3. AFFECTED ENVIRONMENT

Chapter 3 provides an overview of the affected environment of the alternative sites under consideration for the treatment and management of sodium-bonded spent nuclear fuel. The chapter first addresses the approach to defining the affected environment, and then provides a discussion of the affected environments of the Idaho National Engineering and Environmental Laboratory and Savannah River Site. The discussion of each resource area at each site initially addresses the site as a whole, followed by a description of the proposed treatment locations.

3.1 APPROACH TO DEFINING THE AFFECTED ENVIRONMENT

In accordance with Council on Environmental Quality's Guidance under National Environmental Policy Act (NEPA) regulations (40 CFR 1500-1508) for 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. They serve as a baseline for identifying and evaluating the environmental changes that may result from implementing any of the alternatives.

Candidate sites for the treatment and management of sodium-bonded spent nuclear fuel include the U.S. Department of Energy's (DOE) Argonne National Laboratory-West (ANL-W), located within the boundaries of the Idaho National Engineering and Environmental Laboratory (INEEL), and the Savannah River Site's (SRS) F-Area and L-Area. The affected environment is described for the following resource areas: land use, site infrastructure, air quality and noise, water resources, geology and soils, ecological resources, cultural and paleontological resources, socioeconomics, environmental justice, existing human health risk, and waste management. For each DOE site, each resource area is described first for the site as a whole and then for the candidate treatment sites, as appropriate. The level of detail varies depending on the potential for impacts resulting from each treatment and management alternatives.

The affected environment for each candidate site presented in this section is based on the *Surplus Plutonium Disposition Draft Environmental Impact Statement* (DOE 1998b), unless otherwise noted. Additional information on the affected environment was determined from other recent environmental impact statements, 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 National Environmental Policy Act (NEPA) documents such as the *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Final Environmental Impact Statement* (DOE 1999a) and the *Savannah River Site Spent Nuclear Fuel Management Draft Environmental Impact Statement* (DOE 1998f).

3.2 IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

INEEL is located on approximately 230,700 hectares (570,000 acres) in southeastern Idaho and is 55 kilometers (34 miles) west of Idaho Falls; 61 kilometers (38 miles) northwest of Blackfoot; and 35 kilometers (22 miles) east of Arco. INEEL is owned by the Federal Government and administered, managed, and controlled by DOE. 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.

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

Fifty-two research and test reactors have been used at INEEL over the years to test reactor systems, fuel and target design, and overall safety. In addition to nuclear reactor research, other INEEL facilities are operated to support reactor operations. These facilities include high-level radioactive and low-level radioactive waste processing and storage sites; hot cells; analytical laboratories; machine shops; and laundry, railroad, and administrative facilities. Other activities include management of one of DOE's largest storage sites for low-level radioactive waste and transuranic waste.

3.2.1 Land Resources

3.2.1.1 Land Use

The Federal Government, the State of Idaho, and private parties own lands surrounding INEEL. 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. Two national natural landmarks border INEEL: Big Southern Butte (2.4 kilometers [1.5 miles] south) and Hell's Half Acre (2.6 kilometers [1.6 miles] southeast). A portion of Hell's Half Acre National Natural Landmark is designated as a Wilderness Study Area. The Black Canyon Wilderness Study Area also is adjacent to the northwest boundary of INEEL.

Land-use categories at INEEL include facility operations, grazing, general open space, and infrastructure (such as roads). Generalized land uses at INEEL and the vicinity are shown in **Figure 3–1.** Facility operations include industrial and support operations associated with energy research and waste management activities. Land also is 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 (4,600 hectares [11,400 acres]) is used for facilities and operation. INEEL facilities are sited within a central core area of about 93,100 hectares (230,000 acres) (Figure 3-1). Public access to most facilities is restricted. DOE land-use plans and policies applicable to INEEL are discussed in the *DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a).

The total land area at ANL-W is 328 hectares (810 acres); however, site facilities cover only about 20 hectares (50 acres) or 6 percent of the site (DOE 1996a). ANL-W is located 7 kilometers (4.3 miles) northwest of the nearest site boundary and is designated as a testing center for advanced technologies associated with nuclear power systems. The area has 52 major buildings, including reactor buildings, laboratories, warehouses, technical and administrative support buildings, and craft shops that comprise 55,700 square meters (600,000 square feet) of floor space (LMITC 1997). Five nuclear test reactors, including the Experimental Breeder Reactor II (EBR-II), have operated on the site, although the only one currently active is a small reactor used for radiography examination of experiments, waste containers, and spent nuclear fuel. The Fuel Conditioning Facility and Hot Fuel Examination facility are also located at the site (DOE 1996a).

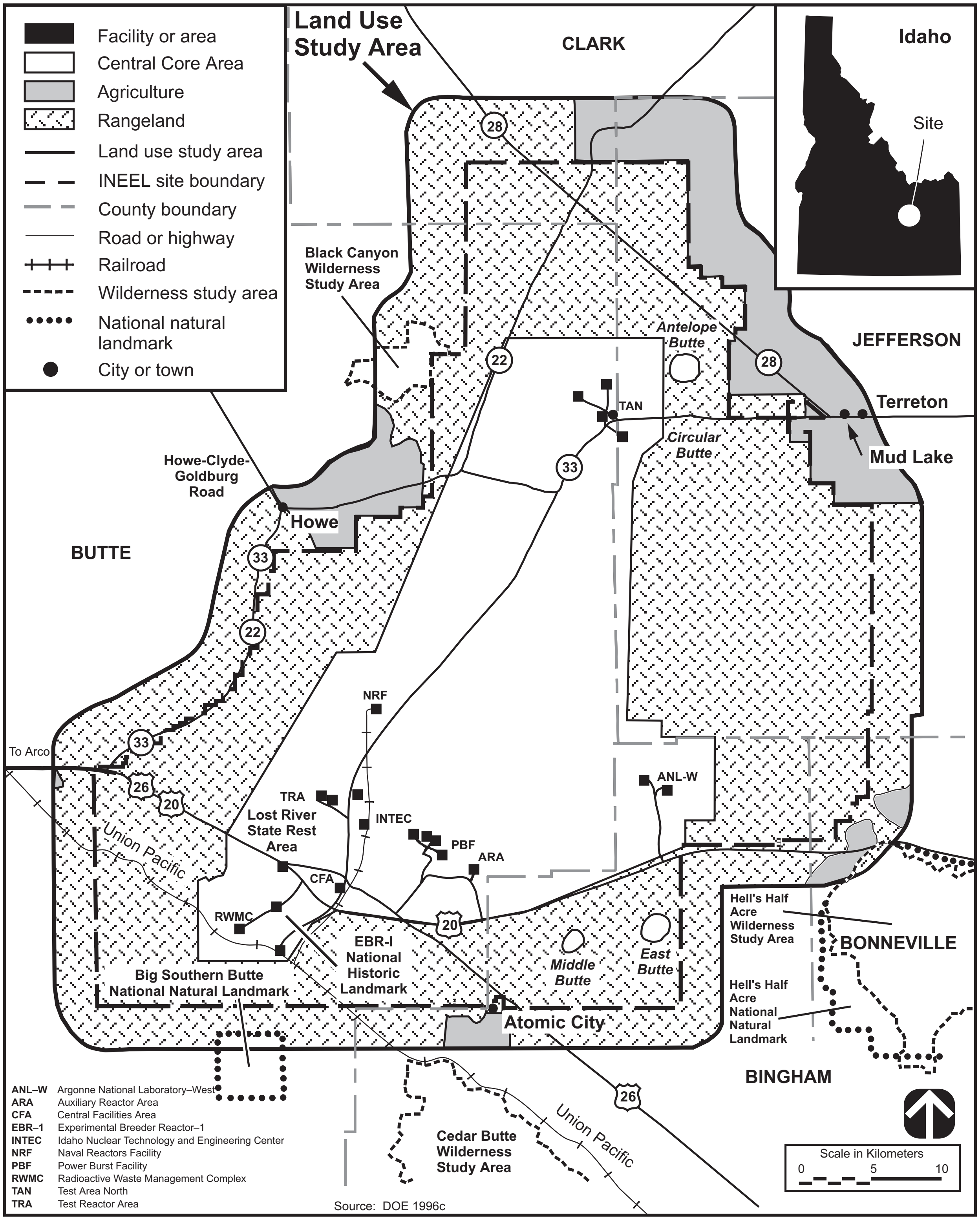

Figure 3–1 Generalized Land Use at INEEL and Vicinity

3.2.1.2 Visual Resources

The Bitterroot, Lemhi, and Lost River mountain ranges border the INEEL site on the north and west. Volcanic buttes near the southern boundary of INEEL can be seen from most locations on the site. Lands adjacent to the site are under Bureau of Land Management jurisdiction and are designated as Visual Resource Management Class II areas. INEEL itself generally consists of open desert land mostly covered by large sagebrush and grasslands. Most land within the site falls within Visual Resource Management Class II and III. Management activities within these classes may be seen but should not dominate the view (DOI 1986).

Ten facility areas are located on the INEEL site. Although INEEL has a master plan, no specific visual resource standards have been established. INEEL facilities appear as low-density commercial/industrial complexes widely dispersed throughout the site. Structure heights range from about 3 to 30 meters (10 to 100 feet); a few stacks and towers reach 76 meters (250 feet). Although many INEEL facilities are visible from highways, most facilities are more than 0.8 kilometers (0.5 miles) from public roads. The operational areas are well defined at night by security lights.

Developed areas within ANL-W are consistent with a Visual Resource Management Class IV designation in which management activities dominate the view and are the focus of viewer attention. The tallest structure at ANL-W is the Fuel Conditioning Facility stack, which is 61 meters (200 feet) in height. The site is visible from Highway 20. Facilities that stand out from the highway include the Hot Fuel Examination Facility, Experimental Breeder Reactor-II containment shell, the Zero Power Physics Reactor, and the Transient Reactor Test Facility. Natural features of visual interest within a 40-kilometer (25-mile) radius of ANL-W include the Big Lost River at 19 kilometers (11.8 miles), Big Southern Butte National Natural Landmark at 30 kilometers (18.6 miles), East Butte at 9 kilometers (5.6 miles), Middle Butte at 11 kilometers (6.8 miles), Hell’s Half Acre Wilderness Study Area, and Hell’s Half Acre National Natural Landmark at 15 kilometers (9.3 miles).

3.2.2 Site Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions. INEEL has extensive production, service, and research facilities. An extensive infrastructure system supports these facilities, as shown in **Table 3–1**.

Table 3–1 INEEL Site-Wide Infrastructure Characteristics

Resource	*Current Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	445[a]	Not applicable
Railroads (kilometers)	48	Not applicable
Electricity		
Energy consumption (megawatt hours per year)	221,772 [b]	394,200
Peak load (megawatts)	39 [b]	124
Fuel		
Natural gas (cubic meters per year)	Not applicable	Not applicable
Oil and propane (liters per year)	5,820,000	16,000,000 [c]
Coal (metric tons per year)	11,340	11,340 [c]
Water (liters per year)	6,100,000,000	43,000,000,000

[a] Includes paved and unpaved roads.
[b] FY 1997 data based on INEEL 1998.
[c] As supplies get low, more can be supplied by truck or rail.
Source: DOE 1998a, except as noted in footnote b.

3.2.2.1 Transportation

The road network at INEEL provides for onsite transportation; railroads are used for deliveries of large volumes of coal and oversized structural components. Commercial shipments are transported by truck; some bulk materials are transported by train; and waste by truck and train. About 140 kilometers (87 miles) of paved surface has been developed out of the 445 kilometers (277 miles) of roads on the site, including 29 kilometers (18 miles) 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.

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. There are 48 kilometers (30 miles) of railroad track at INEEL. Rail shipments to and from INEEL usually are limited to bulk commodities, spent nuclear fuel, and radioactive waste.

3.2.2.2 Electricity

Commercial electric power is supplied to INEEL through two feeders from the Antelope substation to the Federally owned Scoville substation, which supplies electric power directly to the site's 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.

The average electrical availability at INEEL is about 394,200 megawatt hours per year; in 1997 the average usage was 221,772 megawatt hours. The peak load capacity for INEEL is 124 megawatts; the 1997 peak load usage was about 39 megawatts (INEEL 1998).

3.2.2.3 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. The current site usage of fuel oil is about 5.7 million liters per year (1.5 million gallons per year). The current site usage of coal is about 11,340 metric tons per year (12,500 tons per year). If additional coal or fuel oil were needed during the year, it could be shipped to the site.

3.2.2.4 Water

The Snake River Plain Aquifer is the source of all water at INEEL. 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 of 43 billion liters per year (11 billion gallons per year) for the site. The current site usage is about 6.1 billion liters per year (1.6 billion gallons per year).

3.2.2.5 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.

3.2.3 Air Quality and Noise

3.2.3.1 Air Quality

The climate at INEEL and the surrounding region is characterized as a semiarid steppe with low relative humidity, wide daily temperature swings, and large variations in annual precipitation. The average annual temperature at INEEL is 5.6 °C (42 °F), and average seasonal temperatures range from a minimum of -7.3 °C (18.8 °F) in winter to 18.2 °C (64.8 °F) in summer. Temperature extremes range from a summertime maximum of 39.4 °C (103 °F) to a wintertime minimum of -45 °C (-49 °F). The average annual precipitation at INEEL is 22 centimeters (8.7 inches). Prevailing winds at INEEL are predominantly southwest or northeast, although terrain features may cause variations in the flow (DOE 1999a). The average annual wind speed is 3.4 meters per second (7.5 miles per hour).

INEEL is within Eastern Idaho Intrastate Air Quality Control Region # 61. None of the areas within INEEL or its surrounding counties are designated as nonattainment areas, i.e., areas where criteria air pollutant levels exceed the National Ambient Air Quality Standards (NAAQS) established by the U.S. Environmental Protection Agency (EPA) (40 CFR 50). The nearest nonattainment area for particulate matter is in Pocatello, about 80 kilometers (50 miles) to the south. Applicable NAAQS and Idaho State ambient air quality standards are presented in **Table 3–2**.

The primary sources of air pollutants at INEEL currently include calcination of sodium bearing waste, combustion of coal for steam and combustion of fuel oil for heating. Other emission sources include waste burning, coal piles, industrial processes, stationary diesel engines, vehicles, and fugitive dust from burial and construction activities. The existing ambient air concentrations attributable to sources at INEEL are presented in Table 3–2. These concentrations are based on dispersion modeling using maximum emissions for the year 1990 and meteorological data from 1992, and are expected to bound the actual INEEL contribution to ambient levels. Only those toxic and hazardous air pollutants that would be emitted for any of the alternatives evaluated in this EIS are presented. Concentrations attributable to INEEL are in compliance with applicable guidelines and regulations (Table 3–2).

The nearest Prevention of Significant Deterioration Class I area[1] to INEEL is Craters of the Moon Wilderness Are, Idaho, located 53 kilometers (33 miles) west-southwest from the center of the site. There are no other Class I areas within 100 kilometers (62 miles) of INEEL. INEEL and its vicinity are classified as a Prevention of Significant Deterioration Class II area[2].

The EPA has established Prevention of Significant Deterioration increments for certain pollutants: sulfur dioxide, nitrogen dioxide, and particulate matter less than or equal to 10 microns in diameter (PM_{10}). The increments specify a maximum allowable increase above a certain baseline concentration for a given averaging period, and apply only to sources constructed or modified after a specified baseline date. These sources are known as increment-consuming sources. The baseline date is the date of submittal of the first application for a Prevention of Significant Deterioration permit in a given area.

---

1 *Class I areas are defined as national parks and wildlife refuges.*

2 *Class II areas are defined as any area not designated Class I. Please see Appendix B, Impact Assessment Methods, for a more detailed discussion.*

Table 3–2 Comparison of Modeled Ambient Air Concentrations From INEEL Sources With Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meter)*[a]	*INEEL Concentration*[g] *(micrograms per cubic meter)*
Criteria pollutants			
Carbon monoxide	8 hours 1 hour	10,000[b] 40,000[b]	284 614
Nitrogen dioxide	Annual	100[b]	4
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual 24 hours (interim) 24 hours (99th percentile over 3 years)	50[b] 150[b] 150[c]	3 33 (e)
$PM_{2.5}$	3 year annual 24 hours (98th percentile over 3 years)	15[c] 65[c]	(e) (e)
Sulfur dioxide	Annual 24 hours 3 hours	80[b] 365[b] 1,300[b]	6 135 579
Hazardous and other toxic compounds[f]			

[a] The more stringent of the Federal and state standards are presented if both exist for the averaging period.
[b] Federal and state standard.
[c] Federal standard.
[d] Not directly emitted or monitored by the site.
[e] No data are available with which to assess particulate matter concentrations.
[f] Any hazardous and toxic compounds would be well below regulatory levels (ANL 1999b).
[g] Concentrations based on 1990 emissions and 1992 meteorological data.
Source: 40 CFR 50, ID DHW 1998, Moor and Peterson 1999, 62 FR 38855, 62 FR 38652.

Prevention of Significant Deterioration permits have been obtained for the coal-fired steam-generating facility (located next to the Idaho Nuclear Technology and Engineering Center) and the Fuel Processing Facility. The Fuel Processing Facility is not expected to be operated (DOE 1996c). In addition to this facility, INEEL has other increment-consuming sources on site. **Tables 3–3** and **3–4** specify the current amount of Prevention of Significant Deterioration increment consumption in Class I and Class II areas, respectively, by INEEL's increment-consuming sources based on dispersion modeling analyses.

Routine offsite monitoring for nonradiological air pollutants generally is performed only for particulates. Monitoring for PM_{10} is performed by the Environmental Science and Research Foundation at the site boundary and at communities beyond the boundary. In 1997, 49 samples were collected at Rexburg (located about 60 kilometers [19.3 miles] east of the site). The mean PM_{10} concentration at Rexburg was 14 micrograms per cubic meter. Forty-one samples were collected at the Mountain View Middle School in Blackfoot in 1997, with a mean concentration of 15 micrograms per cubic meter. Twenty-nine samples were collected at Atomic City in 1997, with a mean concentration of 15 micrograms per cubic meter (Evans et al. 1998).

Some monitoring data also has been collected by the National Park Service at the Craters of the Moon Wilderness Area. The monitoring program has shown no exceedances of the primary ozone standard, low levels of sulfur dioxide (except for one exceedence of the 24-hour standard in 1985), and total suspended particulates within applicable standards (DOE 1999a). Note that the total suspended particulates within standards have been replaced with PM_{10} standards.

Table 3–3 Prevention of Significant Deterioration Increment Consumption at Craters of the Moon Wilderness (Class I) Area by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation

Pollutant	*Averaging Time*	*Allowable Prevention of Significant Deterioration increment[a] (micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration increment consumed (micrograms per cubic meter)*	*Percent of Prevention of Significant Deterioration Increment Consumed*
Nitrogen dioxide [b]	Annual	2.5	0.004	1.8
Respirable particulates [c]	Annual 24hours	4 8	0.008 0.6	0.2 7.5
Sulfur dioxide	Annual 24 hours 3 hours	2 5 25	0.09 1.8 5.9	4.5 36 24

[a] All increments specified are State of Idaho standards (ID DHW 1998).
[b] Assumes that the New Waste Calcining Facility (the largest source of nitrogen dioxide emissions at INEEL) operates for the entire year.
[c] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Source: DOE 1999a.

Table 3–4 Prevention of Significant Deterioration Increment Consumption at Class II Areas by Existing (1996) and Projected Sources Subject to Prevention of Significant Deterioration Regulation at INEEL

Pollutant	*Averaging Time*	*Allowable Prevention of Significant Deterioration increment [a] (micrograms per cubic meter)*	*Amount of Prevention of Significant Deterioration increment consumed (micrograms per cubic meter)*	*Percent of Prevention of Significant Deterioration Increment Consumed*
Nitrogen dioxide [b]	Annual	25	1.4	5.7
Respirable particulates [c]	Annual 24 hours	17 30	0.92 15	5.4 51
Sulfur dioxide	Annual 24 hours 3 hours	20 91 512	2.4 29 132	12 32 26

[a] All increments specified are State of Idaho standards (ID DHW 1998).
[b] Assumes that the New Waste Calcining Facility operates for the entire year.
[c] Data on particulate size are not available for most sources. For purposes of comparison to the respirable particulate increments, it is conservatively assumed that all particulates emitted are of respirable size (i.e., 10 microns or less in diameter).
Source: DOE 1999a.

The primary sources of nonradiological air emissions at ANL-W include four water tube boilers for site heating and process requirements, various emergency or standby diesel generators used for backup power, a permitted point spray booth, a permitted decontamination facility at the Fuel Conditioning Facility, and two fixed-roof storage tanks that hold fuel for the boilers (DOE 1998a).

3.2.3.2 Noise

Major noise emission sources within INEEL include various industrial facilities, equipment, and machines. 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.

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 recorded 15 meters (50 feet) from U.S. Route 20 indicate that the sound levels from traffic range from 64 to 86 decibels A-weighted, and that the primary source is buses (71 to 80 decibels A-weighted). While few people reside within 15 meters (50 feet) 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 day-night average sound level is in the range of 35 to 50 decibels A-weighted (DOE 1998b). The noise generated at INEEL is not propogated at detectable levels offsite, since all public areas are at least 2.5 kilometers (4 miles) away from site facilities.

No distinguishing noise characteristics at ANL-W have been identified. ANL-W is 9 kilometers (5.6 miles) from the site boundary; thus, the contributions from the area to noise levels at the site boundary are not measurable.

3.2.4 Water Resources

3.2.4.1 Surface Water

Three intermittent streams drain the mountains near INEEL: Big Lost River, Little Lost River, and Birch Creek (**Figure 3–2**). 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 the INEEL site. 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 streams 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, DOE 1996c).

The 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 effluent discharged directly to them. Since INEEL facilities currently do not discharge directly to nor make withdrawals from these water bodies, there are no surface water rights issues at INEEL. None of the rivers have been classified as a Wild and Scenic River (DOE 1995a, DOE 1996c).

A study of the 100-year peak flow for the Big Lost River has been completed by the U.S. Geological Survey (USGS 1998). The 100-year and 500-year flood plains are being studied by the Bureau of Reclamation. No flood maps of the Big Lost River are available from the Federal Emergency Management Agency or other agencies (Abbott, Crockett, and Moor 1997). Flood diversion facilities constructed in 1958 and enlarged in 1984 secured INEEL from the 300-year flood (DOE 1996c).

There are no named streams within the ANL-W area and no permanent, natural, surface water features near the area (ANL 1998a). Neither the 100-year flood nor flooding scenarios that involve failure of Mackay Dam on the Big Lost River indicate that flood waters would reach ANL-W (**Figure 3–3**).

ANL-W discharges 11,900,000 liters per year (3,140,000 gallons per year) of nonhazardous liquid waste to the sewage pond and 68,000,000 liters per year (18,000,000 gallons per year) to the industrial waste pond (ANL 1999b). These are evaporation ponds and water levels may be controlled by land spreading if necessary (Cascade Earth Sciences 1998).

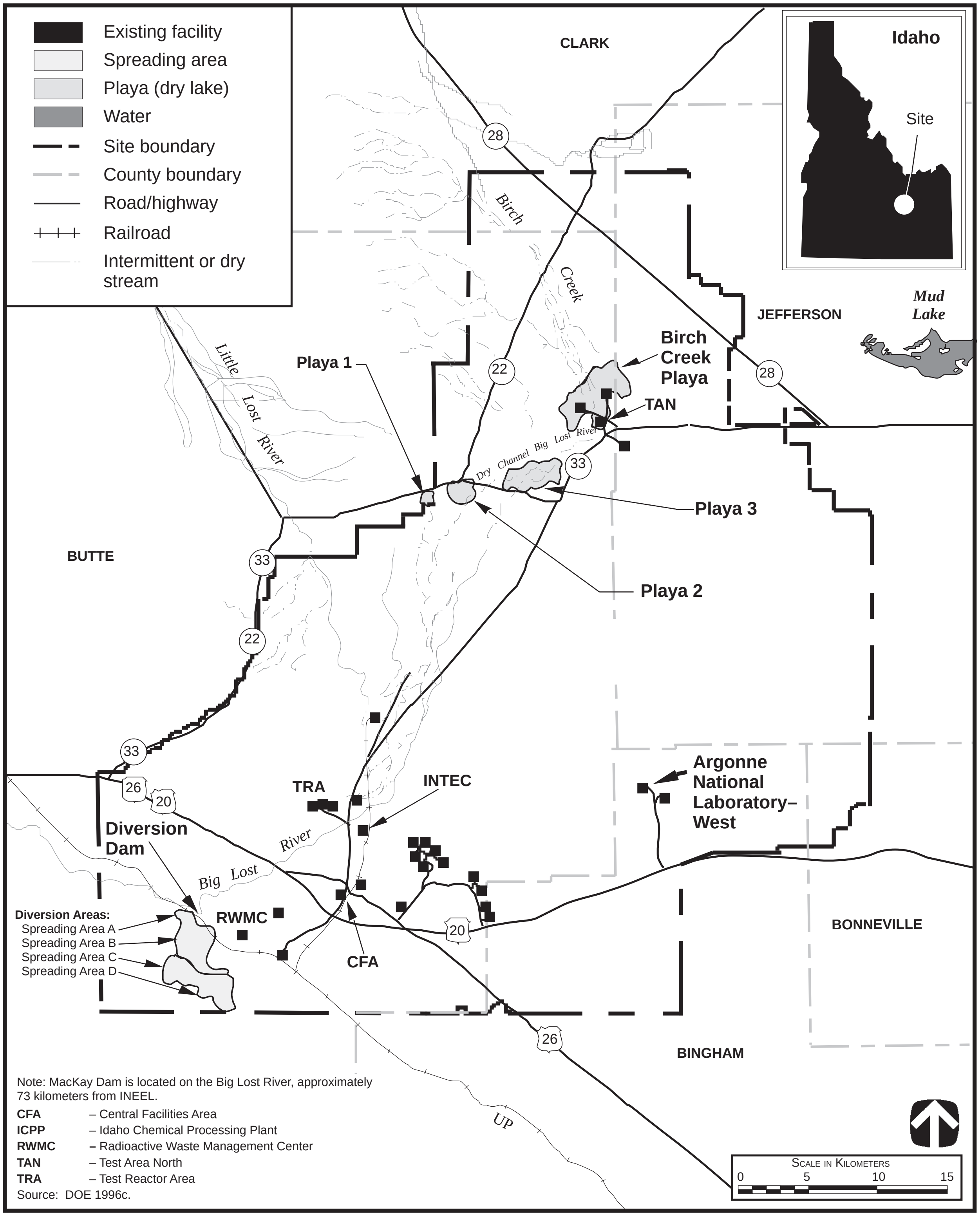

Figure 3–2 Surface Water Features at Idaho National Engineering and Environmental Laboratory

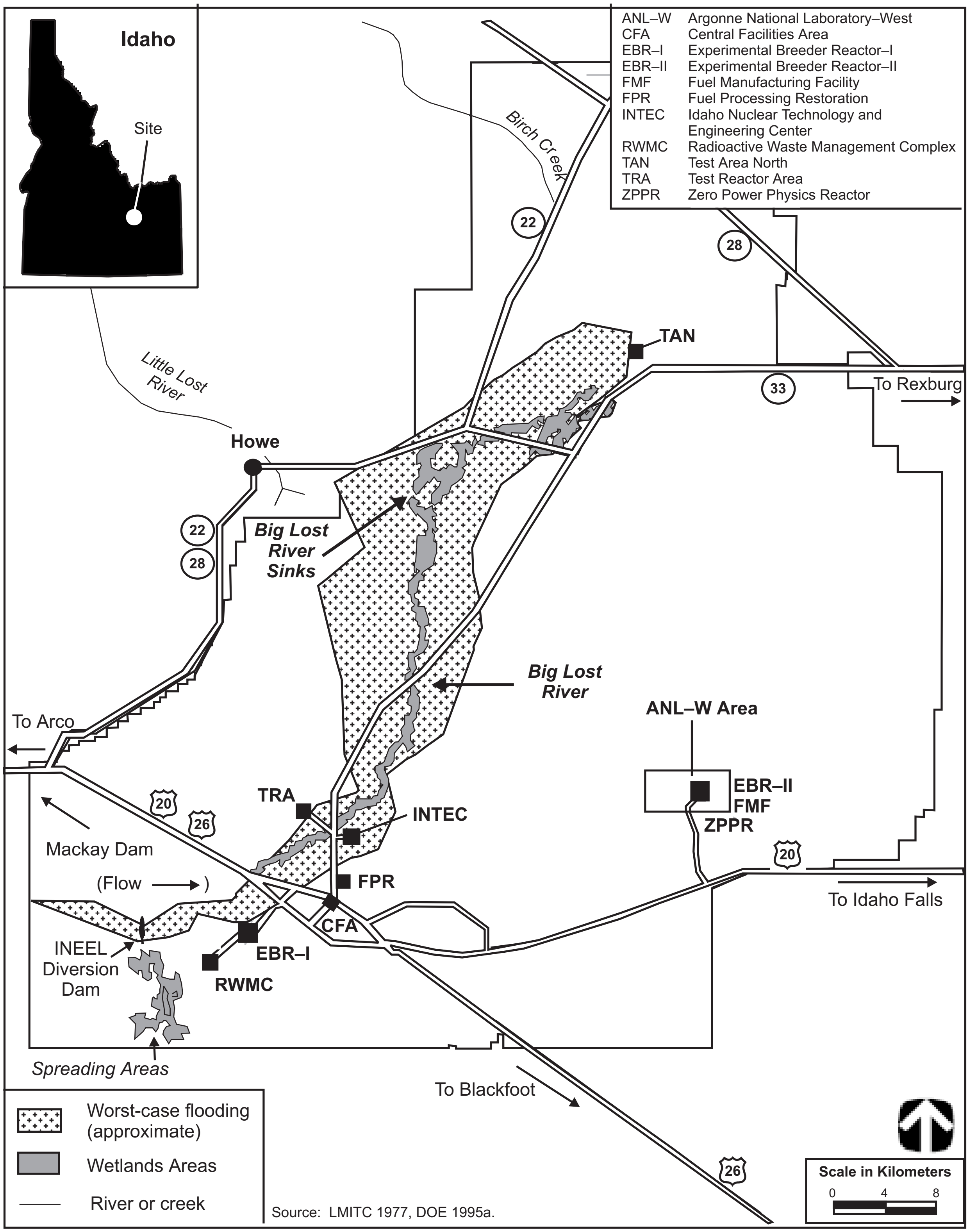

Figure 3–3 Flood Area for the Probable Maximum Flood-Induced Overtopping Failure of the Mackay Dam

3.2.4.2 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.

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 2,486,000 hectares (6,143,000 acres) 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 liters (317 trillion to 660 trillion gallons) 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 1996c).

Groundwater generally flows laterally at a rate of 1.5 to 6.1 meters per day (5 to 20 feet per day). It emerges in springs along the Snake River from Milner to Bliss, Idaho. Depth to the groundwater table ranges from about 61 meters (200 feet) below ground in the northeast corner of the site to about 305 meters (1,000 feet) in the southeast corner (DOE 1995a, DOE 1996c). Perched water tables (i.e., bodies of groundwater lying above a more extensive aquifer) 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 1996c).

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 the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as well as routine monitoring to evaluate the quality of the water in the aquifer. The Snake River Plain 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 trichloroethylene. Components of nonradioactive waste entered the aquifer as a result of past waste disposal practices. Elimination of groundwater injection, except for stormwater management and heat exchange, illustrates a change in disposal practices that has reduced the amount of these constituents in the groundwater (DOE 1996c).

INEEL uses about 7.2 billion liters per year (1.9 billion gallons per year) from the Snake River Plain aquifer, the only source of water at INEEL (DOE 1999a). 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 2.3 cubic meters per second (80 cubic feet per second) with a maximum water consumption of 42 billion liters per year (11 billion gallons per year). INEEL's priority on water rights dates back to its establishment in 1950 (DOE 1996c).

All water used at ANL-W is groundwater from the Snake River Plain aquifer. The depth to the groundwater at ANL-W is approximately 195 meters (640 feet) and the flow is generally to the south-southwest. ANL-W uses approximately 188 million liters per year (49.6 million gallons per year) of water (ANL 1999b, Cascade Earth Sciences 1998).

No significant levels of radioactivity are found in the production wells at ANL-W. Constituents measured in the groundwater monitoring wells in 1997 were all below regulatory levels (ANL 1998b).

3.2.5 Geology and Soils

The upper 1 to 2 kilometers (0.6 to 1.2 miles) 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 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 erupted between 6.5 and 4.3 million years ago. There is no potential for sinkholes at INEEL. Lava tubes, which could have adverse effects similar to those of sinkholes, do occur in the INEEL area.

Within INEEL, economically viable sand, gravel, and pumice resources have been identified. Several quarries have supplied these materials to various onsite construction projects. Geothermal resources are potentially available in parts of the Eastern Snake River Plain, but neither of two boreholes drilled near the Idaho Nuclear Technology and Engineering Center (INTEC) encountered rocks with significant geothermal potential.

The Arco Segment of the Lost River Fault terminates about 12 kilometers (7.5 miles) from the INEEL boundary. The South Creek Segment of the Lemhi fault terminates at the northwest boundary of the site. Both segments are considered capable (Abbott, Crockett, and Moor 1997). 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.

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. No earthquakes have been recorded within 48 kilometers (30 miles) of the site (DOE 1998b). The largest historic earthquake near INEEL took place in 1983, 107 kilometers (66 miles) to the northwest, near Borah Peak in the Lost River Range. The earthquake had a moment magnitude of 6.9 with a ground acceleration of 0.022 g to 0.078 g at INEEL (Jackson 1985). An earthquake with a maximum horizontal acceleration of 0.15 g is calculated to have an annual probability of occurrence of 1 in 5,000 at a central INEEL location.

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 kilometers (12 miles) southwest of INEEL between 4 million and 2,100 years ago. The probability of volcanic activity affecting facilities at INEEL is very low. A detailed discussion relating to the probability of volcanism affecting INEEL is presented in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c).

Four basic soilscapes exist on the INEEL: river-transported sediments deposited on alluvial plains, fine-grained sediments eroded into lake or playa basins, colluvial sediments originating from bordering mountains, and wind-blown sediments over lava flows. The alluvial deposits follow the courses of the modern Big Lost River and Birch Creek. The playa soils are located in the north-central part of the INEEL site. The colluvial sediments are located along the western edge of the site. Wind-blown sediments (silt and sand) covering lava plains occupy the rest of the site's landscape (DOE 1997b). The thickness of surficial sediments ranges from less than 0.3 meters (1 foot) at basalt outcrops east of INTEC to 95 meters (313 feet) near the Big Lost River sinks (DOE 1999a). No prime farmland lies within the INEEL boundaries (DOE 1998b).

The nearest capable fault to ANL-W is the South Creek Segment of the Lemhi Fault, which is located 31 kilometers (19 miles) northwest of the site (Abbott, Crockett, and Moor 1997). ANL-W is located within a topographically closed basin. Low ridges of basalt found east of the area rise as high as 30 meters (100 feet) above the level of the plain. Sediments cover most of the underlying basalt on the plain, except where pressure ridges form basalt outcrops (ANL 1999a). Soils in the ANL-W area have been found to resemble the Pancheri-Polatis-Tenno series, which generally consists of light brown-gray well-drained silty loams to brown extremely stony loams (ANL 1998a, DOA 1973). Soils are highly disturbed within developed areas of the site.

3.2.6 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Material presented in this section, unless otherwise noted, is from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c).

3.2.6.1 Terrestrial Resources

INEEL lies in a cool desert ecosystem dominated by shrub-steppe communities. Most land within the site is relatively undisturbed and provides important habitat for species native to the region. Facilities and operating areas occupy only 2 percent of INEEL. Although sagebrush communities occupy about 80 percent of INEEL, a total of 20 plant communities have been identified (**Figure 3–4**). The interspersion of low and big sagebrush communities in the northern portion of INEEL and juniper communities located in the northwestern and southeastern portions of the site are considered sensitive habitats. The former provides critical winter and spring range for sage grouse and pronghorn, while the latter is important to nesting raptors and songbirds. Riparian vegetation, primarily cottonwood and willow, along the Big Lost River and Birch Creek also provides nesting habitat for hawks, owls, and songbirds. In total, 398 plant taxa have been documented on INEEL.

The INEEL supports numerous animal species, including 2 amphibian, 11 reptile, 225 bird, and 44 mammal species (ESRF 1999). Common animals on the INEEL site include the short-horned lizard, gopher snake, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. Important game animals include the sage grouse, mule deer, elk, and pronghorn. During some winters, 4,500 to 6,000 pronghorn, or about 30 percent of Idaho's total population, may be found on the INEEL site. Pronghorn wintering areas are located in the northeastern portion of the site, in the area of the Big Lost River sinks, in the west-central portion of the site along the Big Lost River, and in the south-central portion of the site (DOE 1996c). Hunting of pronghorn and elk to control crop damage is permitted on site within 0.8 kilometers (0.5 miles) of the site boundary (LMITC 1997). Numerous raptors, such as the golden eagle and prairie falcon, and carnivores, such as the coyote and mountain lion, are also found on the INEEL site.

ANL-W is located within one of several sagebrush communities found on the INEEL site (Figure 3–4). While sagebrush is present on undeveloped portions of the site, developed areas are nearly devoid of vegetation. Wildlife use of developed portions of the site is negligible; however, surrounding areas do provide natural habitat for a variety of wildlife. While elk and mule deer are the most important large mammals present in the area, many of the common species discussed above also would be expected. The ANL-W wastewater pond acts as an important source of water for wildlife found in the vicinity of the site (Cieminski and Flack 1995).

3.2.6.2 Wetlands

National Wetland Inventory maps prepared by the U.S. Fish and Wildlife Service indicate that the primary wetland areas on the INEEL site are associated with the Big Lost River, the Big Lost River spreading areas, and the Big Lost River sinks (or playas) (Figure 3–2). Smaller isolated wetlands (less than 0.4 hectares [1 acre]) also occur on the site (DOE 1996c). The only area of jurisdictional wetland is the Big Lost River sinks (Evans et al. 1998).

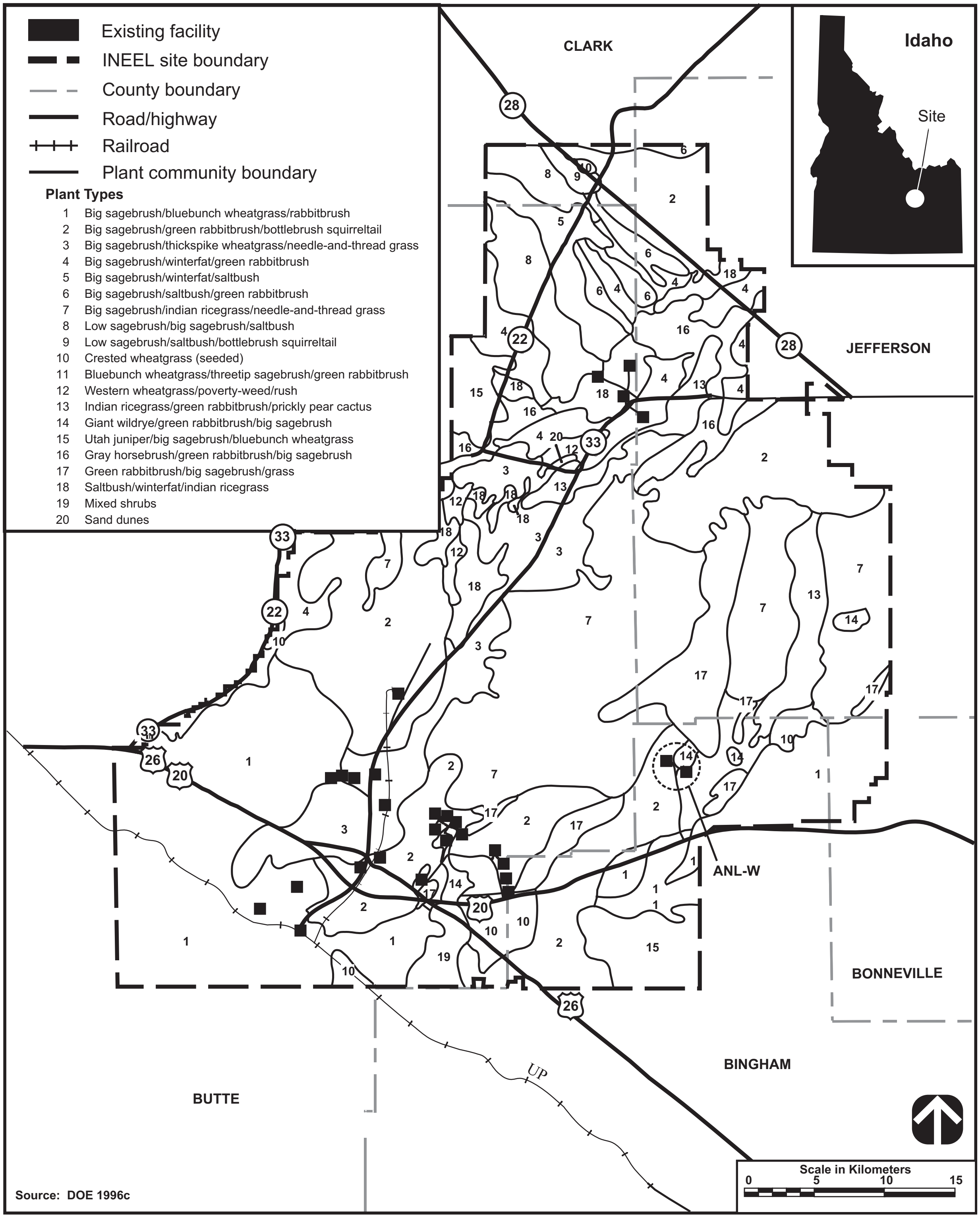

Figure 3–4 Distribution of Plant Communities at Idaho National Engineering and Environmental Laboratory

Wetland vegetation exists along the Big Lost River, which is located 18 kilometers (11 miles) west of ANL-W; however, this vegetation is in poor condition due to recent years of only intermittent flows. The Big Lost River spreading areas and Big Lost River sinks are seasonal wetlands and are located 33 kilometers (21 miles) west southwest and 23 kilometers (14 miles) northeast of ANL-W, respectively. These areas can provide more than 809 hectares (2,000 acres) of wetland habitat during wet years. Within ANL-W itself, small areas of intermittent marsh occur along cooling tower blowdown ditches (Morris 1996).

3.2.6.3 Aquatic Resources

Aquatic habitat on the INEEL site is limited to the Big Lost River, Little Lost River, Birch Creek, and a number of liquid-waste disposal ponds. All three streams are intermittent and drain into four sinks in the north-central part of the site. Six species of fish have been observed within water bodies located on the site (ESRF 1999). Species observed in the Big Lost River include brook trout, rainbow trout, mountain whitefish, speckled dace, shorthead sculpin, and kokanee salmon. The Little Lost River and Birch Creek enter INEEL only during periods of high flow. Surveys of fish in these surface water bodies have not been conducted. The liquid waste disposal ponds on the INEEL site, while considered aquatic habitat, do not support fish.

There is no natural aquatic habitat on or in the vicinity of the ANL-W site. The nearest such habitat is the Big Lost River, which is located 18 kilometers (11 miles) west of the site. ANL-W waste disposal ponds do not contain any fish populations, but do provide habitat for a variety of aquatic invertebrates (Cieminski and Flack 1995).

3.2.6.4 Threatened and Endangered Species

Nineteen Federally and state-listed threatened, endangered, and other special status species may be found on and in the vicinity of the INEEL site, 12 of which have been observed at the site (see Table 3–1 of the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* [DOE 1996c]). Two of these species, the bald eagle and peregrine falcon, are Federally listed as threatened and endangered, respectively. Each is listed as endangered by Idaho. The bald eagle rarely has been seen in the western and northern portion of INEEL. The peregrine falcon is an infrequent visitor to the site. The occurrence of the gray wolf (listed endangered, experimental populations) on the INEEL site is unverified. No critical habitat for threatened or endangered species, as defined in the *Endangered Species Act*, exists on the INEEL site.

The ANL-W area was surveyed in 1996 for threatened, endangered, and special status species (Morris 1996). The only listed species observed were the peregrine falcon and loggerhead shrike. While no peregrine falcon nests were found near ANL-W, one perigrene falcon was observed perched on a power line 1.5 kilometers (0.9 miles) from the site. The loggerhead shrike, which is listed by Idaho as a species of concern, has been seen on numerous occasions in the vicinity of the site. The gray wolf (state endangered), and the pigmy rabbit and Townsend's big-eared bat (state species of concern), were not identified in the vicinity of ANL-W during the surveys. In addition, no Federally or state-listed plants were found in the vicinity of the site. Consultation has been initiated with both the U.S. Fish and Wildlife Service and the state.

3.2.7 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 recording of cultural and paleontological resources. Guidance for the identification, evaluation, and management of these resources is included in the *Idaho National Engineering Laboratory Management Plan for Cultural Resources* (Final Draft) (Miller 1995). Past studies, which covered 4 percent of the site, identified 1,506 cultural resource sites and isolated finds including 688 prehistoric sites, 38 historic sites, 753 prehistoric isolates, and 27 historic isolates (DOE 1996c).

As of January 1998, approximately 7 percent of INEEL has been surveyed, raising the number of potentially significant archaeological sites to 1,839 (DOE 1999a). Most surveys have been conducted near major facility areas in conjunction with modification, demolition, or abandonment of site facilities.

3.2.7.1 Prehistoric Resources

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

The most recent cultural resource survey conducted near ANL-W took place in 1996 and covered an area to the south of the site that had been burned over by a wildfire and was proposed for revegetation (CEEA 1996). A total of 12 isolated finds and 2 archaeological sites were located. Isolated finds included items such as pieces of Shoshone brownware pottery, projectile points, farm implements, and broken glass. The archaeological sites included projectile points, scrappers, and volcanic glass flakes. A number of recent items such as a belt buckle and a large scatter of cans also were found. Areas within the fenced portion of ANL-W are highly disturbed and are not likely to yield significant archaeological material.

3.2.7.2 Historic Resources

Thirty-eight historic sites and 27 historic isolates have been identified at INEEL (DOE 1996a). 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 research and development 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. Additional historic sites are likely to exist in unsurveyed portions of INEEL.

As noted under Prehistoric Resources above, a limited number of recent artifacts have been located in the vicinity of ANL-W. The Experimental Breeder Reactor-II has been designated as an American Nuclear Society Historical Landmark (DOE 1997c). Consultation has been initiated with the State Historic Preservation Office.

3.2.7.3 Native American Resources

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 plant and animal 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. The value of certain areas on the INEEL site was recognized in the *1994 Memorandum of Agreement with the Shoshone-Bannock Tribes* (DOE 1994a), which provides tribal members access to the Middle Butte area to perform sacred or religious ceremonies or other educational or cultural activities.

Although prehistoric Native American resources have been found in the vicinity of ANL-W (see Prehistoric Resources), the *1994 Memorandum of Agreement with the Shoshone-Bannock Tribes* (DOE 1994a) does not affect the site (DOE 1997c). Consultation has been initiated with the Shoshone and Bannock Tribes.

3.2.7.4 Paleontological Resources

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. The region encompassing INEEL has abundant and varied paleontological resources, including plant, vertebrate, and invertebrate remains from soils; lake and river sediments; and organic materials found in caves and archaeological sites. Vertebrate fossils recovered from the Big Lost River floodplain consist of isolated bones or teeth from large mammals of the Pleistocene or Ice Age. Fossils have been recorded in the vicinity of the Naval Reactors Facility, and a single mammoth tooth was salvaged during the excavation of a percolation pond immediately south of INTEC. Occasional fossil mammoth, horse, and camel skeletal elements 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 (DOE 1998b). In total, 24 paleontological localities have been identified at INEEL (Miller 1995).

Paleontological resources were not found in the immediate vicinity of ANL-W during a recent archaeological survey (CEEA 1996).

3.2.8 Socioeconomics

Statistics for employment and economy are presented for the regional economic area, which encompasses 13 counties around INEEL located in Idaho and Wyoming. Statistics for population, and housing, community services, and local transportation are presented for the region of influence. The region of influence is a four-county area in Idaho in which 94.4 percent of all INEEL employees reside (**Table 3–5**). In 1997, total INEEL employment was 8,291 persons (5.5 percent of the regional economic area civilian labor force).

Table 3–5 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
Region of Influence Total	7,828	94.4

Source: DOE 1998b.

3.2.8.1 Regional Economy Characteristics

Between 1990 and 1996, the civilian labor force in the regional economic area increased 26 percent to the 1996 level of 150,835. In 1996, the annual unemployment average in the regional economic area was 4.8 percent, slightly less than the annual unemployment average for Idaho (5.2 percent) and Wyoming (5 percent).

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

3.2.8.2 Population and Housing

In 1996, the region of influence population totaled 213,547. Between 1990 and 1996 the region of influence population increased by 10.6 percent, compared with a 17.5 percent increase in Idaho's population. Between 1980 and 1990 the number of housing units in the region of influence increased by 6.7 percent, compared with a 10.2 percent increase in Idaho (DOE 1998b). The total number of housing units in the region of influence for 1990 was 69,760. In 1995, the total number of owner and renter housing units within the region of influence was 74,600 (DOE 1996a). The 1990 region of influence homeowner vacancy rate was 2.1 percent, compared with Idaho's rate of 2.0 percent. The region of influence renter vacancy rate was 8.3 percent, compared with Idaho's rate of 7.3 percent.

3.2.8.3 Community Services

Community services include public education and public safety. In 1997, school districts providing public education in the INEEL region of influence were operating at capacities of between 50 to 100 percent. Total student enrollment in the INEEL region of influence in 1997 was 50,168, and the student-to-teacher ratio averaged 18.8 to 1. In 1990, the average student-to-teacher ratio for Idaho was 12.8 to 1. In 1997, a total of 475 sworn police officers were serving the four-county region of influence. The average INEEL region of influence officer-to-population ratio was 2.2 officers per 1,000 persons. This compares with the 1990 state average of 1.5 officers per 1,000 persons.

3.2.8.4 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 (Figure 3–1). DOE shuttle vans provide transportation between INEEL facilities and Idaho Falls for DOE and contractor personnel. The major railroad in the region of influence 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 region of influence capable of accommodating waterborne transportation of material shipments to INEEL. Fanning Field in Idaho Falls and Pocatello Municipal Airport in Pocatello provide jet air passenger and cargo service for both national and local carriers.

3.2.9 Environmental Justice

Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse health or environmental effects of programs and policies on minority and low-income populations in potentially affected areas. Minority populations refer to all people of color, exclusive of white non-Hispanics. Low-income populations refer to households whose incomes are below the

Federal poverty thresholds. In the case of INEEL, the potentially affected area includes only parts of central Idaho.

The 1990 census data show that the percentage of minorities within the contiguous United States was 24.1 percent, while within the State of Idaho it was 7.7 percent. The data also show that 13.1 percent of the incomes within the United States were below the poverty threshold. Within Idaho, 13.3 percent of the incomes were below the poverty threshold.

The potentially affected area surrounding the ANL-W is defined by a circle with an 80-kilometer (50-mile) radius centered at latitude 43°35'41.7" N, longitude 112°39'18.7" W. The total population residing within that area in 1990 was 180,582. The proportion of this population that was considered minority was 8.7 percent. At the time of the 1990 census, Hispanics and Native Americans were the largest minority groups within that area, constituting 5.2 percent and 2.2 percent of the total population, respectively. Asians constituted about 1 percent, and blacks about 0.3 percent.

A breakdown of incomes in the potentially affected area also is available from the 1990 census data. 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 25,046 persons (15.0 percent of the total population) residing within the potentially affected area around ANL-W reported incomes below that threshold.

3.2.10 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.

3.2.10.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of INEEL are shown in **Table 3–6**. 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 3–6 Sources of Radiation Exposure to Individuals in the INEEL Vicinity Unrelated to INEEL Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural background radiation[a]	
Cosmic radiation	48
External terrestrial radiation	74
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	less than 1
Air travel	1
Consumer and industrial products	10
Total	427

[a] Evans et al. 1998.
[b] An average for the United States.
[c] NCRP 1987.

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 1997 are listed in the *Idaho National Engineering Laboratory Site Environmental Report for Calendar Year 1997* (Evans et al. 1998). The doses to the public resulting from these releases are presented in **Table 3–7.** These doses fall within radiological limits per DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, and are much lower than those of background radiation.

Table 3–7 Radiation Doses to the Public From Normal INEEL 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 (millirem)	10	0.021	4	0	100	0.021
Population within 80 kilometers (person-rem)[b]	None	0.23	None	0	100	0.23
Average individual within 80 kilometers (millirem)[c]	None	0.0019	None	0	None	0.0019

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act, and the 4-millirem per year limit is required by the Safe Drinking Water Act. For this EIS, the 4-millirem per year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year is the limit from all pathways combined. The 100-person-rem value for the population is given in the proposed 10 CFR 834, *Radiation Protection of the Public and Environment; Proposed Rule*, as published in 58 FR 16268. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility is required to notify DOE.

[b] About 121,400 in 1997.

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

Source: Evans et al. 1998.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (see Appendix E), the fatal cancer risk to the maximally exposed member of the public due to radiological releases from INEEL operations in 1997 is estimated to be 1.1×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with one 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.)

According to the same risk estimator, 1.2×10^{-4} excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of INEEL from normal operations in 1997. 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 1995 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1997 from all causes in the population living within 80 kilometers (50 miles) of INEEL was 243. This expected number of fatal cancers is much higher than the 1.2×10^{-4} fatal cancers estimated from INEEL operations in 1997.

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. The average dose to the individual worker and the cumulative dose to all workers at INEEL from operations in 1997 are presented in **Table 3–8.** These doses fall within the radiological regulatory limits of 10 CFR 835 (DOE 1995a). According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers (see Appendix E), the number of projected fatal cancers among INEEL workers from normal operations in 1997 is 0.046. 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.

Table 3–8 Radiation Doses to Workers From Normal INEEL Operations in 1997 (Total Effective Dose Equivalent)

Occupational Personnel	Onsite Releases and Direct Radiation	
	Standard [a]	Actual
Average radiation worker (millirem)	None[b]	101[c]
Total workers (person-rem)[d]	None	115[c]

[a] The radiological limit for an individual worker is 5,000 millirem per year. 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 millirem per year; 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] 1,141 workers with measurable doses in 1997.
Source: DOE 1995a, DOE 1998g.

A more detailed presentation of the radiation environment, including background exposures and radiological releases and doses, is presented in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 1997* (Evans et al. 1998). 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.

External radiation doses and concentrations of plutonium in air have been measured at ANL-W. The onsite dose is measured for comparison against natural background levels measured at offsite control locations; the numerical difference in these measurements may be directly attributable to radiological sources that are located in the vicinity of the onsite measurement location. In 1997, the annual average dose within the area was about 144 millirem. This is about 5 millirem higher than the average dose measured at offsite control locations. Concentrations in air of plutonium-239 and plutonium-240 in 1996 were 3.4×10^{-18} microcuries per milliliter. This value is essentially the same as those measured at an offsite control location. Finally, concentrations in air of gross alpha and beta at ANL-W are 6.0×10^{-16} microcuries per milliliter and 2.0×10^{-14} microcuries per milliliter, respectively. These alpha and beta concentrations are essentially the same as those measured at offsite control locations (Evans et al. 1998).

3.2.10.2 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 cancerous and noncancerous health effects.

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 by inhaling air containing hazardous chemicals released to the atmosphere during normal INEEL operations. Risks to public health from other possible pathways, such as ingesting 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.

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 E.

Exposure pathways to INEEL workers during normal operation may include inhaling contaminants in the workplace 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 also are protected by adherence to Occupational Health and Safety 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 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.

3.2.10.3 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 of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE 1996c). No excess cancer mortality was reported, and although excess cancer incidence was observed, no association 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" (DOE 1996c).

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, are investigating the effects of workforce restructuring (downsizing) in the nuclear weapons industry. The health of displaced workers will be studied. Under a National Institute of Occupational Safety and Health 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 begun 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; Mount Sinai School of Medicine; the University of Massachusetts at Lowell; and Alice Hamilton College. A mortality study of the workforce at INEEL being conducted by National Institute of Occupational Safety and Health is pending publication. 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 of Weapons-Usable Fissile Materials Final Programmatic EIS* (DOE 1996c).

3.2.10.4 Accident History

DOE conducted a study, the *Idaho National Engineering Laboratory Historical Dose Evaluation*, to estimate the potential offsite radiation doses for the entire operating history of INEEL (DOE 1996c). 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 substances at INEEL facilities in the last 10 years of operation.

3.2.10.5 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, training, preparedness, and response.

Government agencies whose plans are interrelated with the INEEL Emergency Plan for Action include the State of Idaho, Bingham, Bonneville, Butte, Clark, and Jefferson Counties, 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, notification, 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 available to provide routine and emergency service. In addition, 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.

3.2.11 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 is in compliance with all applicable Federal and state statutes and DOE Orders.

3.2.11.1 Waste Inventories and Activities

INEEL manages the following types of waste: high-level radioactive waste, transuranic waste, mixed transuranic, low-level radioactive waste, mixed waste, hazardous, and nonhazardous. Waste generation rates and the inventory of stored waste from activities at INEEL are provided in **Table 3–9.** The INEEL waste management capabilities are summarized in **Table 3–10.** More detailed descriptions of the waste management system capabilities at INEEL are included in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c) and the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a).

EPA placed INEEL on the National Priorities List[1] 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 the year 2019 (DOE 1996c). More information on regulatory requirements for waste disposal is provided in Chapter 5.

[1]The National Priorities List is a list of those sites requiring cleanup that appear to have the most serious threat to public health or the environment due to the release of hazardous substances. The list is promulgated by the EPA under CERCLA.

Table 3–9 Waste Generation Rates and Inventories at INEEL

Waste Type	*Generation Rate (cubic meters)*	*Inventory (cubic meters)*
High-Level Radioactive	0[a]	4,000[b]
Transuranic	0[c]	65,000[d]
Low-Level Radioactive	6,400[e]	6,000[f]
Mixed	230	1,700
Hazardous	835[c,h]	Not applicable[i]
Nonhazardous		
Liquid	2,000,000[c,j]	Not applicable[i]
Solid	62,000[c]	Not applicable[i]

[a] Refer to the text.
[b] INEEL 1999b. The inventory is calcined high-level radioactive waste.
[c] Moor and Peterson 1999.
[c] DOE 1995a.
[e] LMITC 1998.
[f] Bright 1999.
[g] DOE 1998e.
[h] Includes 760 cubic meters that are recyclable.
[I] Generally, hazardous and nonhazardous wastes are not held in long-term storage.
[j] Projected annual average generation amounts for 1997–2006.
Note: To convert from cubic meters to cubic yards, multiply by 1.31.
Sources: Given in footnotes b through g, above.

Table 3–10 Waste Management Capabilities at INEEL

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*						
			HLW	*TRU*	*Mixed TRU*	*LLW*	*Mixed*	*Haz*	*Non-Haz*
Treatment Facility (cubic meters per year except as otherwise specified)									
INTEC High-Efficiency Particulate Air Filter Leach, cubic meters per day	0.21	Online			X		X		
INTEC Debris Treatment and Containment, cubic meters per day	88	Waiting for Part B Permit			X		X		
Advanced Mixed Waste Treatment Project	6,500	Planned for 2003			X		X		
INTEC New Waste Calcining Facility	248	Online	X						
ANL–W Remote Treatment Facility	42	Planned for 2000		X	X	X	X		
ANL–W Hot Fuel Examination Facility 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 High-Level Radioactive Waste 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		

Facility Name/Description	*Capacity*	*Status*	*Applicable Waste Type*						
			HLW	*TRU*	*Mixed TRU*	*LLW*	*Mixed*	*Haz*	*Non-Haz*
Test Area North Cask Dismantlement	11	Online					X		
Waste Reduction Operations Complex - Debris Sizing, kilograms per hour	1,149	Planned for 2000				X	X		
Waste Reduction Operations Complex - Macroencapsulation, kilograms per hour	2,257	Planned for 1999					X		
Waste Reduction Operations Complex - Stabilization, cubic meters per day	7.6	Online					X		
Waste Experimental Reduction Facility	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 (cubic meters)									
INTEC Tank Farm	12,533	Online			X		X		
INTEC Calcine Bin Sets	6,950	Online	X						
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		
ANL–W EBR-II Sodium Boiler Drain Tank	64	Online					X		
ANL–W Hot Fuel Examination Facility Waste Characterization Area	37	Online		X	X				
INTEC Fluorinel Dissolution Process High-Efficiency Particulate Air Storage	25	Online			X		X		
INTEC New Waste Calcining Facility High-Efficiency Particulate Air Storage	56	Online			X		X		
INTEC Chemical Processing Plant-1619 Storage	45	Online					X	X	
INTEC Chemical Processing Plant-1617 Staging	8,523	Online					X	X	
Radioactive Waste Management Complex Transuranic Storage Area-RE[a]	64,900	Online		X	X	X	X		
Radioactive Waste Management Complex Waste Storage[a]	112,400	Online		X	X	X	X		
Radioactive Waste Management Complex Intermediate-Level Storage	100	Online		X					
Waste Reduction Operations Complex Power Burst Facility Mixed Waste Storage	129	Online					X	X	

Facility Name/Description	Capacity	Status	Applicable Waste Type HLW	TRU	Mixed TRU	LLW	Mixed	Haz	Non-Haz
Portable Storage at Special Power Excursion Reactor Test IV	237	Online					X	X	
Power Burst Facility Waste Experimental Reduction Facility Waste Storage Building	685	Online					X	X	
Test Area North 647 Waste Storage	104	Online					X	X	
Test Area North 628 Specific Manufacturing Complex Container Storage	125	Online					X	X	
Disposal Facility (cubic meters per year)									
Radioactive Waste Management Complex Disposal Facility	37,700	Online				X			
Central Facilities Area Landfill Complex	48,000	Online							X
Percolation Ponds	2,000,000	Online							X

EBR = Experimental Breeder Reactor, HAZ = hazardous waste, HLW = high-level radioactive waste, INTEC = Idaho Nuclear Technology and Engineering Center, LLW = low-level radioactive waste, TRU = transuranic waste

[a] For these facilities, the low-level radioactive waste and mixed waste are considered alpha contaminated low-level radioactive waste and alpha contaminated mixed waste (waste containing between 10 and 100 nanocuries per gram).

Source: DOE 1998b, DOE 1999d.

3.2.11.2 High-Level Radioactive Waste

High-level radioactive waste at INEEL was generated in the process of extracting useful isotopes from spent nuclear fuel at INTEC. Most of this fuel was from the Naval Reactors Program. Most aqueous solutions from spent nuclear fuel processing and isotope extraction were concentrated by evaporation and separated into low-level radioactive waste streams in the Process Equipment Waste Evaporator. The liquid high-level radioactive waste was stored in subsurface tanks and then transformed by calcination into solid metallic oxides in a granular form. This calcination was completed in February 1998. The calcine is stored in stainless steel bins in near-surface concrete vaults where it awaits further processing into a form suitable for emplacement in a Federal repository. INEEL met the requirements of a December 1991 consent order with the State of Idaho and the EPA to cease the use of existing storage tanks without constructing new tanks. Subsequently, the calcined waste will be treated to meet RCRA provisions on a schedule to be negotiated with the State of Idaho under the Federal Facility Compliance Act.

3.2.11.3 Transuranic Waste

Transuranic 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 1996c). Some transuranic waste is also stored at the Radioactive Scrap and Waste Facility at ANL–W (DOE 1995a). There is very little transuranic waste generated at INEEL. Most of the transuranic waste in storage was received from the Rocky Flats Environmental Technology Site (DOE 1996a). Transuranic waste is currently being stored pending shipment to the Waste Isolation Pilot Plant. The first shipment of transuranic waste from INEEL was received at the Waste Isolation Pilot Plant on April 28, 1999 (DOE 1999c). Transuranic waste is treated to meet the Waste Isolation Pilot Plant waste acceptance criteria, packaged in accordance with DOE and U.S. Department of Transportation requirements, and transported to the Waste Isolation Pilot Plant for disposal (DOE 1996c).

The existing treatment facilities for transuranic waste at INEEL are limited to testing, characterization, and repackaging. The planned Waste Characterization Facility will characterize (identify) transuranic waste and either reclassify it (if it is found to be low-level radioactive waste) for disposal on the site, or prepare it so that it meets Waste Isolation Pilot Plant waste acceptance criteria (DOE 1996c).

The Advanced Mixed Waste Treatment Project will be operated as a private sector treatment facility after its construction is completed (INEEL 1999a). This facility will: (1) treat waste to meet Waste Isolation Pilot Plant waste acceptance criteria, RCRA Land Disposal Restrictions, 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. Construction of a mixed waste Disposal Facility and Plasma Hearth Treatment Facility is being considered to support commercial treatment of mixed transuranic waste and alpha-contaminated mixed waste subject to funding restraints and additional NEPA review (DOE 1998b).

Waste containing between 10 and 100 nanocuries per gram of transuranic radionuclides is called alpha low-level radioactive waste. Although this waste is technically considered low-level radioactive waste rather than transuranic waste, it cannot be disposed of at INEEL because it does not meet all INEEL low-level radioactive waste disposal facility acceptance criteria. Alpha low-level radioactive waste and alpha mixed waste are managed together as part of the Transuranic Waste program. It is expected that these wastes will be treated by the Advanced Mixed Waste Treatment Project and then disposed of at the Waste Isolation Pilot Plant (DOE 1998b).

3.2.11.4 Low-Level Radioactive Waste

Liquid low-level radioactive waste either is evaporated and processed to a calcine form or solidified before disposal (DOE 1996a). INTEC has the capability to treat aqueous low-level radioactive waste. Liquid low-level radioactive waste is concentrated at the INTEC Process Equipment Waste Evaporator, and the condensed vapor is processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated materials remaining after evaporation are pumped to the INTEC tank farm. Some small volumes of liquid low-level radioactive waste are solidified at the Waste Experimental Reduction Facility for disposal at the Radioactive Waste Management Complex. In addition, small volumes of aqueous low-level radioactive waste are discharged to the double-lined pond at the Test Reactor Area for evaporation (DOE 1995a).

Most solid low-level radioactive waste 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 (DOE 1998b). Disposal occurs in pits and concrete-lined soil vaults in the subsurface disposal area of the Radioactive Waste Management Complex (DOE 1995a). About 40 percent of the low-level radioactive waste generated at INEEL (containing less than 10 nanocuries per gram of radioactivity) is buried in shallow trenches; the remaining 60 percent is buried at the Radioactive Waste Management Complex following treatment for volume reduction. Additionally, some low-level radioactive waste is shipped offsite 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, although some proposals would close the low-level radioactive waste Disposal Facility by 2006 (DOE 1998b).

3.2.11.5 Mixed Waste

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

Mixed waste, including polychlorinated biphenyls–contaminated low-level radioactive waste, is stored in several onsite areas awaiting the development of treatment methods (DOE 1996c). Mixed waste is stored at the mixed waste storage facility (the Waste Experimental Reduction Facility Waste Storage Building) and in portable storage units at the Power Burst Facility area. In addition, smaller quantities of mixed waste 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 1995a). 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 1996c).

Aqueous mixed waste is concentrated at INTEC. The condensate from the waste evaporator is processed by the Liquid Effluent Treatment and Disposal Facility. The concentrated material remaining after evaporation (mixed waste) is pumped to the INTEC tank farm for storage (DOE 1998b).

As part of the site treatment plans required by the Federal Facility Compliance Agreement, preferred treatment options have been identified to eliminate the hazardous waste component for many types of mixed waste (DOE 1995a). Mixed waste is or will be processed to RCRA Land Disposal Restrictions treatment standards through several treatment facilities. Those treatment facilities and their 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 Filter Leach (operational); (6) Waste Reductions Operations Complex Macroencapsulation (March 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. Currently, limited amounts of mixed waste are disposed of at Envirocare of Utah (DOE 1998b).

3.2.11.6 Hazardous Waste

Approximately 1 percent of the total waste generated at INEEL is hazardous waste. Most of the hazardous waste generated annually at INEEL is transported offsite for treatment and disposal (DOE 1995a). Offsite shipments are surveyed to determine that the wastes have no radioactive content and, therefore, are not mixed waste (DOE 1996c). 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.

3.2.11.7 Nonhazardous Waste

Approximately 90 percent of the waste generated at INEEL is classified as industrial waste and is disposed of on site in a landfill complex in the Central Facilities Area and off site at the Bonneville County landfill (DOE 1995a). The onsite landfill complex contains separate areas for petroleum-contaminated media, industrial waste, and asbestos waste (DOE 1998b). The onsite landfill is 5 hectares (12 acres), and is being expanded by 91 hectares (225 acres) to provide capacity for at least 30 years (DOE 1996c).

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. Combustible waste is taken to the solid waste handling facility for sorting and cubing. The cubed material is taken to a steam-generating facility and converted from waste to energy (DOE 1998b).

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, and the resulting sludge is placed in the landfill. Solids are separated and reclaimed where possible (DOE 1996c). Nonhazardous service wastewater generated at INTEC is disposed of in percolation ponds at a flow rate of 3.8 million to 7.6 million liters per day (1 million to 2 million gallons per day). 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 cubic meters per year (4,190,000 cubic yards per year) (DOE 1998b).

3.2.11.8 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 of the waste that is generated to reduce its volume, toxicity, or mobility prior to storage or disposal. The 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. Implementation of pollution prevention projects reduced the total amount of waste generated at INEEL in 1997 by approximately 3,100 cubic meters (4,000 cubic yards) (DOE 1998d).

The INEEL waste minimization program has significantly reduced the quantities of hazardous waste generated at INEEL. For example, in 1992, 760 cubic meters (994 cubic yards) of hazardous waste were recycled. Recyclable hazardous materials include metals (such as bulk lead, mercury, chromium), solvents, fuel, and other waste materials (DOE 1995a). 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 1996c).

Another goal of the INEEL waste minimization program is to reduce nonhazardous waste generation by 33 percent by the end of 1999 (DOE 1998d). During 1993–1995, INEEL recycled more than 680,400 kilograms (1.5 million pounds) of paper and cardboard (DOE 1998b). Efforts are also underway to expand the recycling program to include asphalt and metals and to convert scrap wood into mulch (DOE 1995a).

3.2.11.9 Preferred Waste Management Alternatives from the Final Waste Management Programmatic Environmental Impact Statement and Associated Records of Decision

Preferred waste management alternatives from the Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive Hazardous Waste (Waste Management Programmatic EIS) (DOE 1997a) are shown in **Table 3–11** for the waste types analyzed in this 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 Record of Decisions to be issued on the Waste Management Programmatic EIS. The transuranic waste Record of Decision was issued on January 20, 1998 (63 FR 3629), and the hazardous waste Record of Decision on August 5, 1998 (63 FR 41810). The transuranic waste Record of Decision states, "each of the Department's sites that currently has or will generate transuranic waste will prepare and store its transuranic waste on site. . . ." The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of their nonwastewater hazardous waste, and the Oak Ridge Reservation and SRS will continue to treat some of their own nonwastewater hazardous waste on 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 are presented in the Waste Management Programmatic EIS and the hazardous waste and transuranic waste Record of Decisions.

Table 3–11 Preferred INEEL Waste Management Alternatives From the Waste Management Programmatic EIS and Associated Records of Decision

Waste Type	*Preferred Action*
High-level radioactive	DOE prefers onsite storage of INEEL's immobilized high-level radioactive waste pending disposal in a geologic repository.[a]
Transuranic and mixed transuranic	DOE has decided that INEEL should prepare and store its transuranic waste on site pending disposal at the Waste Isolation Pilot Plant.[b]
Low-level radioactive	DOE prefers to treat INEEL's low-level radioactive waste on site. INEEL could be selected as one of the regional disposal sites for low-level radioactive waste.[a]
Mixed	DOE prefers regionalized treatment of mixed waste at INEEL. This includes the onsite treatment of INEEL's wastes and could include treatment of some mixed waste generated at other sites. INEEL could be selected as one of the regional disposal sites for mixed waste.[a]
Hazardous	DOE has decided to continue to use commercial facilities for treatment of INEEL nonwastewater hazardous waste and onsite facilities for treatment of wastewater hazardous waste.[c]

[a] From the Waste Management Programmatic EIS (DOE 1997a).
[b] From the ROD for transuranic waste (63 FR 3629).
[c] From the ROD for hazardous waste (63 FR 41810).
Source: DOE 1997a; 63 FR 3629; 63 FR 41810.

3.3 SAVANNAH RIVER SITE

SRS is located on about 80,130 hectares (198,000 acres) in southwest South Carolina. The site is approximately 40 kilometers (25 miles) southeast of Augusta, Georgia, and 19 kilometers (12 miles) south of Aiken, South Carolina. First established in 1950, SRS has been involved in tritium operation and nuclear material production for more than 40 years. Today the site includes 16 major production, service, research, and development areas, not all of which are currently in operation. The site is owned by the Federal Government and is administered, managed, and controlled by DOE. It is bordered by the Savannah River to the southwest and includes portions of three South Carolina counties: Aiken, Allendale, and Barnwell.

There are more than 3,000 facilities at SRS, including 740 buildings with 511,000 square meters (5,500,000 square feet) of floor area. Major nuclear facilities at SRS include fuel and plutonium storage facilities, target fabrication facilities; nuclear material production reactors; chemical separations plants; a uranium fuel processing area; liquid high-level radioactive waste 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 with specification tritium for nuclear stockpile weapons. Filled reservoirs are delivered to Pantex for weapons assembly and directly to the Department of Defense to replace expired reservoirs. Historically, DOE has produced tritium at SRS, but has not produced any since 1988.

3.3.1 Land Resources

3.3.1.1 Land Use

Forest and agricultural land predominate in the areas bordering SRS (**Figure 3–5)**. 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 closest residences are to the west, north, and northeast, within 61 meters (200 feet) of the site boundary. The three counties in which SRS is located, Aiken, Allendale, and Barnwell, have not zoned any of the site land.

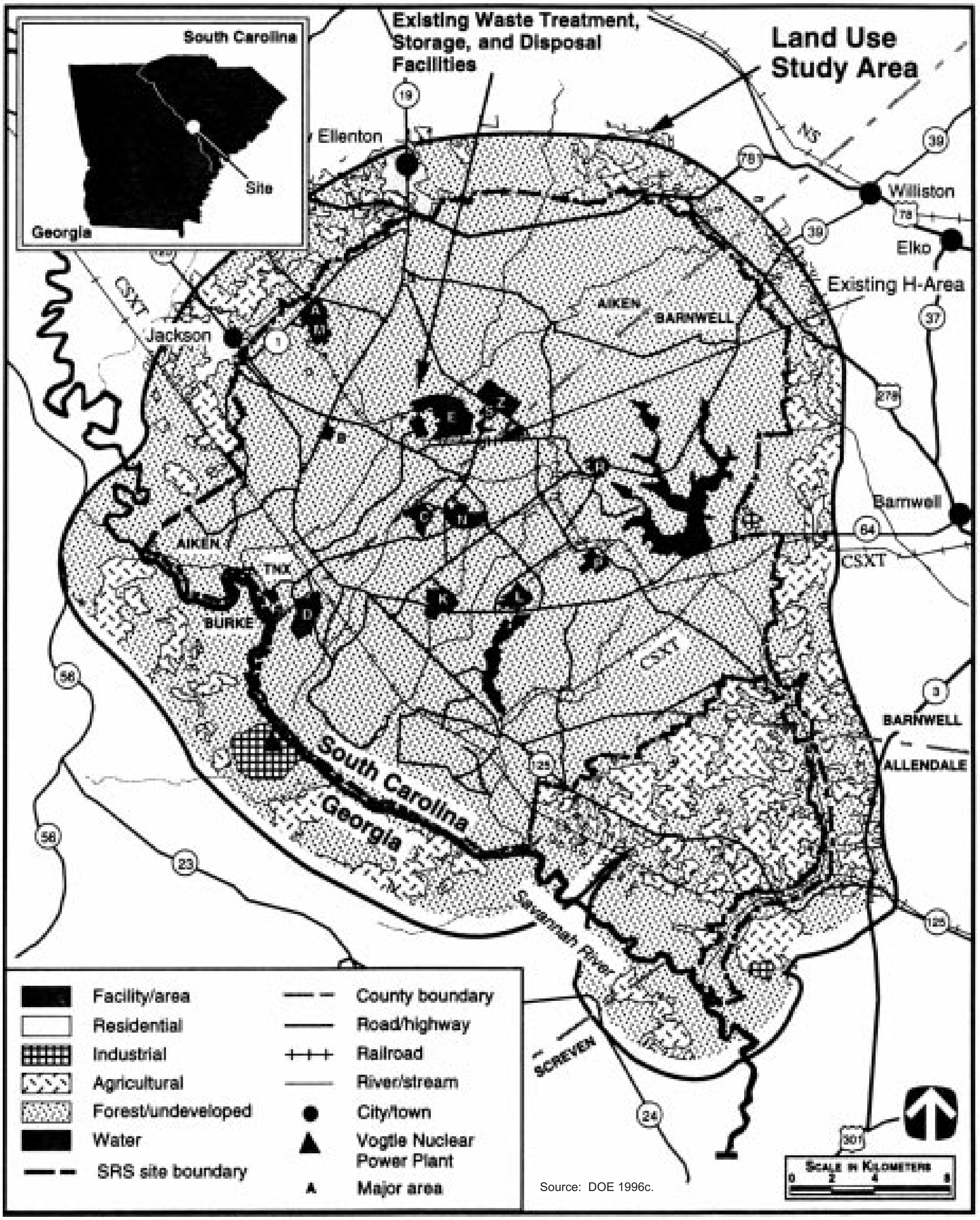

Figure 3–5 Generalized Land Use at Savannah River Site and Vicinity

Outdoor public recreation facilities are plentiful and varied in the SRS region. Included are the Sumter National Forest, 75 kilometers (47 miles) to the northwest; Santee National Wildlife Refuge, 80 kilometers (50 miles) to the east; and Clarks Hill/Strom Thurmond Reservoir, 70 kilometers (43 miles) 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. The Crackerneck Wildlife Management Area, which occupies over 1,930 hectares (4,770 acres) of SRS adjacent to the Savannah River, is open to the public for hunting and fishing.

Land use at SRS can be classified into three major categories: forest/undeveloped, water/wetlands, and developed facilities. Approximately 58,500 hectares (144,600 acres) (i.e., 73 percent) of the site is undeveloped. Wetlands, streams, and lakes account for 18,000 hectares (44,500 acres) or 22 percent of the site. Developed facilities, including production and support areas, roads, and utility corridors, encompass 4,000 hectares (9,900 acres) or 5 percent of SRS. Woodland areas are primarily managed for timber production. The U.S. Forest Service, under an interagency agreement with DOE, harvests about 730 hectares (1,800 acres) of timber from SRS each year. 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 has set aside approximately 5,700 hectares (14,100 acres) of SRS exclusively for nondestructive environmental research.

Land use in F-Area is classified as heavy industrial. The many facilities located in this area have historically been associated with chemical and physical processes used to separate uranium, plutonium, and fission products (DOE 1996b). Of the many buildings situated in these areas, the F-Canyon is the dominant structure.

Land use in L-Area is classified as heavy industrial. Facilities located in the area historically have been associated with nuclear materials production for national defense. The L Reactor was shut down in 1988 for safety upgrades and has not restarted (DOE 1998f). This facility would be used for processing sodium-bonded spent nuclear fuel if the melt and dilute alternative were selected.

3.3.1.2 Visual Resources

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 forested upland hills. DOE facilities are scattered throughout the site and are brightly lit at night. These facilities are generally not visible off site, 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 Visual Resource Management Class IV designation in which management activities dominate the view and are the focus of viewer attention (DOI 1986). The remainder of SRS generally ranges in Visual Resource Management designation from Class II to Class III. Management activities within these classes may be seen, but should not dominate the view.

Industrial facilities within F-Area and L-Area consist of large concrete structures, smaller administrative and support buildings, and parking lots. Structures generally range in height from 3 to 30 meters (10 to 100 feet). Facilities in these areas are brightly lit at night and are visible when approached via SRS access roads. However, neither area is visible from State Highway 125 or SRS Road 1 because of the distances involved and the presence of heavily wooded areas next to the roadways. Visual resource conditions in the F-Area and L-Area hold a Visual Resource Management Class IV designation.

3.3.2 Site Infrastructure

Site infrastructure includes those utilities and other resources required to support construction and continued operation of mission-related facilities identified under the various alternative actions. SRS comprises numerous research, processing, and administrative facilities. An extensive infrastructure system supports these facilities, as shown in **Table 3–12.**

Table 3–12 Savannah River Site-Wide Infrastructure Characteristics

Resource	*Current Usage*	*Site Capacity*
Transportation		
Roads (kilometers)	230	Not applicable
Railroads (kilometers)	103	Not applicable
Electricity		
Energy consumption (megawatt hours per year)	420,000	5,200,000
Peak load (megawatts)	70	330
Fuel		
Natural gas (cubic meters per year)	Not applicable	Not applicable
Oil (liters per year)	28,400,000	Not applicable[a]
Coal (tons per year)	210,000	Not applicable[a]
Water (liters per year)	1,780,000,000	3,870,000,000

[a] As supplies get low, more can be supplied by truck or rail.
Source: DOE 1998b.

3.3.2.1 Transportation

SRS has an extensive network—230 kilometers (140 miles)—of roads to meet its onsite intrasite transportation requirements. The railroad infrastructure, which consists of 103 kilometers (64 miles) of track, provides deliveries of large volumes of coal and oversized structural components.

3.3.2.2 Electricity

The SRS electrical grid is a 115-kilovolt system in a ring arrangement that supplies power to operating areas, administrative areas, and independent and support function areas. That system includes about 160 kilometers (100 miles) of transmission lines. Power is supplied to the grid by three South Carolina Electric and Gas Company 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.

Current site electricity consumption is about 420,000 megawatt hours per year. Site capacity is about 5.2 million megawatt hours per year. The peak load capacity is 330 megawatts; the peak load usage, 70 megawatts.

3.3.2.3 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. The A-Area powerhouse provides process and heating steam for the main administrative area at SRS. The D-Area powerhouse provides most of the steam for the SRS process area. Natural gas is not used at SRS.

3.3.2.4 Water

A new central domestic water system serves the majority of the site. The system includes: three wells and a 17-million-liters per day (4.5-million-gallons per day) water treatment plant in A-Area; two wells and an 8.3-million-liters per day (2.2-million-gallons per day) backup water treatment plant in B-Area; three elevated storage tanks; and a 43-kilometer (27-mile) piping loop. This central loop system has an estimated 1,680 liters per minute (444 gallons per minute) excess capacity that could be increased by the installation of an additional elevated storage tank. Process water is provided to individual site areas.

3.3.2.5 Site Safety Services

The SRS fire department operates under a 12-hour 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, who are responsible for rescues of all types. The fire department is supported by a fleet of 20 vehicles, including a 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.

3.3.3 Air Quality and Noise

3.3.3.1 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.

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°C (63.2°F); temperatures vary from an average daily minimum of 0°C (32°F) in January to an average daily maximum of 33.2°C (91.7°F) in July. The average annual precipitation at SRS is 114 centimeters (45 inches). 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, the nearest National Weather Service Station, is 2.9 meters per second (6.5 miles per hour) (NOAA 1994b).

SRS is near the center of the Augusta-Aiken Interstate Air Quality Control Region #53. None of the areas within SRS and its surrounding counties are designated as nonattainment areas with respect to the National Ambient Air Quality Standards (NAAQS) for criteria air pollutants (40 CFR 50). Applicable NAAQS and state ambient air quality standards are presented in **Table 3–13.**

Table 3–13 Comparison of Modeled Ambient Air Concentrations From Savannah River Site Sources With Most Stringent Applicable Standards or Guidelines

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meter)* [a]	*Savannah River Site Concentration (micrograms per cubic meter)*
Criteria pollutants			
Carbon monoxide	8 hours 1 hour	10,000[b] 40,000[b]	632 5010
Nitrogen dioxide	Annual	100[b]	8.8
Ozone	8 hours	157[c]	(d)
PM_{10}	Annual 24 hours (interim) 24 hours (99th percentile over 3 years)	50[b] 150[b] 150[c]	4.8 80.6 (e)
$PM_{2.5}$	3 year annual 24 hours (98th percentile over 3 years)	15[c] 65[c]	(e) (e)
Sulfur dioxide	Annual 24 hours 3 hours	80[b] 365[b] 1,300[b]	16.3 215 690
State regulated pollutants			
Gaseous fluoride	30 days 7 days 24 hours 12 hours	0.8[f] 1.6[f] 2.9[f] 3.7[f]	0.11 0.06 1.2 2.4
Total suspended particulates	Annual	75[f]	43.3
Hazardous and other toxic compounds			
1,1,1-Trichloroethane	24 hours	9,550	22
Benzene	24 hours	150	31
Ethanolamine	24 hours	200	less than 0.01
Ethyl benzene	24 hours	4,350	0.12
Ethylene glycol	24 hours	650	0.08
Formaldehyde	24 hours	7.5	less than 0.01
Glycol ethers	24 hours	Not applicable	less than 0.01
Hexachloronaphthalene	24 hours	1	less than 0.01
Hexane	24 hours	200	0.07
Manganese	24 hours	25	0.1
Mercury	24 hours	0.25	less than 0.01
Methyl alcohol	24 hours	1,310	0.51
Methyl ethyl ketone	24 hours	14,750	0.99
Methyl isobutyl ketone	24 hours	2,050	0.51
Methylene chloride	24 hours	515	1.8
Naphthalene	24 hours	1,250	0.01
Nitric acid	24 hours	125	6.7
Phenol	24 hours	190	0.03
Phosphorous	24 hours	0.5	less than 0.001

Pollutant	*Averaging Period*	*Most Stringent Standard or Guideline (micrograms per cubic meter)*[a]	*Savannah River Site Concentration (micrograms per cubic meter)*
Sodium hydroxide	24 hours	20	0.01
Toluene	24 hours	2,000	1.6
Trichloroethene	24 hours	6,750	1
Vinyl acetate	24 hours	176	0.02
Xylene	24 hours	4,350	3.8

[a] The more stringent of the Federal and state standards is presented if both exist for the averaging period.
[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 particulate matter concentrations.
[f] South Carolina state standard.
Source: DOE 1998f, Bickford et al. 1997, SCDHEC 1998, 40 CFR 50, 62 FR 38855, 62 FR 38652.

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, 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.

Table 3–13 presents the ambient air concentrations attributable to sources at SRS. These concentrations are based on dispersion modeling using emissions for the year 1994 (DOE 1998f). Only those toxic and hazardous air pollutants that would be emitted for any of the alternatives analyzed in this EIS are presented. Concentrations shown in Table 3–13 that are attributable to SRS are in compliance with applicable guidelines and regulations.

Data for 1995 from nearby South Carolina monitors at Jackson, Barnwell, and Beech Island (located 30 kilometers [18.6 miles] west of the site) indicate that the NAAQS for particulate matter, lead, ozone, sulfur dioxide, and nitrogen dioxide are not exceeded in the area around SRS. Air pollutant measurements at these monitoring locations during 1995 showed: (1) for nitrogen dioxide, an annual average concentration of 9.4 micrograms per cubic meter; (2) for sulfur dioxide, concentrations of 99 micrograms per cubic meter for 3-hour averaging, 24 micrograms per cubic meter for 24-hour averaging, and 5 micrograms per cubic meter for the annual average; (3) for total suspended particulates, an annual average concentration of 37 micrograms per cubic meter; and (4) for PM_{10}, concentrations of 62 micrograms per cubic meter for 24-hour averaging and 19 micrograms per cubic meter for the annual average.

There are no Prevention of Significant Deterioration Class I areas within 100 kilometers (62 miles) of SRS. None of the facilities at SRS have been required to obtain a Prevention of Significant Deterioration permit (DOE 1996c). There are no Prevention of Significant Deterioration increment-consuming sources at SRS.

The meteorological conditions described for SRS are considered representative of F-Area and L-Area. The primary sources of nonradiological air emissions at the F-Area and L-Area are diesel generators.

3.3.3.2 Noise

Major noise sources at SRS are primarily in developed or active areas and include various industrial facilities, equipment, and machines. 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. Major noise emission sources outside of these active areas consist primarily of vehicles and rail operations.

An 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 meters (50 feet) from the roadway, indicate that the 1-hour equivalent sound level from traffic ranged from 48 to 72 decibels A-weighted. The estimated day-night average sound levels along this route were 66 decibels A-weighted for summer and 69 decibels A-weighted for winter. Similarly, noise measurements along State Route 19 in the town of New Ellenton at a point about 15 meters (50 feet) from the roadway indicate that the 1-hour equivalent sound level from traffic ranged from 53 to 71 decibels A-weighted. The estimated day-night average sound levels along this route were 68 decibels A-weighted for summer and 67 decibels A-weighted for winter.

No distinguishing noise characteristics at F-Area and L-Area have been identified. These areas are 8 kilometers (5 miles) and 13 kilometers (8 miles) or more from the site boundary, respectively. Thus, contributions to noise levels at the site boundary from these areas are not measurable.

3.3.4 Water Resources

3.3.4.1 Surface Water

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 2 tributaries, Tims Branch and Tinker Creek; Pen Branch has 1 tributary, called Indian Grave Branch; and Steel Creek has 1 tributary, called Meyers Branch **(Figure 3–6)** (DOE 1996c).

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, up to 350 to 400 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 stormwater runoff (DOE 1996c, DOE 1998f, WSRC 1997b).

Water historically has been withdrawn from the Savannah River for use mainly as cooling water; some, however, has been used for domestic purposes. SRS currently withdraws about 140 billion liters per year (37 billion gallons per year) from the river. Most of this water is returned to the river through discharges to various tributaries (DOE 1996c).

The average flow of the Savannah River is 280 cubic meters per second (10,000 cubic feet per second). 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 1995b).

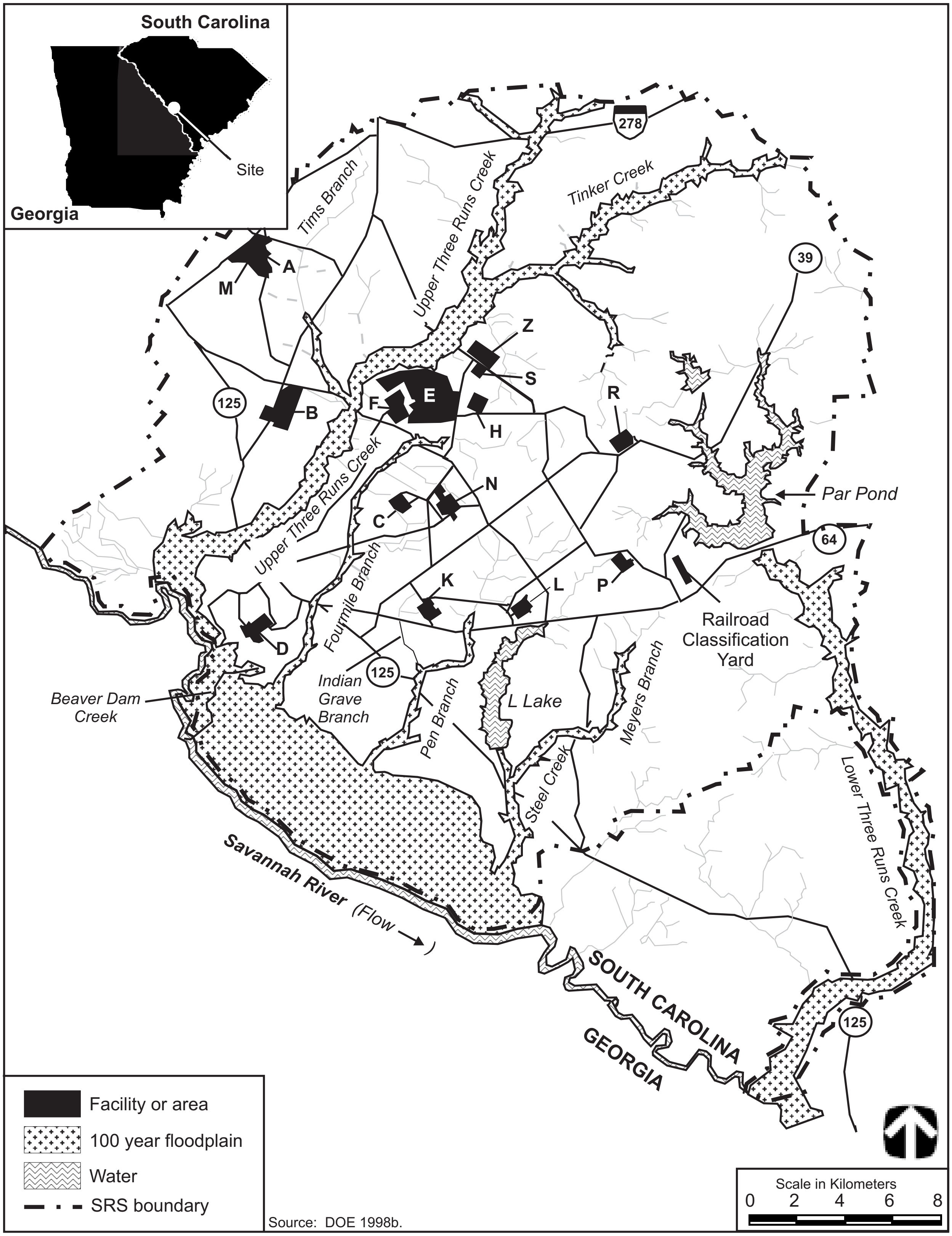

Figure 3–6 Locations of Water Bodies and Floodplains at the Savannah River Site

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 0.23 cubic meters per second (8.1 cubic feet per second) 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 liters (185 million gallons) (DOE 1996c, Barghusen and Feit 1995). The F- and L-Area facilities are not located within a 100-year floodplain; there is no information available concerning 500-year floodplains (WSRC 1995). A map showing the 100-year floodplain is presented as Figure 3–6. No Federally designated Wild and Scenic Rivers occur within the site (Barghusen and Feit 1995).

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). 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 of South Carolina; 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; DOE 1996c).

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 1996c). SRS had five NPDES permits in 1997, one (SC0000175) for industrial wastewater discharges, one (SCG250162) general permit for utility water discharge, two (SCR000000 and SCR100000) for general stormwater discharges, and one (ND0072125) for land application. Permit SC0000175 regulates 37 outfalls. The 1997 compliance rate for these outfalls was 99.9 percent. The 48 stormwater-only outfalls regulated by the stormwater permits are monitored as required. A pollution prevention plan has been developed to identify where the best available technology and best management practices must be used. For stormwater runoff from construction activities extending over 2 hectares (5 acres), a sediment reduction and erosion plan is required (Arnett and Mamatey 1996; Arnett and Mamatey 1997; Arnett and Mamatey 1998a).

The land around F-Area drains to Upper Three Runs Creek and Fourmile Branch (DOE 1995b). Upper Three Runs Creek is a large, cool blackwater stream that flows into the Savannah River. It drains about 54,390 hectares (134,400 acres), and during water year 1991, had a mean discharge of 6.8 cubic meters per second (240 cubic feet per second) 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 2.8 cubic meters per second (100 cubic feet per second). The stream is about 40 kilometers (25 miles) long, yet 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 A-, B-, F-, H-, and S-Areas. Flow from the sanitary wastewater discharge averages less than 0.001 cubic meters per second (0.035 cubic feet per second). A comparison with the 7-day, 10-year low flow of 2.8 cubic meters per second (100 cubic feet per second) in Upper Three Runs Creek shows that the present discharges are very small (DOE 1994b; DOE 1995b).

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 5,420 hectares (13,400 acres) 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 31°C (89°F), as opposed to ambient water temperatures that exceeded 60°C (140°F) when the reactor was operating. The average flow in the stream during C-Reactor operation was 11.3 cubic meters per second (400 cubic feet per second); since then flows have averaged 1.8 cubic meters per second (64 cubic feet per second). In its lower reaches, this stream widens and flows via braided channels through a delta. Downstream of this delta area, it reforms 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 1995b).

The land around L-Area drains to Steel Creek and Pen Branch. In its headwaters, Pen Branch is a largely undisturbed blackwater stream. Pen Branch and Indian Grave Branch drain an area of about 5,440 hectares (13,440 acres). Pen Branch flows southwesterly from its headwaters east of the K-Area to the Savannah River Swamp. At the swamp it flows parallel to the Savannah River for about 8 kilometers (5 miles) before it enters and mixes with Steel Creek. If the K-Reactor and its cooling tower were to operate, the flow in Indian Grave Branch would be reduced and a large part of its flow would be from cooling tower blowdown. This change would alter the water quality and temperature and flow regimes in Pen Branch. Currently, the Pen Branch system receives nonthermal effluents from K-Area and sanitary effluent from the Central Shops (N-) Area. In water year 1991, the mean flow of Pen Branch at SC125 was 4.1 cubic meters (145 cubic feet) per second. Since the shutdown of K-Reactor, the mean temperature of Pen Branch has been 22°C (72°F) and the flow at Road A-13.2 has averaged 0.55 cubic meters per second (19.3 cubic feet per second) (DOE 1995b; DOE 1997b).

The headwaters of Steel Creek originate near P-Reactor. The creek flows approximately 3 kilometers (2 miles) before it enters the headwaters of L-Lake. L-Lake is 6.5 kilometers (4 miles) long with an area of about 420 hectares (1,040 acres). Flow from the outfall of L-Lake travels about 5 kilometers (3 miles) before entering Savannah River Swamp and then another 3 kilometers (1.9 miles) before entering the Savannah River. Myers Branch joins Steel Creek downstream of the L-Lake dam. The total area drained by the Steel Creek-Myers Branch system is about 9,070 hectares (22,400 acres). When L-Reactor was operating, Steel Creek received cooling water from L-Reactor, ash basin runoff, nonprocess cooling water, powerhouse wastewater, reactor process effluents, sanitary treatment plant effluents, and vehicle wash waters. During water year 1996, the mean flow rate of Steel Creek was 1.7 cubic meters (59.2 cubic feet) per second (DOE 1998f).

3.3.4.2 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.

Although many different systems have been used to describe groundwater systems at SRS, for this EIS the system used in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c) 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 1996c).

Groundwater in the area is used extensively for domestic and industrial purposes. Most municipal and industrial water supplies in Aiken County are withdrawn from the Cretaceous or water table aquifer, while small domestic supplies are withdrawn from the Congaree or water table aquifer. In Barnwell and Allendale counties, the Congaree aquifer supplies some municipal users. It is estimated that about 13 billion liters per year (3.4 billion gallons per year) are withdrawn from the aquifers within a 16-kilometer (10-mile) radius of the site, which is similar to the volume used by SRS (DOE 1996c). The Cretaceous aquifer is an important water resource for the SRS region. Aiken, South Carolina, for example, uses the Cretaceous aquifer for drinking water. The water is generally soft, slightly acidic, and low in dissolved and suspended solids (DOE 1995b).

Groundwater is the only source of domestic water at the SRS (DOE 1995b). All groundwater at the SRS is classified by the EPA as a Class II water source, and depth to groundwater ranges from near the surface to about 46 meters (150 feet) (DOE 1996c). SRS withdraws more than 5 billion liters per year (1.3 billion gallons per year) of groundwater to support site operations (DOE 1998f). There are no designated sole source aquifers in the area (Barghusen and Feit 1995).

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 trichlorothylene has been reported. Trichlorothylene also has 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 1996c), but groundwater contamination has not been detected beyond SRS boundaries (DOE 1995b).

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 liters per day (100,000 gallons per day) to report their withdrawals. SRS is required to report because its usage is above the reporting level (DOE 1996c).

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 F-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 1994b).

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 because of 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 21 meters (4 to 68 feet) (DOE 1994b).

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 (DOE 1994b).

Groundwater quality in the F-Area 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).

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).

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. 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. 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).

L-Area groundwater exceeds guidelines for tritium, other radionuclides, carbon disulfide, chlorinated and volatile organics, and metals. Groundwater beneath the L-Area Disassembly Basin has been contaminated with metals, chlorinated organics, and tritium (DOE 1998f).

3.3.5 Geology and Soils

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]), which is 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.

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. These are shown in Figure 3.1-3 of the *Savannah River Site Spent Nuclear Fuel Management Draft Environmental Impact Statement* (DOE 1998f). The largest fault is the Pen Branch fault. However, there is no evidence of movement within the last 38 million years along this fault.

SRS is located within Seismic Zone 2, indicating moderate damage could occur as a result of an earthquake. Three earthquakes have occurred inside the SRS boundary between 1985 and 1997. The acceleration produced by these earthquakes did not activate seismic monitoring instruments in the reactor areas (these instruments have detection limits of 0.0002g). Existing information does not conclusively correlate these earthquakes with any of the known faults on the site (1998a). Historically, two large earthquakes have occurred within 160 kilometers (100 miles) of SRS. The Charleston earthquake of 1886 had an estimated Richter magnitude ranging of 6.8, while the Union County, South Carolina, earthquake of 1913 had an estimated Richter magnitude of 6.0. The SRS area experienced an estimated peak horizontal acceleration of 0.10 g during the Charleston earthquake. An earthquake with a maximum horizontal acceleration of 0.2 g is estimated to have an annual probability of occurrence of 1 in 5,000 at SRS. An earthquake of this magnitude would not result in structural damage since this represents the design-based earthquake (DOE 1995e).

There is no volcanic hazard at SRS. The area has not experienced volcanic activity within the last 230 million years. Future volcanism is not expected because SRS is along the passive continental margin of North America.

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 meters (6.6 feet) 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's Natural Resources Conservation Service does not identify these as prime farmlands 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.

The soils of the F-Area and L-Area fall within the Fuquay-Blanton-Dothan Association. This association consists of nearly level to sloping, well-drained soils on broad upland ridges. Soils in this association have moderately thick, sandy surface and subsurface layers and a loamy subsoil (WSRC 1997b). Most soils within the F-Area and L-Area have been disturbed by site development activities.

3.3.6 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and threatened and endangered species. Material presented in this section, unless otherwise noted, is from the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c).

3.3.6.1 Terrestrial Resources

Most of SRS has remained undeveloped since it was established in 1950. Only about 5 percent of the site is occupied by DOE facilities. Five major plant communities have been identified at SRS (**Figure 3-7**). Of these, the largest is the loblolly, longleaf, slash pine community, which covers approximately 65 percent of the site. This community type, as well as upland hardwood-scrub oak, occurs primarily in upland areas. Swamp forests and bottomland hardwood forests are found along the Savannah River and the numerous streams that traverse SRS. More than 1,300 taxa of vascular plants have been identified on the site.

Because of the variety of plant communities on the site, as well as the region's mild climate, SRS supports a diversity and abundance of wildlife, including 43 amphibian, 58 reptile, 213 bird, and 54 mammal species. Common species at SRS include the slimy salamander, eastern box turtle, Carolina chickadee, common crow, eastern cottontail, and gray fox. A number of game animals are found on SRS, but only the whitetail deer and feral hog are hunted on site. Raptors, such as the Cooper's hawk and black vulture, and carnivores, such as the gray fox and raccoon, are ecologically important groups on SRS.

F-Area is an industrial area situated on an upland plateau between the drainage areas of Upper Three Runs Creek and Fourmile Branch. It is surrounded primarily by evergreen forests with areas of grassland, scrub-shrub, and barren land also present. A roughly 6-hectare (15-acre) oak-hickory forest area designated as a National Environmental Research Park set aside is located northwest of the site. Bottomland hardwood forest is located along Upper Three Runs Creek and Fourmile Branch. Buildings, paved parking lots, graveled construction areas, and laydown yards dominate this heavily industrialized area; little natural vegetation remains inside the fenced areas (DOE 1996b; DOE 1998b). A total of 41 animal species have been identified in and around F-Area, including 18 species of birds, 11 species of mammals, and 12 species of reptiles (WSRC 1997a).

L-Area is an industrial area largely surrounded by the loblolly, longleaf, and slash pine community, although an area of pine/hardwood community is located to the west. L-Area lies within the Steel Creek drainage just north of L-Lake (Figure 3–7). Plant communities found along Steel Creek include bottomland hardwood. While grassy areas occur within the L-Area, it is largely disturbed with little vegetation. A total of 35 animal species have been identified in and around L-Area, including 15 species of birds, 8 species of mammals, and 12 species of reptiles (WSRC 1997a).

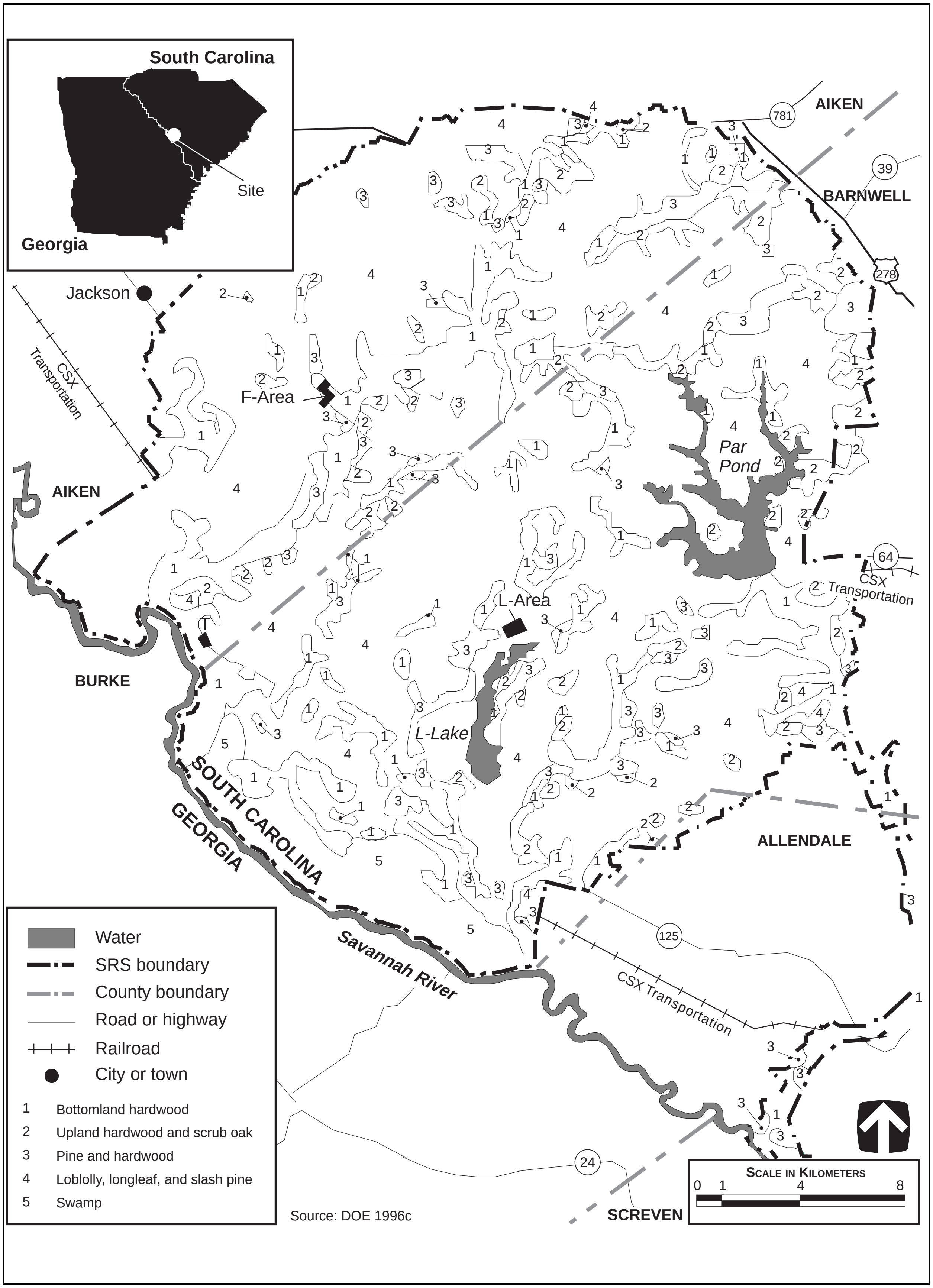

Figure 3–7 Distribution of Plant Communities at Savannah River Site

3.3.6.2 Wetlands

SRS contains approximately 19,800 hectares (49,000 acres) of wetlands, most of which are associated with floodplains, streams and impoundments. Wetlands on the site may be divided into the following categories: bottomland hardwoods, cypress-tupelo, scrub-shrub, emergent, and open water. The most extensive wetland type on SRS is swamp forest associated with the Savannah River floodplain, which covers approximately 3,800 hectares (9,390 acres). Past releases of cooling water effluent into site streams and the Savannah River Swamp have resulted in shifts in plant community composition, including reduction in bottomland forests along streams and replacement of bald cypress by scrub-shrub and emergent vegetation in the swamp. As many as 350 to 400 Carolina bays, a type of wetland unique to the southeastern United States, also are found on SRS (DOE 1998c). These natural shallow depressions occur on interstream areas and range from lakes to shallow marshes, herbaceous bogs, shrub bogs, or swamp forests.

Wetlands in the vicinity of the F-Area are primarily associated with Upper Three Runs Creek and Fourmile Branch and their tributaries. These wetlands have been classified as bottomland hardwood. Below C-Area, Fourmile Branch was affected by cooling water discharged from the C-Reactor. These releases resulted in shifts in natural vegetation along the lower stream corridor and where it drains into the Savannah River Swamp. Since areas affected by shutdown of the reactor have revegetated, species composition is not the same as it was originally (WSRC 1997b).

Wetlands in the vicinity of L-Area are associated with Pen Branch, Steel Creek, and L-Lake. Prior to the establishment of SRS, wetlands associated with Pen Branch and Steel Creek were primarily classified as bottomland hardwood forest and swamp forest. Past releases of cooling water from the K-, L-, and P-Reactors resulted in shifts in plant community composition from bottomland forests along the stream corridors and cypress/tupelo in the Savannah River Swamp to scrub-shrub and emergent vegetation. Since shutdown of the reactors, some recovery of these areas has occurred; however, new growth has not always included the same species that were present in the original canopy. Wetlands associated with L-Lake include several shoreline zones, including a submersed and floating-leaved zone, emergent zone, and an upper emergent/shrub zone. Efforts have been made to revegetate both Ben Pranch and L-Lake (WSRC 1997b).

3.3.6.3 Aquatic Resources

Aquatic habitat on SRS includes manmade ponds, Carolina bays, reservoirs, and the Savannah River and its tributaries. There are more than 50 manmade impoundments located throughout the site that support populations of bass and sunfish. Fewer than 20 Carolina bays have permanent fish populations. Species present in these bays include redfin pickerel, mud sunfish, lake chubsucker, and mosquitofish. Par Pond and L-Lake support similar fish populations, including largemouth bass, black crappie, and various species of pan fish. Although sport and commercial fishing is not allowed on SRS, they do take place on the Savannah River. In the past, water intake structures for C- and K-Reactors and the D-Area powerhouse caused annual estimated entrainment of approximately 10 percent of the fish eggs and larvae passing the intake canals during the spawning season. In addition, estimated impingement losses were approximately 7,600 fish per year.

Streams in the vicinity of the F-Area include Upper Three Runs Creek and Fourmile Branch and their tributaries. Fish species present in Upper Three Runs Creek in the vicinity of the F-Area include the dusky shiner, yellowfin shiner, redbreast sunfish, and bluegill. 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. Fish species present in Fourmile Branch near the F-Area include the dusky shiner, creek chubsucker, yellow bullhead, and spotted sunfish. Studies of fish communities in Upper Three Runs Creek and Fourmile Branch indicated that no measurable community level impacts were associated with contaminants from the F-Area seepage basins (DOE 1996b; DOE 1998b).

Aquatic resources in the vicinity of L-Area are associated with Pen Branch, Steel Creek, and L-Lake. Pen Branch has been affected over the years by the operation and subsequent shutdown of K-Reactor. During operations, fish populations in warmed portions of the stream were greatly reduced. With the end of reactor operations, a more diverse fish population has recolonized thermal portions of the stream. Steel Creek also has been affected by DOE operations, including the operation and subsequent shutdown of L-Reactor, operation of K-Reactor and the eventual diversion of its cooling waters to Par Pond, and the construction of L-Lake. L-Lake has undergone numerous changes in fish populations since it was first formed in 1985. These changes have been associated with colonization of the lake by fish originally in Steel Creek, as well as introduced fish, and operation and eventual shutdown of L-Reactor. Fish species that are common in the lake include largemouth bass, bluegill, redbreast sunfish, and threadfin shad (WSRC 1997b).

3.3.6.4 Threatened and Endangered Species

As shown in Table 3.7.6-1 in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a), 61 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. Ten species are Federally or state-listed as threatened or endangered (WSRC 1997b). No critical habitat for threatened or endangered species exists on SRS.

No Federally-listed threatened or endangered species are known to occur in the F-Area, although several species may occur in the general vicinity. The American alligator (listed as threatened by virtue of its similarity in appearance to the endangered American crocodile), while fairly abundant on SRS, is uncommon in the F-Area. The nearest active bald eagle nest is located along Pen Branch, 8 kilometers (5 miles) southeast of F-Area. Bald eagles are listed as threatened by the U.S. Fish and Wildlife Service and endangered by South Carolina. Wood storks have been observed 14.5 kilometers (9 miles) from the F-Area, near the Fourmile Branch delta. The closest colony of red-cockaded woodpeckers is 12 kilometers (7.5 miles) to the northeast, but suitable forage habitat exists near the F-Area (WSRC 1997b). Both wood storks and red-cockaded woodpeckers are Federally and state-listed as endangered. The smooth purple coneflower, the only endangered plant species found on SRS, has been found along Burma Road 4.8 kilometers (3 miles) southwest of the F-Area. The state-listed rare Oconee azalea has been found on steep slopes adjacent to the Upper Three Runs Creek floodplain just northwest of F-Area (DOE 1995b). Consultation has been initiated with both the U.S. Fish and Wildlife Service and the state.

No Federally-listed threatened or endangered species are known to occur in the L-Area, but several species may exist in the general vicinity. The American alligator has been observed in L-Lake and in Steel Creek below L-Lake. Bald eagles have been observed in the L-Lake area; the nearest bald eagle nest is located on Pen Branch 3.2 kilometers (2 miles) southeast of the L-Area. Wood storks have been observed in the Steel Creek delta, located about 9.8 kilometers (6 miles) south of the L-Area. The closest colony of red-cockaded woodpeckers to the L-Area is located about 8 kilometers (5 miles) to the east-southeast (WSRC 1997b). The nearest colony of the smooth purple coneflower to the site is located about 2.4 kilometers (1.5 miles) to the east near the junction of SRS Roads 9 and B. The Oconee azalea has been identified on the steep slopes adjacent to the Upper Three Runs Creek floodplain about 12 kilometers (7.5 miles) northwest of L-Area (DOE 1995b). Consultation has been initiated with both the U.S. Fish and Wildlife Service and the state.

3.3.7 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 University of South Carolina's Institute of Archaeology and Anthropology 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. There are 67 sites considered potentially eligible for listing on the National Register; most of the sites have not yet been evaluated. 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.

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. Guidance on the management of cultural resources at SRS is included in the *Archaeological Resources Management Plan of the Savannah River Archaeological Research Program* (SHARP 1989).

3.3.7.1 Prehistoric Resources

Prehistoric resources are physical properties that remain from human activities that predate written records. 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 evidence of more than 800 prehistoric 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.

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with construction and operation of the existing 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 potential for prehistoric sites in the L-Area is limited. The area is in an archaeological site density zone that has the least potential for prehistoric sites of significance (DOE 1998f).

3.3.7.2 Historic Resources

Historic resources consist of physical properties that postdate the existence of written records. 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.

Within F-Area, land areas have been disturbed over the past 46 years by activities associated with the construction and operation of the existing 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.

The Savannah River Archaeological Research Program has not examined any areas in and immediately around Building 105-L. Archaeological resources in the footprint of the building are unlikely to have survived construction, although 1951 aerial photographs show that houses were present in the L-Area before the development of the SRS in the early 1950s (DOE 1998f). Consultation has been initiated with the State Historic Preservation Office.

3.3.7.3 Native American Resources

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.

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.

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.

In 1991, DOE conducted a survey of Native American concerns about religious rights in the central Savannah River Valley (DOE 1991). During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian Peoples 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 (e.g., redroot, button snakeroot, and American ginseng) 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 L-Area because of past clearing associated with past development. In addition to those Native American tribal organizations noted above, consultation has been initiated with the United Keetowah Band, Pee Dee Indian Association, and Ma Chris Lower Alabama Creek Indian Tribe.

3.3.7.4 Paleontological Resources

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

Paleontological resources have not been recorded in the F-Area and their occurrence in the L-Area is unlikely.

3.3.8 Socioeconomics

Statistics for employment and economy are presented for the regional economic area which encompasses 15 counties around SRS that are located in Georgia and South Carolina. Statistics for population and housing, community services, and local transportation are presented for the region of influence. The region of influence is a five-county area in which 90.7 percent of all SRS employees reside (**Table 3–14**). In 1997, SRS employed 15,032 persons (5.8 percent of the regional economic area civilian labor force).

Table 3–14 Distribution of Employees by Place of Residence in the Savannah River Site 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
Edgewell	210	1.6
Region of Influence Total	11,759	90.7

Source: DOE 1998b.

3.3.8.1 Regional Economy Characteristics

Between 1990 and 1996, the civilian labor force in the regional economic area increased 4.4 percent to the 1996 level of 259,174. In 1996, the unemployment rate in the regional economic area was 7.5 percent, which was greater than the unemployment rates for Georgia (4.6 percent) and South Carolina (6 percent that year).

In 1995, manufacturing represented the largest sector of employment in the regional economic area (25.6 percent). This was followed by government (20.9 percent) and service activities (19.9 percent). 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.

3.3.8.2 Population and Housing

In 1996, the region of influence estimated population totaled 453,778. Between 1990 to 1996, the region of influence 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. Between 1980 and 1990, the number of housing units in the region of influence increased by 25.1 percent, compared with a 30.1 percent increase in Georgia and a 23.5 percent increase in South Carolina. The total number of housing units within the region of influence for 1990 was 165,443 (DOE 1998b). In 1995, the total number of owner and renter housing units within the region of influence was 171,400 (DOE 1996c). The 1990 homeowner vacancy rate for the region of influence was 2.2 percent, compared with statewide rates of 2.5 percent for Georgia and 1.7 percent for South Carolina. The renter vacancy rate for the region of influence counties was 10 percent compared with the statewide rates of 12.2 percent for Georgia and 11.5 percent for South Carolina.

3.3.8.3 Community Services

3.3.8.3.1 Education

Community services include public education and public safety. In 1997, school districts providing public education in the region of influence were operating at capacities between 85 to 100 percent. Total student enrollment in the region of influence in 1997 was approximately 89,000, and the student-to-teacher ratio averaged 17 to 1. In 1990, the average student-to-teacher ratios were 10.8 to 1 for Georgia and 11.5 to 1 for South Carolina. In 1997, a total of 973 sworn police officers were serving the five-county region of influence. The average region of influence officer-to-population ratio was 2.1 officers per 1,000 persons. This compares with the 1990 state averages of 2 officers per 1,000 persons for Georgia and 1.8 officers per 1,000 persons for South Carolina.

3.3.8.4 Local Transportation

Vehicular access to SRS is provided by South Carolina State Routes 19, 64, and 125 (Figure 3–5). There is no public transportation to SRS. Rail service in the region of influence 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. SRS has no commercial docking facilities, but it has a boat ramp that has accepted large transport barge shipments. Columbia Metropolitan Airport in Columbia, South Carolina, and Bush Field in Augusta, Georgia, receive jet air passenger and cargo service from both national and local carriers.

3.3.9 Environmental Justice

Under Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse health or environmental effects of programs and policies on minority and low-income populations in potentially affected areas. Minority populations refer to all people of color, exclusive of white non-Hispanics. Low-income populations refer to households whose incomes are below the Federal poverty thresholds. In the case of SRS, the potentially affected area includes parts of Georgia and South Carolina.

Data obtained during the 1990 census 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 were 29.8 and 31.4, respectively. The same census data also show that, of the total population of the contiguous United States, 13.1 percent reported incomes below the poverty threshold, and Georgia and South Carolina reported 14.7 and 15.4 percent, respectively.

The potentially affected area surrounding the F-Area is defined by a circle with an 80-kilometer (50-mile) radius centered at Building 221–F (latitude 33°17'11" N, longitude 81°40'38" W). The total population residing within that area in 1990 was 615,734. The proportion of the population around this building that was considered minority was 42 percent. At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting 35.7 percent of the total population. Hispanics constituted about 1 percent, and Asians about 1 percent. Native Americans constituted about 0.2 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 107,479 persons (18 percent of the total population) residing within the potentially affected area around F-Area reported incomes below the poverty threshold.

The potentially affected area surrounding the L-Area is defined by a circle with a radius equal to 80 kilometers (50 miles) centered at Building 105-L (latitude 33°12'38.5" N and longitude 81°37'26.5" W). The total population residing within the potentially affected area in 1990 was 606,819 persons. Approximately 39.1 percent of the population in 1990 was composed of individuals who identified themselves as having racial or ethnic origins that are used by the Council on Environmental Quality to define minority populations (CEQ 1997).

At the time of the 1990 census, Blacks were the largest minority group within the potentially affected area, constituting approximately 36.8 percent of the total population. Less that 3 percent of the total population in the potentially affected area designated themselves as Asian, Native American, or Hispanic (DOC 1992).

Within the potentially affected area in 1990, 107,468 persons (nearly 21 percent of the total population) reported incomes that were less than the threshold for poverty.

3.3.10 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.

3.3.10.1 Radiation Exposure and Risk

Major sources and levels of background radiation exposure to individuals in the vicinity of SRS are shown in **Table 3–15.** 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.

Table 3–15 Sources of Radiation Exposure to Individuals in the Savannah River Site Vicinity Unrelated to Savannah River Site Operations

Source	*Effective Dose Equivalent (millirem per year)*
Natural background radiation[a]	
Cosmic radiation	27
External terrestrial radiation	28
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	less than 1
Air travel	1
Consumer and industrial products	10
Total	360

[a] Arnett and Mamatey 1998a.
[b] An average for the United States.
[c] NCRP 1987.

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 1997 are listed in the *Savannah River Site Environmental Report for 1997* (Arnett and Mamatey 1998a). The doses to the public resulting from these releases are presented in **Table 3–16.** These doses fall within radiological limits per DOE Order 5400.5, *Radiation Protection of the Public and Environment*, and are much lower than those of background radiation.

Using a risk estimator of 500 cancer deaths per 1 million person-rem to the public (see Appendix E), the fatal cancer risk to the maximally exposed member of the public resulting from radiological releases from SRS operations in 1997 is estimated to be 9.0×10^{-8}. That is, the estimated probability of this person dying of cancer at some point in the future from radiation exposure associated with one year of SRS operations is less than 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, 0.004 excess fatal cancers are projected in the population living within 80 kilometers (50 miles) of SRS from normal operations in 1997. 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 1995 mortality rate associated with cancer for the entire U.S. population was 0.2 percent per year. Based on this mortality rate, the number of fatal cancers expected during 1997 from all causes in the population living within 80 kilometers (50 miles) of SRS was 1,240. This expected number of fatal cancers is much higher than the 0.004 fatal cancers estimated from SRS operations in 1997.

Table 3–16 Radiation Doses to the Public From Normal Savannah River Site Operations in 1997 (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 offsite individual (millirem)	10	0.050	4	0.13	100	0.18
Population within 80 kilometers (person-rem)[c]	None	5.5	None	2.4	100	7.9
Average individual within 80 kilometers (millirem)[d]	None	0.0089	None	0.0035	None	0.013

[a] The standards for individuals are given in DOE Order 5400.5. As discussed in that Order, the 10-millirem per year limit from airborne emissions is required by the Clean Air Act, and the 4-millirem per year limit is required by the Safe Drinking Water Act. For this EIS, the 4-millirem per year value is conservatively assumed to be the limit for the sum of doses from all liquid pathways. The total dose of 100 millirem per year 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. If the potential total dose exceeds the 100 person-rem value, the contractor operating the facility is required to 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 1997. For liquid releases, an additional 70,000 water users in Port Wentworth, Georgia, and Beaufort, South Carolina, (about 160 kilometers [98 miles] downstream) are included in the assessment.

[d] Obtained by dividing the population dose by the number of people living within 80 kilometers (50 miles) of the site for atmospheric releases; for liquid releases the number of people includes water users who live more than 80 kilometers (50 miles) downstream of the site.

Source: Arnett and Mamatey 1998a.

SRS 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. The average dose to the individual worker and the cumulative dose to all workers at SRS from operations in 1997 are presented in **Table 3–17.** These doses fall within the radiological regulatory limits of 10 CFR 835. According to a risk estimator of 400 fatal cancers per 1 million person-rem among workers (Appendix E), the number of projected fatal cancers among SRS workers from normal operations in 1997 is 0.066. 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.

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 1997* (Arnett and Mamatey 1998a). 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.

Table 3–17 Radiation Doses to Workers From Normal Savannah River Site Operations in 1997 (Total Effective Dose Equivalent)

Occupational Personnel	*Onsite Releases and Direct Radiation*	
	Standard[a]	*Actual*
Average radiation worker (millirem)	None[b]	50
Total workers (person-rem)[c]	None	165

[a] The radiological limit for an individual worker is 5,000 millirem per year. 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 millirem per year; 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] 3,327 workers with measurable doses in 1997.
Sources: DOE 1995a, DOE 1998g.

External radiation doses and concentrations of gross alpha, plutonium, and americium in air have been measured in F-Area. Onsite doses are measured for comparison against natural background levels, which are measured at offsite locations; the numerical difference in these measurements may be directly attributable to radiological sources that are located in the vicinity of the onsite measurement location(s). In 1997, the annual dose in the F-Area was 105 millirem. This is about 20 millirem higher than the average dose measured at offsite locations. In the same year, the concentration of gross alpha was about 1.1×10^{-3} picocuries per cubic meter in the F-Area, compared with the approximately 9.9×10^{-4} picocuries per cubic meter measured at the offsite control location. The concentration of plutonium-239 in the F-Area was 0 picocuries per cubic meter. Offsite controls also did not detect any plutonium-239 in the air in 1997 (Arnett and Mamatey 1998b).

External radiation doses have been measured in the L-Area. In 1997, the annual dose in the L-Area was 80 millirem (Arnett and Mamatey 1998b).

3.3.10.2 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 cancerous and noncancerous health effects.

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.

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 E.

Exposure pathways to SRS 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. SRS 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 SRS are substantially better than required by standards.

3.3.10.3 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 of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c).

3.3.10.4 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 their consequences 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 curies of tritiated water vapor were released. 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 curies of tritium were released.

3.3.10.5 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.

In addition, 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.

3.3.11 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.

3.3.11.1 Waste Inventories and Activities

SRS manages the following types of waste: high-level radioactive waste; transuranic; mixed transuranic; low-level radioactive waste; mixed waste; hazardous; and nonhazardous. Waste generation rates and the inventory of stored waste from activities at SRS are provided in **Table 3–18.** **Table 3–19** summarizes the SRS waste management capabilities. More detailed descriptions of the waste management system capabilities at SRS are included in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c) and the *Savannah River Site Waste Management Final Environmental Impact Statement* (DOE 1995b).

Table 3–18 Waste Generation Rates and Inventories at Savannah River Site

Waste Type	*Generation Rate (cubic meters per year)*	*Inventory (cubic meters)*
High-level radioactive	1,561	131,000
Transuranic[a]		
Contact-handled	427	6,977
Remotely-handled	4	0
Low-level radioactive	10,043	1,616
Mixed		
RCRA	1,135	6,940
Toxic Substances Control Act	0	110
Hazardous	74	1,416
Nonhazardous		
Liquid	416,100	Not applicable[b]
Solid	6,670	Not applicable[b]

[a] Includes mixed transuranic wastes.
[b] Generally, nonhazardous wastes are not held in long-term storage.
Source: DOE 1998b, except High-Level Radioactive Waste Generations Rate (DOE 1996c) and High-Level Radioactive Waste Inventory (DOE 1997a).

EPA placed SRS on the National Priorities List in December 1989. In accordance with CERCLA, DOE entered into a Federal Facilities Compliance Agreement with EPA and the State of South Carolina to coordinate cleanup activities at SRS under one comprehensive strategy. As stated in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996c), this agreement combines the RCRA Facility Investigation Program Plan with a CERCLA cleanup program titled the *RCRA Facility Investigation/Remedial Investigation Program Plan.* More information on regulatory requirements for waste disposal is provided in Chapter 5.

Table 3–19 Waste Management Capabilities at Savannah River Site

			Applicable Waste Type						
Facility Name/Description	***Capacity***	***Status***	***HLW***	***TRU***	***Mixed TRU***	***LLW***	***Mixed***	***Haz***	***Non-Haz***
Treatment Facility (cubic meters per year)									
Savannah River Technology Center Ion Exchangers, Evaporators	53,700	Online	X						
Transuranic Waste Characterization/ Certification Facility	1,720	Planned for 2007		X	X				
Consolidated Incineration Facility and 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	1,030,000	Online							X
Storage Facility (cubic meters)									
Transuranic Storage Pads	34,400	Online		X	X				
Defense Waste Processing Facility 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		
F- and H-Area Tank Farm	133,000	Online	X						
Defense Waste Processing Facility	2,286 canisters	Online	X						

Facility Name/Description	Capacity	Status	Applicable Waste Type						
			HLW	TRU	Mixed TRU	LLW	Mixed	Haz	Non-Haz
Disposal Facility (cubic meters)									
Intermediate-Level Radioactive Waste Vaults	3,665	Online				X			
Low-Activity Waste Vaults	30,500	Online				X			
Low-Level Radioactive Waste Disposal Facility Slit Trenches	26,000	Planned				X			
Z-Area Saltstone Vaults	1,110,000	Online				X			

DWPF = Defense Waste Processing Facility, Haz = hazardous, HLW = high-level radioactive waste, LLW = low-level radioactive waste, TRU = transuranic
Sources: DOE 1998b, except High-Level Radioactive Waste (DOE 1996c).

3.3.11.2 High-Level Radioactive Waste

Liquid high-level radioactive waste at SRS is made up of many waste streams generated during the recovery and purification of transuranic waste products and unburned fissile material from spent reactor fuel elements. These wastes are separated by waste form, radionuclide, and heat content before their transfer to underground storage tanks in the F- and H-Area tank farms. Processes routinely used to treat liquid high-level radioactive waste are separation, evaporation, and ion exchange. Evaporation produces a cesium-contaminated condensate. Cesium is removed from the condensate, resulting in a low-level radioactive waste stream that is treated in the Effluent Treatment Facility. The remaining high-level radioactive waste stream salts are precipitated; some can be decontaminated. The decontaminated salt solution is sent with residues from the Effluent Treatment Facility to the Defense Waste Processing Z-Area Saltstone Facility, where it is mixed with a blend of cement, flyash, and blast furnace slag to form grout. The grout is pumped into disposal vaults where it hardens for permanent disposal as solid low-level radioactive waste. The remaining high-level radioactive salt and sludge are permanently immobilized as a glass solid cast in stainless steel containers at the Defense Waste Processing Facility Vitrification Plant. The stainless steel containers are decontaminated to U.S. Department of Transportation standards, welded closed, and temporarily stored on site for eventual transport to and disposal in a repository. Future high-level radioactive waste generation could result from the processing and stabilization of spent nuclear fuel for long-term storage as a result of the Record of Decision (60 FR 28680) on the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering and Environmental Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995a), and from remediation or materials recovery activities performed in the F- and H-Canyons.

3.3.11.3 Transuranic Waste

Transuranic waste generated between 1974 and 1986 is stored on five concrete pads and one asphalt pad that have been covered with approximately 1.2 meters (4 feet) of soil. Transuranic waste generated since 1986 is stored on 13 concrete pads that are not covered with soil. The transuranic waste storage pads are in the Low-Level Radioactive Waste Disposal Facility (DOE 1998b).

A planned Transuranic Waste Characterization and Certification Facility would provide extensive containerized waste certification capabilities. The facility is needed to prepare transuranic waste for treatment and to certify transuranic waste for disposal at the Waste Isolation Pilot Plant. Drums that are certified for shipment to the Waste Isolation Pilot Plant will be placed in interim storage on concrete pads in E-Area. Low-level radioactive waste containing concentrations of transuranic nuclides between 10 and 100 nanocuries (referred to as alpha-contaminated low-level radioactive waste) is managed like transuranic waste because its physical and chemical properties are similar and similar procedures will be used to determine its final disposition (DOE 1996c). The Waste Isolation Pilot Plant is expected to begin receiving waste from SRS in 2000 (DOE 1999b).

3.3.11.4 Low-Level Radioactive Waste

Both liquid and solid low-level radioactive waste are treated at SRS. Most aqueous low-level radioactive waste 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 1996c).

After completion of a series of extensive readiness tests, the Consolidated Incinerator Facility began radioactive operations in 1997. The Consolidated Incinerator Facility is designed to incinerate both solid and liquid low-level radioactive waste, mixed waste, and hazardous waste (DOE 1998b).

Solid low-level radioactive waste is segregated into several categories to facilitate proper treatment, storage, and disposal. Solid low-level radioactive waste that radiates less than 200 millirem per hour at 5 centimeters (2 inches) from the unshielded container is considered low-activity waste. If it radiates greater than 200 millirem per hour at 5 centimeters (2 inches), it is considered intermediate-activity waste. Intermediate-activity tritium waste is intermediate-activity waste with more than 10 curies of tritium per container. Long-lived radioactive waste is contaminated with long-lived isotopes that exceed the waste acceptance criteria for onsite disposal (DOE 1996c).

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

Currently, DOE places low-activity low-level radioactive waste in carbon steel boxes and deposits them in the low-activity waste vaults in E-Area. Intermediate-activity low-level radioactive waste is packaged according to waste form and disposed of in the intermediate-level radioactive waste vaults in E-Area. Long-lived radioactive wastes are stored in the Long-Lived Waste Storage Building in E-Area until treatment and disposal technologies are developed (DOE 1998a).

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

3.3.11.5 Mixed Waste

The Federal Facilities Compliance Agreement addresses SRS compliance with RCRA Land Disposal Restrictions. The agreement requires DOE facilities storing mixed radioactive waste to develop site-specific treatment plans and to submit them for approval (DOE 1996c). The site treatment plan for mixed radioactive waste specifies treatment technologies or technology development schedules for all SRS mixed radioactive waste (DOE 1998a). SRS is allowed to continue to generate and store mixed radioactive waste, subject to

Land Disposal Restrictions. Schedules to provide compliance through treatment in the Consolidated Incinerator Facility are included in the Federal Facilities Compliance Agreement (DOE 1996c).

The SRS mixed radioactive waste program consists primarily of safely storing waste until treatment and disposal facilities are available. Mixed waste 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 Defense Waste Processing Facility Organic Waste Storage Tank. 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 1998b).

3.3.11.6 Hazardous Waste

Hazardous waste is accumulated at the generating facility for a maximum of 90 days, or stored in U.S. Department of Transportation-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 site to commercial RCRA-permitted treatment and disposal facilities using U.S. Department of Transportation-certified transporters. DOE plans to incinerate up to 9 percent of the hazardous waste (organic liquids, sludge, and debris) in the Consolidated Incinerator Facility (DOE 1996c). In 1995, 72 cubic meters (94 cubic yards) of hazardous waste were sent to onsite storage. Of this amount, 20 cubic meters (26 cubic yards) were shipped off site for commercial treatment or disposal (DOE 1998b).

3.3.11.7 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 4,160 cubic meters per day (1.1 million gallons per day) central treatment facility, and connecting them with a new 29-kilometer (18-mile) 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 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 ultraviolet light disinfection systems to meet NPDES limitations (DOE 1996c).

SRS has privatized the collection, hauling, and disposal of its sanitary waste (DOE 1998b). SRS-generated solid sanitary waste is sent to the Three Rivers Landfill (DOE 1998f) a permitted disposal facility. 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 site for disposal (DOE 1996c).

3.3.11.8 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 1996c). The program focuses mainly on source reduction, recycling, and increasing employee participation in pollution prevention. For example, nonhazardous solid waste generation in 1995 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 cubic meters (22,000 cubic yards), from 1991 through 1995. In 1995, more than 2,990 metric tons (3,300 tons) of nonradioactive materials were recycled at SRS, including 963 metric tons (1,062 tons) of paper and cardboard (DOE 1998b). The pollution prevention projects reduced the total amount of waste generated at SRS in 1997 by approximately 18,200 cubic meters (23,800 cubic yards) (DOE 1998d).

3.3.11.9 Preferred Alternatives From the Final Waste Management Programmatic Environmental Impact Statement and Associated Records of Decision

Preferred alternatives from the Waste Management Programmatic EIS (DOE 1997a) are shown in **Table 3–20** for the four waste types analyzed in this 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 Record of Decisions to be issued on the Waste Management Programmatic EIS. The transuranic waste Record of Decision was issued on January 20, 1998 (63 FR 3629), and the hazardous waste Record of Decision issued on August 5, 1998 (63 FR 41810). The transuranic waste Record of Decision states, ". . . .each of the Department's sites that currently has or will generate transuranic waste will prepare and store its transuranic waste on site. . . ." The hazardous waste Record of Decision states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of the nonwastewater hazardous waste, and Oak Ridge Reservation and SRS will continue to treat some of their own hazardous waste on site and 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 Waste Management Programmatic EIS and the hazardous waste and transuranic waste Record of Decisions.

Table 3–20 Preferred SRS Waste Management Alternatives From the Waste Management Programmatic EIS and Associated Records of Decision

Waste Type	*Preferred Action*
High-level radioactive	DOE prefers onsite storage of SRS's immobilized high-level radioactive waste pending disposal in a geologic repository.[a]
Transuranic and mixed transuranic	DOE has decided that SRS should prepare and store its transuranic waste on site pending disposal at the Waste Isolation Pilot Plant.[b]
Low-level radioactive	DOE prefers to treat SRS low-level radioactive waste on site. SRS could be selected as one of the regional disposal sites for low-level radioactive waste.[a]
Mixed	DOE prefers regionalized treatment of mixed waste at SRS. This includes the onsite treatment of SRS waste and could include treatment of some mixed waste generated at other sites. SRS could be selected as one of the regional disposal sites for mixed waste.[a]
Hazardous	DOE has decided to use commercial and onsite SRS facilities for treatment of SRS nonwastewater hazardous waste, and continue to use onsite facilities for wastewater hazardous waste.[c]

[a] From the Waste Management Programmatic EIS (DOE 1997a).
[b] From the Record of Decision for transuranic waste (63 FR 3629).
[c] From the Record of Decision for hazardous waste (63 FR 41810).

3.4 REFERENCES

Abbott, D. G., A. B. Crockett, and K. S. Moor, 1997, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Surplus Plutonium Disposition Environmental Impact Statement* (Predecisional Draft), INEL/EXT-97-00563, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho, June.

ANL (Argonne National Laboratory-West), 1998a, *Petition for a Wastewater Land Application Permit for the Argonne National Laboratory-West Sanitary Waste Treatment Pond Land Application Area*, Scoville, Idaho, July.

ANL (Argonne National Laboratory-West), 1998b, *Argonne National Laboratory-West 1997 Environmental Surveillance Report*, Engineering Division, July.

ANL (Argonne National Laboratory-West), 1999a, *Groundwater Monitoring Plan for Waste Area Group-9 Argonne National Laboratory-West*, Doc. No. W7500-4260-ES, March 18.

ANL (Argonne National Laboratory), 1999b, Response to Data Call from SAIC for Sodium-Bonded Spent Nuclear Fuel Treatment Technologies, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho, June.

Arnett, M. W. and A. R. Mamatey, eds., 1996, *Savannah River Site Environmental Report for 1995*, WSRC-TR-96-0075, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W. and A. R. Mamatey, eds., 1997, *Savannah River Site Environmental Report for 1996*, WSRC-TR-97-0171, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W. and A. R. Mamatey, eds., 1998a, *Savannah River Site Environmental Report for 1997*, WSRC-TR-97-00322, Westinghouse Savannah River Company, Aiken, South Carolina.

Arnett, M. W. and A. R. Mamatey, eds., 1998b, *Savannah River Site Environmental Data for 1997*, WSRC-TR-97-00324, Westinghouse Savannah River Company, Aiken, South Carolina.

Barghusen, J., and R. Feit, 1995, *Technical Report on Affected Environment for the DOE Sites Considered in the DOE Waste Management Programmatic Environmental Impact Statement*, META/Berger-SR-01, META/Berger, Gaithersburg, Maryland, July.

Bickford, W. E., J. F. Krupa, D. L. McWhorter, M. E. Dupont, 1997, *Savannah River Site Spent Nuclear Fuel Environmental Impact Statement Engineering Data Book for Routine Releases*, WSRC-TR-97-0044, Westinghouse Savannah River Company, Aiken, South Carolina, April 8.

Bright, D. J., 1999, *Low-Level Waste and Mixed Low-Level Waste Activity at the INEEL for CY 1999* (memorandum to distribution), Idaho Operations Office, Idaho Falls, ID, February 1.

Cascade Earth Sciences, Ltd. 1998, *Management Plan for the Land Application of Sewage Effluent at Argonne National Laboratory-West*, Pocatello, Idaho, July15.

CEEA (Center for Environmental and Ecological Anthropology), 1996, *The Argonne National Laboratory Burn Survey*, Idaho State University, Pocatello, Idaho, August 28.

CEQ (Council on Environment Quality), 1997, *Environmental Justice, Guidance Under the National Environmental Policy Act*, Washington, DC, December 10.

Cieminski, K. L. and L. D. Flack, 1995, "Invertebrate Fauna of Wastewater Ponds in Southeastern Idaho," *Great Basin Naturalist*, Vol. 55:105-116.

DOA (U.S. Department of Agriculture), 1973, *Soil Survey of Bingham Area*, Idaho, Soil Conservation Service, October.

DOC (U.S. Department of Commerce), 1992, *Census of Population and Housing, 1990: Summary Tape File 3 on CD-ROM*, Bureau of the Census, May.

DOE (U.S. Department of Energy), 1991, *American Indian Religious Freedom Act (AIRFA) Compliance at the Savannah River Site*, Savannah River Operations Office, Environmental Division, Aiken, South Carolina, April.

DOE (U.S. Department of Energy), 1994a, *Memorandum of Agreement Between the United States Department of Energy Idaho Operations Office and the Shoshone-Bannock Tribes*, Idaho Operations Office, Idaho Falls, Idaho, January 26.

DOE (U.S. Department of Energy), 1994b, *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility*, DOE/EIS-0082-S, DOE Savannah River Site Operations Office, Aiken, South Carolina, November.

DOE (U.S. Department of Energy), 1995a, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, DOE/EIS-0203-F, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho, April.

DOE (U.S. Department of Energy), 1995b, *Savannah River Site Waste Management Final Environmental Impact Statement*, DOE/EIS-0217, Savannah River Operations Office, Aiken, South Carolina, July.

DOE (U.S. Department of Energy), 1995c, Final Environmental Impact Statement, Interim Management of Nuclear Materials, DOE/EIS-0220, DOE Savannah River Site, Aiken, South Carolina, December.

DOE (U.S. Department of Energy), 1996a, *Environmental Assessment, Electrometallurgical Treatment Research and Demonstration Project in the Fuel Conditioning Facility at Argonne National Laboratory-West*, DOE/EA-1148, Office of Nuclear Energy, Science and Technology, Washington, DC, May 15.

DOE (U.S. Department of Energy), 1996b, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE\EIS-0236, Washington, DC, September.

DOE (U.S. Department of Energy), 1996c, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage and Disposal of Radioactive Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b, *Shutdown of the River Water System at the Savannah River Site Final Environmental Impact Statement*, DOE/EIS-0268, Savannah River Operations Office, Aiken, South Carolina, May.

DOE (U.S. Department of Energy), 1997c, *Environmental Assessment Shutdown of Experimental Breeder Reactor II at Argonne National Laboratory-West*, DOE/EA-1199, Chicago Operations Office, Chicago, Illinois, September 25.

DOE (U.S. Department of Energy), 1998a, *Air Emissions Inventory for the Idaho National Engineering and Environmental Laboratory, 1997 Emissions Report*, DOE/ID-10646, Idaho Operations Office, Idaho Falls, Idaho, June.

DOE (U.S. Department of Energy), 1998b, *Surplus Plutonium Disposition Draft Environmental Impact Statement*, DOE/EIS-0283-D, Office of Fissile Materials Disposition, Washington, DC, July.

DOE (U.S. Department of Energy), 1998c, *Draft Environmental Assessment for the Implementation of the Wetland Mitigation Bank Program at the Savannah River S*ite, DOE/EA-1205, Savannah River Operations Office, Aiken, South Carolina, August.

DOE (U.S. Department of Energy), 1998d, *Annual Report of Waste Generation and Pollution Prevention Progress 1997*, DOE/EM-0365, Office of Environmental Management, Pollution Prevention Program, September.

DOE (U.S. Department of Energy), 1998e, *Annual Update, Idaho National Engineering and Environmental Laboratory Site Treatment Plan*, DOE/ID-10493, Rev. 8, Idaho Operations Office, Idaho Falls, ID, October 31.

DOE (U.S. Department of Energy), 1998f, *Savannah River Site Spent Nuclear Fuel Management Draft Environmental Impact Statement*, DOE/EIS-0279D, Savannah River Operations Office, Aiken, South Carolina, December.

DOE (U.S. Department of Energy), 1998g, *DOE Occupational Radiation Exposure, 1997 Report*, DOE/EH-0575, Office of Worker Health and Safety.

DOE (U.S. Department of Energy), 1999a, *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement*, DOE/EIS-290, Office of Environmental Management, Idaho Operations Office, Idaho Falls, Idaho, January.

DOE (U.S. Department of Energy), 1999b, Facsimile from K. Aragon, Carlsbad Area Office, Carlsbad, New Mexico, to J. DiMarzio, Science Applications International Corporation, Germantown, Maryland, “Schedule for TRU Waste Shipments Sent from Generator Sites,” February 4.

DOE (U.S. Department of Energy), 1999c, *DOE News*, “INEEL Shipment Arrives Safely at Waste Isolation Pilot Plant,” Carlsbad Area Office, Carlsbad, New Mexico, April 28.

DOE (U.S. Department of Energy), 1999d, facsimile from J. Depperschmidt, Idaho Operations Office, Idaho Falls, ID, to S. Lesica, Germantown, Maryland, “Comments on Tables in Chapters 3 and 4,” June 29.

DOI (U.S. Department of Interior), 1986, *Visual Resource Contrast Rating*, Bureau of Land Management (BLM) Manual Handbook H-8431-1, January 17.

ESRF (Environmental Science and Research Foundation), 1999, personal communication from T.D. Reynolds, Idaho Falls, ID to J. R. Schinner, Science Applications International Corporation, Germantown, MD, *Numbers of Animals Present at INEEL*, June 22.

Evans, R. B., D. Roush, R. W. Brooks, and D.B. Martin, 1998, *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 1997,* DOE/ID-12082(97), Environmental Science and Research Foundation, Inc., Idaho Falls, Idaho, August.

ID DHW (Idaho Department of Health and Welfare), 1998, *Rules for the Control of Air Pollution in Idaho:* 577, Ambient Standards for Specific Air Pollutants;" 585, "Toxic Air Pollutants Non-Carcinogenic Increments;" 586, "Toxic Air Pollutants Carcinogenic Increments," IDAPA 16, Title 01, Chapter 01, Boise, Idaho.

INEEL (Idaho National Engineering and Environmental Laboratory), 1998, personal communication from J. E. Donhiser, Idaho Falls, Idaho, to K. Johnson, Jason Associates, Idaho Falls, Idaho, "Electrical Consumption," April 21.

INEEL (Idaho National Engineering and Environmental Laboratory), 1999a, personal communication from K. S. Moor, Idaho Falls, Idaho to R. Schlegel, Science Applications International Corporation, Germantown, Maryland, "Advanced Mixed Waste Treatment Project," May 19.

INEEL (Idaho National Engineering and Environmental Laboratory), 1999b, *Graphics Showing Tank Farm Volumes and Calcine Storage Facilities*, Idaho Falls, ID.

Jackson, S. M., 1985, "Acceleration Data from the 1983 Borah Peak, Idaho, Earthquake Recorded at the Idaho National Engineering Laboratory," in Proceedings of Workshop XXVIII on the Borah Peak, Idaho, Earthquake, R. S. Stein and R. C. Buckman (edc.), Open File Report 85-290, U.S. Geological Survey, Idaho Falls, Idaho, pp. 385-400.

LMITC (Lockheed Martin Idaho Technologies Company), 1997, *Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan*, DOE/ID-10514, Integrated Services Department, Idaho Falls, Idaho, December.

LMITC (Lockheed Martin Idaho Technologies Company), 1998, *Low-Level Waste Forecasting Assessment for the Idaho National Engineering and Environmental Laboratory*, EDF-RWMC-787, Revision 4, Idaho Falls, ID.

Miller, S. J., 1995, *Idaho National Engineering Laboratory Management Plan for Cultural Resources (Final Draft)*, DOE/ID-10361 Lockheed Idaho Technologies Company, Idaho Fall, Idaho, July 9.

Moor, K. S., and H. K. Peterson, 1999, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Plutonium-238 Production at ATR Environmental Impact Statement* (Predecisional Draft), INEL/EXT-99-Draft, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho, February.

Morris, R. C., 1996, *Draft Biological Assessment for INEL T/E and C2 Species, WAG 9,* Environmental Science and Research Foundation, Inc., Idaho Falls, Idaho, September 12.

NOAA (National Oceanic and Atmospheric Administration), 1994b, *Local Climatological Data, Annual Summary with Comparative Data, 1993,* "Augusta, Georgia" National Environmental Satellite, Data, and Information Service, National Climatic Data Center, Asheville, North Carolina, November.

NCRP (National Council on Radiation Protection and Measurements), 1987, *Ionizing Radiation Exposure of the Population of the United States,* NCRP Report No. 93, Bethesda, Maryland, September 1.

SCDHEC (South Carolina Department of Health and Environmental Control), 1998, *Regulation 61-62, Air Pollution Control Regulations and Standards,* Standard 2, "Ambient Air Quality Standards;" Standard 8, "Toxic Air Pollutants," Air Pollution Control, Columbia, South Carolina.

SHARP (Savannah River Archaeological Research Program), 1989, Archaeological Resource Management Plan of the Savannah River Archaeological Research Program, South Carolina Institute of Archaeology and Anthropology, December.

USGS (United States Geological Survey), 1998, *Preliminary Water-Surface Elevations and Boundaries of the 100-Year Peak Flow in the Big Lost River at the Idaho National Engineering and Environmental Laboratory, Idaho,* Water Resources Investigations Report 98-4065, Boise, ID.

WSRC (Westinghouse Savannah River Company), 1995, *Land-Use Baseline Report, Savannah River Site,* WSRC-TR-0276, Savannah River Site Land-Use Technical Committee, Aiken, South Carolina, June.

WSRC (Westinghouse Savannah River Company), 1997a, J. J. Mayer and L. D. Wike, *Urban Wildlife, Environmental Information Document,* WSRC-TR-97-0093, Aiken, South Carolina, May.

WSRC (Westinghouse Savannah River Company), 1997b, N.V. Halverson, L. D. Wike, K. K. Patterson et. al. *Ecology, Environmental Information Document,* WSRC-TR-0223, Aiken, South Carolina.