90 EF), as opposed to ambient water temperatures that exceeded 60 EC (140 EF) when the reactor was operating. The average flow in the stream during C-Reactor operation was about 11.3 m^3/s (400 ft^3/s); since then flows have averaged about 1.8 m^3/s (64 ft^3/s) (DOE 1995c:3-19). In its lower reaches, this stream widens and flows via braided channels through a delta. Downstream of this delta area, it re-forms into one main channel, and most of the flow discharges into the Savannah River at river mile 152.1. When the Savannah River floods, water from Fourmile Branch flows along the northern boundary of the floodplain and joins with other site streams to exit the swamp via Steel Creek instead of flowing directly into the Savannah River (DOE 1995c:3-19).

The land surrounding S-Area also drains to Upper Three Runs Creek and Fourmile Branch. (Except for the differences noted in this section, stream information for F-Area is also relevant to S-Area.) Storm-water runoff from most of the area near DWPF is collected and discharged into a retention basin north of S-Area. Effluent from this basin is discharged at Outfall DW-005 to Crouch Branch, then to Upper Three Runs Creek (Arnett and Mamatey 1996:167; DOE 1994c:3-15). Analyses of samples from this outfall show a minimal impact of storm water on the water quality of Upper Three Runs Creek. Construction of DWPF adversely affected the water quality of Crouch Branch and McQueen Branch; however, enhanced erosion and sedimentation controls have been instituted at DWPF and in Z-Area. Also, startup of DWPF and the concurrent reduction in construction activities have assisted in reducing sediment loads to these streams (DOE 1994c:3-15).

3.5.7.2 Groundwater

Aquifers are classified by Federal and State authorities according to use and quality. The Federal classifications include Class I, II, and III groundwater. Class I groundwater is either the sole source of drinking water or is ecologically vital. Class IIA and IIB are current or potential sources of drinking water (or other beneficial use), respectively. Class III is not considered a potential source of drinking water and is of limited beneficial use.

3.5.7.2.1 General Site Description

Although many different systems have been used to describe groundwater systems at SRS, for this SPD EIS the same system used in the *Storage and Disposition PEIS* has been adopted. The uppermost aquifer is referred to as the water table aquifer. It is supported by the leaky "Green Clay" aquitard, which confines the Congaree aquifer. Below the Congaree aquifer is the leaky Ellenton aquitard, which confines the Cretaceous aquifer, also known as the Tuscaloosa aquifer. In general, groundwater in the water table aquifer flows downward to the Congaree aquifer or discharges to nearby streams. Flow in the Congaree aquifer is downward to the Cretaceous aquifer or horizontal to stream discharge or the Savannah River, depending on the location within SRS (DOE 1996a:3-239).

Groundwater in the area is used extensively for domestic and industrial purposes. Most municipal and industrial water supplies are withdrawn from the Cretaceous or water table aquifer, while small domestic supplies are withdrawn from the Congaree or water table aquifer. It is estimated that about 13 billion l/yr (3.4 billion gal/yr) are withdrawn from the aquifers within a 16-km (10-mi) radius of the site, which is similar to the volume used by SRS (DOE 1996a:3-239). The Cretaceous aquifer is an important water resource for the SRS region. The water is generally soft, slightly acidic, and low in dissolved and suspended solids (DOE 1995c:3-11, 3-13). Aiken, South Carolina, for example, uses the Cretaceous aquifer for drinking water.
Groundwater is the only source of domestic water at SRS (DOE 1995c:3-13). All groundwater at SRS is classified by EPA as a Class II water source, and depth to groundwater ranges from near the surface to about 46 m (150 ft). In 1993, SRS withdrew about 13 billion l/yr (3.4 billion gal/yr) of groundwater to support site operations (DOE 1996a:3-239). There are no designated sole source aquifers in the area (Barghusen and Feit 1995:2.13-2).

Groundwater ranges in quality across the site: in some areas it meets drinking water quality standards, while in areas near some waste sites it does not. The Cretaceous aquifer is generally unaffected except for an area near A-Area, where TCE has been reported. TCE has also been reported in the A- and M-Areas in the Congaree aquifer. Tritium has been reported in the Congaree aquifer in the Separations Area. The water table aquifer is contaminated with solvents, metals, and low levels of radionuclides at several SRS sites and facilities. Groundwater eventually discharges into onsite streams or the Savannah River (DOE 1996a:3-239), but groundwater contamination has not been detected beyond SRS boundaries (DOE 1995c:3-13).

Groundwater rights in South Carolina are associated with the absolute ownership rule. Owners of land overlying a groundwater source are allowed to withdraw as much water as they desire; however, the State requires users who withdraw more than 379,000 l/day (100,000 gal/day) to report their withdrawals. SRS is required to report because its usage is above the reporting level (DOE 1996a:3-239).

3.5.7.2.2 Proposed Facility Locations

Groundwater in the shallow, intermediate, and deep aquifers flows in different directions, depending on the depths of the streams that cut the aquifers. The shallow aquifer discharges to Upper Three Runs Creek and Fourmile Branch. Shallow groundwater in the vicinity of S-Area flows toward Upper Three Runs Creek, McQueen Branch, or Fourmile Branch. Groundwater in the intermediate and deep aquifers flows horizontally toward the Savannah River and southeast toward the coast (DOE 1994c:3-4, 3-6).

Groundwater also moves vertically. In the shallow aquifer, it moves downward until its movement is obstructed by impermeable material. Operating under a different set of physical conditions, groundwater in the intermediate and deep aquifers flows mostly horizontally. Near F-Area it moves upward due to higher water pressure below the confining unit between the upper and lower aquifers. This upward movement helps to protect the lower aquifers from contaminants found in the shallow aquifer. The depth to groundwater in F-Area varies from about 1 to 20 m (3.3 to 66 ft) (DOE 1994c:3-6).

Groundwater quality in F-Area is not significantly different from that for the site as a whole. It is abundant, usually soft, slightly acidic, and low in dissolved solids. High dissolved iron concentrations occur in some aquifers. Where needed, groundwater is treated to raise the pH and remove iron. Results of sampling in the shallow aquifer have indicated excursions from drinking water standards for lead, tetrachloroethylene, and tritium in S-Area wells (DOE 1994c:3-6, 3-9).

F-Area groundwater quality can exceed drinking water standards for several contaminants. Near the F-Area seepage basins and inactive process sewer line, radionuclide contamination is widespread. Most of these wells contain tritium above drinking water standards. Other wells exhibit gross alpha, gross beta, strontium 90, and iodine 129 above their standards. Other radionuclides found above proposed standards in several wells include americium 241; curium 243 and 244; radium 226 and 228; strontium 90; total alpha–emitting radium; and uranium 233, 234, 235, and 238. Cesium 137, curium 245 and 246, and plutonium 238 were also found (Arnett and Mamatey 1996:143, 144).

Near the F-Area Tank Farm, tritium, mercury, nitrate-nitrite as nitrogen, cadmium, gross alpha, and lead were detected above drinking water standards in one or more wells. The pH exceeded the basic standard, and trichlorofluoromethane (Freon 11), which has no drinking water standard, was present in elevated levels (Arnett and Mamatey 1996:153).

At the F-Area Sanitary Sludge Land Application Site, tritium, specific conductance, lead, and copper were found to exceed their drinking water standards in one or more wells (Arnett and Mamatey 1996:154). Groundwater near the F-Area Acid/Caustic Basin consistently exceeded drinking water standards for gross alpha. Total alpha-emitting radium, alkalinity, gross beta, nitrate as nitrogen, and pH were above their respective standards in one or more wells (Arnett and Mamatey 1996:138). The groundwater near the F-Area Coal Pile Runoff Containment Basin did not exceed any chemical or radiological standard during 1995 (Arnett and Mamatey 1996:141).

Groundwater flow and conditions in S-Area are not significantly different from those in F-Area. Tritium, tetrachloroethylene, and TCE exceeded the drinking water standards near the S-Area facilities. The groundwater in one well near the S-Area Low-Point Pump Pit also contained tritium in excess of drinking water standards. No other radiological or chemical constituents have been detected above standards since 1989 (Arnett and Mamatey 1996:149). Near the S-Area vitrification building, also known as the S-Area Canyon, tritium exceeded drinking water standards, and specific conductance and alkalinity were elevated (Arnett and Mamatey 1996:149).

3.5.8 Ecological Resources

Ecological resources are defined as terrestrial (predominantly land) and aquatic (predominantly water) ecosystems characterized by the presence of native and naturalized plants and animals. For the purposes of this SPD EIS, those ecosystems are differentiated in terms of habitat support of threatened, endangered, and other special-status species—that is, "nonsensitive" versus "sensitive" habitat.

3.5.8.1 Nonsensitive Habitat

Nonsensitive habitat comprises those terrestrial and aquatic areas of the site that typically support the region's major plant and animal species.

3.5.8.1.1 General Site Description

At least 90 percent of the SRS land cover is composed of upland pine and bottomland hardwood forests (DOE 1997a:4-97). Five major plant communities have been identified at SRS: bottomland hardwood (most commonly sweetgum and yellow poplar); upland hardwood-scrub oak (predominantly oaks and hickories); pine/hardwood; loblolly, longleaf, and slash pine; and swamp. The loblolly, longleaf, and slash pine community covers about 65 percent of the upland areas of the site. Swamp forests and bottomland hardwood forests occur along the Savannah River and the numerous streams found on the site (Figure 3–32) (DOE 1995a:vol. 1, app. C, 4-47; 1996a:3-242).

The biodiversity of the region is extensive due to the variety of plant communities and the mild climate. Animal species known to inhabit SRS include 44 species of amphibians, 255 species of birds, 54 species of mammals, and 59 species of reptiles. Common species include the eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox (DOE 1996a:3-242; WSRC 1997b:3-3). Game animals include a number of species, two of which, the white-tailed deer and feral hogs, are hunted on the site (DOE 1996d:3-56). Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the gray fox are ecologically important groups at SRS (DOE 1996a:3-242).

Aquatic habitat includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments throughout the site that support populations of bass and sunfish. Carolina bays, a type of wetland unique to the southeastern United States, are natural shallow depressions that occur in interstream areas. These bays can range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests. Among the 299 Carolina bays found throughout SRS, fewer than 20 have permanent fish populations. Redfin pickerel, mud sunfish, lake chubsucker, and mosquito fish are present in these bays. Although sport and commercial fishing is not permitted at SRS, the Savannah River is used extensively for both. Important commercial species are the American shad, hickory shad, and striped bass, all of which are anadromous. The most important warm-water game fish are bass, pickerel, crappie, bream, and catfish (DOE 1996a:3-244; WSRC 1997b:6-124).

3.5.8.1.2 Proposed Facility Locations

F-Area and S-Area are situated on an upland plateau between the drainage areas of Upper Three Runs Creek and Fourmile Branch. These heavily industrialized areas are dominated by buildings, paved parking lots, graveled construction areas, and laydown yards; little natural vegetation remains inside the fenced areas. Grassed areas occur around the administration buildings, and some vegetation is present along drainage ditches, but most of the developed areas have no vegetation (DOE 1994c:3-24; 1995b:vol. 1, app. C, 4-47). The most common plant communities in the vicinities of F-Area and S-Area include loblolly, longleaf, and slash pine; upland hardwood-scrub oak; pine/hardwood; and bottomland hardwood (DOE 1995c:3-34, 3-35; DOE 1996a:3-242). Cleared fields are also common in F-Area, and a roughly 6-ha (15-acre) oak-hickory forest area designated as a National Environmental Research Park set aside is northwest of F-Area (DOE 1996a:3-242).

A recent (1994–1997) study was conducted to document the composition and diversity of urban wildlife, those species of amphibians, birds, mammals and reptiles that inhabit or temporarily use the developed areas on SRS. Results indicate that the use of the developed areas by wildlife species is more common than has been previously reported (Mayer and Wike 1997:8, 52). A total of 41 wildlife species were observed in and around F-Area, including 18 species of birds, 11 species of mammals, and 12 species of reptiles. Similarly, S-Area produced sightings of 36 wildlife species, including 19 species of birds, 9 species of mammals, and 8 species of reptiles. Bird species commonly seen include the bufflehead (F-Area only), turkey vulture, black vulture, killdeer, rock dove, mourning dove, chimney swift (F-Area only), great crested flycatcher (F-Area only), barn swallow, common crow, fish crow, northern mockingbird, American robin, loggerhead shrike (S-Area only), European starling, house sparrow (S-Area only), red-winged blackbird (S-Area only), and common grackle. Frequently sighted mammals include the Virginia opossum, eastern cottontail (F-Area only), house mouse, feral cat, striped skunk, and raccoon. The only reptile commonly observed is the banded water snake (Mayer and Wike 1997:9–14).

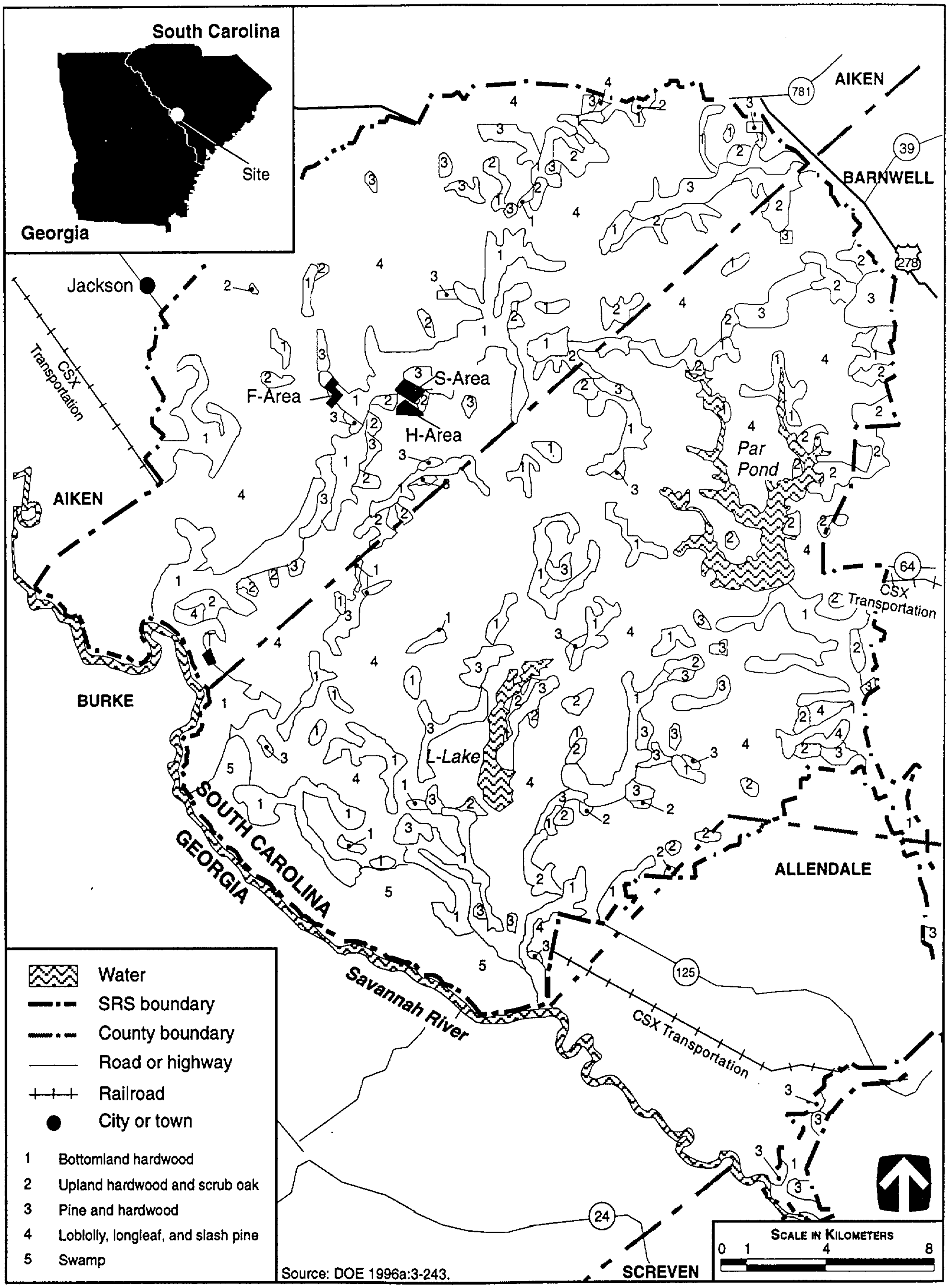


Figure 3–32. Major Plant Communities at SRS

Upper Three Runs Creek and its tributaries and three Carolina bays constitute the aquatic habitat in the vicinity of F-Area and S-Area. Streams support largemouth bass, black crappie, and various species of pan fish. Upper Three Runs Creek has a rich fauna; more than 551 species of aquatic insects have been collected (DOE 1996a:3-244; WSRC 1997b:5-32). It is important as a spawning area for blueback herring, and as a seasonal nursery habitat for American shad, striped bass, and other Savannah River species. Aquatic resources information on the three Carolina bays is unavailable (DOE 1996a:3-244).

3.5.8.2 Sensitive Habitat

Sensitive habitat comprises those terrestrial and aquatic (including wetlands) areas of the site that support threatened and endangered, State-protected, and other special-status plant and animal species.[9]

3.5.8.2.1 General Site Description

SRS wetlands, most of which are associated with floodplains, streams, and impoundments, include bottomland hardwood, cypress-tupelo, scrub-shrub, and emergent vegetation, as well as open water. Swamp forest along the Savannah River is the most extensive wetlands vegetation type (DOE 1996a:3-242).

Sixty-one threatened, endangered, and other special-status species listed by the Federal Government or the State of South Carolina may be found in the vicinity of SRS, as shown in Table 3.7.6–1 in the *Storage and Disposition PEIS*. No critical habitat for threatened or endangered species exists on SRS (DOE 1996a:3-245).

3.5.8.2.2 Proposed Facility Locations

No federally listed threatened or endangered species are known to occur in F-Area or S-Area, but several species that may exist in the general vicinity of these areas are listed in Table 3–47. The American alligator, although listed as threatened (by virtue of similarity in appearance to the endangered crocodile) is fairly abundant on SRS. It was recently observed near F-Area, but its occurrence there is seen as uncommon. Furthermore, no State-listed protected species have been found in any developed area on SRS, and of the State-listed organisms known to occur, none would be expected to use any of the disturbed areas for extended periods (Mayer and Wike 1997:42).

The Pen Branch area, about 14 km (8.7 mi) southwest of the proposed sites, and an area south of Par Pond, about 12 km (7.5 mi) to the southeast, support active bald eagle nests. Wood storks have been observed about 21 km (13 mi) from the proposed site, near the Fourmile Branch delta. The closest colony of red-cockaded woodpeckers is about 5 km (3.1 mi) away, but suitable forage habitat exists on the proposed sites. The smooth purple coneflower, the only endangered plant species found on SRS, could be found on the proposed sites (DOE 1996a:3-245). Botanical surveys conducted by the Savannah River Forest Station in 1992 and 1994 identified three populations of Oconee azalea in the area northwest of F-Area. This State-listed rare plant species, was found on the steep slopes adjacent to the Upper Three Runs Creek floodplain (DOE 1995c:3-37).

3.5.9 Cultural and Paleontological Resources

Cultural resources are human imprints on the landscape and are defined and protected by a series of Federal laws, regulations, and guidelines. Field studies conducted over the past two decades by the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina have provided considerable information about the distribution and content of cultural resources at SRS. About 60 percent of SRS has been surveyed, and 858 archaeological (historic and prehistoric) sites have been identified (DOE 1995c). There are 67 sites considered potentially eligible for listing on the National Register; most of the sites have not yet been

[9] The Federal Government defines threatened and endangered species in the Endangered Species Act, and wetlands in 33 CFR 328.3.

Table 3–47. Threatened and Endangered Species, Species of Concern, and Sensitive Species Occurring or Potentially Occurring in the Vicinity of F-Area and S-Area

Common Name	Scientific Name	Federal Status	State Status
Birds			
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Endangered
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Endangered
Wood stork	*Mycteria americana*	Endangered	Endangered
Plants			
Oconee azalea	*Rhododendron flammeum*	Not listed	Species of Concern
Smooth purple coneflower	*Echinacea laevigata*	Endangered	Endangered
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened (S/A)[a]	Not listed

[a] Protected under the Similarity of Appearance Provision of the Endangered Species Act.

Source: DOE 1996a:3-245–3-248; EuDaly 1998; Mayer and Wike 1997:9–14, 42.

evaluated (DOE 1996a:3-249). No SRS nuclear production facilities have been nominated for the National Register, and there are no plans for nominations. Existing SRS facilities lack architectural integrity and do not contribute to the broad historic theme of the Manhattan Project and the production of World War II era nuclear materials (DOE 1995c:vol. I, 3-53, 3-54).

Cultural sites are often occupied continuously or intermittently over substantial time spans. For this reason, a single location (sites) may contain evidence of use during both historic and prehistoric periods. In the discussions that follow, the numbers of prehistoric and historic resources are presented; the sum of these resources may be greater than the total number of sites reported due to this dual-use history at sites. Therefore, where the total number of sites reported is less than the sum of prehistoric and historic sites certain locations were used during both periods.

Cultural resources at SRS are managed under the terms of a programmatic memorandum of agreement among the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Officer, and the Advisory Council on Historic Preservation, dated August 24, 1990 (WSRC 1997b:sec. 2.6). Guidance on the management of cultural resources at SRS is included in the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SRARP 1989).

3.5.9.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records.

3.5.9.1.1 General Site Description

Prehistoric resources at SRS consist of villages, base camps, limited-activity sites, quarries, and workshops. An extensive archaeological survey program begun at SRS in 1974 includes numerous field studies such as reconnaissance surveys, shovel test transects, and intensive site testing and excavation. There is prehistoric evidence of more than 800 sites, some of which may fall in the vicinity of the proposed facilities. Fewer than 8 percent of these sites have been evaluated for National Register eligibility (DOE 1996a:3-249).

3.5.9.1.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with construction and operation of the extant facilities. Although no archaeological surveys have been conducted within the boundary of F-Area, no prehistoric cultural materials have been, or are expected to be, identified within this industrial area.

The proposed construction area adjacent to F-Area has been surveyed for prehistoric and historic archaeological resources. A number of archaeological sites within this area contain prehistoric materials considered potentially eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312; SRARP 1997; Stephenson and King 1999). Prior to any activity with potential impact on the sites in this area, a consultation process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area prior to construction of DWPF revealed no archaeological resources potentially eligible for nomination to the National Register.

3.5.9.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. In the United States, historic resources are generally considered to be those that date no earlier than 1492.

3.5.9.2.1 General Site Description

Types of historic sites include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farm dikes, dams, cattle pens, ferry locations, towns, churches, schools, cemeteries, commercial building locations, and roads. About 400 historic sites or sites with historic components have been identified within SRS, and some of these may fall within the locations of the proposed facilities. To date, about 10 percent of the historic sites have been evaluated for National Register eligibility. Most pre-SRS era historic structures were demolished during the initial establishment of SRS in 1950. Two SRS era buildings built in 1951 remain in use. From a Cold War perspective, SRS has been involved in tritium operations and other nuclear material production for more than 40 years; therefore, some existing facilities and engineering records may have significant historical and scientific content (DOE 1996a:3-249).

3.5.9.2.2 Proposed Facility Locations

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with the construction and operation of the extant facilities. Although no surveys have been conducted within the boundary of F-Area, no historic resources are expected to be identified with the possible exception of surviving facilities and engineering records from the Cold War era (DOE 1996a:3-249).

The proposed construction area adjacent to and northeast of F-Area has been surveyed for prehistoric and historic archaeological resources. Four known archaeological resources containing historic materials are considered potentially eligible for nomination to the National Register (Cabak, Sassaman, and Gillam 1996:199–312). Prior to any activity with potential impact on the sites in this area, a consultation process would be initiated with the South Carolina State Historic Preservation Officer to formally determine the eligibility of specific sites and to determine necessary and appropriate mitigation measures.

A survey of S-Area in conjunction with the 1982 DWPF EIS revealed no archaeological resources potentially eligible for nomination to the National Register (DOE 1994c:3–37).

3.5.9.3 Native American Resources

Native American resources are sites, areas, and materials important to Native Americans for religious or heritage reasons. In addition, cultural values are placed on natural resources such as plants, which have multiple purposes within various Native American groups. Of primary concern are concepts of sacred space that create the potential for land-use conflicts.

3.5.9.3.1 General Site Description

Native American groups with traditional ties to the area include the Apalachee, Cherokee, Chickasaw, Creek, Shawnee, Westo, and Yuchi. At different times, each of these groups was encouraged by the English to settle in the area to provide protection from the French, Spanish, or other Native American groups. Main villages of both the Cherokee and Creek were located southwest and northwest of SRS, respectively, but both groups may have used the area for hunting and gathering activities. During the early 1800s, most of the remaining Native Americans residing in the region were relocated to the Oklahoma Territory (DOE 1996a:3-249).

Native American resources in the region include remains of villages or townsites, ceremonial lodges, burials, cemeteries, and natural areas containing traditional plants used in religious ceremonies. Literature reviews and consultations with Native American representatives have revealed concerns related to the American Indian Religious Freedom Act within the central Savannah River valley, including some sensitive Native American resources and several plants traditionally used in ceremonies (DOE 1996a:3-249).

3.5.9.3.2 Proposed Facility Locations

In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed continuing interest in the SRS region with regard to the practice of their traditional religious beliefs. The Yuchi Tribal Organization and the National Council of Muskogee Creek have expressed concerns that several plant species—for example, redroot (*Lachnanthese carolinianum*), button snakeroot (*Eryngium yuccifolium*), and American ginseng (*Panax quinquefolium*)—traditionally used in tribal ceremonies could exist on SRS. Redroot and button snakeroot are known to occur on SRS, but are typically found in wet, sandy areas such as evergreen shrub bogs and savannas. Neither species is likely to be found in F-Area or S-Area due to clearing prior to the establishment of SRS in the 1950s (DOE 1994c:3-37). Consultations (see Chapter 5 and Appendix O) were initiated with appropriate Native American groups to determine any concerns associated with the actions evaluated in this SPD EIS.

3.5.9.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age.

3.5.9.4.1 General Site Description

Paleontological materials from the SRS area date largely from the Eocene Age (54 to 39 million years ago) and include fossil plants, numerous invertebrate fossils, giant oysters (*Crassostrea gigantissima*), other mollusks, and bryozoa. With the exception of the giant oysters, all other fossils are fairly widespread and common; therefore, the assemblages have low research potential or scientific value (DOE 1996a:3-249).

3.5.9.4.2 Proposed Facility Locations

No paleontological resources have been recorded for either F-Area or S-Area.

3.5.10 Land Use and Visual Resources

3.5.10.1 Land Use

Land may be characterized by its potential for the location of human activities (land use). Natural resource attributes and other environmental characteristics could make a site more suitable for some land uses than for others. Changes in land use may have both beneficial and adverse effects on other resources (biological, cultural, geological, aquatic, and atmospheric).

Located in southwestern South Carolina, SRS occupies an area of about 800 km^2 (310 mi^2) in a generally rural area about 40 km (25 mi) southeast of Augusta, Georgia, and 19 km (12 mi) south of Aiken, South Carolina, the nearest population centers (DOE 1996a:3-228). The site is owned by the Federal Government and is administered, managed, and controlled by DOE (DOE 1996a:3-230). It is bordered by the Savannah River to the southwest and includes portions of three South Carolina counties: Aiken, Allendale, and Barnwell (DOE 1996a:3-230).

3.5.10.1.1 General Site Description

Forest and agricultural land predominate in the areas bordering SRS. There are also significant open water and nonforested wetlands along the Savannah River Valley. Incorporated and industrial areas are the only other significant land uses. There is limited urban and residential development bordering SRS. The three counties in which SRS is located have not zoned any of the site land. The only adjacent area with any zoning is the town of New Ellenton, which has lands in two zoning categories bordering SRS: urban development and residential development. The closest residences are to the west, north, and northeast, within 60 m (200 ft) of the site boundary (DOE 1996a:3-230).

Various industrial, manufacturing, medical, and farming operations are conducted in areas around the site. Major industrial and manufacturing facilities in the area include textile mills, plants producing polystyrene foam and paper products, chemical processing plants, and a commercial nuclear power plant. Farming is diversified in the region; it includes crops such as peaches, watermelon, cotton, soybeans, corn, and small grains (DOE 1995b:vol. 1, app. C, 4-2).

Outdoor public recreation facilities are plentiful and varied in the SRS region. Included are the Sumter National Forest, 75 km (47 mi) to the northwest; Santee National Wildlife Refuge, 80 km (50 mi) to the east; and Clarks Hill/Strom Thurmond Reservoir, 70 km (43 mi) to the northwest. There are also a number of State, county, and local parks in the region, most notably Redcliffe Plantation, Rivers Bridge, Barnwell and Aiken County State Parks in South Carolina, and Mistletoe State Park in Georgia (DOE 1995b:vol. I, app. C, 4-2). The Crackerneck Wildlife Management Area, which extends over 1,930 ha (4,770 acres) of SRS adjacent to the Savannah River, is open to the public for hunting and fishing. Public hunts are allowed under DOE Order 4300.1C, which states that "all installations having suitable land and water areas will have programs for the harvesting of fish and wildlife by the public" (Noah 1995:48). SRS is a controlled area, public access being limited to through traffic on South Carolina Highway 125 (SRS Road A), U.S. Highway 278 (SRS Road 1), and the CSX railway line (DOE 1995b:vol. 1, app. C, 4-2).

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Generalized land uses at SRS and vicinity are shown on Figure 3–33. Approximately

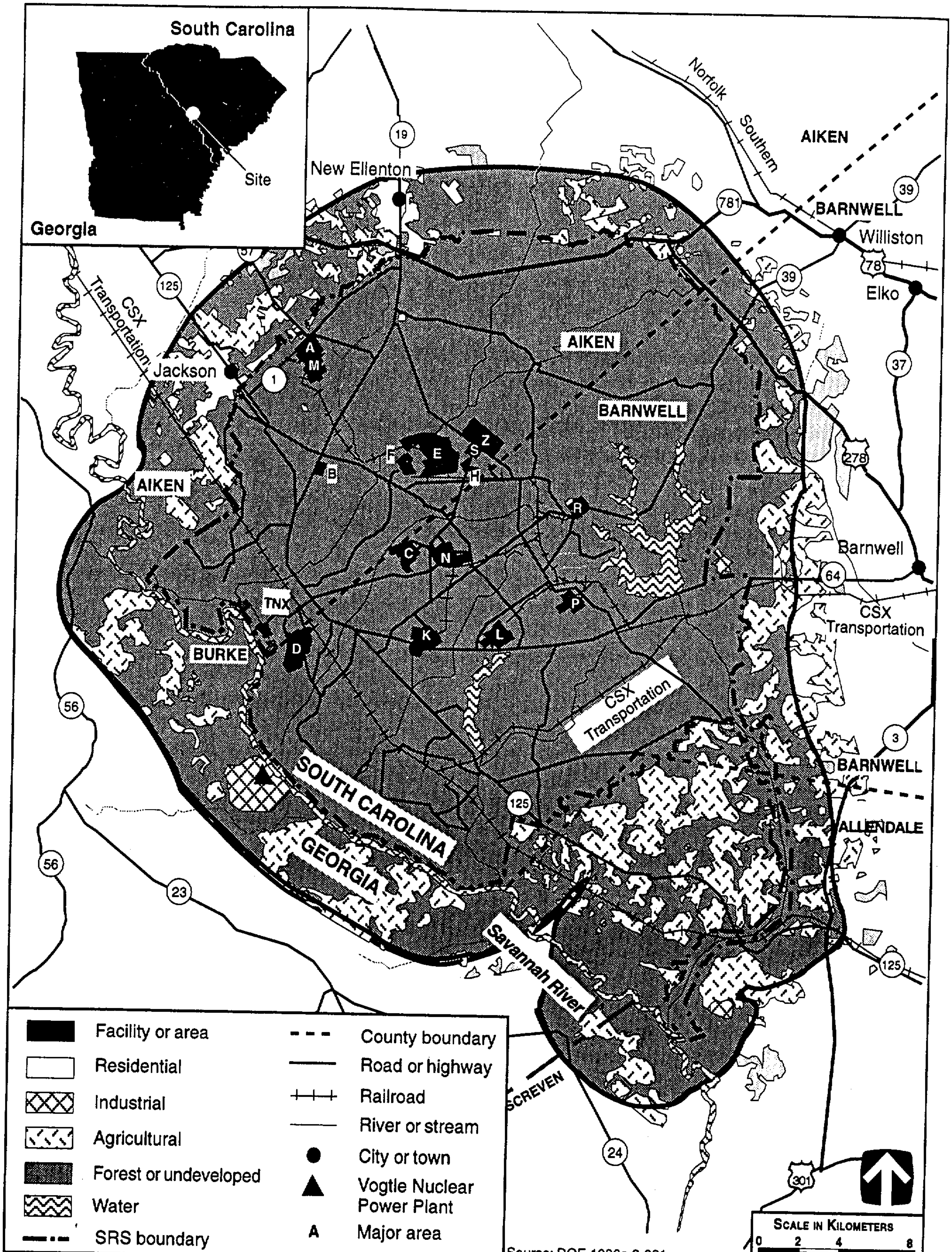


Figure 3–33. Generalized Land Use at SRS and Vicinity

585 km^2 (226 mi^2) of SRS—i.e., 73 percent of the area—is undeveloped (DOE 1996a:3-230). Wetlands, streams, and lakes account for 180 km^2 (70 mi^2) or 22 percent of the site, while developed facilities including production and support areas, roads, and utility corridors only make up approximately 5 percent or 40 km^2 (15 mi^2) of SRS (DOE 1996a:3-230). The woodlands area is primarily in revenue-producing, managed timber production. The U.S. Forest Service, under an interagency agreement with DOE, harvests about 7.3 km^2 (2.8 mi^2) of timber from SRS each year (DOE 1997e:4-57). Soil map units that meet the requirements for prime farmland soils exist on the site. However, the U.S. Department of Agriculture, Natural Resources Conservation Service, does not identify these as prime farmlands because the land is not available for agricultural production (DOE 1996a:3-230).

In 1972, DOE designated all of SRS as a National Environmental Research Park. The National Environmental Research Park is used by the national scientific community to study the impacts of human activities on the cypress swamp and hardwood forest ecosystems (DOE 1996a:3-230). DOE has set aside approximately 57 km^2 (22 mi^2) of SRS exclusively for nondestructive environmental research (DOE 1997e:4-57). A portion of SRS is open to the public for hunting and fishing.

Decisions on future land uses at SRS are made by DOE through the site development, land use, and future planning processes. SRS has established a Land Use Technical Committee composed of representatives from DOE, Westinghouse Savannah River Company, and other SRS organizations. DOE prepared the *FY 1994 Draft Site Development Plan*, which describes the current SRS mission and facilities, evaluates possible future missions and requirements, and outlines a master development plan that is now being prepared. In January 1996a, DOE published the *SRS Future Use Project Report*, which summarizes stakeholder-preferred future use recommendations that DOE considers throughout future planning and decisionmaking activities (DOE 1997e:4-57).

The State of South Carolina, through Act 489, as amended in 1994, requires local jurisdictions to undertake comprehensive planning. Regional-level planning also occurs within the State, with the State divided into 10 planning districts guided by regional advisory councils (DOE 1996a:3-230). The counties of Aiken, Allendale, and Barnwell together constitute part of the Lower Savannah River Council of Governments. Private lands bordering SRS are subject to the planning regulations of these three counties.

No onsite areas are subject to Native American Treaty Rights. However, five Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, the Indian Peoples Muskogee Tribal Town Confederacy, the Pee Dee Indian Association, and the Ma Chis Lower Alabama Creek Indian Tribe, have expressed concern over sites and items of religious significance on SRS. DOE routinely notifies these organizations about major planned actions at SRS and asks them to comment on SRS documents prepared in accordance with NEPA.

3.5.10.1.2 Proposed Facility Locations

Many buildings are situated within F-Area. Included is Building 221–F, one of the canyons where plutonium was recovered from targets during DOE's plutonium production phase. Land use at Building 221–F in F-Area is classified as heavy industrial. This 30-m (100-ft) concrete structure is designed for plutonium immobilization. F-Area occupies approximately 160 ha (395 acres) of the site; S-Area, 110 ha (272 acres). These areas are about 14 km (8.7 mi) and 10 km (6.2 mi), respectively, from the site boundary.

Also within F-Area will be the Actinide Packaging and Storage Facility (if built), a planned below-grade facility for receiving and storing Category I quantities of special nuclear material (UC 1999). For those alternatives that involve installing the plutonium conversion and immobilization facilities at SRS, DWPF in S-Area would provide the second-stage immobilization services (DOE 1994c:3-29).

3.5.10.2 Visual Resources

Visual resources are natural and human-created features that give a particular landscape its character and aesthetic quality. Landscape character is determined by the visual elements of form, line, color, and texture. All four elements are present in every landscape; however, they exert varying degrees of influence. The stronger the influence exerted by these elements in a landscape, the more interesting the landscape. The more visual variety that exists with harmony, the more aesthetically pleasing the landscape.

3.5.10.2.1 General Site Description

The dominant viewshed in the vicinity of SRS consists mainly of agricultural land and forest, with some limited residential and industrial areas. The SRS landscape is characterized by wetlands and upland hills. Vegetation is composed of bottomland hardwood forests, scrub oak and pine woodlands, and wetland forests. DOE facilities are scattered throughout SRS and are brightly lit at night. These facilities are generally not visible offsite, as views are limited by rolling terrain, normally hazy atmospheric conditions, and heavy vegetation. The only areas visually impacted by the DOE facilities are those within the view corridors of State Highway 125 and SRS Road 1.

The developed areas and utility corridors (transmission lines and aboveground pipelines) of SRS are consistent with a VRM Class IV designation. The remainder of SRS is consistent with VRM Class III or IV (DOE 1996a:3-230; DOI 1986a, 1986b).

3.5.10.2.2 Proposed Facility Locations

Industrial facilities within F-Area consist of large concrete structures, smaller administrative and support buildings, and parking lots (DOE 1994c:3-38). The structures range in height from 3 to 30 m (10 to 100 ft), with a few stacks and towers that reach 60 m (200 ft). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in F-Area are consistent with VRM Class IV (DOI 1986a, 1986b; Sessions 1997c:sec. 2.1, table 2-1). F-Area is about 7 km (4.3 mi) from State Highway 125 and 8.5 km (5.3 mi) from SRS Road 1. Public view of F-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 10 km (6.2 mi) to the west.

Industrial facilities within S-Area consist of large concrete buildings, smaller administrative and support buildings, and parking lots (DOE 1994c:3-38). The facilities in this area are brightly lit at night and visible when approached via SRS access roads. Visual resource conditions in S-Area are consistent with a VRM Class IV designation (DOI 1986a, 1986b; Sessions 1997c:sec. 2.1, table 2-1). S-Area is about 10 km (6.2 mi) from State Highway 125 and 11 km (6.8 mi) from SRS Road 1. Public view of S-Area facilities is restricted by heavily wooded areas bordering segments of the SRS Road 1 system and site-crossing State Highway 125. Moreover, those facilities are not visible from the Savannah River, which is about 15 km (9.3 mi) to the west.

3.5.11 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.

3.5.11.1 General Site Description

SRS comprises numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in Table 3–48.

Table 3–48. SRS Sitewide Infrastructure Characteristics

Resource	Current Usage	Site Capacity
Transportation		
Roads (km)	230	230
Railroads (km)	103	103
Electricity		
Energy consumption (MWh/yr)	420,000	5,200,000
Peak load (MW)	70	330
Fuel		
Natural gas (m^3/yr)	NA	NA
Oil (l/yr)	28,400,000	NA[a]
Coal (t/yr)	210,000	NA[a]
Water (l/yr)	1,780,000,000	3,870,000,000

[a] As supplies get low, more can be supplied by truck or rail.
Key: NA, not applicable.
Source: Sessions 1997a:2.

3.5.11.1.1 Transportation

SRS has an extensive network—230 km (143 mi)—of roads to meet its onsite intrasite transportation requirements. The railroad infrastructure, which consists of 103 km (64 mi) of track, provides for deliveries of large volumes of coal and oversized structural components (Table 3–48).

3.5.11.1.2 Electricity

The SRS electrical grid is a 115-kV system in a ring arrangement that supplies power to operating areas, administrative areas, and independent and support function areas. That system includes about 160 km (100 mi) of transmission lines. Power is supplied to the grid by three South Carolina Electric & Gas Company (SCE&G) transmission lines. SRS is situated in, and draws its power from, the Virginia-Carolina Sub-Region, an electric power pool area that is a part of the Southeastern Electrical Reliability Council. Most of that power comes from offsite coal-fired and nuclear-powered generating plants (Sessions 1997c:sec. 2.8).

Current site electricity consumption is about 420,000 MWh/yr. Site capacity is about 5.2 million MWh/yr. The peak load capacity is 330 MW; the peak load usage, 70 MW (Sessions 1997c:sec. 2.8).

3.5.11.1.3 Fuel

Coal and oil are used at SRS primarily to power the steam plants. Steam generation facilities at SRS include coal-fired powerhouses at A-, D-, and H-Areas and two package steam boilers, which use number 2 fuel oil, in K-Area. Coal is delivered by rail and is stored in coal piles in A-, D- and H-Areas. Oil is delivered by truck to K-Area. Coal is used to fuel A-Area powerhouse that provides process and heating steam for the main administrative area at SRS. D-Area powerhouse provides most of the steam for the SRS process area (Sessions 1998a). Natural gas is not used at SRS.

3.5.11.1.4 Water

A new central domestic water system serves the majority of the site. The system includes three wells and a 17-million-l/day (4.5-million-gal/day) water treatment plant in A-Area; two wells and an 8.3-million-l/day (2.2-million-gal/day) backup water treatment plant in B-Area; three elevated storage tanks; and a 43-km (27-mi) piping loop (Sessions 1997c:sec. 2.8). The system's available flow capacity is approximately 13,060 l/min (3,450 gal/min) (DOE 1997f:3-35). Process water is provided to individual site areas. See Section 3.5.11.2.3 for more information.

3.5.11.1.5 Site Safety Services

The SRS fire department operates under a 12-hr rotational shift schedule, with three fire stations. Among the firefighters and officers are members of the SRS Hazardous Materials Response Team and the Rescue Team, responsible for rescues of all types. The fire department is supported by a fleet of 20 vehicles, including six pumpers, one pumper-tanker, one tanker, one aerial platform ladder truck, one light duty rescue vehicle, one mini-pumper for grass fires, one specially prepared emergency response step van and trailer for hazardous materials response, and two boats for waterway spill response and control. Inspections are performed periodically according to National Fire Protection Codes and Standards (WSRC 1994).

3.5.11.2 Proposed Facility Locations

A summary of the infrastructure characteristics for F-Area and S-Area is provided in Table 3–49.

Table 3–49. SRS Infrastructure Characteristics for F-Area and S-Area

Resource	F-Area		S-Area	
	Current Usage	Capacity	Current Usage	Capacity
Electricity				
Energy consumption (MWh/yr)	78,300	561,000	37,400	385,000
Peak load (MW)	14.5	64.0	6.0	14.5
Fuel				
Natural gas (m^3/yr)	NA	NA	NA	NA
Oil (l/yr)	NA	NA	NA	NA
Coal (t/yr)	NA	NA	NA	NA
Water (l/yr)	374,000,000	1,590,000,000	49,800,000	797,000,000

Key: NA, not applicable.
Source: Sessions 1997a.

3.5.11.2.1 Electricity

Electric power for F-Area is provided by the 200–F Power Loop, which is supplied by the 251–F electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through a 2,000-A–rated bus (Sessions 1997c:sec. 2.8). F-Area electrical energy consumption is about 78,300 MWh/yr; F-Area electrical capacity, about 561,000 MWh/yr (Sessions 1997a).

Electric power for S-Area is provided by two 13.8-kV feeders supplied by the 251–H electrical substation. This substation consists of two 115/13.8-kV, 24/32-MVA transformers and associated switchgear. The 13.8-kV power is distributed through two 2,000-A–rated buses. The 13.8-kV bus tie breaker is normally closed. S-Area electrical energy consumption is about 37,400 MWh/yr; electrical capacity in S-Area, about 385,000 MWh/yr (Sessions 1997a; 1997c:sec. 2.8).

3.5.11.2.2 Fuel

Coal and oil are not required in F- or S-Area because steam is supplied from the central facility, and electricity is supplied from the site electrical grid system (Sessions 1998b).

3.5.11.2.3 Water

F-Area water usage of domestic water is about 374 million l/yr (100 million gal/yr) from the new central domestic water system. Currently available capacity for F-Area is about 1.6 billion l/yr (420 million gal/yr) (Sessions 1997a; 1997c:sec. 2.8).

S-Area has managed its supply of water until recently and has used an average of 50 million l/yr (13 million gal/yr). Now that it is connected to the new central domestic water system, the area has access to the system's excess capacity of 797 million l/yr (211 million gal/yr) (Sessions 1997a; 1997c:sec. 2.8).

Process and service water are supplied through deep-well systems within site areas. Wells 905-100F and 905-102F supply process and service water to F-Area; wells 905-1S and 905-2S to S-Area's DWPF. These wells are screened in the McQueen Branch (Lower Tuscaloosa) aquifer (Sessions 1997c:sec. 2.8). Each of these process water systems is capable of delivering 1,987 million 1/yr (525 million gal/yr) of water (Sessions 1997a; 1997c:sec 2.8). Current usage of process and service water in F-Area is 481 million 1/yr (127 million gal/yr) and about 3.79 million 1/yr (1 million gal/yr) in S-Area (Sessions 1997a).

3.6 LEAD ASSEMBLY FABRICATION AND POSTIRRADIATION EXAMINATION SITES

3.6.1 Hanford Overview

Hanford is located in the southeast portion of Washington State, occupying about 1,450 km^2 (560 mi^2). The 400 Area occupies 0.6 km^2 (0.2 km^2). Additional information on Hanford and the 400 Area is provided in Section 3.2.

[Text deleted.]

The options proposed for lead assembly fabrication at Hanford would use existing employees and buildings; therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not required for the 400 Area. For additional information on the resource areas that could be impacted by lead assembly fabrication activities in the 400 Area, refer to Sections 3.2.1, 3.2.2, 3.2.4, and 3.2.11.

3.6.2 ANL–W Overview

Located in the southeast portion of INEEL is ANL–W. ANL–W is about 328 ha (820 acres). Atomic City, 29 km (18 mi) southwest, is the closest populated area to ANL–W; it has a population of 25. Idaho Falls, population of about 45,000, is 63 km (39 mi) east of ANL–W (see Figure 2–3). In 1997, about 700 employees worked at ANL–W (O'Connor et al. 1998b).

Established in the mid-1950s, the primary mission of the ANL–W was to support advanced liquid metal reactor research (DOE 1996h:Idaho 4). In 1995, ANL–W began a Redirected Nuclear Research and Development Program to conduct research in the treatment of DOE spent nuclear fuel and reactor decontamination and decommissioning technologies (O'Connor et al. 1998b).

[Text deleted.]

The options proposed for lead assembly fabrication and postirradiation examination at ANL–W would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For more information on these resource areas, refer to Section 3.3. The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.2.1 Air Quality

The meteorological conditions at INEEL are considered to be representative for ANL–W. Emissions of criteria pollutants at ANL–W result from the ongoing operation of onsite boilers used to produce steam for heating. Existing ambient air pollutant concentrations at INEEL are in compliance with applicable guidelines and regulations. See Section 3.3.1 for additional information on air quality for areas surrounding INEEL.

3.6.2.2 Waste Management

ANL–W analyzes, stores, and ships TRU waste, hazardous waste, mixed waste, LLW, and nonhazardous waste generated by the numerous research and support facilities at INEEL (O'Connor et al. 1998b).

The Waste Characterization Area, in the ANL–W Hot Fuels Examination Facility, is a glovebox facility used for characterization of TRU. The Radioactive Scrap and Waste Facility, in the northeast corner of ANL–W, provides underground vault storage for remote-handled LLW, mixed LLW, and TRU waste. The Radioactive Scrap and Waste Facility is a State of Idaho RCRA-permitted facility (O'Connor et al. 1998b).

The Radioactive Sodium Storage Facility is in an ANL–W controlled access area. The Radioactive Sodium Storage Facility is a RCRA-permitted storage facility used to store radioactive and heavy metal contaminated debris along with sodium and sodium-potassium alloy mixed waste (O'Connor et al. 1998b).

The sanitary wastewater treatment facility, 6,057-m^3/yr (21,390-ft^3/yr) capacity, is the only waste treatment facility at ANL–W. Other forms of waste generated at ANL–W are treated and disposed of at INEEL waste facilities or shipped off the site (O'Connor et al. 1998b). More information on waste management activities at INEEL can be found in Section 3.3.2.

3.6.2.3 Existing Human Health Risk

See Section 3.3.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of INEEL. Site worker radiological exposure data at ANL–W for 1994–1996 is provided in Table 3–50. Worker exposure limits at ANL–W remain within applicable limits.

Table 3–50. Worker Exposure Data for ANL–W, 1994–1996

	Radiation Worker Dose		All Workers	
Year	**(mrem)**	**(person-rem)**	**(mrem)**	**(person-rem)**
1994	34	28	19	34
1995	50	41	27	43
1996	56	45	31	45

Key: ANL–W, Argonne National Laboratory–West.
Source: O'Connor et al. 1998b.

3.6.2.4 Infrastructure

The site infrastructure at ANL–W includes those utilities and other resources required to support construction and continued operation of mission-related facilities. Table 3–51 shows facility infrastructure information for the proposed facility location. An adequate infrastructure exists at ANL–W to support current activities. See Section 3.3.11 for more detailed information on INEEL's infrastructure.

3.6.3 LLNL Overview

LLNL is composed of two sites: Livermore Site and Site 300 (see Figure 2–31). The Livermore Site is about 80 km (50 mi) east of San Francisco and 6.4 km (4 mi) from downtown Livermore. It occupies about 332 ha (821 acres) of flat terrain in the Livermore Valley. Site 300 is about 24 km (15 mi) southeast of the Livermore Site (DOE 1996h:California 67; 1996i:4-328).

Table 3–51. ANL–W Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	4,200
Peak load (MWe)	5,088
Fuel	
Natural gas (m^3/yr)	0
Liquid (m^3)	0
Coal (t/yr)	0
Steam (kg/h)	690
Water	
Annual (l/yr)	1,500,000
Peak (l/yr)	2,000,000

Key: ANL–W, Argonne National Laboratory–West.
Source: O'Connor et al. 1998b:S-10.

Originally used as a naval air training station, the Livermore Site was established in 1952 to conduct nuclear weapons research. Site 300 is a remote high-explosives testing facility. The current mission of LLNL is research, testing, and development that focuses on national defense and security, energy, the environment, and biomedicine (DOE 1996h:California 69). Within recent years, LLNL's mission has broadened to include global security, ecology, and mathematics and science education. In early 1998, LLNL had about 7,700 employees (O'Connor et al. 1998c).

[Text deleted.]

The options proposed for lead assembly fabrication at LLNL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For a detailed discussion of these resource areas, refer to the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i). The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.3.1 Air Quality

The Livermore Site is in the San Francisco Bay Area Air Quality Management District. This area is designated as attainment for all criteria pollutants with respect to attainment of the NAAQS (EPA 1998b); however, EPA has recently redesignated the area as nonattainment for ozone (EPA 1998c). The emissions of criteria air pollutants at the Livermore Site result from the ongoing operation of numerous boilers for heating; solvent cleaning operations; emergency generators; and various experimental, testing, and process sources. The Bay Area Air Quality Management District and the San Joaquin Valley Unified Air Pollution Control District requested that the Livermore Site assess the impact of toxic air emissions on the surrounding area. The risks at the Livermore Site were found to be below the threshold values used to determine the need for additional evaluation (DOE 1996i:4-334). For a detailed discussion of this resource area, refer to Section 4.7.2.3 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-333).

3.6.3.2 Waste Management

LLNL was added to EPA's National Priorities List in July 1987 based on the presence of volatile organic compounds in the groundwater. In November 1988, DOE, EPA, the California Department of Health Services, and the Bay Area Regional Water Quality Control Board signed an FFCA to facilitate compliance with CERCLA, the Superfund Amendments and Reauthorization Act, and applicable State laws. In a remedial investigation/feasibility study prepared pursuant to CERCLA, DOE outlined its cleanup strategy for the LLNL Livermore Site. A ROD issued on July 15, 1992, included an announcement of DOE's decision to pump and treat contaminated groundwater and construct approximately seven small treatment facilities. The selected remedies address the principal concerns at LLNL by removing the contaminants from soil and groundwater and treating the effluents to the extent necessary for protection of human health and the environment (O'Connor et al. 1998c:3).

Through its research and operation activities, LLNL treats, stores, packages, and prepares TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes for transport. Waste is treated and stored on the site and then shipped off the site for additional treatment and disposal. No disposal of waste occurs at the Livermore Site (DOE 1996h:California 78). LLNL waste generation rates and inventories are shown in Table 3–52. Table 3–53 provides information on waste management facilities at LLNL.

Table 3–52. Waste Generation Rates and Inventories at LLNL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]	27	257
Contact-handled		
LLW	124	644
Mixed LLW[b]	353	454
Hazardous	579	NA[c]
Nonhazardous		
Liquid	456,000	NA[c]
Solid	4,280	NA[c]

[a] Includes mixed TRU waste.
[b] Includes TSCA mixed LLW.
[c] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996i:4-400 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

For a more detailed discussion of waste management activities at the Livermore Site, refer to Section 4.7.2.10 of the *Stockpile Stewardship and Management Final PEIS* (DOE 1996i:4-358) or Section 4.15.2 of the *Final EIS and Environmental Impact Report for Continued Operation of LLNL and Sandia National Laboratories, Livermore* (DOE 1992:4-239).

Table 3–53. Waste Management Facilities at LLNL

Facility Name/Description	Capacity	Status	Applicable Waste Types: TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m³/yr)							
LLW size reduction	771	Online		X			
Building 513 and 514 Waste Treatment Facility[a]	2,012	Online		X	X	X	X
Decontamination and waste treatment facility	Not determined	Planned	X	X	X	X	X
Storage facilities (m³)							
Building 233, 625	217	Online	X	X	X	X	X
Building 280	513	Online	X	X			X
Building 513, 514, area 612–2	222	Online		X	X	X	X
Area 612–1	1,086	Online	X	X	X	X	X
Area 612–4	169	Online	X	X	X	X	X
Area 612–5	760	Online	X	X	X	X	X
Area 612 tanks	57	Online		X	X	X	X
Building 612 lab packaging unit	16	Online		X	X	X	X
Building 614, 693	298	Online	X	X	X	X	X
612 yard, area 612–3	1,327	Online		X			X
Building 696	590	Online	X	X			X
Disposal facilities (m³/yr)							
LLNL sanitary sewer	2,327,800	Online					X

[a] Treatment methods employed in Building 513 are solidification and shredding. Methods used in Building 514 are evaporation, blending, separation, gas adsorption, silver recovery, and wastewater treatment (Kielusiak 1998a).

Key: Haz, hazardous; LLNL, Lawrence Livermore National Laboratory; LLW, low-level waste; TRU, transuranic.

Source: Kielusiak 1998b.

3.6.3.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of LLNL are shown in Table 3–54. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LLNL operations.

Release of radionuclides to the environment from LLNL operations provides another source of radiation exposure to the population in the vicinity. Doses to the public resulting from these releases are shown in Table 3–55. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LLNL operations in 1996 is estimated to be 4.7×10^{-8}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of LLNL operations is slightly less than 5 chances in 100 million.

Table 3–54. Sources of Radiation Exposure to Individuals in the LLNL Vicinity Unrelated to LLNL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Internal terrestrial radiation	40
Cosmic radiation	30
External terrestrial radiation	30
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Nuclear fuel cycle	<1
Total	354

Key: LLNL, Lawrence Livermore National Laboratory.
Note: Values for radon and weapons test fallout are averages for the United States.
Source: Harrach et al.:12-18.

Table 3–55. Radiation Doses to the Public From Normal LLNL Operations in 1996 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)[a]	10	0.093	4	0	100	0.093
Population within 80 km (person-rem)[b]	None	1.1	None	0	100	1.1
Average exposed individual within 80 km (mrem)[c]	None	0.000175	None	0	None	0.000175

[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; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] In 1996, this population was about 6.3 million.
[c] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Harrach et al.:12-18.

According to the same risk estimator, 5.5×10^{-4} excess fatal cancer per year is projected in the population living within 80 km (50 mi) of LLNL. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of LLNL was 13,000. This number of expected fatal cancers is much higher than the estimated 5.5×10^{-4} fatal cancer that could result from LLNL operations in 1996.

Workers at LLNL receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–56 includes average, maximally exposed, and total occupational doses to LLNL workers from operations in 1997. These doses fall within radiological limits. Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer

Table 3–56. Radiation Doses to Onsite Workers From Normal LLNL Operations in 1997 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	**Standard[a]**	**Actual**
Average radiation worker (mrem)	None[b]	2.5
Maximally exposed worker (mrem)	5,000	1,144
Total workers (person-rem)[c]	None	18.2

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] The total number of badged workers at the site in 1997 was 7,300.
Key: LLNL, Lawrence Livermore National Laboratory.
Source: Zahn 1998.

per person-rem) among workers (see Appendix F), the number of excess fatal cancers to LLNL workers from normal operations in 1997 is estimated to be 0.0073.

More detailed information of the radiation environment, including background exposures and radiological releases and doses, is presented in the *LLNL Environmental Report for 1996* (Harrach et al. 1997). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.3.4 Infrastructure

A summary of the infrastructure characteristics of LLNL is presented in Table 3–57. An adequate infrastructure exists at LLNL to support current activities.

Table 3–57. LLNL Infrastructure Characteristics

Resource	Current Usage[a]	Site Capacity
Electricity		
Energy consumption (MWh/yr)	295,919	100 MW peak
Fuel		
Natural gas (m^3/yr)	13,017,173	4,400 m^3/hr peak
Liquid (l/yr)	1,257,699	NA[b]
Coal (t/yr)	0	0
Water		
Annual (l/yr)	874,138,983	10,977,660 l/day peak

[a] Five-year average for FY93–97.
[b] As supplies get low, more can be supplied by truck.
Key: LLNL, Lawrence Livermore National Laboratory; NA, not applicable.
Source: O'Connor et al. 1998c.

3.6.4 LANL Overview

LANL occupies 11,300 ha (28,000 acres) of land in northern New Mexico (see Figure 2–29). Situated on the Pajarito plateau in the Jemez mountains, the closest population centers are the city of Los Alamos (population 12,000) and White Rock (population 8,000). The closest metropolitan area is Santa Fe (population 50,000), about 40 km (25 mi) southeast of LANL. In 1997, LANL had about 9,200 workers (DOE 1996a:3-304).

The laboratory was established in 1943 to design, develop, and test nuclear weapons. LANL's mission has expanded from the primary task of designing nuclear weapons to include nonnuclear defense programs and a broad array of nondefense programs. Current programs include R&D of nuclear safeguards and security, space nuclear systems, biomedicine, computational science, and lasers (DOE 1996a:3-304). LANL consists primarily of Technical Areas (TAs), of which 49 are actively in use (DOE 1997g:1).

[Text deleted.]

The options proposed for lead assembly fabrication at LANL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For more information on these resource areas, refer to the *Storage and Disposition PEIS* (DOE 1996a). The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.4.1 Air Quality

LANL is within the New Mexico Intrastate AQCR 157. None of the areas within LANL and its surrounding communities are designated as nonattainment areas with respect to any of the NAAQS (EPA 1997h). The criteria pollutants, nitrogen dioxide, carbon monoxide, volatile organic hydrocarbons, particulate matter, and sulphur dioxide make up about 79 percent of the stationary source emissions at LANL. The sources of these criteria pollutants are power plants, steam plants, asphalt plants, and space heaters. Toxic and other hazardous pollutants comprise the remaining 21 percent of emissions from stationary sources at LANL. These emissions are generated by equipment cleaning, coating processes, and acid baths. Concentrations of criteria and hazardous and toxic air pollutants are in compliance with applicable guidelines and regulations (DOE 1996a:3-310). For a detailed discussion of this resource area, refer to Section 3.9.3 of the *Storage and Disposition PEIS* (DOE 1996a:3–310).

3.6.4.2 Waste Management

Although not listed on the National Priorities List, LANL adheres to the CERCLA guidelines for environmental restoration projects that involve certain hazardous substances not covered by RCRA. LANL's environmental restoration program originally consisted of approximately 2,100 potential release sites. At the end of FY97, there remained only about 756 sites requiring investigation or remediation and 118 buildings awaiting decontamination and decommissioning. LANL's environmental restoration program is scheduled for completion in 2006 (LANL 1998:21).

Through its research and operation activities, LANL manages the following waste categories generated at 33 technical areas: TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes (DOE 1996h:New Mexico 38; 1996i:4-272). LANL waste generation rates and inventories are presented in Table 3–58.

Table 3–58. Waste Generation Rates and Inventories at LANL

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[a]		
Contact-handled	262	11,262
LLW	1,585	NA[c]
Mixed LLW[b]	90	6,801
Hazardous	942	NA[c]
Nonhazardous		
Liquid	692,857	
Solid	5,453	NA[c]

[a] Includes mixed TRU waste.
[b] Includes TSCA mixed LLW.
[c] Generally, LLW, hazardous, and nonhazardous wastes are not held in long-term storage.

Key: LANL, Los Alamos National Laboratory; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996a:3-339 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

LANL currently stores TRU waste on the site pending shipment to WIPP for disposal. The site also treats and disposes of LLW on the site. Mixed LLW is stored on the site pending treatment at a combination of onsite and offsite facilities. Hazardous waste is treated and stored on the site for offsite disposal. Nonhazardous solid wastes are shipped off the site for treatment and disposal. Nonhazardous liquid wastes are treated and disposed of on the site (DOE 1996a:3-337, 3-340, 3-341). See Table 3–59 for information on selected treatment, storage, and disposal facilities at LANL.

Table 3–59. Selected Waste Management Facilities at LANL

Facility Name/Description	Capacity	Status	Applicable Waste Types: TRU	Mixed TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m^3/yr)								
TRU waste volume reduction	1,080	Online	X	X				
RAMROD & RANT facilities	1,050	Online	X	X				
LLW compaction	76	Online			X			
Sanitary Wastewater Treatment Plant	1,060,063	Online						X
Storage facilities (m^3)								
TA–54 TRU waste storage	24,355	Online	X	X				
LLW storage	663	Online			X			
Mixed LLW storage	583	Online				X		
Hazardous waste storage	1,864	Online					X	
Disposal facilities (m^3)								
TA–54 Area G LLW Disposal	252,500[a]	Online			X			
Sanitary tile fields (m^3/yr)	567,750	Online						X

[a] Current inventory of 250,000 m^3 (8.8 million ft^3), therefore, capacity will be exhausted in the next 2 to 5 years (O'Connor et al. 1998d). The *LANL Site-Wide Final EIS* (DOE 1999b) evaluates alternatives for LLW disposal.

Key: Haz, hazardous; LANL, Los Alamos National Laboratory; LLW, low-level waste; RAMROD, Radioactive Materials Research, Operations, and Demonstration; RANT, Radioactive Assay and Nondestructive Test; TRU, transuranic.

Source: DOE 1996a:3-337–3-341; Triay 1999.

For a more detailed description of this resource area, see Section 3.9.10 of the *Storage and Disposition PEIS* (DOE 1996a), or Sections 2.2.2.14 and 2.2.2.15 of the *Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory* (DOE 1999b).

3.6.4.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of LANL are shown in Table 3–60. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to LANL operations (DOE 1996a:3-334).

Table 3–60. Sources of Radiation Exposure to Individuals in the LANL Vicinity Unrelated to LANL Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic radiation	48
External terrestrial radiation	44
Neutron cosmic radiation	10
Internal terrestrial	40
Radon in homes (inhaled)	200
Other background radiation	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	407

Key: LANL, Los Alamos National Laboratory.
Note: Value for radon is an average for the United States.
Source: DOE 1996a:3-333.

Release of radionuclides to the environment from LANL operations provides another source of radiation exposure to the population in the vicinity. The doses to the public resulting from these releases are shown in Table 3–61. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from LANL operations in 1995 is estimated to be 2.9×10^{-6}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of LANL operations is about three chances in one million (DOE 1998g:3-77).

According to the same risk estimator, 1.6×10^{-3} excess fatal cancer per year is projected in the population living within 80 km (50 mi) of LANL in 1995. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1995 in the population living within 80 km (50 mi) of LANL was 482. This number of expected fatal cancers is much higher than the estimated 1.6×10^{-3} fatal cancers that could result from LANL operations in 1995 (DOE 1998g:3-77).

Table 3–61. Radiation Doses to the Public From Normal LANL Operations in 1995 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual[b]	Standard[a]	Actual[b]
Maximally exposed individual (mrem)	10	5.1	4	0.58	100	5.7
Population within 80 km (person-rem)[c]	None	3.2	None	Negligible	100	3.2
Average individual within 80 km (mrem)[d]	None	0.013	None	Negligible	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 from airborne emissions is required by the Clean Air Act. The 4-mrem/yr limit is required by the Safe Drinking Water Act; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] Actual dose values given in this column conservatively include all water pathways, not just drinking water.
[c] In 1995, this population was about 241,000.
[d] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1998g:3-77.

Workers at LANL receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–62 includes average, maximally exposed, and total occupational doses to LANL workers from operations in 1991–1995. Based on a risk estimator of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers (see Appendix F), the average annual number of fatal cancers to LANL workers from normal operations during the 1991–1995 timeframe is estimated to be 0.066 (DOE 1998g:3-77).

Table 3–62. Radiation Doses to Onsite Workers From Normal Operations at LANL, 1991–1995 (Total Effective Dose Equivalent)

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

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] Annual doses are averaged over the 5-year period.
[c] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
Key: LANL, Los Alamos National Laboratory.
Source: DOE 1998g:3-77.

More detailed information of the radiation environment at LANL is presented in *Environmental Surveillance at Los Alamos During 1995* (UC 1996). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the same reference.

3.6.4.4 Infrastructure

A summary of the infrastructure characteristics of LANL is presented in Table 3–63. An adequate infrastructure exists at LANL to support current activities.

Table 3–63. LANL Infrastructure Characteristics

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	372,145
Fuel	
Natural gas (m^3/yr)	43,414,560
Fuel oil (l/yr)	0
Steam (kg/h)	33,554
Water	
Annual (l/yr)[a]	5,490,000,000

[a] In 1994, LANL's water system had an annual demand of 80 percent of its current allotment of 6,830 million l/yr (1,804 million gal/yr) (DOE 1999b:4-182). Demand includes use by Los Alamos County and National Park Service. LANL alone used 1,843 million l (approximately 487 million gal).

Key: LANL, Los Alamos National Laboratory.

Source: DOE 1996a:3-308, 1999b:4-181, 4-182.

3.6.5 SRS Overview

SRS occupies about 806 km^2 (310 mi^2) in the southern portion of South Carolina, about 19 km (12 mi) south of Aiken, South Carolina (see Figure 2–5) (DOE 1996a:3-228). Additional information on SRS is presented in Section 3.5.

[Text deleted.]

The options proposed for lead assembly fabrication at SRS would use existing employees and buildings; therefore, major facility modifications would not be required. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. The resource areas that could be impacted by lead assembly fabrication activities are air quality, waste management, existing human health risk, and infrastructure. These resource areas are described below.

3.6.5.1 Air Quality

The meteorological conditions at H-Area are considered to be representative for SRS. Existing ambient air pollutant concentrations at SRS are in compliance with applicable guidelines and regulations. See Section 3.5.1 for additional information on air quality for areas surrounding SRS.

3.6.5.2 Waste Management

TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes are generated by R&D, production, and decontamination activities in H-Area. These wastes are managed at SRS facilities and at offsite locations, as appropriate. The total quantities of waste generated and the inventories in storage at SRS are presented in

Section 3.5.2. Three of the major waste management facilities located in H-Area are described below. Additional SRS waste management facilities are described in Section 3.5.2.

The Consolidated Incineration Facility is designed to incinerate solid and liquid LLW, mixed LLW, and hazardous waste. This H-Area facility has a capacity of 4,630 m^3/yr (6,056 yd^3/yr) of liquid waste and 17,830 m^3/yr (23,322 yd^3/yr) of solid waste (DOE 1996a:E-109).

Liquid LLW and mixed LLW generated in H-Area are conveyed to the F- and H-Area Effluent Treatment Facility for treatment. This facility has a capacity of 1,930,000 m^3/yr (2,524,000 yd^3/yr). Treated effluents are discharged to Upper Three Runs Creek in compliance with permit limits. Treatment residuals are concentrated by evaporation and stored in the H-Area tank farm for eventual treatment in the Z-Area Saltstone Facility. In that facility, wastes are immobilized with grout for onsite disposal (DOE 1996a:E-98, E-109).

Sanitary wastewater from H-Area is conveyed to the Central Sanitary Wastewater Treatment Facility for treatment and disposal. The H-Area sanitary sewer has a capacity of 136,274 m^3/yr (178,246 yd^3/yr) (O'Connor et al. 1998e), and the Central Sanitary Wastewater Treatment Facility has a capacity of 1,030,000 m^3/yr (1,347,000 yd^3/yr) (Sessions 1997a). More information on waste management activities at SRS is presented in Section 3.5.2.

3.6.5.3 Existing Human Health Risk

See Section 3.5.4 for major sources and levels of background radiation, mean concentrations of radiological releases, and offsite estimated dose rates to individuals within the vicinity of SRS.

3.6.5.4 Infrastructure

The site infrastructure at Building 221–H includes those utilities and other resources required to conduct mission-related activities. A summary of the infrastructure characteristics at Building 221–H is presented in Table 3–64. An adequate infrastructure exists at this facility to support current activities. See Section 3.5.11 for more detailed information on the infrastructure at SRS.

Table 3–64. Infrastructure Characteristics of Building 221–H at SRS

Resource	Current Usage
Electricity	
Energy consumption (MWh/yr)	120,000
Fuel	
Natural gas (m^3/yr)	NA
Fuel oil (l/yr)	NA
Coal (t/yr)	0
Water (l/yr)	380,000,0000

Key: NA, not applicable.
Source: O'Connor et al. 1998e.

3.6.6 ORR Overview

ORR, established in 1943 as one of the three original Manhattan Project sites, occupies about 13,974 ha (34,516 acres) west of Knoxville, Tennessee, in and around the city of Oak Ridge, Tennessee (DOE 1999g:S-9). ORR is composed of three separate operations areas: East Tennessee Technology Park (ETTP), ORNL, and Y–12. ETTP serves as an operations center for ORR's environmental restoration and waste management programs. Y–12 engages in national security activities and manufacturing outreach to U.S. industries.

ORNL is one of the country's largest multidisciplinary laboratories and research facilities. Its primary mission is to perform leading-edge nonweapons R&D in energy, health, and the environment. Other missions include production of radioactive and stable isotopes not available from other production sources; fundamental research in a variety of sciences; research involving hazardous and radioactive materials; and radioactive waste disposal. The facilities that would be used for postirradiation examination are located at ORNL.

The options proposed for postirradiation examination at ORNL would occur in existing facilities that would not require major modifications and would use existing employees. For this reason, detailed descriptions of environmental resources such as geology and soils, water, ecological, cultural and paleontological, land use and visual, socioeconomics, and environmental justice are not provided. For a detailed discussion of these resource areas, refer to the *Storage and Disposition PEIS* (DOE 1996a) and the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g). The resource areas that are discussed include air quality, waste management, existing human health risk; and infrastructure.

3.6.6.1 Air Quality

ORR is in the Eastern Tennessee and Southwestern Virginia Interstate AQCR (DOE 1996a:3-192). This area is designated as attainment for all criteria pollutants with respect to the NAAQS (DOE 1999g:4-17). The primary sources of criteria air pollutants at ORR are the steam plants at ETTP, ORNL, and Y–12. Other emissions sources include the Toxic Substances Control Act incinerator, various process sources, vehicles, temporary emissions from construction activities, and fugitive particulate emissions from coal piles (DOE 1996a:3-192). For a detailed discussion of this resource area, refer to Section 4.1.3 of the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g:4-14).

3.6.6.2 Waste Management

ORR was added to EPA's National Priorities List on November 21, 1989. In January 1, 1992, DOE, EPA, and the Tennessee Department of Environmental Conservation signed an FFCA to facilitate compliance with RCRA and applicable State laws. This agreement coordinates ORR inactive site assessment and remedial actions. In addition, portions of the FFCA are applicable to operating waste management systems (DOE 1996a:3-219).

Through its research and operation activities, ORR treats, stores, packages, and prepares for transport TRU, low-level, mixed low-level, hazardous, and nonhazardous wastes and spent nuclear fuel. Most waste is treated and stored on the site and then shipped off the site for additional treatment and disposal (DOE 1996a:3-219–3-227). ORR waste generation rates and inventories are shown in Table 3–65. Table 3–66 provides information on waste management facilities at ORR. For a more detailed discussion of waste management activities at ORR, refer to Sections 3.6.10 and E.2.5 of the *Storage and Disposition PEIS* (DOE 1996a:3-219, E-63).

Table 3–65. Waste Generation Rates and Inventories at ORR[a]

Waste Type	Generation Rate (m^3/yr)	Inventory (m^3)
TRU[b]		
Contact-handled	9	1,339
LLW	5,181	18,414
Mixed LLW [c]	1,122	48,763
Hazardous	34,048	NA [d]
Nonhazardous		
Liquid	2,406,300	NA [d]
Solid	49,470	NA [d]

[a] Includes ETTP, ORNL, and Y–12.
[b] Includes mixed TRU waste.
[c] Includes TSCA mixed LLW.
[d] Generally, hazardous and nonhazardous wastes are not held in long-term storage.

Key: ETTP, East Tennessee Technology Park; ORNL, Oak Ridge National Laboratory; ORR, Oak Ridge Reservation; LLW, low-level waste; NA, not applicable; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996a:3-220–3-225 for hazardous and nonhazardous waste; DOE 1996d:15, 16 for all other wastes.

Table 3–66. Selected Waste Management Facilities at ORR

Facility Name/Description	Capacity	Status	Applicable Waste Types: TRU	LLW	Mixed LLW	Haz	Non-Haz
Treatment facilities (m^3/yr)							
TRU Waste Treatment Plant (ORNL)	620	Planned for 2001	X				
Waste Compactor Facility (ORNL)	11,300	Online		X			
TSCA Incinerator (ETTP)	15,700	Online			X	X	
Bldg K–1203 Sewage Treatment Plant	829,000	Online					X
Oak Ridge Sewage Treatment Plant	1,934,500	Online					X
Sanitary Wastewater Treatment Facility (ORNL)	414,000	Online					X
Storage facilities (m^3)							
TRU Waste Storage (ORNL)	1,760	Online	X				
LLW Storage (ETTP and ORNL)	51,850	Online		X			
Mixed Waste Storage (ETTP, ORNL, and Y–12)	231,753	Online			X		
Hazardous Waste Storage (ORNL and Y–12)	1,051	Online				X	
Disposal facilities (m^3)							
Industrial & sanitary landfill (Y–12)	1,100,000	Online					X

Key: ETTP, East Tennessee Technology Park; Haz, hazardous; ORNL, Oak Ridge National Laboratory; ORR, Oak Ridge Reservation; LLW, low-level waste; TRU, transuranic; TSCA, Toxic Substances Control Act.

Source: DOE 1996a:3-219–3-225, E-78–E-95.

3.6.6.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of ORR are shown in Table 3–67. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to ORR operations.

Table 3–67. Sources of Radiation Exposure to Individuals in the ORR Vicinity Unrelated to ORR Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation [a]	
Internal terrestrial radiation	40
Cosmic radiation	27
External terrestrial radiation	28
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	360

[a] Hamilton et al. 1998.
[b] NCRP 1987.
Key: ORR, Oak Ridge Reservation.
Note: Value for radon is an average for the United States.

Release of radionuclides to the environment from ORR operations provides another source of radiation exposure to the population in the vicinity. Doses to the public resulting from these releases are shown in Table 3–68. These doses fall within regulatory limits (DOE 1993a) and are small when compared with background radiation exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from ORR operations in 1997 is estimated to be $1.4\text{x}10^{-6}$. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of ORR operations is slightly more than one chance in one million.

According to the same risk estimator, 0.0079 excess fatal cancer per year is projected in the population living within 80 km (50 mi) of ORR. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year. Based on this national rate, the number of fatal cancers from all causes expected during 1996 in the population living within 80 km (50 mi) of ORR was 1,760. This number of expected fatal cancers is much higher than the estimated 0.0079 fatal cancers that could result from ORR operations in 1997.

Table 3–68. Radiation Doses to the Public From Normal ORR Operations in 1997 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	10	0.41	4	1.4 [b]	100	2.8 [c]
Population within 80 km (person-rem)[d]	None	10.0	None	5.7	100	15.7
Average exposed individual within 80 km (mrem)[e]	None	0.011	None	0.0065	None	0.018

[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; for this SPD EIS, the 4-mrem/yr value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 mrem/yr is the limit from all combined pathways. The 100-person-rem value for the population is given in proposed 10 CFR 834 (DOE 1993b).
[b] These doses are mainly from drinking water and eating fish from the Clinch River section of Poplar Creek.
[c] This total dose includes a conservative value of 1 mrem/yr from direct radiation exposure to a cesium field near the Clinch River.
[d] In 1997, this population was about 880,000.
[e] Obtained by dividing the population dose by the number of people living within 80 km (50 mi) of the site.
Key: ORR, Oak Ridge Reservation.
Source: Hamilton et al. 1998.

Workers at ORR receive the same dose as the general public from background radiation; however, they receive an additional dose from normal operations. Table 3–69 includes average, maximally exposed, and total occupational doses to ORR workers from operations in 1997. These doses fall within radiological limits. Based on a dose-to-risk conversion factor of 400 fatal cancers per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers (see Appendix F), the number of excess fatal cancers to ORR workers from normal operations in 1997 is estimated to be 0.031.

Table 3–69. Radiation Doses to Onsite Workers From Normal ORR Operations in 1997 (Total Effective Dose Equivalent)

	Onsite Releases and Direct Radiation	
Occupational Personnel	Standard[a]	Actual
Average radiation worker (mrem)	None[b]	48
Total workers (person-rem)[c]	None	78

[a] The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995a:para. 835.202); however, DOE's goal is to maintain radiological exposures as low as is reasonably achievable. Therefore, DOE has established an administrative control level of 2,000 mrem/yr (DOE 1994a:2-3); DOE must make reasonable attempts to maintain worker doses below this level.
[b] No standard is specified for an "average radiation worker"; however, the maximum dose that this worker may receive is limited to that given in footnote "a."
[c] The total number of badged workers at the site in 1997 was 1,614.
Key: ORR, Oak Ridge Reservation.
Source: DOE 1999h.

More detailed information of the radiation environment, including background exposures and radiological releases and doses, is presented in the *ORR Annual Site Environmental Report for 1997* (Hamilton et al. 1998), and Section 4.1.9.1 of the *Final EIS, Construction and Operation of the Spallation Neutron Source*

(DOE 1999g:4-60). Concentrations of radioactivity in various environmental media (e.g., air and water) and animal tissues in the site region are also presented in the *ORR Annual Site Environmental Report for 1997.*

3.6.6.4 Infrastructure

A summary of the infrastructure characteristics of ORR is presented in Table 3–70. An adequate infrastructure exists at ORR to support current activities. For a more detailed discussion of the site infrastructure, refer to Section 4.2.10.2 of the *Final EIS, Construction and Operation of the Spallation Neutron Source* (DOE 1999g:4-144), and Sections 3.6.2 and 3.6.4 of the *Storage and Disposition PEIS* (DOE 1996a:3-190,3-194).

Table 3–70. ORR Infrastructure Characteristics

Resource	Current Usage[a]	Site Capacity
Electricity		
Energy consumption (MWh/yr)	726,000	13,880,000
Fuel		
Natural gas (m^3/yr)	95,000,000	250,760,000
Liquid (l/yr)	416,000	416,000 [a]
Coal (t/yr)	16,300	16,300 [a]
Water		
Annual (l/yr)	14,210,000,000	44,347,500,000

[a] As supplies get low, more can be supplied by truck.
Key: ORR, Oak Ridge Reservation.
Source: DOE 1996a:3-190, 3-194.

3.7 REACTOR SITES FOR MOX FUEL IRRADIATION

3.7.1 Catawba Units 1 and 2 Site Overview

The Catawba nuclear power plant occupies 158 ha (391 acres) in York County, South Carolina, 9.3 km (5.8 mi) north-northwest of Rock Hill, South Carolina, and 16.9 km (10.5 mi) west-southwest of Charlotte, North Carolina (see Figure 3–34). The site is on a peninsula bounded by Beaver Dam Creek to the north, Big Allison Creek to the south, Lake Wylie to the east, and private property to the west (Duke Power 1997:2-3). Lake Wylie has a surface area of 5,040 ha (12,455 acres), a shoreline of approximately 523 km (325 mi), and a volume of 3.46×10^8 m^3 (281,900 acre-ft). The towns of Mount Holly and Belmont, North Carolina, take their raw water supplies from Lake Wylie. The communities of Chester, Fort Lawn, Fort Mill, Great Falls, Lancaster, Mitford, Riverview, and Rock Hill, South Carolina, obtain at least a portion of their municipal water supplies from the Catawba River within 80 km (50 mi) downstream from the site (Duke Power 1997:2-41, table 2-52).

In 1997, the plant employed 1,232 persons (DOE 1999f). The Catawba reactors are operated by Duke Power Company. The operating licenses (Nos. NPF–35 and NPF–52) for Units 1 and 2 were granted in 1985 and 1986 and expire in 2024 and 2026, respectively (NRC 1997). The population within an 80-km (50-mi) radius of these reactors is estimated to be 1,656,093 (Duke Power 1997:table 2-13).

Reactor cooling is accomplished using mechanical draft cooling towers, with water obtained from Lake Wylie (Duke Power 1997). During normal operations of Catawba, cooling water is pumped from the Beaver Dam Creek arm of Lake Wylie at a rate of 266,680 million l/yr (70,450 million gal/yr) and returned to Big Allison Creek at a rate of 172,902 million l/yr (45,676 million gal/yr). The net difference in water (93,779 million l/yr [24,774 million gal/yr]) is due to evaporation in the cooling towers (DOE 1999f).

New (unirradiated) fuel assemblies are dry stored in racks located in the two New Fuel Storage Buildings. Each New Fuel Storage Building is designed to accommodate 98 fuel assemblies (a total of 196 assemblies). Spent (irradiated) fuel assemblies are stored in two spent fuel pools in the two fuel buildings. The spent fuel storage pools have a total capacity of 2,836 assemblies (Duke Power 1997:9-3–9-6). Security at the site is provided in accordance with U.S. Nuclear Regulatory Commission (NRC) regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–413 and 50–414.

3.7.1.1 Air Quality

Catawba is within the Metropolitan Charlotte, North Carolina, AQCR #167. None of the areas within the site or York County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998d).

Sources of criteria air pollutants from Catawba include five emergency diesel generators, a safe shutdown facility generator, and miscellaneous equipment such as trucks and forklifts. Table 3–71 provides a summary of criteria pollutant concentrations from operations of Catawba. The concentrations resulting from operations are well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

3.7.1.2 Waste Management

Table 3–72 presents the 5-year average annual waste generation rates for Catawba.

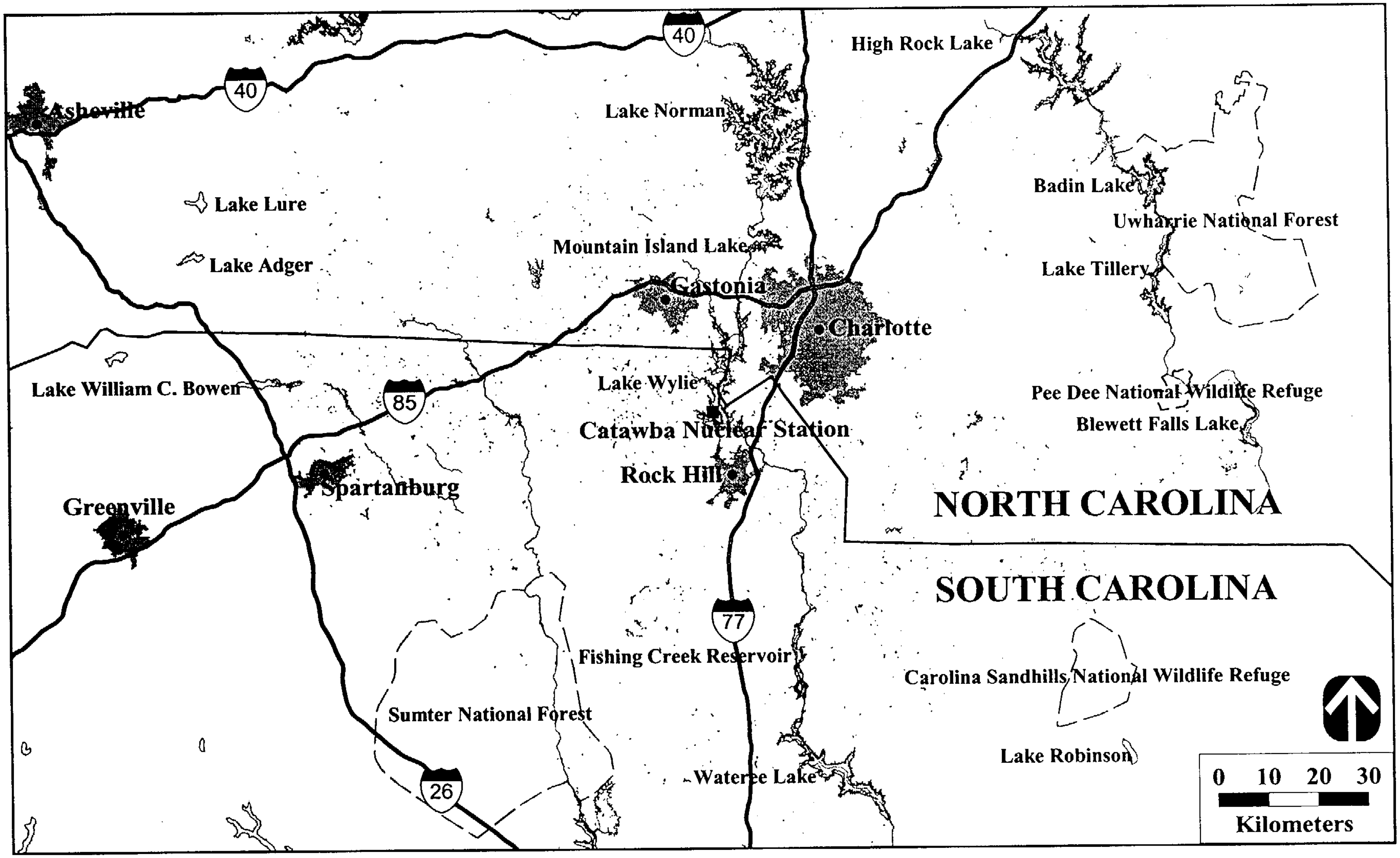


Figure 3–34. Catawba Nuclear Power Plant, South Carolina

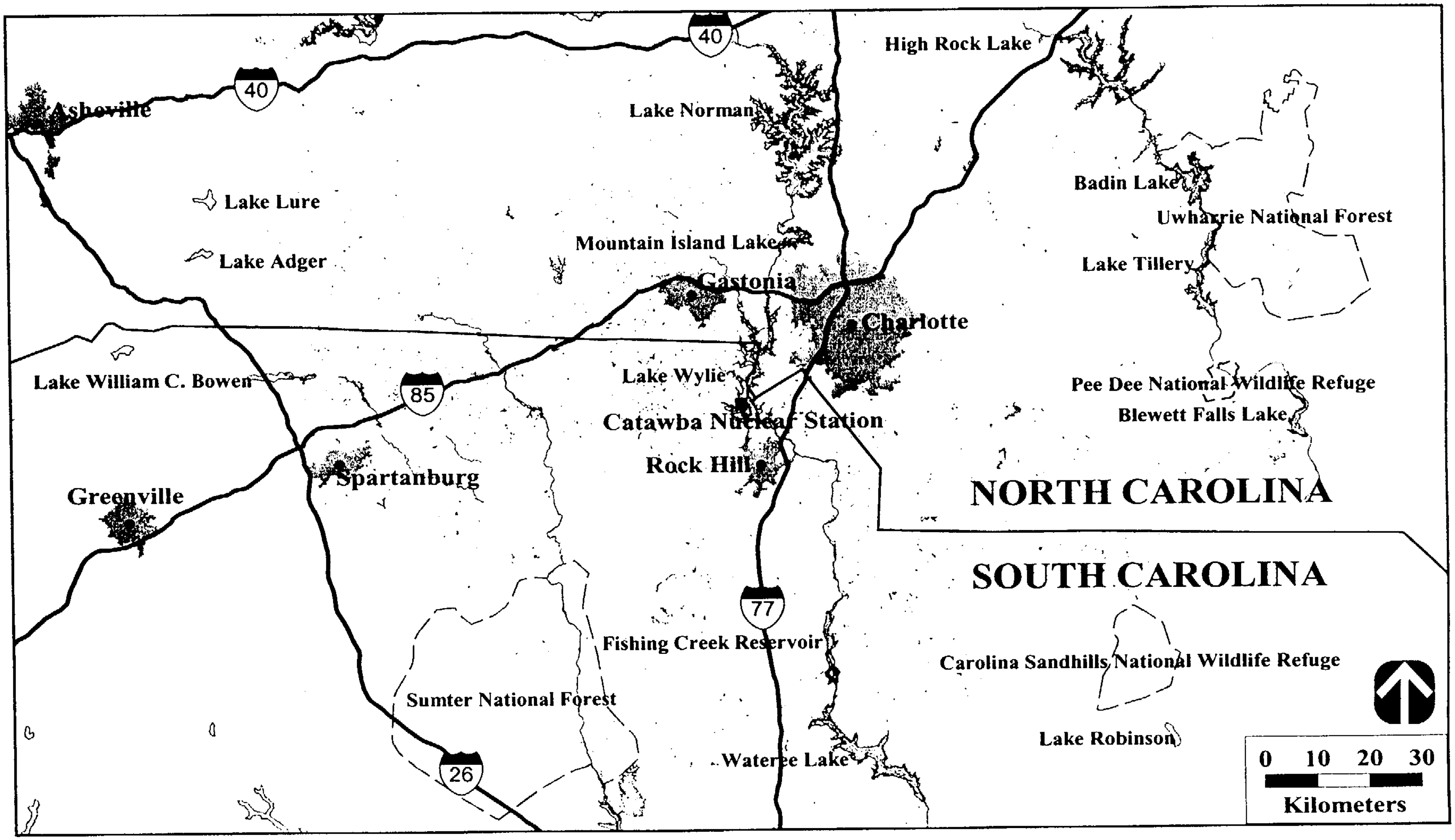


Figure 3–34. Catawba Nuclear Power Plant, South Carolina

Table 3–71. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From Catawba Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS (g/m^3)	Catawba (g/m^3)
Carbon monoxide	8 hours	10,000	978
	1 hour	40,000	1,400
Nitrogen dioxide	Annual	100	3.26
PM_{10}	Annual	50	0.102
	24 hours	150	65.9
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0418
	24 hours	365	26.9
	3 hours	1,300	60.4

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1994–1995 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

Table 3–72. Annual Waste Generation for Catawba (m^3)

Waste Type	Generation Rate
LLW	50
Mixed LLW	0.6[a]
Hazardous waste	29[a]
Nonhazardous waste	
Liquid	60,794[b]
Solid	455[a]

[a] Values converted from kilograms assuming a waste density such that 1 m^3 = 1,000 kg.
[b] Assuming sanitary wastewater is generated at the same rate 365 days per year.
Key: LLW, low-level waste.
Source: DOE 1999f.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the steam generator blowdown system, ventilation unit condensate system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, and laundry drains. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the National Pollutant Discharge Elimination System (NPDES) permit. If liquids are determined to be radioactively contaminated, they are treated by filtration, evaporation, or mixing and settling, or are sent to the demineralizers, before being discharged. Continuous radiation monitoring is provided for treated liquid waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Duke Power 1997:11-9–11-27).

Table 3–74. Radiological Impacts on the Public From Catawba Operations in 1997 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	5	0.045	3	0.11	25	0.16
Population within 80 km (person-rem)[b]	NA	4.0	NA	4.3	NA	8.3

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for the maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.
[b] Population used: 1,656,093; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997.
Key: NA, not applicable.
Source: DOE 1999f; Duke Power 1997:tables 2-13, 11-12, and 11-15.

probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about 1 chance in 13 million.

According to the same risk estimator, 0.0042 excess fatal cancer is projected among the population living within 80 km (50 mi) of Catawba in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of Catawba was about 3,300. This number of expected fatal cancers is much higher than the estimated 0.0042 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public; however, they receive an additional dose from normal operations of the reactors. Table 3–75 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.11.

Table 3–75. Radiological Impacts on Involved Workers From Catawba Operations in 1997

Number of badged workers[a]	3,420
Total dose (person-rem/yr)	265
Annual latent fatal cancers	0.11
Average worker dose (mrem/yr)	78
Annual risk of latent fatal cancer	3.1×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999f.

3.7.1.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of Catawba, the potentially affected area includes parts of North Carolina and South Carolina.

The potentially affected area around Catawba is defined by a circle with an 80-km (50-mi) radius centered at these reactors (lat. 35°03′05″ N, long. 81°04′10″ W). The total population residing within that area in 1990 was 1,519,392. The proportion of the population that was considered minority was 20.7 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages of the States of North Carolina and South Carolina were 25.0 and 31.5, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 19.0 percent of the total population. Asians and Hispanics contributed about 0.7 percent, and Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 159,956 persons (10.5 percent of the total population) residing within the potentially affected area around Catawba reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold and that the figures for North Carolina and South Carolina were 13.0 and 15.4 percent, respectively (DOC 1992).

3.7.2 McGuire Units 1 and 2 Site Overview

The McGuire nuclear power plant occupies 280 ha (700 acres) in northwestern Mecklenburg County, North Carolina, 27.4 km (17 mi) northwest of Charlotte, North Carolina (see Figure 3–35). The site is bounded to the west by the Catawba River and to the north by Lake Norman. Surrounding land is generally rural nonfarmland. Lake Norman, with a surface area of 13,156 ha (32,510 acres), a volume of 1,349 million m^3 (1,093,600 acre-ft) and a shoreline of 837 km (520 mi), stretches 54.7 km (34 mi) from Cowans Ford Dam to the tailrace of Lookout Lake. The Charlotte municipal water intake is 18 km (11.2 mi) downstream from the site (Duke Power 1996:2-3, 2-27, 2-28; Nesbit 1999; Ritchey 1996). In addition, the communities of Belmont, Gastonia, and Mount Holly, North Carolina, and Chester, Fort Lawn, Fort Mill, Lancaster, Mitford, Riverview, and Rock Hill, South Carolina, obtain at least a portion of their municipal water supplies from the Catawba River within 80 km (50 mi) downstream from the site (Duke Power 1997:2-41, table 2-52).

In 1997, the plant employed 1,238 persons (DOE 1999f). The McGuire reactors are operated by Duke Power Company. The operating licenses (Nos. NPF–9 and NPF–17) for these reactors were granted in 1981 and 1983, and expire in 2021 and 2023, respectively (NRC 1997). The population within an 80-km (50-mi) radius of these reactors is estimated to be 2,140,720 (Duke Power 1996:table 2-1). Reactor cooling is accomplished using a once-through cooling system. Cooling water is withdrawn from Lake Norman at a rate of 7,025,937 million l/yr (1,856,062 million gal/yr) and discharged back into Lake Norman at a rate of 6,966,567 million l/yr (1,840,378 million gal/yr). The net difference in water (59,370 million l/yr [15,684 million gal/yr]) is due to evaporation (DOE 1999f).

New (unirradiated) fuel assemblies are dry stored in racks located in the two New Fuel Storage Vaults. Each New Fuel Storage Vault is designed to accommodate 96 fuel assemblies (a total of 192 assemblies). Spent (irradiated) fuel assemblies are stored in two spent fuel pools in the two Auxiliary Buildings. The two spent fuel storage pools have a total capacity of 2,926 assemblies. New fuel can also be stored in the spent fuel pools (Duke Power 1996:9-3–9-8). Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–369 and 50–370.

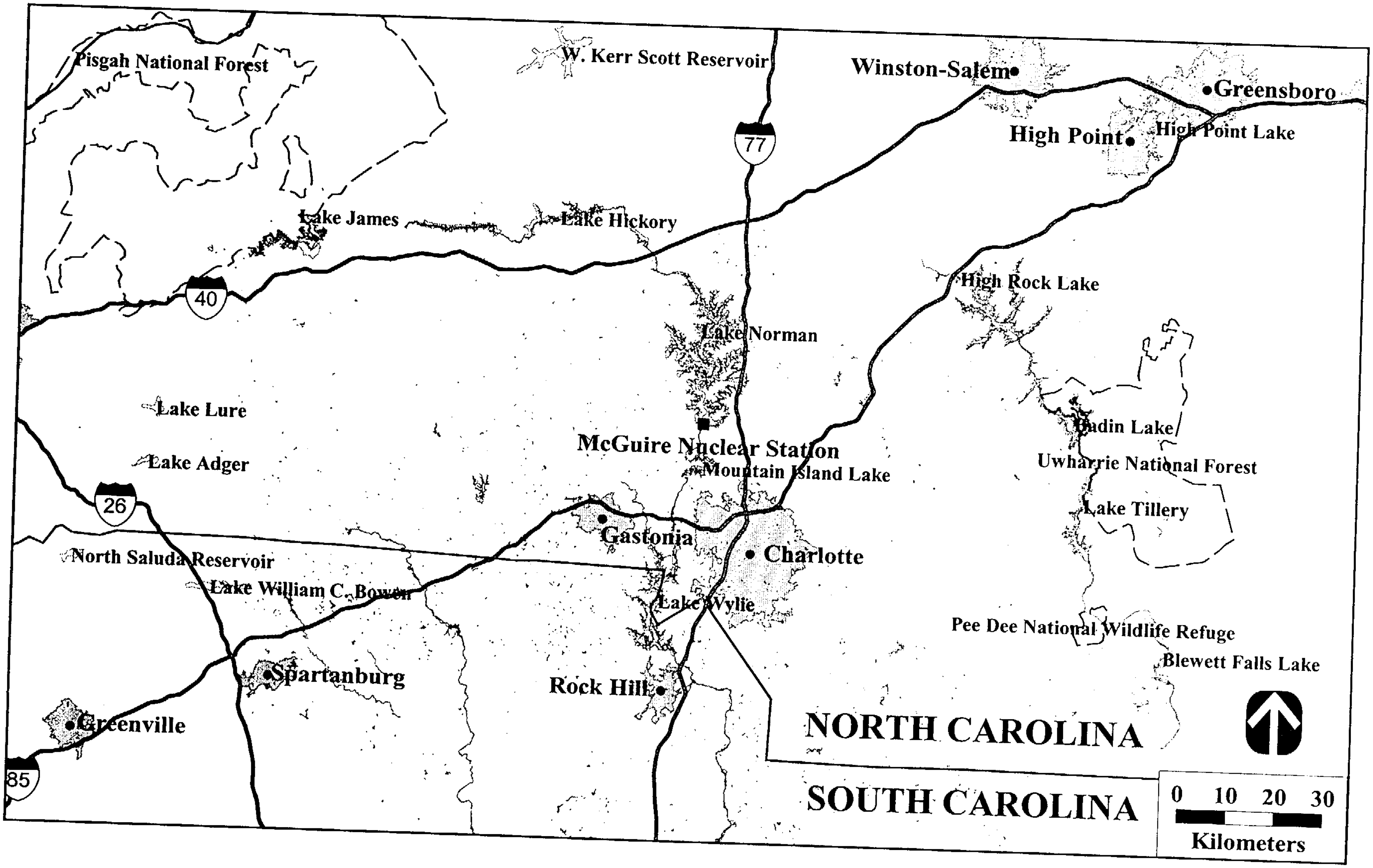


Figure 3–35. McGuire Nuclear Power Plant, North Carolina

3.7.2.1 Air Quality

McGuire is within the Metropolitan Charlotte AQCR #167. None of the areas within the site or Mecklenberg County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998e).

Sources of criteria air pollutants from McGuire include five emergency diesel generators, a safe shutdown facility generator, and miscellaneous equipment such as trucks and forklifts. Table 3–76 provides a summary of criteria pollutant concentrations from operations of McGuire. The concentrations resulting from operations are well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

Table 3–76. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From McGuire Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS ($\mu g/m^3$)	McGuire ($\mu g/m^3$)
Carbon monoxide	8 hours	10,000	1,060
	1 hour	40,000	1,510
Nitrogen dioxide	Annual	100	2.55
PM_{10}	Annual	50	0.0799
	24 hours	150	71.2
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0336
	24 hours	365	29.9
	3 hours	1,300	67.4

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1994–1997 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

3.7.2.2 Waste Management

Table 3–77 presents the 5-year average annual waste generation rates for McGuire.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the steam generator blowdown system, ventilation unit condensate system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, and laundry drains. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the NPDES permit. If liquids are determined to be radioactively contaminated, they are treated by filtration, evaporation, or mixing and settling, or are sent to the demineralizers, before being discharged. Continuous radiation monitoring is provided for treated waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Duke Power 1996:11-9–11-26).

Table 3–77. Annual Waste Generation for McGuire (m^3)

Waste Type	Generation Rate
LLW	42.2
Mixed LLW	0.19[a]
Hazardous waste	28.6[a]
Nonhazardous waste	
Liquid	49,740[b]
Solid	568[a]

[a] Values converted from kilograms assuming a waste density such that 1 m^3 = 1,000 kg.
[b] Assuming sanitary wastewater is generated at the same rate 365 days per year.
Key: LLW, low-level waste.
Source: DOE 1999f.

The radioactive solid waste disposal system provides facilities for holdup, packaging, and storage of wastes before shipment to offsite licensed treatment and disposal facilities. Radioactive solid waste may include evaporator concentrates, spent demineralizer resins, spent filters, laboratory wastes, contaminated oils, rags, gloves, boots, sweepings, brooms, and other miscellaneous tools and apparel that become contaminated during normal plant operations and maintenance. Treatment on the site may include dewatering, or solidification using a contractor-supplied mobile unit. Low-activity solid wastes, such as rags, clothing, and sweepings, are loaded directly into storage containers for shipment to an offsite treatment or disposal facility. Spent radioactive filter cartridges are packaged in drums or other waste containers, with spent resin solidified, if required. The disposal of slightly contaminated sludge from the wastewater treatment plant is carried out by landspreading the sludge on a site contiguous to McGuire using a method approved by the State of North Carolina and NRC. Packaged wastes are stored in the filter storage bunker, solidified liner storage bunker, and the shielded storage bunker before being shipped to an offsite treatment or disposal facility (Duke Power 1996:11-49–11-56).

The small quantities of mixed LLW and hazardous waste generated are accumulated on the site before being shipped for commercial treatment and disposal in offsite permitted facilities. Nonhazardous solid wastes are generated by typical industrial processes and housekeeping activities and are collected on the site and managed off the site at the local permitted sanitary landfill. Nonhazardous sanitary wastewater is discharged to the Charlotte Mecklenburg Utility Department sanitary sewer system (Duke Power 1994).

3.7.2.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of McGuire are shown in Table 3–78. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to reactor operations.

Releases of radionuclides to the environment from normal reactor operations provide another source of radiation exposure to populations within the vicinity of the site. The doses to the public resulting from these releases are shown in Table 3–79. These doses fall within regulatory limits and are small when compared with background exposure.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from normal reactor operations in 1997 is estimated to be 4.9×10^{-8}. That is, the estimated

Table 3–78. Sources of Radiation Exposure to Individuals in the McGuire Vicinity Unrelated to McGuire Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external and internal terrestrial radiation[a]	125
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	390

[a] Virginia Power 1998:11B-3.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Table 3–79. Radiological Impacts on the Public From McGuire Operations in 1997 (Total Effective Dose Equivalent)

Members of the Public	Atmospheric Releases		Liquid Releases		Total	
	Standard[a]	Actual	Standard[a]	Actual	Standard[a]	Actual
Maximally exposed individual (mrem)	5	0.033	3	0.065	25	0.098
Population within 80 km (person-rem)[b]	NA	2.8	NA	93	NA	96

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.
[b] Population used: 2,140,720; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997.
Key: NA, not applicable.
Source: DOE 1999f; Duke Power 1974:5.3-7, table 5.3.5-1; 1996:table 2-1.

probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about 1 chance in 20 million.

According to the same risk estimator, 0.048 excess fatal cancer is projected among the population living within 80 km (50 mi) of McGuire in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of McGuire was about 4,300. This number of expected fatal cancers is much higher than the estimated 0.048 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public; however, they receive an additional dose from normal operations of the reactors. Table 3–80 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.20.

Table 3–80. Radiological Impacts on Involved Workers From McGuire Operations in 1997

Number of badged workers[a]	3992
Total dose (person-rem/yr)	492
Annual latent fatal cancers	0.20
Average worker dose (mrem/yr)	123
Annual risk of latent fatal cancer	4.9×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999f.

3.7.2.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of McGuire, the potentially affected area includes parts of North Carolina and South Carolina.

The potentially affected area around McGuire is defined by a circle with an 80-km (50-mi) radius centered at these reactors (lat. 35°25′59″ N, long. 80°56′55″ W). The total population residing within that area in 1990 was 1,738,966. The proportion of the population that was considered minority was 17.6 percent. The same census data show that the percentage of minorities for the contiguous United States was 24.1, and the percentages of the States of North and South Carolina were 25.0 and 31.5, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 15.9 percent of the total population. Hispanics and Asians contributed about 0.7 percent, and Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 170,956 persons (9.8 percent of the total population) residing within the potentially affected area around McGuire reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for North Carolina and South Carolina were 13.0 and 15.4 percent, respectively (DOC 1992).

3.7.3 North Anna Units 1 and 2 Site Overview

The North Anna nuclear power plant occupies 422 ha (1,043 acres) in Louisa County, Virginia, approximately 64.4 km (40 mi) north-northwest of Richmond, Virginia, and 113 km (70 mi) southwest of Washington, D.C. (see Figure 3–36). The largest community within 16 km (10 mi) of the site is the town of Mineral in Louisa County. The site is on a peninsula on the southern shore of Lake Anna. Lake Anna is approximately 27.4 km (17 mi) long, with a surface area of 5,260 ha (13,000 acres) and 322 km (200 mi) of shoreline. The reservoir contains approximately 380 billion l (100 billion gal) of water (Virginia Power 1998:2.1-1, 2.1-2).

In 1997, the plant employed 552 persons (DOE 1999f). The North Anna reactors are operated by the Virginia Power Company. The operating licenses (Nos. NPF–4 and NPF–7) for these reactors were granted in 1978 and 1980, and expire in 2018 and 2020, respectively (NRC 1997). It is estimated that the population within an 80-km (50-mi) radius of the reactor is 1,614,983 (Virginia Power 1998:2.1-21).

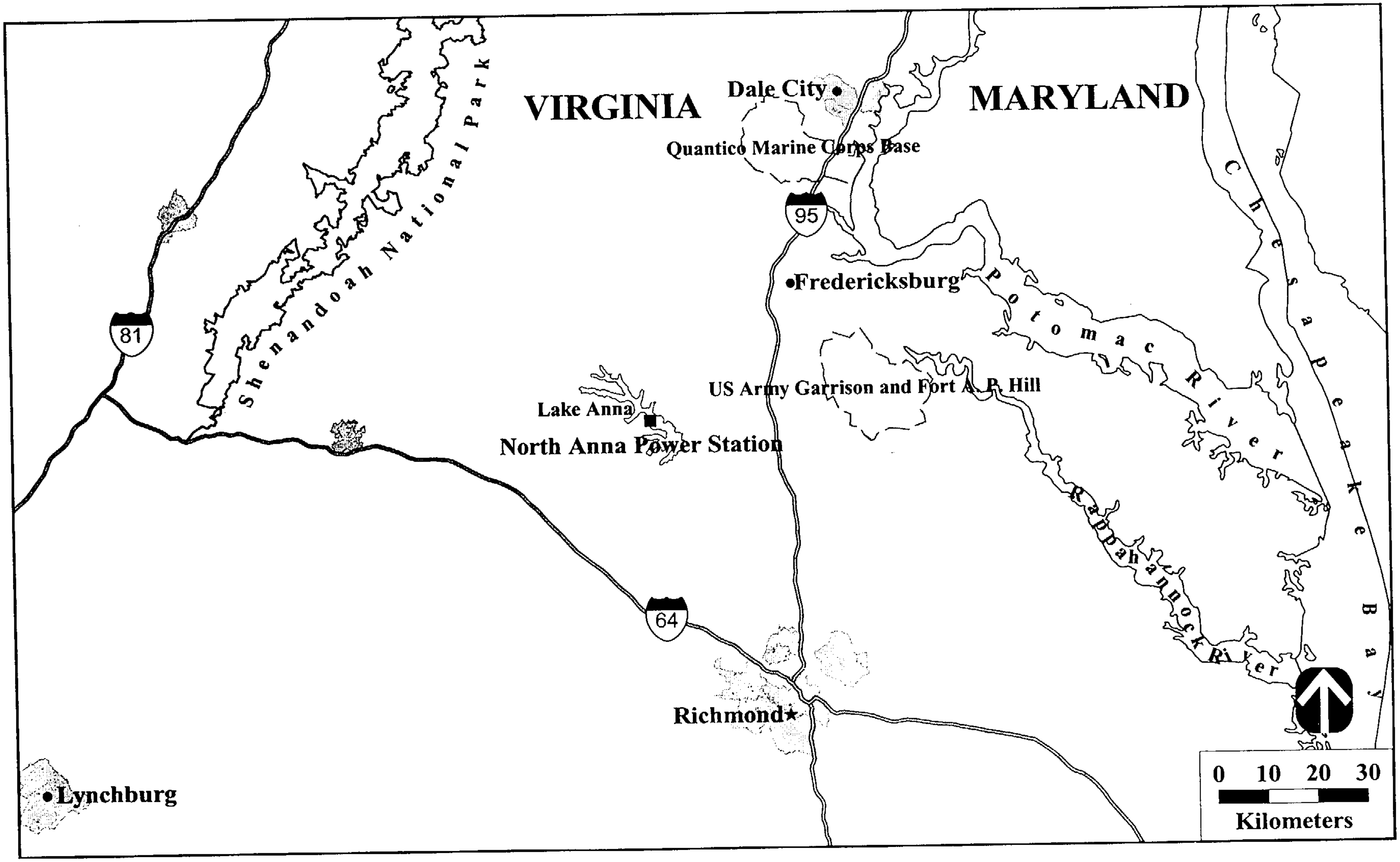


Figure 3–36. North Anna Nuclear Power Plant, Virginia

Reactor cooling is accomplished using a once-through cooling system with water obtained from Lake Anna (Virginia Power 1998:2.1-2). The rate of cooling water withdrawal is 5,564,000 million l/yr (1,470,000 million gal/yr), with all water returned to Lake Anna (DOE 1999f). There are no known industrial users downstream from the site until some 97 km (60 mi) downstream at West Point, where a large pulp and paper manufacturing plant is located. There are no known potable water withdrawals along the entire stretch of the river downstream to West Point, where the river becomes brackish (Virginia Power 1998:2.4-3).

New (unirradiated) fuel assemblies are dry stored in the new fuel storage area of the fuel building. The new fuel storage area has a capacity of 126 fuel assemblies. Spent (irradiated) fuel assemblies are stored under water in the spent fuel pit in the fuel building. The spent fuel storage pit has a capacity of 1,737 fuel assemblies (Virginia Power 1998:9.1-1, 9.1-2). Dry cask storage is being developed and is expected to have a capacity of an additional 1,824 assemblies (NRC 1998). Security at the site is provided in accordance with NRC regulations and includes security checkpoints, barbed wire fencing, surveillance cameras, and intruder detection. More information about these reactors can be found at the NRC Web site at http://www.nrc.gov/OPA/finder.htm (NRC 1999) and in NRC Docket Nos. 50–338 and 50–339.

3.7.3.1 Air Quality

North Anna is within the Northeastern Virginia AQCR #224. None of the areas within the site or Louisa County are designated as nonattainment areas with respect to the NAAQS for criteria air pollutants (EPA 1998f).

Sources of criteria air pollutants from North Anna include two auxiliary boilers, four emergency diesel generators, a station blackout generator, and miscellaneous equipment such as trucks and forklifts. Table 3–81 provides a summary of criteria pollutant concentrations from operations of North Anna. The concentrations resulting from operationsare well below the applicable ambient air quality standards even when background concentrations from other offsite sources are considered.

3.7.3.2 Waste Management

Table 3–82 presents the 5-year average annual waste generation rates for North Anna.

The waste disposal systems provide all equipment necessary to collect, process, store, and prepare for disposal of all radioactive liquid and solid wastes produced as a result of reactor operations. Potentially radioactive liquids may originate from a variety of sources, including the boron recovery system, steam generator blowdown system, drainage system sumps, laboratory drains, personnel decontamination area drains, decontamination system, sampling system, laundry drains, and spent resin flush system. Potentially radioactive liquid wastes are collected and characterized as to the level of contamination present. If contamination is below regulated levels, liquids may be discharged to the circulating water discharge outfall in accordance with the NPDES permit. If liquids are determined to be radioactively contaminated, they are treated by the ion exchange filtration system or demineralizers to reduce contamination before being discharged. Continuous radiation monitoring is provided for treated liquid waste before its release to the circulating water discharge outfall. Liquid waste is analyzed and monitored to ensure that radionuclide concentrations are maintained as low as practical and well within the limits of applicable regulations and permits (Virginia Power 1998:11.2-1, 11.2-2).

The radioactive solid waste disposal system provides facilities for holdup, packaging, and storage of wastes before shipment to offsite treatment and disposal facilities. Radioactive solid waste may include spent resin slurries, spent filter cartridges, rags, gloves, boots, brooms, and other miscellaneous tools and apparel that become contaminated during normal plant operations and maintenance. Contaminated solid materials resulting

Table 3–81. Comparison of Contribution to Nonradiological Ambient Air Pollutant Concentrations From North Anna Sources With National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS ($\mu g/m^3$)	North Anna ($\mu g/m^3$)
Carbon monoxide	8 hours	10,000	416
	1 hour	40,000	594
Nitrogen dioxide	Annual	100	0.00504
PM_{10}	Annual	50	0.00407
	24 hours	150	15.4
$PM_{2.5}$	3-year annual	15	(a)
	24 hours (98th percentile over 3 years)	65	(a)
Sulfur dioxide	Annual	80	0.0167
	24 hours	365	63
	3 hours	1,300	142

[a] No data is available with which to assess $PM_{2.5}$ concentrations.
Key: NAAQS, National Ambient Air Quality Standards.
Note: Based on 1997 emissions data for diesel generators.
Source: Modeled concentrations based on DOE 1999f; EPA 1997a.

Table 3–82. Annual Waste Generation for North Anna (m^3)

Waste Type	Generation Rate
LLW	236.6[a]
Mixed LLW	0
Hazardous waste	11.4
Nonhazardous waste	
Liquid	681
Solid	10,400

[a] Two-year average (1996–1997).
Key: LLW, low-level waste.
Source: DOE 1999f.

from station maintenance are stored in specified areas of the auxiliary building and the decontamination building. Materials that are compressible are placed in 208-l (55-gal) drums for compaction at the bailing facility. Compressible materials and other contaminated solid materials that are not placed in drums are placed in 6.1-m (20-ft) seavans for shipment to offsite licensed treatment and disposal facilities. Contaminated metallic materials and highly contaminated solid objects are placed inside disposable containers for shipment to a disposal facility (Virginia Power 1998:11.5-1–11.5-3).

The small quantities of mixed LLW and hazardous waste generated are accumulated on the site before being shipped for commercial treatment and disposal in offsite permitted facilities. Nonhazardous solid wastes are generated by typical industrial processes and housekeeping activities and are collected on the site and managed off the site at the local permitted sanitary landfill. Nonhazardous sanitary wastewater is treated in the onsite sanitary wastewater treatment facility and then discharged to Lake Anna (VADEQ 1997:9, 28).

3.7.3.3 Existing Human Health Risk

Major sources and levels of background radiation exposure to individuals within the vicinity of North Anna are shown in Table 3–83. Annual background radiation doses to individuals are expected to remain constant over time. Total dose to the population changes as population size changes. Background radiation doses are unrelated to reactor operations.

Table 3–83. Sources of Radiation Exposure to Individuals in the North Anna Vicinity Unrelated to North Anna Operations

Source	Effective Dose Equivalent (mrem/yr)
Natural background radiation	
Cosmic and external and internal terrestrial radiation[a]	125
Radon in homes (inhaled)[b]	200[c]
Other background radiation[b]	
Diagnostic x rays and nuclear medicine	53
Weapons test fallout	<1
Air travel	1
Consumer and industrial products	10
Total	390

[a] Virginia Power 1998:11B-3.
[b] NCRP 1987:11, 40, 53.
[c] An average for the United States.

Releases of radionuclides to the environment from normal reactor operations provide another source of radiation exposure to populations within the vicinity of the site. The doses to the public resulting from these releases are shown in Table 3–84. These doses fall within regulatory limits and are small when compared with background exposure.

Table 3–84. Radiological Impacts on the Public From North Anna Operations in 1997 (Total Effective Dose Equivalent)

	Atmospheric Releases		Liquid Releases		Total	
Members of the Public	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**	**Standard[a]**	**Actual**
Maximally exposed individual (mrem)	5	6.1×10^{-4}	3	0.28	25	0.28
Population within 80 km (person-rem)[b]	NA	6.0	NA	9.0	NA	15.0

[a] The standards for individuals are given in 10 CFR 50, Appendix I. The standard for the maximally exposed offsite individual (25 mrem/yr total body from all pathways) is given in 40 CFR 190.
[b] Population used: 1,614,983; this population dose was estimated for the year 2000 and is assumed to be representative for the year 1997. Population doses were ratioed to reflect latest census data projections.
Key: NA, not applicable.
Source: DOE 1999f; Virginia Power 1998:2.1-21, 11B-3, 11.3-13.

Using a risk estimator of 500 cancer deaths per 1 million person-rem (5×10^{-4} fatal cancer per person-rem) to the public (see Appendix F.10), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from normal reactor operations in 1997 is estimated to be 1.4×10^{-7}. That is, the estimated probability of this person dying from cancer from radiation exposure from 1 year of normal reactor operations is about one chance in seven million.

According to the same risk estimator, 0.0075 excess fatal cancer is projected among the population living within 80 km (50 mi) of North Anna in 1997. For perspective, this number can be compared with the number of fatal cancers expected in this population from all causes. The 1996 mortality rate associated with cancer for the entire population was 0.2 percent per year (Famighetti 1998:964). Based on this national rate, the number of fatal cancers from all causes expected during 1997 in the population living within 80 km (50 mi) of North Anna was about 3,200. This number of expected fatal cancers is much higher than the estimated 0.0075 fatal cancer that could result from normal reactor operations in 1997.

Workers at the reactors receive the same background radiation dose as the general public, however, they receive an additional dose from normal operations of the reactors. Table 3–85 includes average, maximally exposed, and total occupational doses to reactor workers from operations in 1997. Based on a risk estimator of 400 cancer deaths per 1 million person-rem (4×10^{-4} fatal cancer per person-rem) among workers, the number of fatal cancers to reactor workers from 1997 normal operations is estimated to be 0.041.

Table 3–85. Radiological Impacts on Involved Workers From North Anna Operations in 1997

Number of badged workers[a]	2,243
Total dose (person-rem/yr)	103
Annual latent fatal cancers	0.041
Average worker dose (mrem/yr)	46
Annual risk of latent fatal cancer	1.8×10^{-5}

[a] A badged worker is equipped with an individual dosimeter.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (10 CFR 20). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999f.

3.7.3.4 Environmental Justice

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionately high and adverse (CEQ 1997). In the case of North Anna, the potentially affected area includes parts of Maryland and Virginia.

The potentially affected area around North Anna is defined by a circle with an 80-km (50-mi) radius centered around these reactors (lat. 38°03′37″ N, long. 77°47′24″ W). The total population residing within that area in 1990 was 1,286,156. The proportion of the population that was considered minority was 21.9 percent. The same census data show that the percentages of minorities for the contiguous United States was 24.1, and the percentage of the States of Maryland and Virginia were 30.4 and 24.0, respectively (DOC 1992).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 18.8 percent of the total population. Asians contributed about 1.5 percent, and Hispanics, about 1.4 percent. Native Americans made up about 0.3 percent of the population (DOC 1992).

A breakdown of incomes in the potentially affected area is also available from the 1990 census data (DOC 1992). At that time, the poverty threshold was $9,981 for a family of three with one related child under 18 years of age. A total of 88,162 persons (6.9 percent of the total population) residing within the potentially affected area around North Anna reported incomes below that threshold. Data obtained during the 1990 census also show that of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and that the figures for Maryland and Virginia were 8.3 and 10.3 percent, respectively (DOC 1992).

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