CHAPTER 3. AFFECTED ENVIRONMENT

EC Chapter 3 describes the existing Savannah River Site (SRS) environment as it relates to the alternatives described in Chapter 2.

3.1 Geologic Setting and Seismicity

The SRS is in west-central South Carolina, approximately 100 miles from the Atlantic coast (Figure 3.1-1). It is on the Aiken Plateau of the Upper Atlantic Coastal Plain, about 25 miles southeast of the Fall Line that separates the Atlantic Coastal Plain from the Piedmont.

3.1.1 GENERAL GEOLOGY

In South Carolina, the Atlantic Coastal Plain Province consists of a wedge of seaward-dipping and thickening unconsolidated and semi-consolidated sediments that extend from the Fall Line to the Continental Shelf. The Aiken Plateau is the subdivision of the Coastal Plain that includes the location of the SRS. The plateau extends from the Fall Line to the oldest of several scarps incised in the Coastal Plain sediment. The plateau surface is highly dissected and characterized by broad interfluvial areas with narrow steep-sided valleys. Although it is generally well drained, poorly drained depressions (called Carolina bays) do occur (DOE 1995). At the Site, the plateau is underlain by 600 to 1,400 feet of sands, clays, and limestones of Tertiary and Cretaceous age. These sediments are underlain, in turn, by sandstones of Triassic age and older metamorphic and igneous rocks (Arnett and Mamatey 1996). Because of the proximity of the SRS to the Piedmont Province, it has more relief than areas that are nearer the coast, with onsite elevations ranging from 89 to 420 feet above mean sea level.

The sediments of the Atlantic Coastal Plain (Figure 3.1-2) dip gently seaward from the Fall Line and range in age from Late Cretaceous to Recent. The sedimentary sequence thickens from essentially 0 feet at the Fall Line to more than 4,000 feet at the coast. Regional dip is to the southeast. Coastal Plain sediments underlying the SRS consist of sandy clays and clayey sands, although occasional beds of clean sand, gravel, clay, or carbonate occur (DOE 1995). The formations of interest in F and H Areas (General Separations Area) are part of the shallow (Floridan) aquifer system (Figure 3.1-2 and Table 3.1-1). Contaminants released to these formations could be transported by groundwater to local SRS streams.

3.1.2 LOCAL GEOLOGY AND SOILS

The principal surface and near-surface soils in F and H Areas consist of cross-bedded, poorly sorted sands and pebbly sands with lenses and layers of silts and clays. The surface and near-surface soils contain a greater percentage of clay, which has demonstrated a good retention capacity for most radionuclides. A significant portion of the surface soils around the F- and H-Area Tank Farms is composed of backfill material resulting from previous excavation and construction activities.

The vadose zone is comprised of the middle to late Miocene-age "Upland Unit," which extends over much of SRS. The term "Upland Unit" is an informal name used to describe sediments at higher elevations in the Upper Coastal Plain in southwestern South Carolina. This area has also been referred to as the Aiken Plateau, which is bounded by the Savannah and Congaree Rivers and extends from the Fall Line to the Orangeburg escarpment. This unit is highly dissected and is characterized by broad interfluvial areas with narrow, steep-sided valleys (SCDNR 1995). Erosion in these dissected, steep-sided valley areas expose older underlying deposits.

The occurrence of cross-bedded, poorly sorted sands with clay lenses indicate fluvial deposition (high-energy channel deposits to channel-fill deposits) with occasional transitional marine influence. This depositional environment results in wide differences in lithology and presents a very complex system of transmissive and

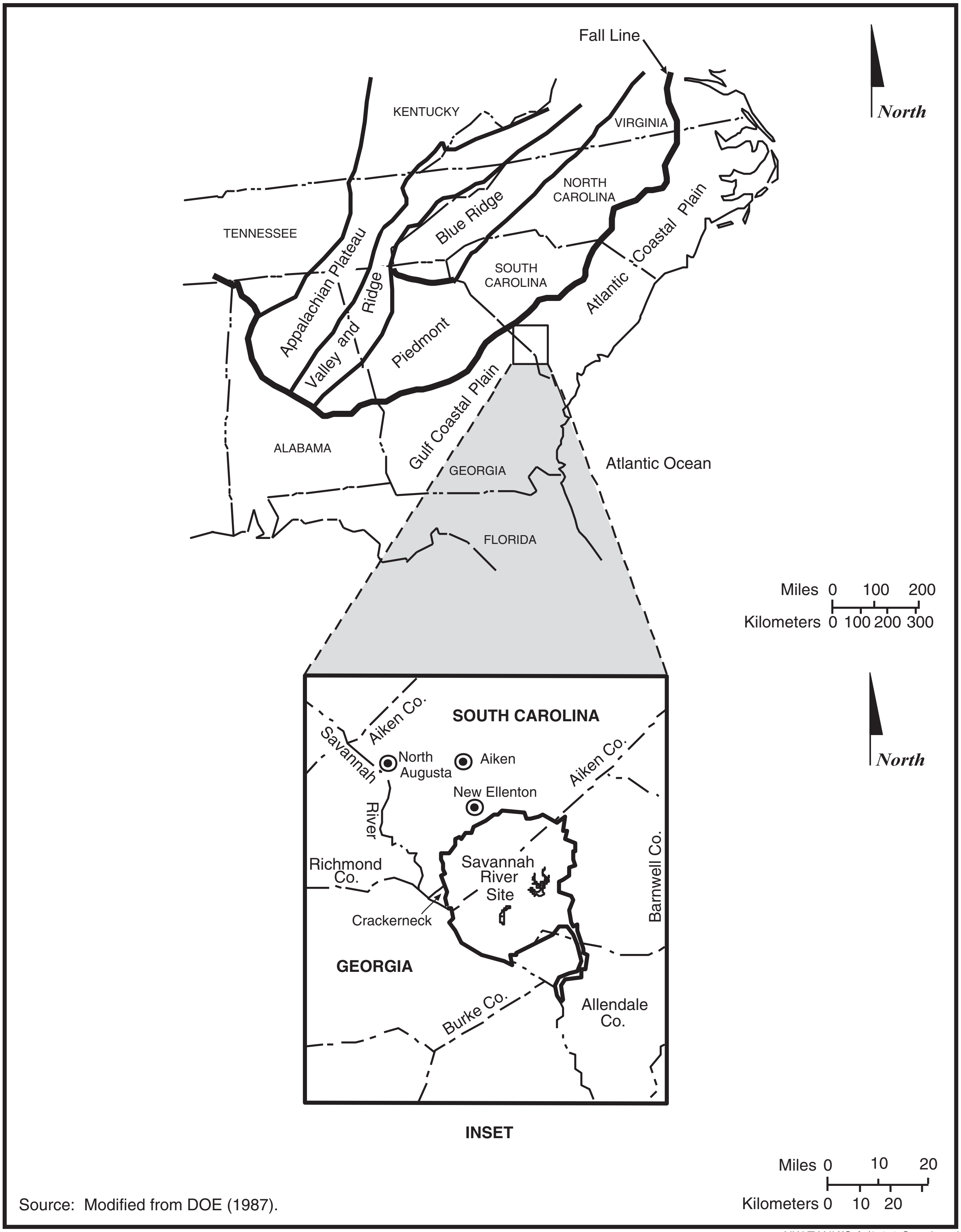

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Figure 3.1-1. Generalized location of Savannah River Site and its relationship to physiographic provinces of the southeastern United States.

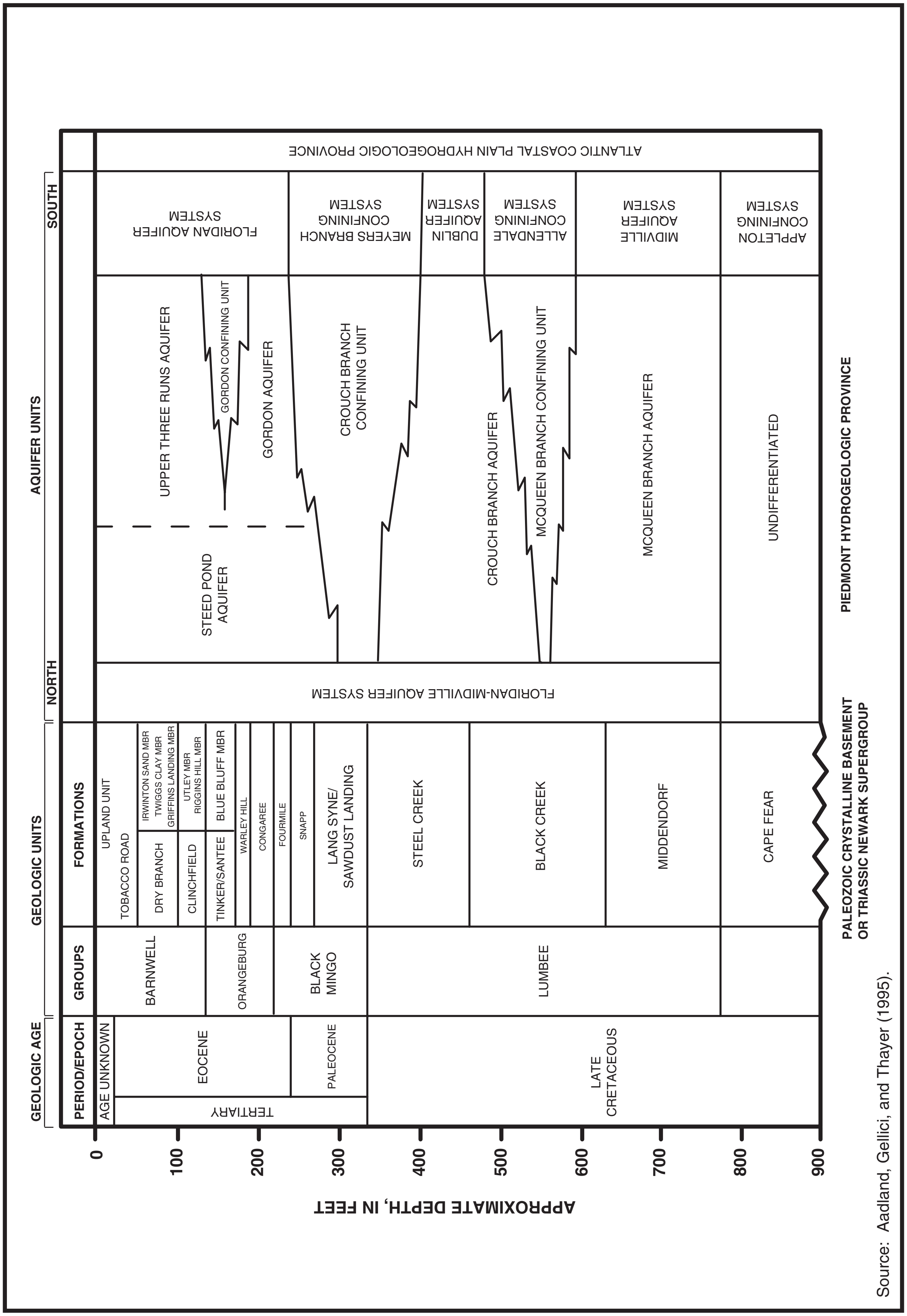

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Figure 3.1-2. Generalized geologic and aquifer units in the Savannah River Site region.

Table 3.1-1. Formations of the Floridan aquifer system in F and H Areas.[a]

Aquifer unit	Formation	Description
Upper Three Runs Aquifer -upper zone [Water Table]	"Upland Unit"	Poorly sorted, clayey-to-silty sands, with lenses and layers of conglomerates, pebbly sands, and clays. Clay clasts are abundant, and cross-bedding and flecks of weathered feldspar are locally common.
	Tobacco Road Formation	Moderately to poorly sorted, variably colored, fine-to-coarse-grained sand, pebbly sand, and minor clay beds.
"Tan Clay" Confining Zone Upper Three Runs Aquifer -lower zone [Barnwell-McBean]	Dry Branch Formation -Twiggs Clay Member -Griffins Landing Member -Irwinton Sand Member	Variably colored, poorly sorted to well-sorted sand with the interbedded tan to gray clay ("Tan Clay") of the Twiggs Clay Member. The Tan Clay, where present, divides the Upper Three Runs Aquifer into an upper and lower zone.
	Clinchfield Formation	Light-colored basal quartz sand and glauconitic, biomoldic limestone, calcareous sand and clay. Sand beds of the formation constitute Riggins Mill Member and consist of medium-to-coarse, poorly to well-sorted, loose and slightly indurated, tan, gray, and green quartz. The carbonate sequence of the Clinchfield consists of Utley Member - sandy, glauconitic limestone and calcareous sand with indurated biomoldic facies.
	Tinker/Santee Formation	Unconsolidated, moderately sorted, subangular, lower coarse-to-medium-grained, slightly gravelly, immature yellow and tan quartz sand and clayey sand; calcareous sands and clays and limestone also occur in F and H Areas.
Gordon Confining Unit [Green Clay]	Blue Bluff Member of Santee Limestone	Micritic limestone.
	Warley Hill Formation	Fine-grained, glauconitic, clayey sand, and clay that thicken, thin, and pinch out abruptly.
Gordon Aquifer [Congaree]	Congaree Formation	Yellow, orange, tan, gray, and greenish gray, well-sorted, fine-to-coarse-grained quartz sands. Thin clay laminae occur throughout the section, with pebbly layers, clay clasts, and glauconite in places. In some places on SRS, upper part of Congaree Formation is cemented with silica; in other places, it is slightly calcareous. Glauconitic clay, encountered in some borings on SRS near the base of this formation, indicates that basal contact is unconformable.
	Fourmile Formation	Tan, yellow-orange, brown, and white, moderately to well-sorted sand, with clay beds near middle and top of unit. The sand is very coarse-to-fine-grained, with pebbly zones common. Glauconite and dinoflagellate fossils occur.
	Snapp Formation	Silty, medium-to-coarse-grained quartz sand interbedded with clay. Dark, micaceous, lignitic sand also occurs. In northwestern part of SRS, this formation is less silty and better sorted, with thinner clay interbeds.

a. Source: Aadland, Gellici, and Thayer (1995).

confining beds or zones (SCDNR 1995). The lower surface of the "Upland Unit" is very irregular, due to erosion of the underlying formations (Fallow and Price 1992). The thickness of the "Upland Unit" ranges from 16 feet to 40 feet in the vicinity of the F- and H-Area Seepline Basins (WSRC 1991), but may be as thick as 70 feet in the Central Savannah River Area (Fallow and Price 1992). The F- and H-Area Seepage Basins are located southwest and west of the F- and H-Area Tank Farms, respectively.

A notable feature of the "Upland Unit" is its compositional variability (Figure 3.1.2). This formation predominantly consists of red-brown to yellow-orange, gray, and tan-colored, coarse-to-fine-grained sand, pebbly and with lenses and beds of sandy clay and clay. Generally vertically upward through the unit, sorting of grains becomes poorer, clay beds become more abundant and thicker, and sands become more argilaceous and indurated (Fallow and Price 1992). In some areas, small-scale joints and fractures, both of which are commonly filled with sand or silt, traverse the unit. The mineralogy of the sands and pebbles primarily consists of quartz, with some feldspars. In areas to the east-southeast, sediments may become more phosphatic and dolomitic. The mineralogy of the clays consists of kaolinite, resulting from highly weathered feldspars, and muscovite (Nystrom, Widoughby and Price 1991). The soils at F and H Areas may contain as much as 20 to 40 percent clay (WSRC 1991).

3.1.3 SEISMICITY

There are several fault systems off the Site, northwest of the Fall Line (DOE 1990). A recent study of geophysical evidence (Wike, Moore-Shedrow and Shedrow 1996) and an earlier study (Stephenson and Stieve 1992) also identified the onsite faults indicated on Figure 3.1-3. The earlier study identified the following faults – Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs – under SRS. The more recent study (Wike Moore-Shedrow and Shedrow 1996) identified a previously unknown fault that passes through the southeastern corner of H Area and passes approximately one-half mile south of F Area, between F Area, and Fourmile Branch.

The Upper Three Runs Fault, which is a Paleozoic fault that does not cut Coastal Plain sediments, passes approximately 1 mile north and west of F Area. The lines shown on Figure 3.1-3 represent the projection of faults to the ground surface. The actual faults do not reach the surface, but stop several hundred feet below.

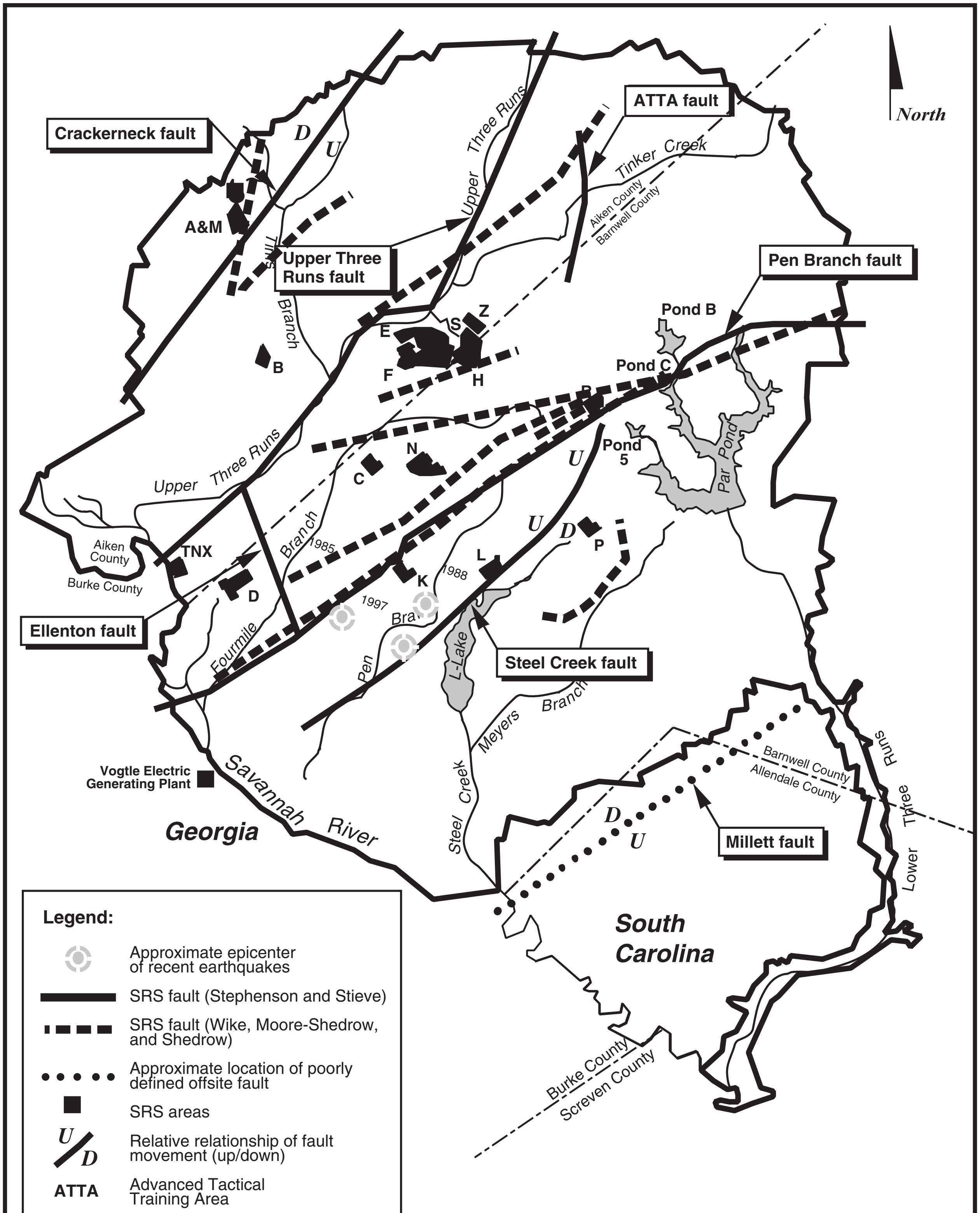
Based on available information, none of the faults discussed in this section is capable, which means that none of the faults has moved at or near the ground surface within the past 35,000 years or is associated with another fault that has moved in the past 35,000 years. Regulation 10 Code of Federal Regulations (CFR) 100 contains a more detailed definition of a capable fault. Two major earthquakes have occurred within 186 miles of SRS.

- According to URS/Blume (1982), the Charleston, South Carolina, earthquake of 1886 had an estimated Richter scale magnitude of 6.8; it occurred approximately 90 miles from the SRS area, which experienced an estimated peak horizontal acceleration of 10 percent of gravity (0.10*g*). Lee, Maryak, and McHood (1997) re-evaluated the data and determined the magnitude to have been 7.5.

- The Union County, South Carolina, earthquake of 1913 had, according to Bollinger (1973), an estimated Richter scale magnitude of 6.0 and occurred about 99 miles from the Site. The magnitude has since been revised downward to 4.5, based on a re-evaluation of the duration data (Geomatrix 1991).

These earthquakes are not associated conclusively with a specific fault.

In recent years, three earthquakes occurred inside the SRS boundary.



Source: Modified from Stephenson and Stieve (1992) and Wike et al. (1996).

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NW TANK/Grfx/3.1-3 Fault lines.ai

Figure 3.1-3. Savannah River Site, showing seismic fault lines and locations of onsite earthquakes and their years of occurrence.

- On May 17, 1997, with a duration magnitude of 2.3 and a focal depth of 3.38 miles; its epicenter was southeast of K Area.
- On June 8, 1985, with a duration magnitude of 2.6 and a focal depth of 0.59 mile; its epicenter was south of C Area and west of K Area.
- On August 5, 1988, with a duration magnitude of 2.0 and a focal depth of 1.66 miles; its epicenter was northeast of K Area.

Existing information does not relate these earthquakes conclusively to known faults under the Site. In addition, the focal depth of these earthquakes is currently being evaluated. Figure 3.1-3 shows the locations of the epicenters of these earthquakes.

Outside the SRS boundary, an earthquake with a Richter scale magnitude of 3.2 occurred on August 8, 1993, approximately 10 miles east of the City of Aiken near Couchton, South Carolina. People reported feeling this earthquake in Aiken, New Ellenton (immediately north of SRS), North Augusta (approximately 25 miles northwest of the SRS), and on the Site.

3.2 Water Resources

3.2.1 SURFACE WATER

The Savannah River bounds SRS on its southwestern border for about 20 miles, approximately 160 river miles from the Atlantic Ocean. Five upstream reservoirs – Jocassee, Keowee, Hartwell, Richard B. Russell, and Strom Thurmond – reduce the variability of flow downstream in the area of SRS. River flow averages about 10,000 cubic feet per second at SRS (DOE 1995).

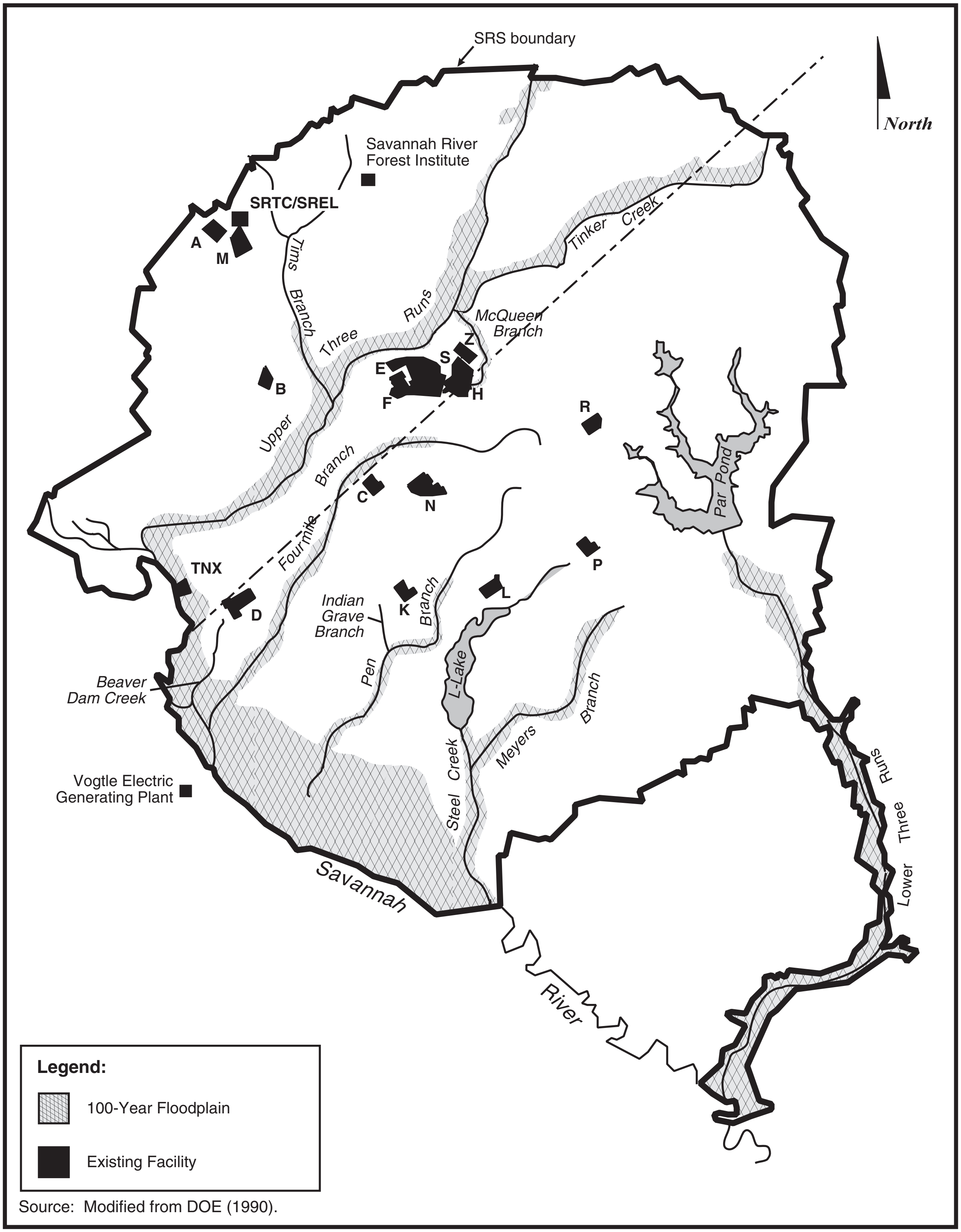
Upstream of SRS, the river supplies domestic and industrial water for Augusta, Georgia, and North Augusta, South Carolina. Approximately 130 river miles downstream of SRS, the river supplies domestic and industrial water for Savannah, Georgia, and Beaufort and Jasper Counties in South Carolina through intakes at about River Mile 29 and River Mile 39, respectively (DOE 1995).

Five tributaries discharge directly to the Savannah River from SRS: Upper Three Runs, Beaver Dam Creek, Fourmile Branch, Steel Creek, and Lower Three Runs (Figure 3.2-1). A sixth stream, Pen Branch, which does not flow directly into the river, joins Steel Creek in the Savannah River floodplain swamp. Each of these six streams originates on the Aiken Plateau in the Coastal Plain and descends 50 to 200 feet before discharging into the river (DOE 1995). The streams, which historically have received varying amounts of effluent from SRS operations, are not commercial sources of water.

F and H Areas are situated on the divide that separates the drainage into Upper Three Runs (including McQueen Branch and Crouch Branch) and Fourmile Branch; approximately half of each area drains into each stream (DOE 1996). F and H Areas are relatively elevated areas of SRS and are centrally located inside the SRS boundary. Surface elevations range from approximately 270 to 320 feet above mean sea level for both F and H Areas. The F and H Areas are drained by Upper Three Runs to the north and west and by Fourmile Branch to the south. In addition, the Water Table Aquifer for both F and H Areas outcrops at the seeplines along both Fourmile Branch and Upper Three Runs.

Upper Three Runs, the longest of the SRS streams, is a large blackwater stream in the northern part of SRS that discharges to the Savannah River. It drains an area of over 195 square miles and is approximately 25 miles long, with its lower 17 miles within SRS boundaries. This stream receives more water from underground sources than other SRS streams and is the only stream with headwaters arising outside the Site. It is the only major tributary on SRS that has not received thermal discharges (Halverson et al. 1997).

Fourmile Branch is a blackwater stream that originates near the center of SRS and flows southwest for 15 miles before emptying into the Savannah River (Halverson et al. 1997). It



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NW Tank/Grfx/3.2-1 Floodplain.ai

Figure 3.2-1. Savannah River Site, showing 100-year floodplain and major stream systems.

drains an area of about 22 square miles inside SRS, including much of F, H, and C Areas. Fourmile Branch flows parallel to the Savannah River behind natural levees and enters the river through a breach downriver from Beaver Dam Creek. In its lower reaches, Fourmile Branch broadens and flows via braided channels through a delta formed by the deposition of sediments eroded from upstream during high flows.

Downstream from the delta, the channels rejoin into one main channel. Most of the flow discharges into the Savannah River, while a small portion flows west and enters Beaver Dam Creek (DOE 1995).

The natural flow of SRS streams ranges from about 10 cubic feet per second in smaller streams to 245 cubic feet per second in Upper Three Runs. From 1974 to 1995, the mean flow of Upper Three Runs at Road A was 245 cubic feet per second, and the 7Q10 (minimum 7-day average flow rate that occurs with an average frequency of once in 10 years) was 100 cubic feet per second (Halverson et al. 1997). The mean flow of Fourmile Branch southwest of SC Highway 125 from 1976 to 1995 was 113 cubic feet per second, and the 7Q10 was 7.6 cubic feet per second (Halverson et al. 1997). The *SRS Ecology Environmental Information Document* (Halverson et al. 1997) and the *Final Environmental Impact Statement for the Shutdown of the River Water System at the Savannah River Site* (DOE 1997) contain detailed information on flow rates and water quality of the Savannah River and SRS streams.

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There are various potential sources of contamination to the Upper Three Runs and Fourmile Branch watersheds in and around F and H Areas. These potential sources have been identified in the SRS *Federal Facility Agreement*, Appendix C, RCRA/CERCLA Units (WSRC 1993) and are listed in Table 3.2-1. These potential sources could contribute contaminants to the surface waters of Upper Three Runs and Fourmile Branch in the same manner as the F- and H-Area Tank Farms.

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The South Carolina Department of Health and Environmental Control (SCDHEC) regulates the physical properties and concentrations of chemicals and metals in SRS effluents under the National Pollutant Discharge Elimination System (NPDES) program. SCDHEC, which also regulates biological water quality standards for SRS waters, has classified the Savannah River and SRS streams as "Freshwaters." In 1998, 99.3 percent of the NPDES water quality analyses on SRS effluents were in compliance with the SRS NPDES permit; only 42 of 5,790 analyses exceeded permit limits (Arnett and Mamatey 1999a). The 1998 exceedances were higher than in previous years. Repeat exceedances at four outfalls accounted for a majority of the exceedances; some of these can be attributed to ongoing heavy rainfall. In particular, heavy rainfall caused groundwater levels to rise significantly at outfall D-1A, which had a total of 18 exceedances. A comparison of 1998 Savannah River water quality analyses showed no significant differences between up- and downstream SRS stations (Arnett and Mamatey 1999a). Table 3.2-2 summarizes the water quality of Fourmile Branch and Upper Three Runs for 1998.

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3.2.2 GROUNDWATER RESOURCES

3.2.2.1 <u>Groundwater Features</u>

In the SRS region, the subsurface contains two hydrogeologic provinces. The uppermost, consisting of a wedge of unconsolidated Coastal Plain sediments of Late Cretaceous and Tertiary age, is the Atlantic Coastal Plain Hydrogeologic Province. Beneath the sediments of the Atlantic Coastal Plain Hydrogeologic Province are rocks of the Piedmont Hydrogeologic Province. These rocks consist of Paleozoic igneous and metamorphic basement rocks and lithified mudstone, sandstone, and conglomerates of the Dunbarton basin of the Upper Triassic. Sediments of the Atlantic Coastal Plain Hydrogeologic Province are divided into three main aquifer systems, the Floridan Aquifer System, the Dublin Aquifer System, and the Midville Aquifer System, as shown in Figure 3.1-2 (Aadland, Gellici, and Thayer 1995). The Meyers Branch Confining System and/or the Allendale Confining System, as

EC

Table 3.2-1. Potential F and H Area contributors of contamination to Upper Three Runs and Fourmile Branch.[a]

Fourmile Branch Watershed	Upper Three Runs Watershed
Burial Ground Complex Groundwater[b]	Burial Ground Complex Groundwater[a]
Burial Ground Complex [the Old Radioactive Waste Burial Ground (643-E) and Solvent Tanks S01-S22 portions]	Burial Ground Complex (the Low-Level Radioactive Waste Disposal Facility [643-7E] portion)
F-Area Coal Pile Runoff Basin, 289-F	Burma Road Rubble Pit, 231-4F
F-Area Hazardous Waste Management Facility, 904-41G, -42G, -43G	F-Area Burning/Rubble Pits, 231-F, -1F, -2F
F-Area Inactive Process Sewer Lines from Building to the Security Fence[a], 081-1F	F-Area Inactive Process Sewer Lines from Building to the Security Fence[a], 081-1F
F-Area Retention Basin, 281-3F	
F-Area Seepage Basin Groundwater Operable Unit	H-Area Coal Pile Runoff Basin, 289-H
H-Area Hazardous Waste Management Facility, 904-44G, -45G, -46G, -56G	H-Area Inactive Process Sewer Lines from Building to the Security Fence[a], 081-H
H-Area Inactive Process Sewer Lines from Building to the Security Fence[a], 081-H	
H-Area Retention Basin, 281-3H	Old F-Area Seepage Basin, 904-49G
H-Area Seepage Basin Groundwater Operable Unit	211-FB Plutonium-239 Release, 081-F
H-Area Tank Farm Groundwater	
Mixed Waste Management Facility, 643-28E	
Warner's Pond, 685-23G	

a. Source: WSRC (1993).
EC b. Units located in more than one watershed.

shown in Figure 3.1-2, separate the aquifer systems of interest.

Groundwater within the Floridan System (the shallow aquifer beneath the Site) flows slowly toward SRS streams and swamps and into the Savannah River at rates ranging from inches to several hundred feet per year. The depth to which onsite streams cut into sediments, the lithology of the sediments, and the orientation of the sediment formations control the horizontal and vertical movement of the groundwater. The valleys of smaller perennial streams allow discharge from the shallow saturated geologic formations. The valleys of major tributaries of the Savannah River (e.g., Upper Three Runs) drain formations of intermediate depth, and the river valley drains deep formations. With the release of water to the streams, the hydraulic head of the aquifer unit releasing the water can become less than that of the underlying unit. If this occurs, groundwater has the potential to migrate upward from the lower unit to the overlying unit.

Groundwater flow in the shallow aquifer (Floridan) system is generally horizontal, but may have a vertically downward component. In the divide areas between surface water drainages, the vertical component of groundwater flow is downward due to the decreasing hydraulic head with increasing depth. In areas along the lower reaches of most of the Site streams, groundwater moves generally in a horizontal direction and has vertically upward potential from deeper aquifers to the shallow aquifers. In these areas, hydraulic heads increase with depth. In the vicinity of these streams, the potential for vertically upward flow occurs across a confining unit where the underlying aquifer has not been incised by an overlying stream (Aadland, Gellici, and Thayer 1995). EC For example, in the area south of H Area where Fourmile Branch cuts into the Upper

Table 3.2-2. SRS stream water quality (onsite downstream locations).[a]

Parameter[b]	Units	Fourmile Branch (FM-6) average	Upper Three Runs (U3R-4) average	Water Quality Criterion[c], MCL[d], or DCG[e]
Aluminum	mg/L	0.285[f]	0.294[f]	0.087
Cadmium	mg/L	NR[g]	NR	0.00066
Calcium	mg/L	NR	NR	NA[h]
Cesium-137	pCi/L	4.74	0.67	120[e]
Chromium	mg/L	ND[i]	ND	0.011
Copper	mg/L	0.006	ND	0.0065
Dissolved oxygen	mg/L	8.31	6.3	≥5
Iron	mg/L	0.717	0.547	1
Lead	mg/L	0.18	0.011	0.0013
Magnesium	mg/L	NR	NR	0.3
Manganese	mg/L	0.045	0.026	1
Mercury	mg/L	0.0002	ND	0.000012
Nickel	mg/L	ND	ND	0.088
Nitrate (as nitrogen)	mg/L	1.29	0.26	10[d1]
pH	pH	6.4	5.8	6-8.5
Plutonium-238	pCi/L	0.003	ND	1.6[e]
Plutonium-239	pCi/L	0.001	0.005	1.2[e]
Strontium-89,90	pCi/L	6.79	0.04	8[d2]
Suspended solids	mg/L	3.9	5.9	NA
Temperature[j]	°C	20.2	18.8	32.2
Tritium	pCi/L	1.9×10^5	4.2×10^3	20,000[d2]
Uranium-234	pCi/L	0.69	0.093	20[e]
Uranium-235	pCi/L	0.053	0.046	24[e]
Uranium-238	pCi/L	0.84	0.11	24[e]
Zinc	mg/L	0.019	0.02	0.059

a. Source: Arnett and Mamatey (1999b).
b. Parameters DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. Water Quality Criterion (WQC) is Aquatic Chronic Toxicity unless otherwise indicated.
d. MCL = Maximum Contaminant Level; State Primary Drinking Water Regulations [d1 = Chapter 61-58.5 (b)(2)h; d2= Chapter 61-58.5(h)(2)b]. EC
e. DCG = DOE Derived Concentration Guides for Water (DOE Order 5400.5). DCG values are based on committed effective dose of 100 millirem per year; however, because drinking water MCL is based on 4 millirem per year, value listed is 4 percent of DCG.
f. Concentration exceeded WQC; however, these criteria are for comparison only. WQCs are not legally enforceable.
g. NR = Not reported.
h. NA = Not applicable.
i. ND = Not detected. EC
j. Shall not be increased more than 2.8°C (5°F) above natural temperature conditions or exceed a maximum of 32.2°C (90°F) as a result of the discharge of heated liquids unless appropriate temperature criterion mixing zone has been established.

Three Runs Aquifer, but does not cut into the Gordon Aquifer, the hydraulic head is greater in the Gordon Aquifer than the overlying Upper Three Runs Aquifer that discharges to Fourmile Branch. At these locations, any contaminants in the overlying aquifer system are prevented from migrating into deeper aquifers by the prevailing hydraulic gradient and the low permeability of the confining unit. Groundwater flow in the General Separations Area, which includes F and H Areas, is toward Upper Three Runs and its tributaries to the north and Fourmile Branch to the south.

3.2.2.2 Groundwater Use

Groundwater is a domestic, municipal, and industrial water source throughout the Upper Coastal Plain. Regional domestic water supplies come primarily from the shallow aquifers, including the Gordon Aquifer and the Upper Three Runs Aquifer (water-table aquifer). Most municipal and industrial water supplies in Aiken County are from the Crouch Branch and McQueen Branch Aquifers, formerly the Black Creek and Middendorf, respectively. In Barnwell and Allendale Counties, some municipal water supplies are from the Gordon Aquifer and overlying units that thicken to the southeast. At SRS, most groundwater production for domestic and process water comes from the Crouch Branch and McQueen Branch, with a few lower-capacity domestic waterwells pumping from the shallower Gordon (Congaree) Aquifer and the lower zone of the Upper Three Runs (McBean) Aquifer. These wells are located away from the main operations areas in outlying areas including guard barricades and operations offices/laboratories (DOE 1998).

The domestic water requirements for the General Separations Area are supplied from groundwater wells located in A Area (Arnett and Mamatey 1997). From January to December 1998, the total groundwater withdrawal rate in the General Separations Area for industrial use, including groundwater from process production wells and former domestic wells (now used as process wells in F, H, and S Areas) was approximately 2.1 million gallons per day. These wells are installed in the deeper Crouch Branch and McQueen Branch Aquifers. Groundwater in F Area is pumped from four process production and two former domestic wells currently being used for process production. The total F Area groundwater production rate in 1998 was approximately 1.01 million gallons per day. During the same period, wells in H and S Areas produced approximately 1.02 million gallons per day and 49,000 gallons per day, respectively. H Area has two former domestic wells and three process production wells (Wells 1997; WSRC 1999). S Area's groundwater production is from three process/former domestic wells (WSRC 1995).

3.2.2.3 Hydrogeology

The aquifers of interest for F and H Areas within the General Separations Area are the Upper Three Runs and Gordon Aquifers. The Upper Three Runs Aquifer (formerly Water Table and Barnwell-McBean Aquifers) is defined by the hydrogeologic properties of the Tinker/Santee Formation, the Dry Branch Formation, and the Tobacco Road Formation (DOE 1997). Table 3.1-1 provides descriptions of these formations. The Twiggs Clay Member of the Dry Branch Formation acts as a confining unit (Tan Clay) that separates the Upper Three Runs Aquifer into an upper and lower zone. The horizontal hydraulic conductivity for the upper zone of the Upper Three Runs Aquifer ranges between 5 to 13 feet per day, with localized areas as high as 40 feet per day (Aadland, Gellici, and Thayer 1995). The horizontal hydraulic conductivity for the lower zone of the Upper Three Runs Aquifer is approximately 2.5 to 10 feet per day (Aadland, Gellici, and Thayer 1995). The vertical conductivity of the Upper Three Runs Aquifer (upper and lower zones) is generally assumed to be about $1/10^{th}$ to $1/100^{th}$ of the horizontal conductivity, based on its lithology and stratified nature. The vertical hydraulic conductivity of the Tan Clay unit is generally taken to be on the order of 5×10^{-3} to 8×10^{-4} feet per day to support groundwater flow modeling calibration (Flach 1994).

Groundwater flow in the Upper Three Runs Aquifer is generally horizontal, but may have a vertically downward component. In the groundwater divide areas generally located between surface water drainages, a component of groundwater flow is downward due to the decreasing hydraulic head with increasing depth. Because the F- and H-Area Tank Farms lie near the groundwater divide, the groundwater flow direction may be toward either Upper Three Runs and its tributaries to the north or Fourmile Branch to the south. In areas along Fourmile Branch, shallow groundwater moves generally in a horizontal direction and deeper groundwater has vertically upward potential to the shallow aquifers. In these areas, hydraulic heads increase with depth. Therefore, along Fourmile Branch, any contaminants in the Upper Three Runs Aquifer are prevented from migrating into deeper aquifers by the prevailing hydraulic gradient and the low permeability of the Tan and Green Clay confining units. To the north of the tank farms, however, the rising elevation of the Upper Three Runs Aquifer and the deep incision of Upper Three Runs Creek result in truncation of the entire aquifer. In these areas, shallow groundwater may seep out along the major tributaries to Upper Three Runs Creek above the valley floor, or may seep downward to the next underlying aquifer zone and discharge along the stream valley.

The Gordon Confining Unit (green clay), which separates the Upper Three Runs and Gordon Aquifers, consists of the Warley Hill Formation and the Blue Bluff Member of the Santee Limestone (Table 3.1-1). It is not a continuous clay unit, but consists of several superimposed lenses of green and gray clay that thicken, thin, and pinch out abruptly. Locally, beds of calcareous mud add to the thickness of the unit, with minor interbeds of clayey sand or sand (Aadland, Gellici, and Thayer 1995). The vertical hydraulic conductivity is generally taken to be on the order of 1×10^{-4} to 1×10^{-5} foot per day to support groundwater flow modeling calibration (Flach 1994).

EC

The Gordon Aquifer consists of the Congaree, Fourmile, and Snapp Formations. Table 3.1-1 provides soil descriptions for these formations. The Gordon Aquifer is partially eroded near the Savannah River and along Upper Three Runs. This aquifer is recharged directly by precipitation in the outcrop area, at interstream drainage divides in and near the outcrop area, and by leakage from overlying and underlying aquifers. The southeast-to-northwest hydraulic gradient across SRS is consistent and averages 4.8 feet per mile. The horizontal hydraulic conductivity, ranges between approximately 30 to 40 feet per day (Aadland, Gellici, and Thayer 1995). The vertical hydraulic conductivity is generally assumed to be about 1/10th to 1/100th of the horizontal conductivity, based on its lithology and stratified nature (Flach 1994).

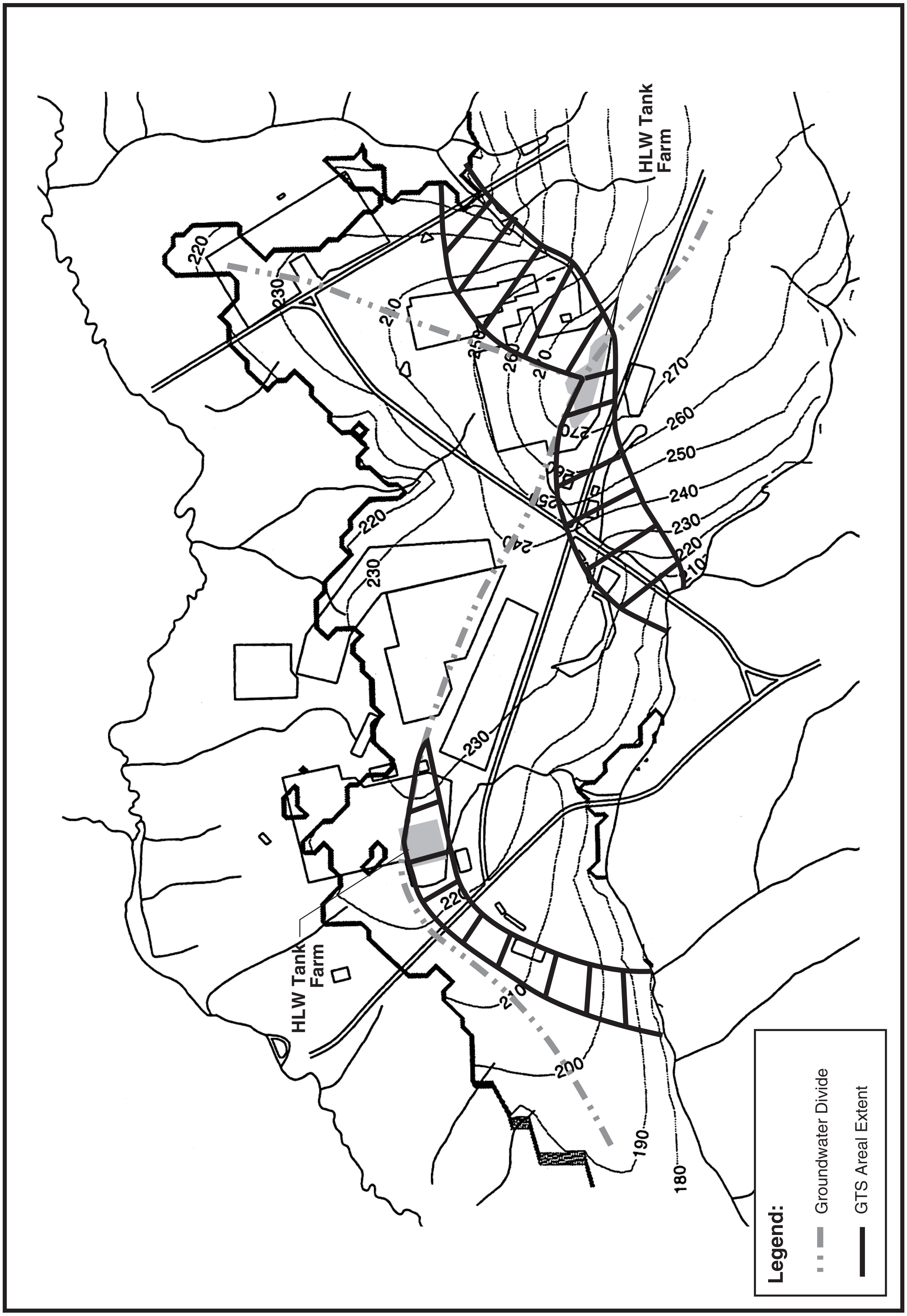
Figures 3.2-2 through 3.2-4 show the approximate groundwater flow paths for F- and H-Area Tank Farms for the Water Table, Barnwell-McBean, and Congaree Aquifers.

3.2.2.4 Groundwater Quality

Industrial solvents, metals, tritium, and other constituents used or generated on SRS have contaminated the shallow aquifers beneath the industrial areas that make up 5 to 10 percent of the Site. In general, DOE does not use these aquifers for SRS process operations or drinking water, although there are a few low-yield wells in the Gordon Aquifer and in the lower zone of the Upper Three Runs Aquifer (formerly known as the McBean and Barnwell-McBean) in remote locations. The shallow aquifer units of the Floridan System discharge to SRS streams and eventually the Savannah River (Arnett and Mamatey 1997).

Most contaminated groundwater at SRS occurs beneath the industrial facilities; the contaminants reflect the operations and chemical processes performed at those facilities. In the General Separations Area, contaminants above regulatory and U.S. Department of Energy (DOE) guidelines include tritium and other radionuclides, metals, nitrates, sulfates, and chlorinated and volatile organics. Tables 3.2-3 through 3.2-7 list concentrations of individual analytes above regulatory or SRS guidelines for the period from fourth quarter 1997 through third quarter 1998 for the General Separations Area that includes E, F, H, S, and Z Areas, respectively (WSRC 1997; WSRC 1998a,b,c).

EC



NW TANK/Grfx/3.2-2 Water table.ai

Figure 3.2-2. Calibrated potentiometric surface (ft) for the Water Table aquifer.

EC

NW TANK/Grfx/3.2-3 Barnw-McB.ai

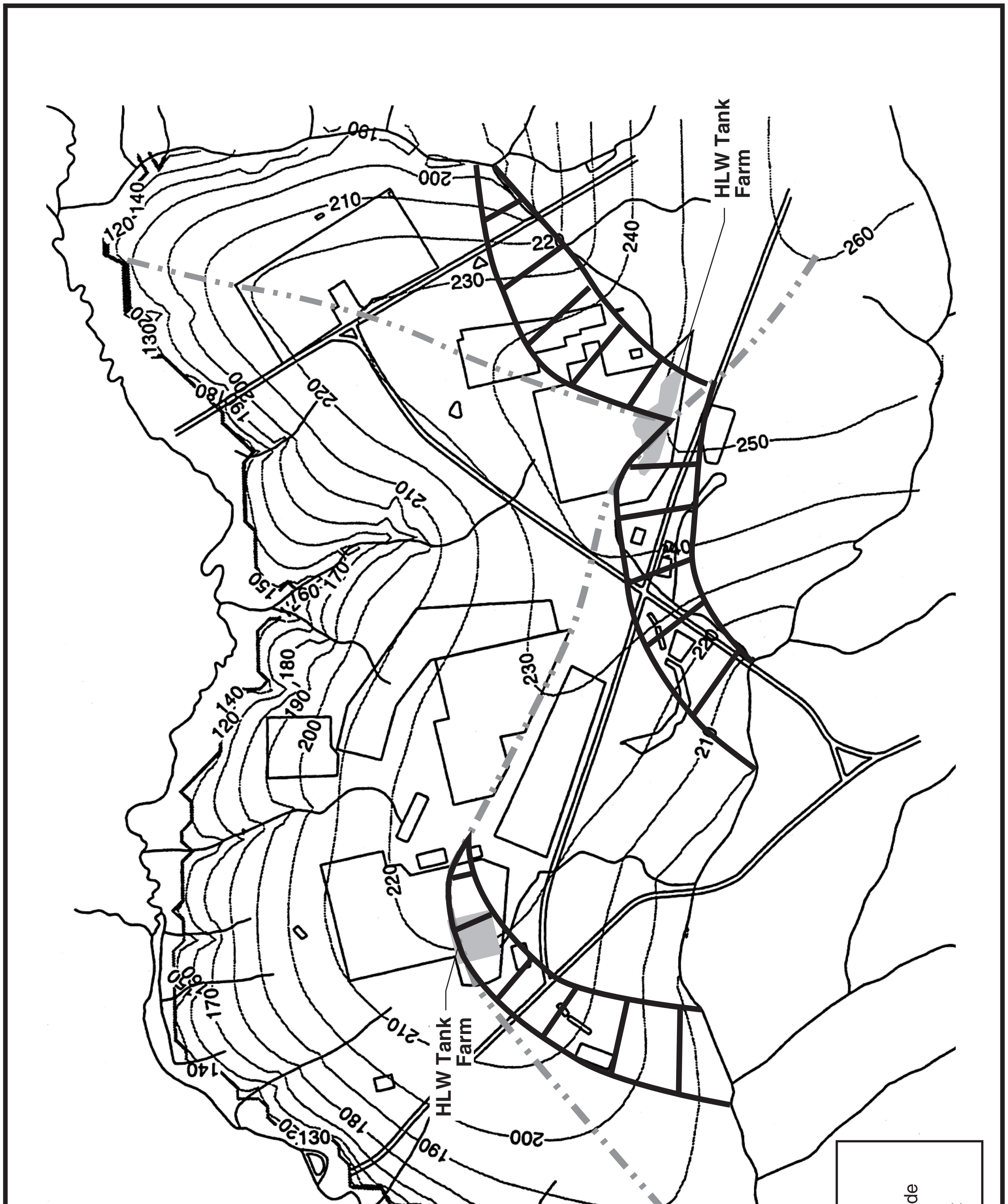


Figure 3.2-3. Calibrated potentiometric surface (ft) for the Barnwell-McBean Aquifer.

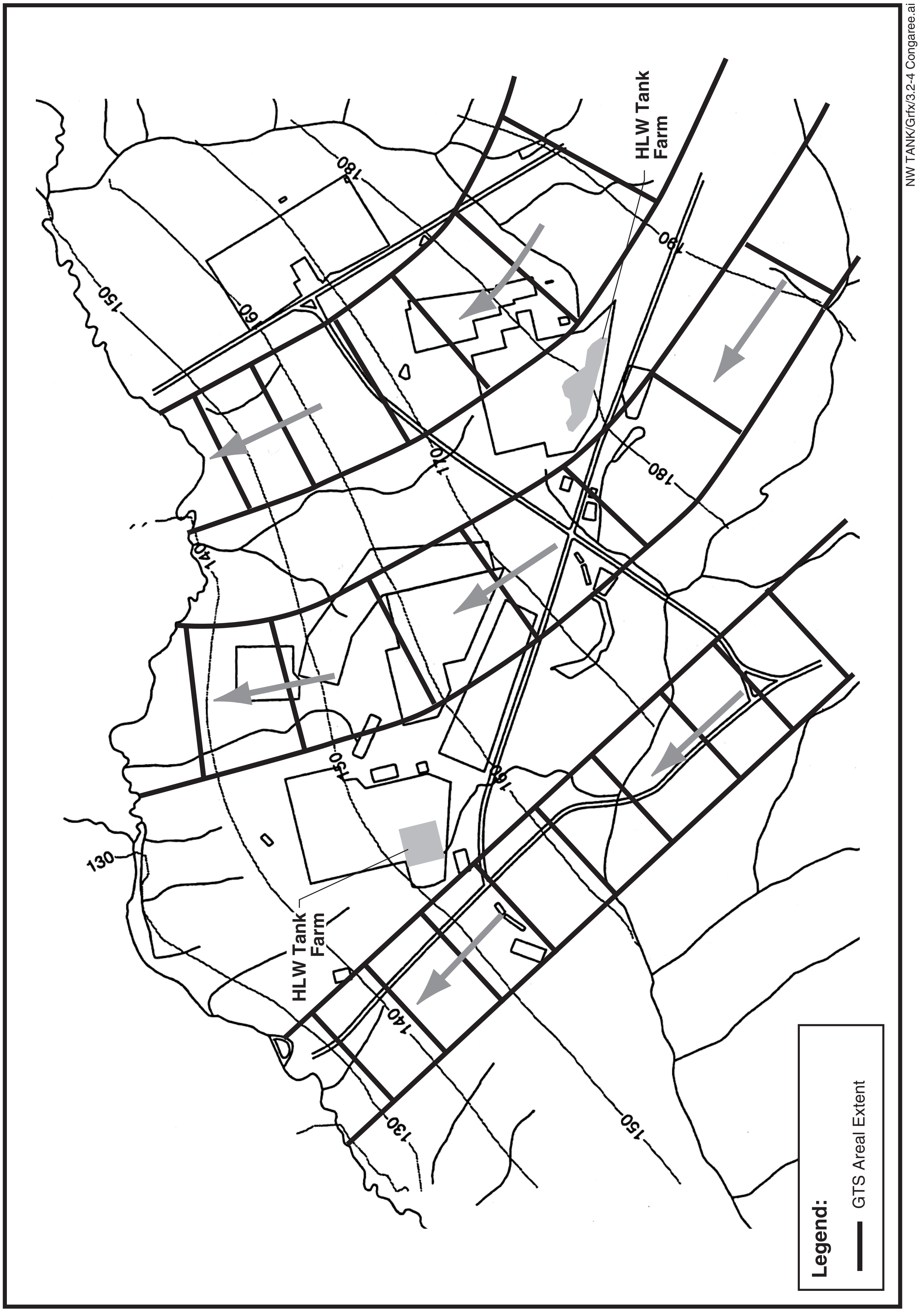


Figure 3.2-4. Calibrated potentiometric surface (ft) for the Congaree Aquifer.

Table 3.2-3. E Area maximum reported groundwater parameters in excess of regulatory and SRS limits.[a]

Analyte	Concentration	Regulatory limit
Aluminum[b]	3,670 µg/L	50 µg/L[c]
Antimony[b]	10.2 µg/L	6.0 µg/L[d]
Bromomethane	20.0 µ/L	20 µg/L[e]
Cadmium[b]	9.48 µg/L	5.0 µg/L[d]
Carbon-14	5.29×10^{-5} µCi/mL	2.0×10^{-6} µCi/mL[f]
Carbon tetrachloride	11.4 µg/L	5.0 µg/L[d]
Chloroethene (vinyl chloride)	24.9 µg/L	2.0 µg/L[d]
Chloroform	163 µg/L	100 µg/L[d]
Chromium[b]	117 µg/L	100 µg/L[d]
1,1-Dichloroethane	60.8 µg/L	5.0 µg/L[e]
1,1-Dichloroethylene	25.6 µg/L	7.0 µg/L[d]
Dichloromethane	150 µg/L	5.0 µg/L[d]
Gross alpha	3.27×10^{-8} µCi/mL	1.5×10^{-8} µCi/mL[d]
Iron[b]	13,500 µg/L	300 µg/L[c]
Lead[b]	116.0 µg/L	50 µg/L[g]
Lithium[b]	1,510 µg/L	250 µg/L[e]
Manganese[b]	309 µg/L	50 µg/L[c]
Mercury[b]	6.67 µg/L	2.0 µg/L[d]
Nickel[b]	134 µg/L	100 µg/L[d]
Nonvolatile beta	1.05×10^{-7} µCi/mL	5.0×10^{-8} µCi/mL[f]
Radium, total alpha-emitting	6.90×10^{-9} µCi/mL	5.0×10^{-9} µCi/mL[f]
Strontium-90	6.44×10^{-8} µCi/mL	8.0×10^{-9} µCi/mL[d]
Tetrachloroethylene	50.2 µg/L	5 µg/L[d]
Thallium[b]	8.30 µg/L	2 µg/L[d]
Total organic halogens	559 µg/L	50 µg/L[e]
Trichloroethylene	1,160 µg/L	5 µg/L[d]
Trichlorofluoromethane	35.1 µg/L	20 µg/L[e]
Tritium	2.96×10^{-1} µCi/mL	2.0×10^{-5} µCi/mL[d]

a. µg/L = micrograms per liter; µCi/mL = microcuries per milliliter.
b. Total recoverable.
c. EPA National Secondary Drinking Water Standards (WSRC 1997; 1998a,b,c). EPA Final Primary Drinking Water Standards (WSRC 1997; 1998a,b,c).
d. Drinking Water Standards do not apply. Criterion 10 times a recently published 90th percentile detection limit was used (WSRC 1997; 1998a,b,c).
e. EPA Interim Final Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).
f. SCDHEC Final Primary Drinking Water Standards (WSRC 1997; 1998a,b,c), Chapter 61-58.6E(7)(d).

Figure 3.2-5 shows generalized groundwater contamination maximum values for analytes at or above regulatory or established SRS guidelines for the areas of concern.

3.3 Air Resources

3.3.1 METEOROLOGY

The southeastern U.S. has a humid, subtropical climate characterized by relatively short, mild winters and long, warm, and humid summers. Summer-like weather typically lasts from May through September, when the area is subject to the persistent presence of the Atlantic subtropical anticyclone (i.e., the “Bermuda” high). The humid conditions often result in scattered afternoon thunderstorms. Average seasonal rainfall is usually lowest during the fall.

Measurable snowfall is rare. Spring is characterized by mild temperatures, relatively

Table 3.2-4. F Area maximum reported groundwater parameters in excess of regulatory and SRS limits.[a]

Analyte	Concentration	Regulatory limit
Aluminum[b]	37,100 µg/L	50 µg/L[c]
Americium-241	5.27×10^{-8} µCi/mL	6.34×10^{-9} µCi/mL[d]
Antimony[b]	27.0 µg/L	6.0 µg/L[e]
Beryllium[b]	16.6 µg/L	4.0 µg/L[e]
Bis (2-ethylhexyl) phthalate	160 µg/L	6 µg/L[e]
Cadmium[b]	36.3 µg/L	5.0 µg/L[e]
Carbon-14	1.97×10^{-5} µCi/mL	2.0×10^{-6} µCi/mL[f]
Cesium-137	2.58×10^{-7} µCi/mL	2.0×10^{-7} µCi/mL[f]
Cobalt[b]	863 µg/L	100 µg/L[g]
Copper[b]	1,530 µg/L	1,000 µg/L[h1]
Curium-243/244	1.08×10^{-7} µCi/mL	8.30×10^{-9} µCi/mL[d]
Dichloromethane	11.3 µg/L	5 µg/L[e]
Gross alpha	2.32×10^{-6} µCi/mL	1.5×10^{-8} µCi/mL[e]
Iodine-129	8.14×10^{-7} µCi/mL	1.0×10^{-9} µCi/mL[f]
Iron[b]	15,200 µg/L	300 µg/L[c]
Lead[b]	548 µg/L	50 µg/L[h2]
Manganese[b]	63.5 µg/L	50 µg/L[c]
Mercury[b]	8.38 µg/L	2.0 µg/L[e]
Nickel[b]	156 µg/L	100 µg/L[e]
Nickel-63	5.58×10^{-8} µCi/mL	5.0×10^{-8} µCi/mL[f]
Nitrate-nitrite as nitrogen	324,000 µg/L	10,000 µg/L[e]
Nonvolatile beta	3.06×10^{-6} µCi/mL	5.0×10^{-8} µCi/mL[f]
Radium-226	1.31×10^{-7} µCi/mL	5.0×10^{-9} µCi/mL[f,i]
Radium-228	6.19×10^{-7} µCi/mL	5.0×10^{-9} µCi/mL[f,i]
Ruthenium-106	5.41×10^{-8} µCi/mL	3.0×10^{-8} µCi/mL[f]
Strontium-89/90	2.46×10^{-5} µCi/mL	8.0×10^{-9} µCi/mL[e]
Strontium-90	9.07×10^{-7} µCi/mL	8.0×10^{-9} µCi/mL[e]
Technicium-99	1.32×10^{-6} µCi/mL	9.0×10^{-7} µCi/mL[f]
Tetrachloroethylene	15.7 µg/L	5 µg/L[e]
Thallium[b]	145 µg/L	2 µg/L[e]
Trichloroethylene	88.3 µg/L	5 µg/L[e]
Trichlorofluoromethane	55.8 µg/L	20µg/L[g]
Tritium	1.55×10^{-2} µCi/mL	2.0×10^{-5} µCi/mL[e]
Uranium-233/234	4.48×10^{-7} µCi/mL	1.38×10^{-8} µCi/mL[d]
Uranium-234	4.71×10^{-7} µCi/mL	1.39×10^{-8} µCi/mL[d]
Uranium-235	3.48×10^{-8} µCi/mL	1.45×10^{-8} µCi/mL[d]
Uranium-238	8.79×10^{-7} µCi/mL	1.46×10^{-8} µCi/mL[d]
Zinc[b]	8,430 µg/L	5,000 µg/L[c]

a. µg/L = micrograms per liter; µCi/mL = microcuries per milliliter.
b. Total recoverable.
c. EPA National Secondary Drinking Water Standards (WSRC 1997, 1998a,b,c).
d. EPA Proposed Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).
e. EPA Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c).
f. EPA Interim Final Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).
g. Drinking Water Standards do not apply. Criterion 10 times a recently published 90th percentile detection limit was used (WSRC 1997, 1998a,b,c).
h. SCDHEC Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c) [h1 = Chapter 61-58.5 0(2); h2 = Chapter 61-58.6 F(7)(d)].
i. Radium 226/228 Combined Proposed Maximum Contaminant Level of 5.0×10^{-8} microcuries per milliliter.

Table 3.2-5. H Area maximum reported groundwater parameters in excess of regulatory and SRS limits.[a]

Analyte	Concentration	Regulatory limit
Aluminum[b]	13,000 µg/L	50 µg/L[c]
Bis (2-ethylhexyl) phthalate	142 µg/L	6 µg/L[d]
Dichloromethane	8.45 µg/L	5 µg/L[d]
Gross alpha	9.74×10^{-8} µCi/mL	1.5×10^{-8} µCi/mL[d]
Iodine-129	1.09×10^{-7} µCi/mL	1.0×10^{-9} µCi/mL[e]
Iron[b]	17,100 µg/L	300 µg/L[c]
Lead[b]	417 µg/L	50 µg/L[f]
Manganese[b]	1,650 µg/L	50 µg/L[c]
Mercury[b]	18.5 µg/L	2.0 µg/L[d]
Nickel-63	4.79×10^{-7} µCi/mL	5.0×10^{-8} µCi/mL[e]
Nitrate-nitrite as nitrogen	52,800 µg/L	10,000 µg/L[d]
Nonvolatile beta	3.37×10^{-6} µCi/mL	5.0×10^{-8} µCi/mL[e]
Phorate	2.28 µg/L	1.7 µg/L[g]
Radium-226	6.52×10^{-8} µCi/mL	5.0×10^{-9} µCi/mL[e, h]
Radium-228	6.98×10^{-8} µCi/mL	5.0×10^{-9} µCi/mL[e,h]
Radium, total alpha-emitting	6.70×10^{-9} µCi/mL	5.0×10^{-9} µCi/mL[e]
Ruthenium-106	3.81×10^{-8} µCi/mL	3.0×10^{-8} µCi/mL[e]
Strontium-89/90	1.01×10^{-8} µCi/mL	8.0×10^{-9} µCi/mL[d]
Strontium-90	1.24×10^{-6} µCi/mL	8.0×10^{-9} µCi/mL[d]
Thallium[b]	1,060 µg/L	2 µg/L[d]
Trichloroethylene	14.7 µg/L	5 µg/L[d]
Tetrachloroethylene	12.6 µg/L	5 µg/L[d]
Tritium	1.02×10^{-2} µCi/mL	2.0×10^{-5} µCi/mL[d]
Uranium-233/234	4.28×10^{-8} µCi/mL	1.38×10^{-8} µCi/mL[i]
Uranium-238	4.20×10^{-8} µCi/mL	1.46×10^{-8} µCi/mL[i]
Vanadium[b]	139 µg/L	133 µg/L[g]

a. µg/L = micrograms per liter; µCi/mL = microcuries per milliliter.
b. Total recoverable.
c. EPA National Secondary Drinking Water Standards (WSRC 1997, 1998a,b,c).
d. EPA Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c).
e. EPA Interim Final Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).
f. SCDHEC Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c) [Chapter 61-58.6 F(7)(d).
g. Drinking Water Standards do not apply. Criterion 10 times a recently published 90th percentile detection limit was used (WSRC 1997, 1998a,b,c).
h. Radium 226/228 Combined Proposed Maximum Contaminant Level of 5.0×10^{-8} microcuries per milliliter.
i. EPA Proposed Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).

low humidity, and a higher frequency of tornadoes and severe thunderstorms.

3.3.1.1 Local Climatology

Sources of data used to characterize the climatology of SRS consist of a standard instrument shelter in A Area (temperature, humidity, and precipitation for 1961 to 1994), the Central Climatology Meteorological Facility near N Area (temperature, humidity, and precipitation for 1995 to 1996), and seven meteorological towers (winds and atmospheric stability). The average annual temperature at SRS is 64.7 degrees Fahrenheit (°F). July is the warmest month of the year with an average daily maximum of 92°F and an average daily minimum near 72°F; January is the coldest month with an average daily high around 56°F and an average daily low of 36°F. Temperature EC

Table 3.2-6. S Area maximum reported groundwater parameters in excess of regulatory and SRS limits.[a]

Analyte	Concentration	Regulatory limit
Trichloroethylene	49.2 µg/L	5 µg/L[b]

a. µg/L = micrograms per liter; µCi/mL = microcuries per milliliter.
b. EPA Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c).

Table 3.2-7. Z Area maximum reported groundwater parameters in excess of regulatory and SRS limits.[a]

Analyte	Concentration	Regulatory limit
Gross alpha	9.77×10^{-8} µCi/mL	1.5×10^{-8} µCi/mL[b]
Nonvolatile beta	5.26×10^{-8} µCi/mL	5.0×10^{-8} µCi/mL[c]
Radium-226	7.78×10^{-9} µCi/mL	5.0×10^{-9} µCi/mL[c, d]
Radium-228	8.09×10^{-9} µCi/mL	5.0×10^{-9} µCi/mL[c, d]
Radium, total alpha emitting	5.55×10^{-8} µCi/mL	5.0×10^{-9} µCi/mL[c]
Ruthenium-106	3.08×10^{-8} µCi/mL	3.0×10^{-8} µCi/mL[c]

a. µg/L = micrograms per liter; µCi/mL = microcuries per milliliter.
b. EPA Final Primary Drinking Water Standards (WSRC 1997, 1998a,b,c).
c. EPA Interim Final Primary Drinking Water Standard (WSRC 1997, 1998a,b,c).
d. Radium 226/228 Combined Proposed Maximum Contaminant Level of 5.0×10^{-8} microcuries per milliliter.

extremes recorded at SRS since 1961 range from a maximum of 107°F in July 1986 to -3°F in January 1985.

Annual precipitation averages 49.5 inches. Summer is the wettest season of the year, with an average monthly rainfall of 5.2 inches. Fall is the driest season, with a monthly average rainfall of 3.3 inches. Relative humidity averages 70 percent annually, with an average daily maximum of 91 percent and an average daily minimum of 45 percent.

Wind directions frequently observed at SRS show that there is no prevailing wind at SRS, which is typical for the lower Midlands of South Carolina. According to wind data collected from 1992 through 1996, winds are most frequently from the southwest sector (9.7 percent) (Arnett and Mamatey 1998a). Measurements of turbulence are used to determine whether the atmosphere has relatively high, moderate, or low potential to disperse airborne pollutants (commonly identified as unstable, neutral, or stable atmospheric conditions, respectively). Generally, SRS atmospheric conditions were categorized as unstable 56 percent of the time (DOE 1997).

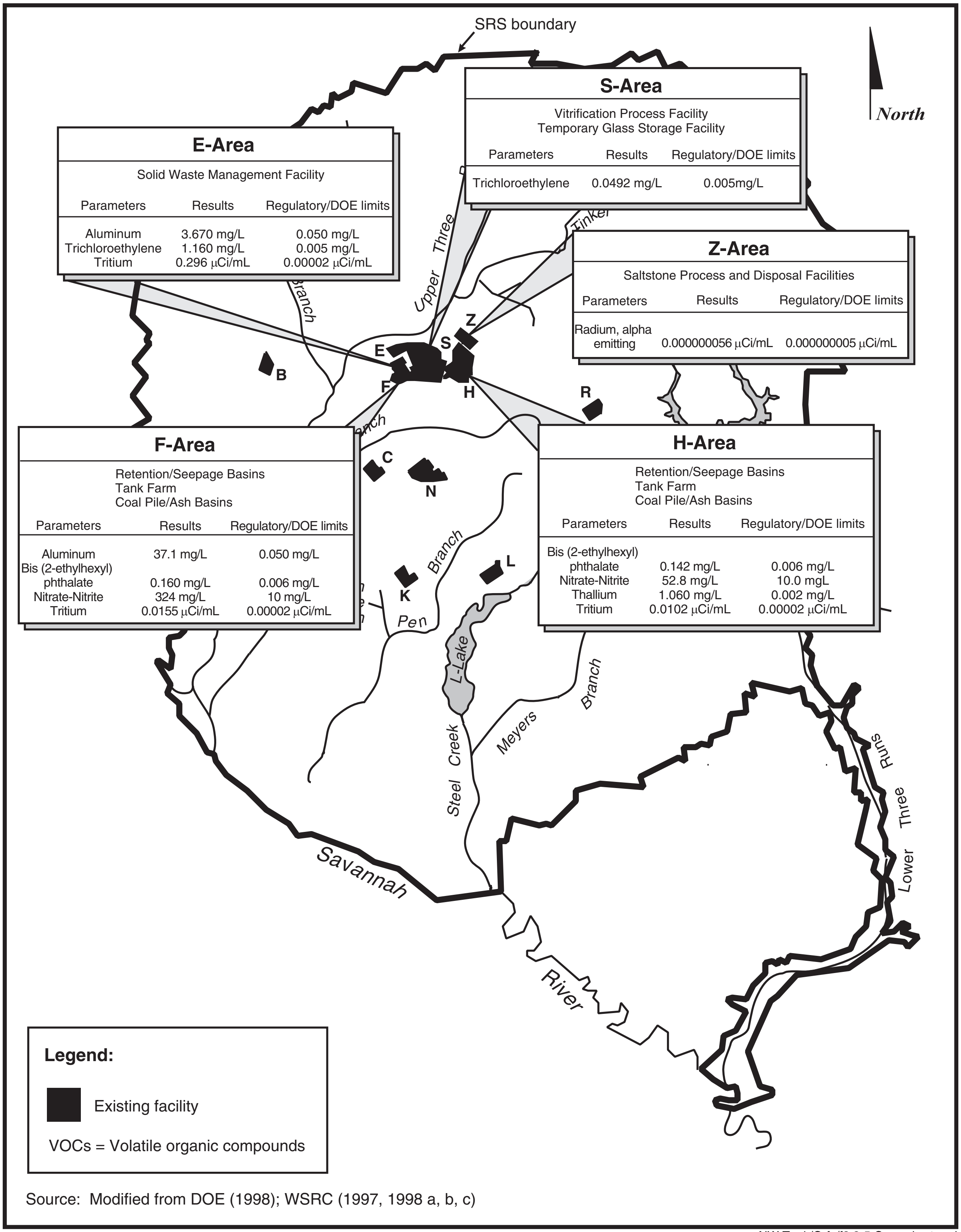
The average wind speed for a measured 5-year period was 8.5 miles per hour. Average hourly wind speeds of less than 4.5 miles per hour occur approximately 10 percent of the time (NOAA 1994).

3.3.1.2 Severe Weather

An average of 54 thunderstorm days per year were observed at the National Weather Service Office in Augusta, Georgia, during the period 1951 to 1995. About half the thunderstorms occurred during the summer. Since operations began at SRS, 10 confirmed tornadoes have occurred on or in close proximity to the Site. Several of these tornadoes, which were estimated to have winds up to 150 miles per hour, did considerable damage to forested areas of SRS. None caused damage to structures. Tornado statistics indicate that the average frequency of a tornado striking any single point on the Site is 2×10^{-4} per year, or about once every 5,000 years (Weber et al. 1998). EC

EC

The highest sustained wind (fastest-mile) recorded at the Augusta National Weather Service Office is 82 miles per hour. Hurricanes



NW Tank/Grfx/f3.2-5 Groundwater.ai

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Figure 3.2-5. Maximum reported groundwater contamination in excess of regulatory/DOE limits at Savannah River Site.

EC struck South Carolina 36 times during the period from 1700 to 1992, which equates to an average recurrence frequency of once every 8 years. A hurricane-force wind of 75 miles per hour has been observed at SRS only once, during Hurricane Gracie in 1959.

3.3.2 AIR QUALITY

3.3.2.1 Nonradiological Air Quality

The SRS is located in the Augusta-Aiken Interstate Air Quality Control Region (AQCR). All areas within this region are classified as achieving attainment with the National Ambient Air Quality Standards (NAAQS) (40 CFR 50). Ambient air is defined as that portion of the atmosphere, external to buildings, to which the general public has access. The NAAQS define ambient concentration criteria or limits for sulfur dioxide (SO_2), particulate matter equal to or less than 10 microns in aerodynamic diameter (PM_{10}), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb). These pollutants are generally referred to as "criteria pollutants." The nearest area not in attainment with the NAAQS is Atlanta, Georgia, which is approximately 150 miles west of SRS.

All of the Aiken-Augusta AQCR is designated a Class II area, with respect to the Clean Air Act's Prevention of Significant Deterioration (PSD) regulations (40 CFR 51.166). The PSD regulations provide a framework for managing the existing clean air resources in areas that meet the NAAQS. Areas designated PSD Class II have sufficient air resources available to support moderate industrial growth. A Class I PSD designation is assigned to areas that are to remain pristine, such as national parks and wildlife refuges. Little additional impact to the existing air quality is allowed with a Class I PSD designation. Industries located within 100 kilometers (62 miles) of Class I Areas are subject to very strict Federal air pollution control standards. There are no Class I areas within 62 miles of SRS. The only Class 1 Area in South Carolina is the Cape Romain National Wildlife Refuge in Charleston County. EC

The U.S. Environmental Protection Agency (EPA) approved more restrictive ambient standards for ground-level ozone and particulate matter that became effective on September 16, 1997 (62 FR 138). The new primary standard for ground-level ozone is based on an 8-hour averaging interval with a limit of 0.08 parts-per-million (ppm). Monitoring data from 1993 to 1997 indicate that ozone concentrations in the urban areas of Greenville-Spartanburg-Anderson, Columbia-Lexington, Rock Hill, Aiken, and Florence may approach or exceed the new standard. Monitoring data from 1997, 1998, and 1999 will be used to determine compliance with the new ozone standard (SCDHEC 1998). EC

Based on review of available scientific data on all particulate matter, the EPA determined that fine particulate matter less than 2.5 microns in diameter, or $PM_{2.5}$, present greater health concerns than larger sized particulates. As a result, in addition to keeping the current PM_{10} regulations, EPA issued a daily (24-hour) $PM_{2.5}$ standard of 65 micrograms per cubic meter ($\mu g/m^3$) and an annual limit of 15.0 $\mu g/m^3$. EC Limited data collected in several rural and urban areas in South Carolina, along with estimates derived from PM_{10} and total suspended particulates (TSP) sampling around the State, EC indicate that many areas of South Carolina may exceed or have the potential to exceed the new annual standard for $PM_{2.5}$. SCDHEC expects that Aiken County will likely comply with the new standards. States will collect 3 years of monitoring data beginning in 1998 and will make attainment demonstrations beginning in 2002 (SCDHEC 1998).

On May 14, 1999, in response to challenges filed by industry and others, a three-judge panel EC of the U.S. Court of Appeals for the District of Columbia Circuit issued a split opinion (2 to 1) on the new clean air standards. The Court vacated the new particulate standard and directed EPA to develop a new standard, meanwhile reverting back to the previous PM_{10} standard. The revised ozone standard was not nullified; however, the judges ruled that the standard "cannot be enforced" (EPA 1999). On June 28, 1999, the EPA filed a petition for rehearing key aspects of the case in the U.S. Court of Appeals for the D.C. Circuit. The EPA has asked the U.S. Department of Justice to appeal this decision and take all judicial steps necessary to overturn the decision.

SCDHEC has been delegated authority to implement and enforce requirements of the Clean Air Act for the State of South Carolina. SCDHEC Air Pollution Regulation 62.5, Standard 2, enforces the NAAQS and sets ambient limits for two additional pollutants: TSP and gaseous fluorides (as hydrogen fluoride). The latter is not expected to be emitted as result of tank closure activities and is not included in subsequent discussions. In addition, SCDHEC Standard 8, Section II, Paragraph E) establishes ambient standards for 256 toxic air pollutants.

Significant sources of regulated air pollutants at SRS include coal-fired boilers for steam production, diesel generators, chemical storage tanks, the Defense Waste Processing Facility (DWPF), groundwater air strippers, and various other process facilities. Another source of criteria pollutant emissions at SRS is the prescribed burning of forested areas across the Site by the U.S. Forest Service (Arnett and Mamatey 1998a). Table 3.3-1 shows the actual atmospheric emissions from all SRS sources in 1997.

Prior to 1991, ambient monitoring of SO_2, NO_2, TSP, CO, and O_3 was conducted at five sites across SRS. Because there is no regulatory requirement to conduct air quality monitoring at SRS, all of these stations have been decommissioned. Ambient air quality data collected during 1997 from monitoring stations operated by SCDHEC in Aiken and Barnwell Counties, South Carolina, are summarized in Table 3.3-2. These data indicate that ambient concentrations of the measured criteria pollutants are generally much less than the standards.

SCDHEC also requires dispersion modeling as a means of evaluating local air quality. Periodically, all permitted sources of regulated air emissions at SRS must be modeled to determine estimates of ambient air pollution concentrations at the SRS boundary. (The ambient limits found under Standards 2 and 8 are enforceable at or beyond the Site boundary.) The results are used to demonstrate compliance with ambient standards and to define a baseline from which to assess the impacts of any new or modified sources. Additionally, a Site-wide inventory of air emissions is developed every year as part of an annual emissions inventory required by SCDHEC Regulation 61-62.1, Section III, "Emissions Inventory." Table 3.3-3 provides a summary of the most recent regulatory compliance modeling for SRS emissions. These calculations were performed with EPA's Industrial Source Complex (ISC3) air dispersion model (EPA 1995) and Site-wide maximum potential emissions data from the annual air emissions inventory for 1998. Site boundary concentrations for the eight South Carolina ambient air pollutants include background concentrations of these pollutants, as observed at SCDHEC monitoring stations. Background concentrations of toxic/hazardous air pollutants are assumed to be zero. As Table 3.3-3 shows, estimated ambient SRS boundary concentrations are within the ambient standards for all regulated air pollutants emitted at SRS.

3.3.2.2 <u>Radiological Air Quality</u>

In the SRS region, airborne radionuclides originate from natural (i.e., terrestrial and cosmic) sources, worldwide fallout, and SRS operations. DOE maintains a network of 23 air sampling stations on and around SRS to determine concentrations of radioactive particulates and aerosols in the air (Arnett and Mamatey 1999a). Table 3.3-4 lists average and maximum atmospheric concentrations of radioactivity at the SRS boundary and at 25-mile radius monitoring locations during 1998.

DOE provides detailed summaries of radiological releases to the atmosphere from SRS operations, along with resulting concentrations and doses, in a series of annual environmental data reports. Table 3.3-5 lists 1998 radionuclide releases from each major operational group of SRS facilities.

Table 3.3-1. Criteria and toxic/hazardous air pollutant emissions from SRS (1997).[a]

Pollutant	Actual tons/year
Criteria pollutants[b]	
Sulfur dioxide (as SO_x)	490
Total suspended particulates	2,000
Particulate matter (≤10 µm)	1,500
Carbon monoxide	5,200
Ozone (as Volatile Organic Components)	290
Nitrogen dioxide (as NO_x)	430
Lead	0.019
Toxic/Hazardous Air Pollutants [c]	
Benzene	13
Beryllium	0.0013
Mercury	0.039

a. Sources: Mamatey (1999). Based on 1997 annual air emissions inventory from all SRS sources (permitted and unpermitted).
b. Includes an additional pollutant, PM_{10}, regulated under SCDHEC Regulation 61-62.5, Standard 2. Note: gaseous fluoride is also regulated under this standard but is not expected to be emitted as a result of tank closure activities.
c. Pollutants listed only include air toxics of interest to tank closure activities. A complete list of 1997 toxic air pollutant emissions for SRS can be found in Mamatey (1999).

Table 3.3-2. SCDHEC ambient air monitoring data for 1997.[a]

Pollutant	Averaging time	SC Standard (µg/m^3)	Aiken Co. (µg/m^3)	Barnwell Co. (µg/m^3)
Sulfur dioxide (as SO_x)	3-hr[d]	1,300	60	44
	24[d]	365	21	10
	Annual[e]	80	5	3
Total suspended particulates[c]	Annual geometric mean	75	36	--
Particulate matter (≤10 µm)	24-hr[d]	150	45	44
	Annual[e]	50	21	19
Carbon monoxide	1-hr[d]	40,000	5,100 [b]	--
	8-hr[d]	10,000	3,300 [b]	--
Ozone[c]	1-hr	235	200	210
Nitrogen dioxide (as NO_x)	Annual[c]	100	9	8
Lead	Calendar quarterly mean	1.5	0.01	--

a. Source: SCDHEC (1998).
b. Richland County in Columbia, South Carolina (nearest monitoring station to SRS).
c. New standards may be applicable in the future; see discussion in text.
d. Second highest maximum concentration observed.
e. Arithmetic mean of observed concentrations.

Table 3.3-3. SRS baseline air quality for maximum potential emissions and observed ambient concentrations.

Pollutant	Averaging time	SCDHEC ambient standard (µg/m^3)[a]	Estimated SRS baseline concentration (µg/m^3)[b]
Criteria pollutants			
Sulfur dioxide (as SO_x)[c]	3-hr	1,300	1,200
	24-hr	365	350
	Annual	80	34
Total suspended particulates	Annual geometric mean	75	67
Particulate matter (≤10 µm)[d]	24-hr	150	130
	Annual	50	25
Carbon monoxide	1-hr	40,000	10,000
	8-hr	10,000	6,900
Nitrogen Dioxides (as NO_x)[e]	Annual	100	26
Lead	Calendar quarterly mean	1.5	0.03
Ozone	1-hr	235	200[f]
Toxic/hazardous air pollutants			
Benzene	24-hr	150	4.6
Beryllium	24-hr	0.01	0.009
Mercury	24-hr	0.25	0.03

Source: SCDHEC Regulation 61-62.5, Standard 2, "Ambient Air Quality Standards," and Regulation 61-62.5, Standard 8, Section II, Paragraph E, "Toxic Air Pollutants" (SCDHEC 1976).

a. Source: Hunter (1999). Concentration is the sum of Industrial Source Complex (ISC3) modeled air concentrations using the maximum potential emissions from the 1998 air emissions inventory for all SRS sources not exempted by Clean Air Act Title V requirements and observed concentrations from nearby ambient air monitoring stations.

b. Based on emissions for all oxides of sulfur (SO_x).

c. New NAAQS for particulate matter ≤2.5 microns (24-hour limit of 65 µg/m^3 and an annual average limit of 15 µg/m^3) may become enforceable during the life of this project.

d. Based on emissions for all oxides of nitrogen (NO_x).

e. Source: SCDHEC (1998). Observed concentration of ozone at SCDHEC ambient monitoring station for Aiken County. Ambient concentration of ozone from SRS emissions is not available.

f. New NAAQS for ozone (8-hour limit of 0.08 parts per million) may become enforceable during the life of this project.

Atmospheric emissions of radionuclides from DOE facilities are limited under the EPA regulation "National Emission Standards for Hazardous Air Pollutants (NESHAP)," 40 CFR Part 61, Subpart H. The EPA annual effective dose equivalent limit of 10 millirem per year to members of the public for the atmospheric pathway is also incorporated in DOE Order 5400.5, "Radiation Protection of the Public and the Environment." To demonstrate compliance with the NESHAP regulations, DOE annually calculates maximally exposed offsite individual (MEI) and collective doses and a percentage of dose contribution from each radionuclide using the CAP88 computer code. The dose to the MEI from 1998 SRS emissions (Table 3.3-5) was estimated at 0.08 millirem, which is 0.8 percent of the 10-millirem-per-year EPA standard. The population dose was calculated, by pathway and radionuclide, using the POPGASP computer code which is discussed later in this section. The POPGASP collective (population) dose was estimated at 3.5 person-rem. Tritium oxide accounts for 94 and 77 percent of the MEI and the population dose, respectively. Plutonium-239 is the second highest contributor to dose, with 3 percent of both the collective and MEI doses (Arnett and Mamatey 1999b). The contributions to dose from other radionuclides

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Table 3.3-4. Radioactivity in air at the SRS boundary and at a 25-mile radius during 1998 (picocuries per cubic meter).[a]

Location	Tritium	Gross alpha	Gross beta	Cobalt-60	Cesium-137	Strontium-89,90	Plutonium-238	Plutonium-239
Site boundary								
Average[b]	11.3	1.4×10^{-3}	0.017	1.3×10^{-3}	2.6×10^{-4}	1.1×10^{-5}	7×10^{-7}	(c)
Maximum[d]	79.6	5.91×10^{-3}	0.061	0.021	0.011	1.1×10^{-4}	4.1×10^{-6}	7.4×10^{-7}
Background (25-mile radius)								
Average	6.7	0.0015	0.019	1.48	2.8×10^{-4}	(c)	(c)	(c)
Maximum	54	0.0036	0.003	0.011	0.0079	5.1×10^{-4}	8.6×10^{-6}	2.9×10^{-6}

a. Source: Arnett and Mamatey (1999b).
b. The average value is the average of the arithmetic means reported for the site perimeter sampling locations.
c. Below background levels.
d. The maximum value is the highest value of the maximum reported for the site perimeter sampling locations.

can be found in *SRS Environmental Data for 1998* (Arnett and Mamatey 1999a).

SRS-specific computer dispersion models such as MAXIGASP and POPGASP (see discussion of these models in Section 4.1.3.2) are also used to calculate radiological doses to members of the public from SRS annual releases. Whereas the CAP88 code assumes that all releases occur from one point (for SRS, at the center of the site), MAXIGASP can model multiple release locations which is truer to actual conditions.

3.4 Ecological Resources

3.4.1 NATURAL COMMUNITIES OF THE SAVANNAH RIVER SITE

The SRS comprises a variety of diverse habitat types that support terrestrial and semi-aquatic wildlife species. These habitat types include upland pine forests, mixed hardwood forests, bottomland hardwood forests, swamp forests, and Carolina bays. Since the early 1950s, the Site has changed from 60 percent forest and 40 percent agriculture to 90 percent forest, with the remainder in aquatic habitats and developed (facility) areas (Halverson et al. 1997). The wildlife correspondingly shifted from forest-farm edge species to a predominance of forest-dwelling species. The SRS now supports 44 species of amphibians, 59 species of reptiles, 255 species of birds, and 54 species of mammals (Halverson et al. 1997). Comprehensive descriptions of the SRS's ecological resources and wildlife can be found in documents such as *SRS Ecology Environmental Information Document* (Halverson et al. 1997) and the *Final Environmental Impact Statement for the Shutdown of the River Water System at the Savannah River Site* (DOE 1997a).

SRS has extensive, widely distributed wetlands, most of which are associated with floodplains, creeks, or impoundments. In addition, approximately 200 Carolina bays occur on SRS (DOE 1995). Carolina bays are unique wetland features of the southeastern United States. They are isolated wetland habitats dispersed throughout the uplands of SRS. The approximately 200 Carolina bays on SRS exhibit extremely variable hydrology and a range of plant communities from herbaceous marsh to forested wetland (DOE 1995).

The Savannah River bounds SRS to the southwest for approximately 20 miles. The river floodplain supports an extensive swamp, covering about 15 square miles of SRS; a natural levee separates the swamp from the river (Halverson et al. 1997).

Timber was cut in the swamp from the turn of the century until 1951, when the Atomic Energy Commission assumed control of the area. At present, the swamp forest is comprised of two

Table 3.3-5. 1998 Radioactive atmospheric releases by source.[a]

	Curies[b]						
Radionuclide	Reactors	Separations[c]	Reactor materials	Heavy water	SRTC[d]	Diffuse and fugitive[e]	Total
			Gases and vapors				
H-3(oxide)	2.28×10^{4}	3.45×10^{4}		4.04×10^{2}		9.31×10^{2}	5.86×10^{4}
H-3(elem.)		2.41×10^{4}					2.41×10^{4}
H-3 Total	2.28×10^{4}	5.86×10^{4}		4.04×10^{2}		9.31×10^{2}	8.27×10^{4}
C-14		7.01×10^{-2}				9.68×10^{-5}	7.02×10^{-2}
Kr-85		1.70×10^{4}					1.70×10^{4}
Xe-135		4.95×10^{-2}					4.95×10^{-2}
I-129		1.25×10^{-2}				1.29×10^{-5}	1.25×10^{-2}
I-131		5.92×10^{-5}			8.29×10^{-6}		6.75×10^{-5}
I-133					1.59×10^{-4}		1.59×10^{-4}
			Particulates				
Na-22						7.76×10^{-11}	7.76×10^{-11}
Cr-51						1.21×10^{-4}	1.21×10^{-4}
Fe-55						3.90×10^{-4}	3.90×10^{-4}
Co-57						9.40×10^{-11}	9.40×10^{-11}
Co-58						1.27×10^{-4}	1.27×10^{-4}
Co-60					2.65×10^{-7}	1.38×10^{-4}	1.38×10^{-4}
Ni-59						8.33×10^{-13}	8.33×10^{-13}
Ni-63						8.21×10^{-6}	8.21×10^{-6}
Zn-65						2.23×10^{-5}	2.23×10^{-5}
Se-79						1.85×10^{-11}	1.85×10^{-11}
Sr-89,90[F,6]	1.62×10^{-3}	3.22×10^{-4}	5.50×10^{-4}	2.61×10^{-4}	2.66×10^{-5}	2.58×10^{-2}	2.85×10^{-2}
Zr-95						1.71×10^{-5}	1.71×10^{-5}
Nb-95						1.13×10^{-4}	1.13×10^{-4}
Tc-99						2.82×10^{-5}	2.82×10^{-5}
Ru-103						2.26×10^{-5}	2.26×10^{-5}
Ru-106		1.80×10^{-5}				2.26×10^{-5}	3.34×10^{-5}
Sn-126						1.29×10^{-13}	1.29×10^{-13}
Sb-125		1.79×10^{-7}				5.27×10^{-5}	5.29×10^{-5}
Cs-134		2.32×10^{-7}				1.31×10^{-4}	1.31×10^{-4}
Cs-137	3.50×10^{-5}	3.77×10^{-4}			2.30×10^{-6}	4.89×10^{-3}	5.30×10^{-3}
Ce-141						4.16×10^{-5}	4.16×10^{-5}
Ce-144						1.45×10^{-4}	1.45×10^{-4}
Pm-147						9.79×10^{-10}	9.79×10^{-10}
Eu-152						4.19×10^{-8}	4.19×10^{-8}
Eu-154						5.74×10^{-6}	5.74×10^{-6}

Table 3.3-5. (Continued).

Radionuclide	Reactors	Separations[c]	Reactor materials	Heavy water	SRTC[d]	Diffuse and fugitive[e]	Total
Eu-155						1.10×10^{-6}	1.10×10^{-6}
Ra-226						8.64×10^{-6}	8.64×10^{-6}
Ra-228						2.13×10^{-5}	2.13×10^{-5}
Th-228						9.44×10^{-6}	9.44×10^{-6}
Th-230						1.02×10^{-5}	1.02×10^{-5}
Th-232						7.51×10^{-7}	7.51×10^{-7}
Pa-231						1.00×10^{-9}	1.00×10^{-9}
U-232			1.20×10^{-6}				1.20×10^{-6}
U-233						2.35×10^{-6}	2.35×10^{-6}
U-234		2.62×10^{-5}	3.39×10^{-5}			1.83×10^{-5}	7.84×10^{-5}
U-235		1.57×10^{-6}	6.21×10^{-6}			2.10×10^{-6}	9.88×10^{-6}
U-236						2.39×10^{-9}	2.39×10^{-9}
U-238		6.92×10^{-5}	6.32×10^{-5}			5.12×10^{-5}	1.84×10^{-4}
Np-237						1.01×10^{-9}	1.01×10^{-9}
Pu-238		1.15×10^{-4}	4.76×10^{-8}			3.28×10^{-4}	4.43×10^{-4}
Pu-239[h]	2.19×10^{-4}	1.12×10^{-4}	5.09×10^{-5}	2.98×10^{-5}	6.71×10^{-6}	1.41×10^{-3}	1.83×10^{-3}
Pu-240						1.12×10^{-6}	1.12×10^{-6}
Pu-241						6.02×10^{-5}	6.02×10^{-5}
Pu-242						1.59×10^{-7}	1.59×10^{-7}
Am-241		3.31×10^{-5}	2.17×10^{-8}			5.75×10^{-6}	3.89×10^{-5}
Am-243						1.89×10^{-5}	1.89×10^{-5}
Cm-242						1.58×10^{-7}	1.58×10^{-7}
Cm-244		3.67×10^{-6}	4.90×10^{-9}			1.30×10^{-4}	1.34×10^{-4}
Cm-245						2.08×10^{-13}	2.08×10^{-13}
Cm-246						9.37×10^{-7}	9.37×10^{-7}
Cf-249						5.27×10^{-16}	5.27×10^{-16}
Cf-251						2.17×10^{-14}	2.17×10^{-14}

Note: Blank spaces indicate no quantifiable activity.
a. Source: Arnett and Mamatey (1999b).
b. One curie equals 3.7×10^{10} Becquerels.
c. Includes separations, waste management, and tritium facilities.
d. Savannah River Technology Center.
e. Estimated releases from minor unmonitored diffuse and fugitive sources.
f. Includes unidentified beta emissions.
g. Includes SR-89.
h. Includes unidentified alpha emissions.

kinds of forested wetland communities (Halverson et al. 1997). Areas that are slightly elevated and well-drained are characterized by a mixture of oak species (*Quercus nigra, Q. laurifolia, Q. michauxii,* and *Q. lyrata*), as well as red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and other hardwood species. Low-lying areas that are continuously flooded are dominated by second-growth bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*).

The aquatic resources of SRS have been the subject of intensive study for more than 30 years. Research has focused on the flora and fauna of the Savannah River, the tributaries of the river that drain SRS, and the artificial impoundments (Par Pond and L-Lake) on two of the tributary systems. Several monographs (Britton and Fuller 1979; Bennett and McFarlane 1983), the eight-volume comprehensive cooling water study (du Pont 1987), and a number of environmental impact statements (EISs) (DOE 1987, 1990, 1997a) describe the aquatic biota (fish and macroinvertebrates) and aquatic systems of SRS. The *SRS Ecology Environmental Information Document* (Halverson et al. 1997) and the *Final Environmental Impact Statement for the Shutdown of the River Water System at the Savannah River Site* (DOE 1997a) review ecological research and monitoring studies conducted in SRS streams and impoundments over several decades.

The SRS was designated as the first National Environmental Research Park by the Atomic Energy Commission in 1972. Especially significant components of the National Environmental Research Park are DOE Research Set-Aside Areas, representative habitats that DOE has preserved for ecological research and that are protected from public intrusion and most Site-related activities. Set-Aside Areas protect major plant communities and habitats indigenous to the SRS, preserve habitats for endangered species, and also serve as controls against which to measure potential environmental impacts of SRS operations. These ecological Set-Aside Areas total 14,005 acres, approximately 7 percent of the Site's total area. Descriptions of the 30 tracts that have been set aside to date can be found in Davis and Janacek (1997).

Under the Endangered Species Act of 1973, the Federal government provides protection to six species that occur on the SRS: American alligator (*Alligator mississippiensis*, threatened due to similarity of appearance to the endangered American crocodile); shortnose sturgeon (*Acipenser brevirostrum*, endangered); bald eagle (*Haliaeetus leucocephalus*, threatened); wood stork (*Mycteria americana*, endangered); red-cockaded woodpecker (*Picoides borealis*, endangered); and smooth purple coneflower (*Echinacea laevigata*, endangered) (SRFS 1994; Halverson et al. 1997). None of these species is known to occur on or near the F- and H-Area Tank Farms, which are intensively developed industrial areas surrounded by roads, parking lots, construction shops, and construction laydown areas and are continually exposed to high levels of human disturbance.

3.4.2 ECOLOGICAL COMMUNITIES POTENTIALLY AFFECTED BY TANK FARM CLOSURE ACTIVITIES

F- and H-Area Biota

The F- and H-Area Tank Farms are located within a densely developed, industrialized area of SRS. The immediate area provides habitat for only those animal species typically classified as urban wildlife (Mayer and Wike 1997). Species commonly encountered in this type of urban landscape include the Southern toad, green anole, rat snake, rock dove, European starling, house mouse, opossum, and feral cats and dogs (Mayer and Wike 1997). Lawns and landscaped areas within F and H Areas also provide some marginal terrestrial wildlife habitat. A number of ground-foraging bird species (e.g., American robin, killdeer, and mourning dove) and small mammals (e.g., cotton mouse, cotton rat, and Eastern cottontail) that use lawns and landscaped areas around buildings may be present at certain times of the year, depending on the level of human activity (e.g., frequency of mowing) (Mayer and Wike 1997). Pine plantations managed for timber production by the U.S. Forest Service (under an interagency agreement with DOE) occupy surrounding areas (DOE 1994).

Wildlife characteristically found in SRS pine plantations include toads (i.e., the southern toad), lizards (e.g., the eastern fence lizard), snakes (e.g., the black racer), songbirds (e.g., the brown-headed nuthatch, and the pine warbler), birds of prey (e.g., the sharp-shinned hawk), and a number of mammal species (e.g., the cotton mouse), the gray squirrel, the opossum, and the white-tailed deer) (Sprunt and Chamberlain 1970; Cothran et al. 1991; Gibbons and Semlitsch 1991; Halverson et al. 1997).

Several populations of rare plants have been found in undeveloped areas adjacent to F and H Areas. One population of Nestronia *(Nestronia umbellula)* and three populations of Oconee azalea (*Rhododendron flammeum*) were located on the steep slopes adjacent to the Upper Three Runs floodplain approximately one mile north of the F-Area Tank Farm (DOE 1995: SRFS 1999). Populations of two additional rare plants, Elliott's croton (*Croton elliotti*) and spathulate seedbox (*Ludwigia spathulata*) were found in the pine forest southeast of H Area, approximately one-half mile from the H-Area Tank Farm (SRFS 1999).

Seeplines and Associated Riparian Communities

As mentioned in Section 3.2, F and H Areas are on a near-surface groundwater divide, and groundwater from these areas discharges at seeplines adjacent to Upper Three Runs and Fourmile Branch. The biota associated with the seepage areas are discussed in the following paragraphs.

The Fourmile Branch seepline area is located in a bottomland hardwood forest community (DOE 1997b). The canopy layer of this bottomland forest is dominated by sweetgum (*Liquidambar styraciflua)*, red maple (*Acer rubrum*), and red bay (*Persea borbonia*). Sweet bay (*Magnolia virginiana)* is also common. The understory consists largely of saplings of these same species, as well as a herbaceous layer of greenbrier (*Smilax* sp), dog hobble (*Leucothoe axillaris*), giant cane (*Arundinaria gigantea*), poison ivy (*Rhus radicans*), chain fern (*Woodwardia virginica*), and hepatica (*Hepatica americana*). At the seepline's upland edge, scattered American holly and white oak occur. Upslope of the seepline area is an upland pine/hardwood forest. Tag alder (*Alnus serrulata*), willow (*Salix nigra)*, sweetgum, and wax myrtle (*Myrica cerifera)* are found along the margins of the Fourmile Branch in this area. The Upper Three Runs seepline is located in a similar bottomland hardwood forest community (DOE 1997b).

The floodplains of both streams in the general vicinity of the seeplines provide habitat for a variety of aquatic, semi-aquatic, and terrestrial animals including amphibians (e.g., leopard frogs), reptiles (e.g., box turtles), songbirds (e.g., wood warblers), birds of prey (e.g., barred owls), semi-aquatic mammals (e.g., beaver), and terrestrial mammals (white-tailed deer). For detailed lists of species known or expected to occur in the riparian forests and wetlands of SRS, see Gibbons et al. (1986), duPont (1987), Cothran et al. (1991), DOE (1997a), and Halverson et al. (1997).

No endangered or threatened fish or wildlife species have been recorded near the Upper Three Runs and Fourmile Branch seeplines. The seeplines and associated bottomland community do not provide habitat favored by endangered or threatened fish and wildlife species known to occur at SRS. The American alligator is the only Federally protected species that could potentially occur in the area of the seeplines. Fourmile Branch does support a small population of American alligator in its lower reaches, where the stream enters the Savannah River swamp (Halverson et al. 1997). Alligators have been infrequently observed in man-made waterbodies (e.g., stormwater retention basins) in the vicinity of H Area (Mayer and Wike 1997).

Aquatic Communities Downstream of F and H Areas

Upper Three Runs

According to summaries of studies on Upper Three Runs documented in the *SRS Ecology Environmental Information Document* (Halverson et al. 1997), the macroinvertebrate communities of Upper Three Runs are characterized by unusually high measures of taxa richness and diversity. Upper Three Runs is a spring-fed stream and is colder and generally clearer than most streams in the upper Coastal Plain. As a result, species normally found in the Northern U.S. and southern Appalachians are found here along with endemic lowland (Atlantic Coastal Plain) species (Halverson et al. 1997).

A study conducted from 1976 to 1977 identified 551 species of aquatic insects within this stream system, including a number of species and genera new to science (Halverson et al. 1997). A 1993 study found more than 650 species in Upper Three Runs, including more than 100 caddisfly species. Although no threatened or endangered species have been found in Upper Three Runs, there are several environmentally sensitive species. Davis and Mulvey (Halverson et al. 1997) identified a rare clam species (*Elliptio hepatica*) in this drainage. Also, in 1997 the U.S. Fish and Wildlife Service listed the American sand-burrowing mayfly (*Dolania americana*), a mayfly relatively common in Upper Three Runs, as a species of special concern. Between 1987 and 1991, the density and variety of insects collected from Upper Three Runs decreased for unknown reasons. More recent data, however, indicate that insect communities are recovering (Halverson et al. 1997).

The fish community of Upper Three Runs is typical of third- and higher-order streams on SRS that have not been greatly affected by industrial operations, with shiners and sunfish dominating collections. The smaller tributaries to Upper Three Runs are dominated by shiners and other small-bodied species (i.e., pirate perch, madtoms, and darters) indicative of unimpacted streams in the Atlantic Coastal Plain (Halverson et al. 1997). In the 1970s, the U.S. Geological Service designated Upper Three Runs as a National Hydrological Benchmark Stream, due to its high water quality and rich fauna. However, this designation was rescinded in 1992, due to increased development of the Upper Three Runs watershed north of the SRS (Halverson et al. 1997).

Fourmile Branch

Until C-Reactor was shut down in 1985, the distribution and abundance of aquatic biota in Fourmile Branch were strongly influenced by reactor operations (high water temperatures and flows downstream of the reactor discharge). Following the shutdown of C-Reactor, macroinvertebrate communities began to recover and, in some reaches of the stream, began to resemble those in nonthermal and unimpacted streams of the SRS (Halverson et al. 1997). Surveys of macroinvertebrates in more recent years showed that some reaches of Fourmile Branch had healthy macroinvertebrate communities (high measures of taxa richness) while others had depauperate macroinvertebrate communities (low measures of diversity or communities dominated by pollution-tolerant forms). Differences appeared to be related to variations in dissolved oxygen levels in different portions of the stream. In general, macroinvertebrate communities of Fourmile Branch show more diversity (taxa richness) in downstream reaches than upstream reaches (Halverson et al. 1997).

Studies of fish populations in Fourmile Branch conducted in the 1980s, when C-Reactor was operating, revealed that very few fish were present downstream of the reactor outfall (Halverson et al. 1997). Water temperatures exceeded 140°F at the point where the discharge entered Fourmile Branch and were as high as 100°F where the stream flowed into the Savannah River Swamp, approximately 10 miles downstream. Following the shutdown of C-Reactor in 1985, Fourmile Branch was rapidly recolonized by fish from the Savannah River swamp system. Centrarchids (sunfish) and cyprinids (minnows) were the most common taxa.

To assess potential impacts of groundwater outcropping to Fourmile Branch, Westinghouse Savannah River Company in 1990 surveyed fish populations in Fourmile Branch up- and downstream of F- and H-Area seepage basins (Halverson et al. 1997). Upstream stations were dominated by pirate perch, creek chubsucker, yellow bullhead, and several sunfish species (redbreast sunfish, dollar sunfish, spotted sunfish). Downstream stations were dominated by shiners (yellowfin shiner, dusky shiner, and taillight shiner) and sunfish (redbreast sunfish and spotted sunfish), with pirate perch and creek chubsucker present, but in lower numbers. Differences in species composition were believed to be due to habitat differences rather than the effect of contaminants in groundwater.

Savannah River

An extensive information base is available regarding the aquatic ecology of the Savannah River in the vicinity of SRS. The most recent water quality data available from environmental monitoring conducted on the river in the vicinity of SRS and its downstream reaches can be found in *Savannah River Site Environmental Data for 1998* (Arnett and Mamatey 1999b). These data demonstrate that the Savannah River is not adversely impacted by SRS wastewater discharges to its tributary streams. A full description of the ecology of the Savannah River in the vicinity of SRS can be found in the *SRS Ecology Environmental Information Document* (Halverson et al. 1997), the *Final Environmental Impact Statement for the Shutdown of the River Water System at the Savannah River Site* (DOE 1997a), and the EIS for *Accelerator Production of Tritium at the Savannah River Site* (DOE 1997c).

3.5 Land Use

The SRS is in west-central South Carolina (Figure 3.1-1), approximately 100 miles from the Atlantic Coast. The major physical feature at SRS is the Savannah River, about 20 miles of which serve as the southwestern boundary of the Site and the South Carolina-Georgia border. The SRS includes portions of Aiken, Barnwell, and Allendale Counties in South Carolina.

The SRS occupies an almost circular area of approximately 300 square miles or 192,000 acres and contains production, service, and research and development areas (Figure 3.2-1). The production facilities occupy less than 10 percent of the SRS; the remainder of the site is undeveloped forest or wetlands (DOE 1997).

The site is a significant large-scale facility available for wildlife management and research activities. SRS is a desirable location for landscape scale studies and externally funded studies conducted as a part of DOE's National Environmental Research Park. Public use of the Site's natural resources is presently limited to controlled hunts and to various science literacy programs encompassing elementary through graduate school levels.

The F and H Areas, of which the tank farms are a part, are in the north-central portion of the SRS, bounded by Upper Three Runs to the north and Fourmile Branch to the South. The F Area occupies about 364 acres, while the H Area occupies 395 acres (DOE 1997). Land within a 5-mile radius of these areas lies entirely within the SRS boundaries and is used for either industrial purposes or as forested land (DOE 1997).

In March 1998, the *Savannah River Future Use Plan* (DOE 1998a) was formally issued. It was developed in partnership with all major Site contractors, support agencies, and DOE Headquarters counterparts, with the input of stakeholders, and defines the future use for the Site. The Plan states as policy the following important points: (1) SRS boundaries shall remain unchanged, and the land shall remain under the ownership of the Federal government, consistent with the Site's designation as a National Environmental Research Park; (2) residential uses of all SRS land shall be prohibited; and (3) an Integral Site Model that incorporates three planning zones (industrial, industrial support, and restricted public uses) will be utilized. The land around the F and

H Areas (i.e., between Upper Three Runs and Fourmile Branch) will be considered in the industrial use category (DOE 1998b). Consequently, DOE's plan is to continue active institutional control for those areas as long as necessary to protect the public and the environment (DOE 1998b). For purposes of analysis, however, DOE assumes institutional control for the next 100 years. After that, the area would be zoned as industrial for an indefinite period, with deed restrictions on the use of groundwater. This was the basis for the analysis in the *Industrial Wastewater Closure Plan for F- and H- Area High-Level Waste Tank Systems* (DOE 1997).

3.6 Socioeconomics and Environmental Justice

This section describes the economic and demographic baseline for the area around SRS. The purpose of this information is to assist in understanding the potential impacts that high-level waste tank closure could have on population and employment income and to identify any potential disproportionately high and adverse impacts the actions could have on minority and low-income populations.

3.6.1 SOCIOECONOMICS

The socioeconomic region of influence for the proposed action is a six-County area around the SRS where the majority of Site workers reside and where socioeconomic impacts are most likely to occur. The six Counties are Aiken, Allendale, Barnwell, and Bamberg in South Carolina, and Columbia and Richmond in Georgia. *Socioeconomic Characteristics of Selected Counties and Communities Adjacent to the Savannah River Site* (HNUS 1997) contains details on the region of influence, as well as most of the information discussed in this section. The study includes full discussions of regional fiscal conditions, housing, community services and infrastructure, social services and institutions, and educational services. This section will, however, focus on population and employment estimates that have been updated to reflect the most recently available data.

<u>Population</u>

Based on State and Federal agency surveys and trends, the estimated 1998 population that lives in the region of influence was 466,222. About 90 percent lived in the following counties: Aiken (29 percent), Columbia (20 percent), and Richmond (41 percent). The population in the region grew at an annual growth rate of about 6.5 percent between 1990 and 1998 (U.S. Bureau of the Census 1999). Columbia County, and to a lesser extent Aiken County, contributed to most of the growth, due to inmigration from other region of influence counties and states. Over the same period, Bamberg and Barnwell Counties experienced net outmigration.

Population projections indicate that the overall population in the region should continue to grow less than 1 percent until about 2040, except Columbia County, which could experience 2 to 3 percent annual growth. Table 3.6-1 presents projections by county through 2040.

Based on the most recent information available (1992), the estimated median age of the population in the region was 31.8 years, somewhat higher than 1980, when the estimated median age was 28. Median ages in the region are generally lower than those of the nation and the two States. The region had slightly higher percentages of persons in younger age groups (under 5 and 5 to 19) than the U.S., while for all other age groups, the region was comparable to U.S. percentages. The only exception to this was Columbia County, with only 6 percent of its population 65 years or older, while the other counties and the U.S. were 10 percent or greater in this age group. The proportion of persons younger than 20 is expected to decrease, while the proportion of persons older than 64 is expected to increase (DOE 1997).

<u>Employment</u>

In 1994, the latest year consistently developed information is available for all counties in the region of influence, the total civilian labor force for the region of influence was 206,518, with 6.9 percent unemployment. The unemployment rate for the U.S. for the same period was 6.1 percent.

Table 3.6-1. Population projections and percent of region of influence.[a]

	2000		2010		2020	
Jurisdiction	Population	% ROI	Population	% ROI	Population	% ROI
South Carolina						
Aiken County	135,126	28.7	143,774	27.9	152,975	26.9
Allendale County	11,255	2.4	11,514	2.2	11,778	2.1
Bamberg County	16,366	3.5	17,528	3.4	18,773	3.3
Barnwell County	21,897	4.6	23,517	4.6	25,257	4.5
Georgia						
Columbia County	97,608	20.7	120,448	23.3	148,633	26.9
Richmond County	189,040	40.1	199,059	38.6	209,609	37.0
Six-county total	471,292	100	515,840	100	567,025	100

	2030		2040	
Jurisdiction	Population	% ROI	Population	% ROI
South Carolina				
Aiken County	162,766	26.0	173,182	24.9
Allendale County	12,049	1.9	12,326	1.8
Bamberg County	20,106	3.2	21,533	3.1
Barnwell County	27,126	4.5	29,134	4.2
Georgia				
Columbia County	184,413	29.4	226,332	32.6
Richmond County	220,718	35.2	232,417	33.4
Six-county total	627,178	100	694,924	100

EC a. Source: Scaled from HNUS (1997) and U.S. Bureau of the Census (1999).
ROI = region of influence.

For the Augusta-Aiken Metropolitan Statistical Area, which does not exactly coincide with the counties in the region of influence, the 1996 labor force totaled 202,400, with an unemployment rate of 6.7 percent. The most recent unemployment rate for the Augusta-Aiken Metropolitan Statistical Area issued for February 1999 was 5.0 percent.

In 1994, total employment according to Standard Industrial Code sectors ranged from 479 workers in the mining sector (e.g., clay and gravel pits) to 58,415 workers in the services sector (e.g., health care and education). Average per capita personal income in 1993 (adjusted to 1995 dollars) was $18,867, in comparison to the U.S. figure of $21,937.

Based on a detailed workforce survey completed in the fall of 1995, the SRS had 16,625 workers (including contractors, permanent and temporary workers, and persons affiliated with Federal agencies and universities who work on the Site) with a total payroll of slightly over $634 million. In September 1997, DOE had reduced the total workforce to 15,112 (DOE 1998).

3.6.2 ENVIRONMENTAL JUSTICE

DOE completed an analysis of the economic and racial characteristics of the population in areas affected by SRS operations for the *Interim Management of Nuclear Materials Environmental Impact Statement* (DOE 1995). That EIS evaluated whether minority or low- EC income communities could receive disproportionately high and adverse human health and environmental impacts from the alternatives included in that EIS. Geographically, it examined the population within a 50-mile radius of the SRS, plus areas downstream of the Site that withdraw drinking water from the Savannah River. The area encompasses a total of 147 census tracts, resulting in a total potentially affected population of 993,667. Of that population, 618,000 (62 percent) are white. In the minority population, approximately 94 percent are African American; the remainder consists of small percentages of Asian, Hispanic, and Native American persons (see Table 3.6-2).

It should be noted that the *Interim Management of Nuclear Materials EIS* used data on minority and low-income populations from the 1990 census. Although the U.S. Bureau of the Census publishes county- and state-level population estimates and projections in odd (inter-census) years, census-tract-level statistics on minority and low-income populations are only collected for decennnial censuses.

The analysis determined that, of the 147 census tracts in the combined region, 80 contain populations of 50 percent or more minorities. An additional 50 tracts contain between 35 and 50 percent minorities. These tracts are well distributed throughout the region, although there are more toward the south and in the immediate vicinities of Augusta and Savannah (see Figure 3.6-1).

Low-income communities (25 percent or more of the population living in poverty [i.e., income of $8,076 for a family of two]) occur in 72 census tracts distributed throughout the region of influence, but primarily to the south and west of SRS (see Figure 3.6-2.). This represents more than 169,000 persons, or about 17 percent of the total population (see Table 3.6-3).

3.7 Cultural Resources

Through a cooperative agreement, DOE and the South Carolina Institute of Archaeology and Anthropology of the University of South Carolina conduct the Savannah River Archaeological Research Program to provide the services required by Federal law for the protection and management of archaeological resources. Ongoing research programs work in conjunction with the South Carolina State Historic Preservation Office. They provide theoretical, methodological, and empirical bases for assessing site significance, using the compliance process specified by law. Archaeological investigations usually begin through the Site Use Program, which requires a permit for clearing land on SRS.

The archaeological research has provided considerable information about the distribution and content of archaeological and historic sites on SRS. Savannah River archaeologists have examined SRS land since 1974. To date they have examined 60 percent of the 300-square-mile area and recorded more than 1,200 archaeological sites (HNUS 1997). Most (approximately 75 percent) of these sites are prehistoric. To facilitate the management of these resources, SRS is divided into three archaeological zones based upon an area's potential for containing sites of historical or archaeological significance (DOE 1995). Zone 1 represents areas with the greatest potential for having significant resources, Zone 2 areas possess sites with moderate potential, and Zone 3 has areas of low archaeological significance.

Table 3.6-2. General racial characteristics of population in the Savannah River Site region of influence.[a]

State	Total population	Total White	Total Minority	African-American	Hispanic	Asian	Native American	Other	Percent minorities
South Carolina ROI	418,685	267,639	151,046	144,147	3,899	1,734	911	355	36.1%
Georgia ROI	574,982	350,233	224,749	208,017	7,245	7,463	1,546	478	39.1%
Total	993,667	617,872	375,795	352,164	11,144	9,197	2,457	833	37.8%

a. Source: DOE (1995).
OI = region of influence.

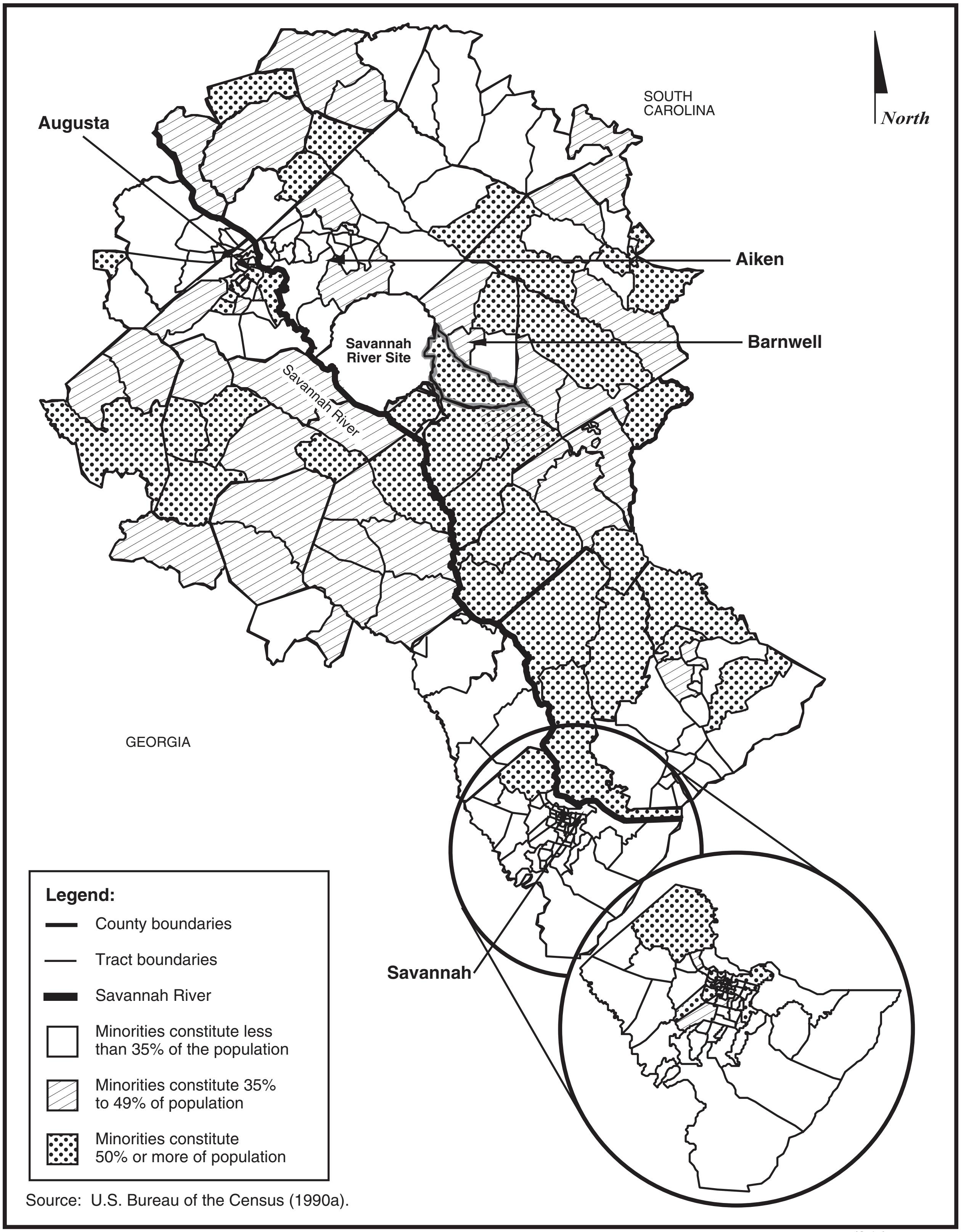

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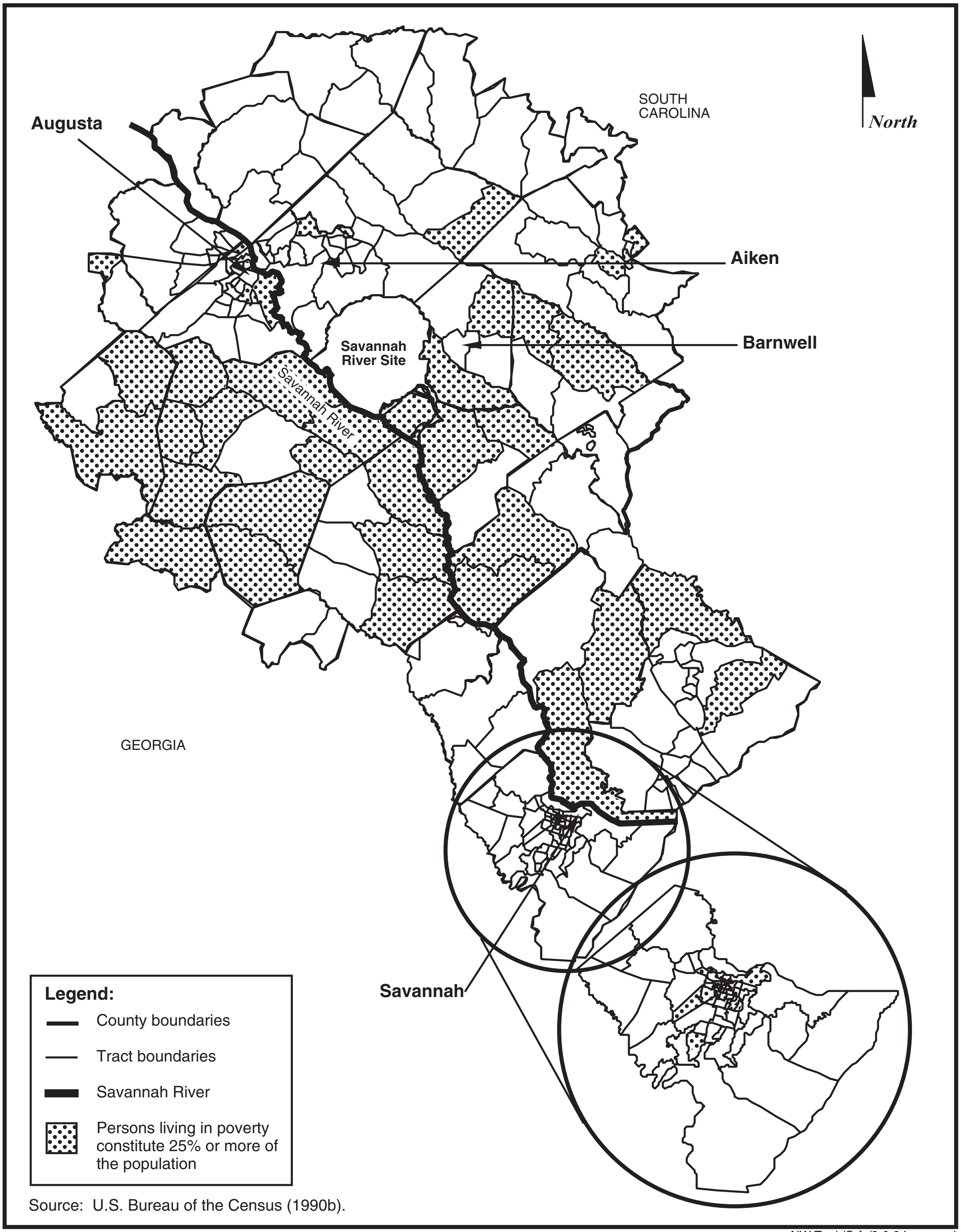
Figure 3.6-1. Distribution of minority population by census tracts in the SRS region of analysis.



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NW Tank/Grfx/3-6-2 Income.ai

Figure 3.6-2. Low income census tracts in the SRS region of analysis.

Table 3.6-3. General poverty characteristics of population in the Savannah River Site region of interest.

Area	Total population	Persons living in poverty[a]	Percent living in poverty
South Carolina	418,685	72,345	17.3%
Georgia	574,982	96,672	16.8%
Total	993,667	169,017	17.0%

a. Families with income less than the statistical poverty threshold, which in 1990 was 1989 income of $8,076 for a family of two [U.S Bureau of the Census (1990b)].

Studies of F and H Areas in a previous EIS (DOE 1994) noted that activities associated with the construction of F and H Areas during the 1950s could have destroyed historic and archaeological resources present in this area. As mentioned in Chapter 2, F and H Areas are heavily industrialized sites. They are surrounded by Zone 2 and Zone 3 lands outside of the facilities' secure parameters.

3.8 Public and Worker Health

3.8.1 PUBLIC RADIOLOGICAL HEALTH

Because there are many sources of radiation in the human environment, evaluations of radioactive releases from nuclear facilities must consider all ionizing radiation to which people are routinely exposed.

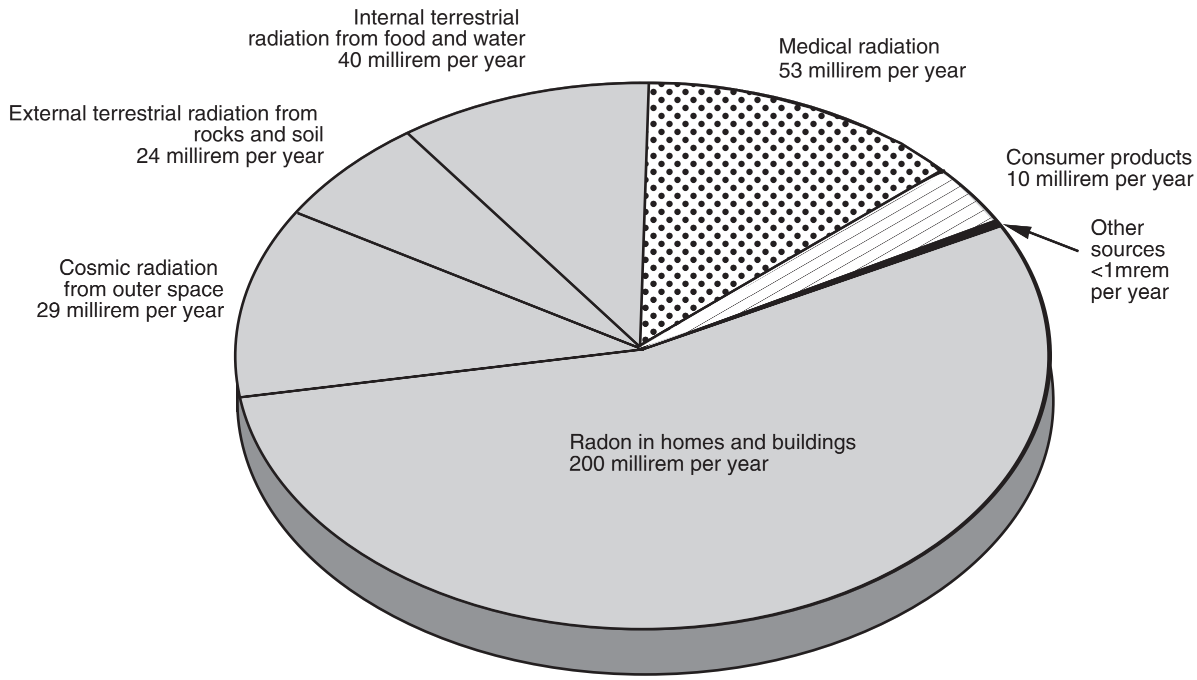
Doses of radiation are expressed as millirem, rem (1,000 millirem), and person-rem (sum of dose to all individual in population).

An individual's radiation exposure in the vicinity of SRS amounts to approximately 357 millirem per year, which is comprised of: natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; weapons test fallout; consumer and industrial products, and nuclear facilities. Figure 3.8-1 shows the relative contribution of each of these sources to the dose an individual living near SRS would receive. All radiation doses mentioned in this EIS are effective dose equivalents. Effective dose equivalents include the dose from internal deposition of radionuclides and the dose attributable to sources external to the body.

Releases of radioactivity to the environment from SRS account for less than 0.1 percent of the total annual average environmental radiation dose to individuals within 50 miles of the Site. Natural background radiation contributes about 293 millirem per year, or 82 percent of the annual dose of 357 millirem received by an average member of the population within 50 miles of the Site. Based on national averages, medical exposure accounts for an additional 15 percent of the annual dose, and combined doses from weapons test fallout, consumer and industrial products, and air travel account for about 3 percent (NCRP 1987a).

Other nuclear facilities within 50 miles of SRS include a low-level waste disposal site operated by Chem-Nuclear Systems, Inc., near the eastern Site boundary and Georgia Power Company's Vogtle Electric Generating Plant, directly across the Savannah River from SRS. In addition, Starmet CMI (formerly Carolina Metals), Inc., which is northwest of Boiling Springs in Barnwell County, processes depleted uranium.

The *South Carolina Department of Health and Environmental Control Annual Report* (SCDHEC 1995) indicated that the Chem-Nuclear and Starmet CMI facilities do not influence radioactivity levels in the air, precipitation, groundwater, soil, or vegetation. Plant Vogtle began commercial operation in 1987: 1992 re leases produced an annual dose of 0.054 millirem to the maximally exposed individual at the plant boundary and a total population dose within a 50-mile radius of 0.045 person-rem (NRC 1996). EC



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Notes:
1. Values are effective dose equivalents from NCRP (1987a) unless noted otherwise.
2. Cosmic: NCRP (1987a) reports 26 millirem per year for sea level. Multiplying value by a factor of 1.1 to correct for the altitude of 300 meters above sea level gives 29 millirem per year.
3. External terrestrial: NCRP (1987b) reports an absorbed dose rate for Augusta, Georgia of 4 microrad per hour, which is 35 millirad per year. NCRP (1987b) uses a factor of 0.7 to convert absorbed dose in air to effective dose equivalent, so 35 x 0.7 = 24 millirem per year.
4. Other sources include SRS operations (0.19 millirem per year; Arnett and Mamatey (1999a)), commercial nuclear facilities (nationwide), occupational exposure, air travel, and fallout.

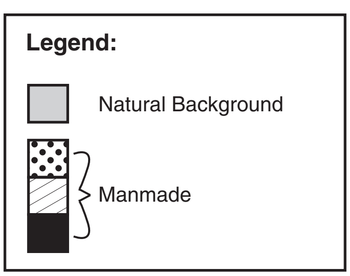

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Figure 3.8-1. Major sources of radiation exposure in the vicinity of the Savannah River Site.

In 1997, releases of radioactive material to the environment from SRS operations resulted in a maximum individual dose of 0.07 millirem in the west-southwest sector of the Site boundary from atmospheric releases, and a maximum dose from liquid releases of 0.12 millirem for a maximum total annual dose at the boundary of 0.19 millirem. The maximum dose to downstream consumers of Savannah River water – 0.05 millirem – occurred to users of the Port Wentworth and the Beaufort-Jasper public water supplies (Arnett and Mamatey 1999a).

In 1990, the population within 50 miles of the Site was approximately 620,100. The collective effective dose equivalent to that population in 1998 was 3.5 person-rem from atmospheric releases. The 1998 population of 10,000 people using water from the Cherokee Hill Water Treatment Plant near Port Wentworth, Georgia, and 60,000 people using water from the Beaufort-Jasper Water Treatment Plant near Beaufort, South Carolina, received a collective dose equivalent of 1.8 person-rem in 1998 (Arnett and Mamatey 1999a). Population statistics indicate that cancer caused 23.2 percent of the deaths in the United States in 1997 (CDC 1998). If this percentage of deaths from cancer continues, 23.2 percent of the U.S. population would contract a fatal cancer from all causes. Thus, in the population of 620,100 within 50 miles of SRS, 143,863 persons would be likely to contract fatal cancers from all causes. The total population dose from SRS of 5.3 person-rem (3.5 person-rem from atmospheric pathways plus 1.8 person-rem from water pathways) could result in 0.0027 additional latent cancer death in the same population (based on 0.0005 cancer death per person-rem [NCRP 1993]).

3.8.2 PUBLIC NONRADIOLOGICAL HEALTH

The hazards associated with the alternatives described in this EIS include exposure to nonradiological chemicals in the form of water and air pollution (see Sections 3.2 and 3.3). Table 3.3-2 lists ambient air quality standards and concentrations for selected pollutants. The purpose of these standards is to protect the public health and welfare. The concentrations of pollutants from SRS sources, listed in Table 3.3-3, are lower than the standards. Section 3.2 discusses water quality in the SRS vicinity.

3.8.3 WORKER RADIOLOGICAL HEALTH

One of the major goals of the SRS Health Protection Program is to keep worker exposures to radiation and radioactive material as low as reasonably achievable. Such a program must evaluate both external and internal exposures, with the goal being to minimize the total effective dose equivalent. An effective as low as reasonably achievable program to keep doses as low as reasonably achievable must also balance minimizing individual worker doses with minimizing the collective dose of workers in a group. For example, using many workers to perform small portions of a task would reduce the individual worker dose to low levels. However, frequent worker changes would make the work inefficient, resulting in a significantly higher collective dose to all the workers than if fewer had received slightly higher individual doses. EC

SRS worker doses have typically been well below DOE worker exposure limits. DOE set administrative exposure guidelines at a fraction of the exposure limits to help enforce doses that are as low as reasonably achievable. For example, the current DOE worker exposure limit is 5,000 millirem per year, and the 1998 SRS as low as reasonably achievable administrative control level for the whole body is 500 millirem per year. Every year DOE evaluates the SRS as low as reasonably achievable administrative control levels and adjusts them as needed.

Table 3.8-1 lists average individual doses and SRS collective doses from 1988 to 1998.

3.8.4 WORKER NONRADIOLOGICAL HEALTH

Industrial hygiene and occupational health programs at the SRS deal with all aspects of worker health and relationship of the worker to

Table 3.8-1. SRS annual individual and collective radiation doses.[a]

Year	Average individual worker dose (rem)[b]	Site worker collective dose (person-rem)
1988	0.070	864
1989	0.056	754
1990	0.056	661
1991	0.038	392
1992	0.049	316
1993	0.051	263
1994	0.022	311
1995	0.018	247
1996	0.019	237
1997	0.013	164
1998	0.015	163

a. Sources: DuPont (1989), Petty (1993), WSRC (1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999).
b. The average dose includes only workers who received a measurable dose during the year.

the work environment. The objective of an effective occupational health program is to protect employees from hazards in their work environment. To evaluate these hazards, DOE uses routine monitoring to determine employee exposure levels to hazardous chemicals.

Exposure limit values are the basis of most occupational health codes and standards. If an overexposure to a harmful agent does not exist, that agent generally does not create a health problem.

EC The Occupational Safety and Health Administration (OSHA) has established Permissible Exposure Limits to regulate worker exposure to hazardous chemicals. These limits refer to airborne concentrations of substances and represent conditions under which nearly all workers could receive repeated exposures day after day without adverse health effects.

EC Table 3.8-2 lists OSHA-regulated workplace pollutants likely to be generated by high-level waste (HLW) tank closure activities and the applicable OSHA limits.

A well-defined worker protection program is in place at the SRS to protect the occupational health of DOE and contractor employees. To prevent occupational illnesses and injuries and to preserve the health of the SRS workforce, contractors involved in the construction and operations programs have implemented DOE-approved health and safety programs. Tables 3.8-3 and 3.8-4 indicate that these health EC and safety programs have resulted in lower incidences of injury and illness than those that occur in the general industry, construction, and manufacturing workforces.

3.9 Waste and Materials

3.9.1 WASTE MANAGEMENT

This section describes the waste generation baseline that DOE uses in Chapter 4 to gauge the relative impact of each tank closure alternative on the overall waste generation at SRS and on DOE's capability to manage such waste. In 1995, DOE prepared an EIS on the management of wastes projected to be generated by SRS for the next 40 years (DOE 1995).

DOE generates six basic types of waste – HLW, low-level radioactive (LLW), hazardous, mixed EC (low-level radioactive and hazardous), transuranic (including alpha-contaminated), and sanitary (nonhazardous, nonradioactive) – which this EIS considers because they are possible byproducts of the SRS tank closure activities. The following sections describe the waste types. Table 3.9-1 lists projected total waste generation

Table 3.8-2. Potential occupational safety and health hazards and associated exposure limits.

Pollutant	OSHA PEL[a] (mg/m^3)	Time period
Carbon monoxide	55	8 hours
Oxides of nitrogen	9	Ceiling limit
Total particulates	15	8 hours
Particulate matter (<10 microns)	150	24 hours
	50	Annual
Oxides of sulfur	13	8 hours

a. PEL = Permissible Exposure Limits. The OSHA PEL listed in Table Z-1-A or Z-2 of the OSHA General Industry Air Contaminants Standard (29 CFR 1910.1000) provided if appropriate. These limits, unless otherwise noted (e.g., ceiling), must not be exceeded during any 8-hour work shift of a 40-hour work week.

Table 3.8-3. Comparison of 1997 rates for SRS construction to general industry construction.

Incident rate	SRS construction department[a]	Construction industry[b]
Total recordable cases	4.6	8.70
Total lost workday cases	2.3	4.09

a. Source: Hill (1999).
b. Source: Bureau of Labor Statistics (1998).

Table 3.8-4. Comparison of 1997 rates for SRS operations to private industry and manufacturing.

Incident rate	SRS operations[a]	Private industry[b]	Manufacturing[b]
Total recordable cases	1.08	6.05	10.30
Total lost workday cases	0.44	2.82	4.83

a. Source: Hill (1999).
b. Source: Bureau of Labor Statistics (1998).

Table 3.9-1. Total waste generation forecast for SRS (cubic meters).[a]

	Waste class				
Inclusive dates	LLW	HLW	Hazardous	Mixed LLW	Transuranic and alpha
1999 to 2029	180,299	14,129	6,315	3,720	6,012

EC

a. Source: Halverson (1999).

volumes for fiscal years 1999 through 2029 (a time period that encompasses the expected duration of the tank closure activities addressed in this EIS). The assumptions and uncertainties applicable to SRS waste management plans and waste generation estimates are described in Halverson (1999). These estimates do not include wastes that would be generated as a result of closure of the SRS HLW tank systems.

Tables 3.9-2 through 3.9-4 provide an overview of the existing and planned facilities that DOE expects to use in the storage, treatment, and disposal of the various waste classes.

3.9.1.1 Low-Level Radioactive Waste

DOE (1999) defines LLW as radioactive waste that cannot be classified as HLW, spent nuclear fuel, transuranic waste, byproduct material, or naturally occurring radioactive material.

At present, DOE uses a number of methods for treating and disposing of LLW at SRS, depending on the waste form and activity. Approximately 41 percent of this waste is low in low-activity waste and place it in either shallow land disposal or vault disposal in E Area.

DOE places LLW of intermediate activity and some tritiated LLW in E Area intermediate activity vaults and will store long-lived LLW (e.g., spent deionizer resins) in the long-lived waste storage buildings in E Area, where they will remain until DOE determines their final disposition.

3.9.1.2 Mixed Low-Level Waste

Mixed LLW is radioactive waste that contains material that is listed as hazardous waste under the Resource Conservation and Recovery Act (RCRA) or that exhibits one or more of the following hazardous waste characteristics: ignitability, corrosivity, reactivity, or toxicity. It includes such materials as tritiated mercury, tritiated oil contaminated with mercury, other mercury-contaminated compounds, radioactively contaminated lead shielding, equipment from the tritium facilities in H Area, and filter paper takeup rolls from the M Area Liquid Effluent Treatment Facility.

As described in the *Approved Site Treatment Plan* (WSRC 1999a), storage facilities for mixed LLW are in several different SRS areas. These facilities are dedicated to solid, containerized, or bulk liquid waste and all are approved for this storage under RCRA as interim status or permitted facilities or as Clean Water Act-permitted tank systems. Several treatment processes described in WSRC (1999a) exist or are planned for mixed LLW. These facilities, which are listed in Table 3.9-3, include the Consolidated Incineration Facility, the M-Area Vendor Treatment Facility, and the Hazardous Waste/Mixed Waste Containment Building.

Depending on the nature of the waste residues remaining after treatment, DOE plans to use either shallow land disposal or RCRA-permitted hazardous waste/mixed waste vaults for disposal.

3.9.1.3 High-Level Waste

HLW is highly radioactive material, resulting from the reprocessing of spent nuclear fuel, that contains a combination of transuranic waste and fission products in concentrations that require permanent isolation. It includes both liquid waste produced by reprocessing and any solid waste derived from that liquid (DOE 1999).

At present, DOE stores HLW in carbon steel and reinforced concrete underground tanks in the F- and H-Area Tank Farms. The HLW in the tanks consists of three physical forms: sludge, saltcake, and liquid. The sludge is solid material that precipitates or settles to the bottom of a tank. The saltcake is comprised of salt compounds that have crystallized as a result of concentrating the liquid by evaporation. The liquid is highly concentrated salt solution. Although some tanks contain all three forms, many tanks are considered primarily sludge tanks, while others are considered salt tanks (containing both saltcake and liquid salt solution).

Table 3.9-2. Planned and existing waste storage facilities.[a]

Storage facility	Location	Capacity	Original waste stream[b]: Low-level	HLW	Transuranic	Alpha[c]	Hazardous	Mixed Low-level	Status
Long-lived waste storage buildings	E-Area	140 m^3/ bldg	X						One exists; DOE plans to construct additional buildings, as necessary.
Containerized mixed waste storage	Buildings 645-2N, 643-29E, 643-43E, 316-M, and Pad 315-4M	4,237 m^3						X	DOE plans to construct additional storage buildings, similar to 643-43E, as necessary.
Liquid mixed waste storage	DWPF Organic Waste Storage Tank (S Area) SRTC Mixed Waste Tanks Liquid Waste Solvent Tanks (H Area) Process Waste Interim Treatment/Storage Facility Tanks (M Area)	9,586 m^3						X	The Process Waste Interim Treatment/Storage Facility ceased operation under RCRA in March 1996 and now operates under the Clean Water Act.
HLW tank farms	F and H Areas	(d)		X					51 underground tanks; one (16H) has been removed from service and two (17F, 20F) have been closed.[e]
Failed equipment storage vaults	Defense Waste Processing Facility (S Area)	300 m^3		X					Two exist; DOE plans approximately 12 additional vaults.
Glass waste storage buildings	Defense Waste Processing Facility (S Area)	2,286 canisters[f]		X					One exists and is expected to reach capacity in 2005; a second is planned to accommodate canister production from 2005 to 2015.
Hazardous waste storage facility	Building 710-B Building 645-N Building 645-4N Waste Pad 1 (between 645-2N and 645-4N) Waste Pad 2 (between 645-4N and 645-N) Waste Pad 3 (east of 645-N)	4,557 m^3					X		Currently in use. No additional facilities are planned, as existing space is expected to adequately support the short-term storage of hazardous wastes awaiting treatment and disposal.
Transuranic waste storage pads	E Area	(g)			X	X		X	19 pads exists; additional pads will be constructed as necessary.

m^3 = cubic meters, SRTC = Savannah River Technology Center.
a. Sources: DOE (1994, 1995), WSRC (1998, 1999a).
b. Sanitary waste is not stored at SRS, thus it is not addressed in this table.
c. Currently, alpha waste is handled and stored as transuranic waste.
d. As of April 1998, there were approximately 660,00 gallons of space available in each of the HLW tank farms.
e. Twenty-four of these tanks do not meet secondary containment requirements and have been scheduled for closure.
f. Usable storage capacity of 2,159 canisters due to floor plug problems.
g. Transuranic waste storage capacities depend on the packaging of the waste and the configuration of packages on the pads.

EC

Table 3.9-3. Planned and existing waste treatment processes and facilities.[a]

Waste Treatment Facility	Waste Treatment Process	Waste type: Low-level	High-level	Transuranic	Alpha[b]	Hazardous	Mixed Low-level	Sanitary	Status
Consolidated Incineration Facility	Incineration	X				X	X		Began treating waste in 1997.
Offsite facility[c]	Incineration	X				X	X		Currently operational.
Offsite facility	Compaction	X							Currently operational.
Offsite facility	Supercompaction	X							Currently operational.
Offsite facility	Smelting	X							Currently operational.
Offsite facility	Repackaging	X							Currently operational.
Defense Waste Processing Facility	Vitrification		X						Currently operational.
Saltstone Manufacturing and Disposal Facility	Stabilization						X		Currently operational.
Replacement High-Level Waste Evaporator[d]	Volume Reduction		X						Planned to replace existing evaporators in December 1999.
M-Area Vendor Treatment Facility	Vitrification						X		Treatment of design basis wastes completed in February 1999.
Hazardous Waste/Mixed Waste Containment Building	Macroencapsulation					X	X		Plan to begin operations in 2006.
Treatment at point of waste stream origin	Decontamination Macroencapsulation						X		As feasible, based on waste and location.
Non-Alpha Vitrification Facility	Vitrification	X				X	X		Under evaluation as a potential process.
DOE Broad Spectrum Contractor	Amalgamation/ Stabilization/ Macroencapsulation						X		DOE is considering use of the Broad Spectrum Contract.
Offsite facility	Offsite Treatment and Disposal					X			Currently operational.
Offsite facility	Decontamination						X		Begin treating waste onsite in December 1998. Plan to pursue treatment offsite in 2000, if necessary.
Various onsite and offsite facilities[e]	Recycle/Reuse	X				X	X	X	Currently operational.
High-activity mixed transuranic waste facility	Repackaging/size reduction			X	X				Planned to begin operations in 2012.
Low-activity mixed transuranic waste facility	Repackaging/size reduction/ supercompaction			X	X				Planned to begin operations in 2002.
Existing DOE facilities	Repackaging/ Treatment			X					Transuranic waste strategies are still being finalized.
F- and H-Area Effluent Treatment Facility	Wastewater Treatment	X					X		Currently operational.

a. Sources: DOE (1994, 1995); Sessions (1999); WSRC (1998, 1999a).
b. Currently, alpha waste is handled as transuranic waste. After it is surveyed and separated, most will be treated and disposed of as LLW or mixed LLW.
c. An offsite incinerator may be used as a back-up to the Consolidated Incineration Facility.
d. Evaporation precedes treatment at the DWPF and is used to maximize HLW storage capacity.
e. Various waste streams have components (e.g., silver, lead, freon, paper) that might be recycled or reused. Some recycling activities might occur onsite, while other waste streams are directed offsite for recycling. Some of the recycled products are released for public sale, while others are reused onsite.

EC

Table 3.9-4. Planned and existing waste disposal facilities.[a]

Disposal facility	Location	Capacity (m^3)	Original waste stream[b]: Low-level	High-level	Transuranic	Hazardous	Mixed Low-level	Sanitary	Status
Shallow land disposal trenches	E Area	(c)	X						Four have been filled; up to 58 more may be constructed.
Low-activity vaults	E Area	30,500/vault	X						One vault exists and one additional is planned.
Intermediate-activity vaults	E Area	5,300/vault	X						Two vaults exist and five more may be constructed.
Hazardous waste/mixed waste vaults	NE of F Area	2,300/vault				X	X		RCRA permit application submitted for 10 vaults. At least 11 additional vaults may be needed.
Saltstone Manufacturing and Disposal Facility	Z Area	80,000/vault[d]	X						Two vaults exist and approximately 13 more are planned.
Three Rivers Landfill	SRS Intersection of SC 125 and Rd. 2	NA						X	Current destination for SRS sanitary waste.
Burma Road Cellulosic and Construction Waste Landfill	SRS Intersection of C Rd. and Burma Rd	NA						X	Current destination for demolition/construction debris. DOE expects to reach permit capacity in 2008.
Waste Isolation Pilot Plant	New Mexico	175,600			X				EPA certification of WIPP completed in April 1998. RCRA permit expected to be finalized in fall of 1999.[e]
Federal repository	See Status	NA		X					Proposed Yucca Mountain, Nevada site is currently under investigation.

NA = Not Available, WIPP = Waste Isolation Pilot Plant.
a. Sources: DOE (1994, 1995, 1997); WSRC (1998, 1999a,b).
b. After alpha waste is assayed and separated from the transuranic waste, DOE plans to dispose of it as LLW or mixed LLW so it is not addressed separately here. | EC
c. Various types of trenches exist including engineered low-level trenches, greater confinement disposal boreholes and engineered trenches, and slit trenches. The different trenches are designed for different waste types, are constructed differently, and have different capacities.
d. This is the approximate capacity of a double vault. One single vault and one double vault have been constructed. Future vaults are currently planned as double vaults.
e. SRS is scheduled for WIPP certification audit in summer 1999, after which WIPP could begin receiving SRS waste.

The sludge portion of the HLW is currently being transferred to the DWPF for immobilization in borosilicate glass. The saltcake and liquid portions of the HLW must be separated into high-radioactivity and low-radioactivity fractions before ultimate treatment. The process for separating HLW is the subject of a Supplemental EIS, *High-Level Waste Salt Disposition Alternatives at the Savannah River Site*. The high-radioactivity fraction would be transferred to the DWPF for vitrification. The low-radioactivity fraction would be treated and disposed at the Saltstone Manufacturing and Disposal Facility. Both treatment processes are described in the *Final Supplemental Environmental Impact Statement for the Defense Waste Processing Facility* (DOE 1994).

DOE has committed to complete closure by 2022 of the 24 HLW tank systems that do not meet the secondary containment requirements in the Federal Facility Agreement (WSRC 1998). Figure 3.9-1 presents the approved schedule for waste removal and closure of these 24 tanks. During waste removal, DOE will retrieve as much of the stored HLW as can be removed using the existing waste transfer equipment. The retrieved waste will be processed through the remaining tank systems and treated at either the DWPF Vitrification Facility or the Saltstone Manufacturing and Disposal Facility. The tank closure activities described in this EIS would occur after waste removal is completed.

3.9.1.4 Sanitary Waste

Sanitary waste is solid waste that is neither hazardous, as defined by RCRA, nor radioactive. It consists of salvageable material and material that is suitable for disposition in a municipal sanitary landfill. Sanitary waste streams include such items as paper, glass, discarded office material, and construction debris (DOE 1994).

Sanitary waste volumes have declined due to recycling and the decreasing SRS workforce. DOE sends sanitary waste that is not recycled or reused to the Three Rivers Landfill on SRS. The SRS also continues to operate the Burma Road Cellulosic and Construction Waste Landfill to dispose of demolition and construction debris.

3.9.1.5 Hazardous Waste

Hazardous waste is nonradioactive waste that SCDHEC regulates under RCRA and corresponding State regulations. Waste is hazardous if the EPA lists it is as such or if it exhibits the characteristic(s) of ignitability, corrosivity, reactivity, or toxicity. SRS hazardous waste streams consist of a variety of materials, including mercury, chromate, lead, paint solvents, and various laboratory chemicals.

At present, DOE stores hazardous wastes in three buildings and on three solid waste storage pads that have RCRA permits. Hazardous waste is sent to offsite treatment and disposal facilities and is also treated at the Consolidated Incineration Facility. DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons. Wastes remaining after treatment might be suitable for either shallow land disposal or disposal in the Hazardous/Mixed Waste Disposal Vaults (DOE 1995).

3.9.1.6 Transuranic and Alpha Waste

Transuranic waste contains alpha-emitting transuranic radionuclides (those with atomic weights greater than 92) that have half-lives greater than 20 years at activities exceeding 100 nanocuries per gram (DOE 1999). At present, DOE manages low-level alpha-emitting waste with activities between 10 and 100 nanocuries per gram, referred to as alpha waste, as transuranic waste at SRS.

WSRC (1999a) defines the future handling, treatment, and disposal of the SRS transuranic and alpha waste stream. Current SRS efforts consist primarily of providing continued safe storage until treatment and disposal facilities are available. Eventually, DOE plans to ship the SRS retrievably - stored transuranic and mixed transuranic waste to the Waste Isolation Pilot Plant in New Mexico for disposal.

Before disposition, DOE plans to measure the radioactivity levels of the wastes stored on the

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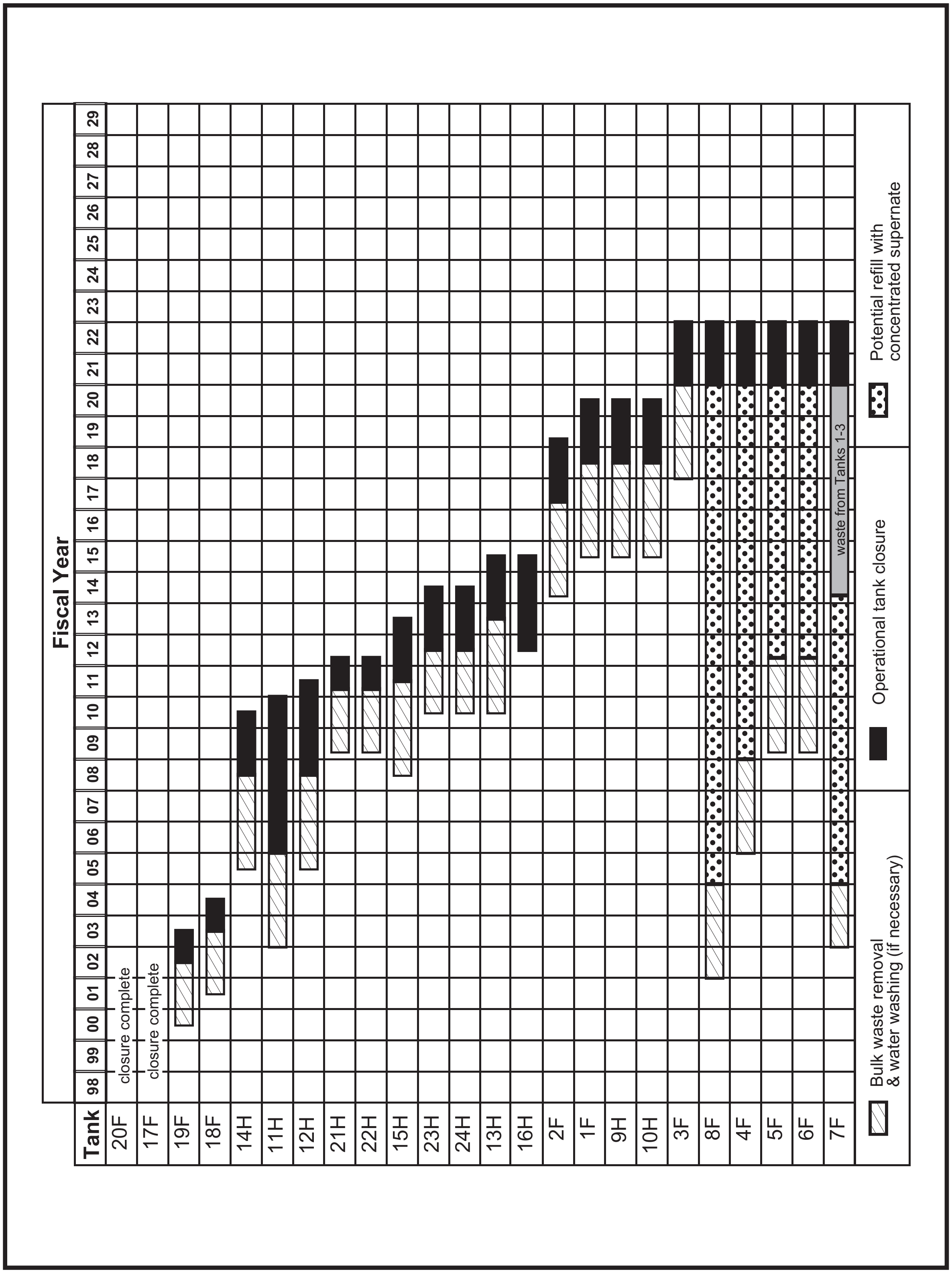

NW TANK/Final EIS/Graphic files/chp 3/3.9-1 App FFA Waste Rem Plan&Sch.ai

Figure 3.9-1. Approved Federal Facility Agreement Waste Removal Plan and Schedule.

transuranic waste storage pads and segregate the alpha waste. A high-activity mixed transuranic waste facility could be constructed to process the higher activity SRS waste in preparation for shipment to the Waste Isolation Pilot Plant. This facility would use repackaging, sorting, and size reduction technologies. A low-activity mixed transuranic waste facility could also be constructed to process the lower activity SRS waste. The technology to process low-activity SRS waste is currently under development. A compactor could also be used to process lower activity mixed transuranic waste in preparation for shipment to the Waste Isolation Pilot Plant. After segregation and repackaging, DOE could dispose of much of the alpha waste as either
EC | mixed LLW or LLW.

3.9.2 HAZARDOUS MATERIALS

The *Savannah River Site Tier II Emergency and Hazardous Chemical Inventory Report* for 1998 (WSRC 1999c) lists more than 79 hazardous chemicals that were present at SRS at some time during the year in amounts that exceeded the minimum reporting thresholds (generally 10,000 pounds for hazardous chemicals and 500 pounds for extremely hazardous substances). Four of the 79 hazardous chemicals are considered extremely hazardous substances under the Emergency Planning and Community Right-to-Know Act of 1986. The actual number and quantity of hazardous chemicals present on the Site and at individual facilities changes daily as a function of use and demand.

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Table 3.9-2. Planned and existing waste storage facilities.[a]

Storage facility	Location	Capacity	Original waste stream[b] Low-level	HLW	Transuranic	Alpha[c]	Hazardous	Mixed Low-level	Status
Long-lived waste storage buildings	E-Area	140 m^3/ bldg	X						One exists; DOE plans to construct additional buildings, as necessary.
Containerized mixed waste storage	Buildings 645-2N, 643-29E, 643-43E, 316-M, and Pad 315-4M	4,237 m^3						X	DOE plans to construct additional storage buildings, similar to 643-43E, as necessary.
Liquid mixed waste storage	DWPF Organic Waste Storage Tank (S Area) SRTC Mixed Waste Tanks Liquid Waste Solvent Tanks (H Area) Process Waste Interim Treatment/Storage Facility Tanks (M Area)	9,586 m^3						X	The Process Waste Interim Treatment/Storage Facility ceased operation under RCRA in March 1996 and now operates under the Clean Water Act.
HLW tank farms	F and H Areas	(d)		X					51 underground tanks; one (16H) has been removed from service and two (17F, 20F) have been closed.[e]
Failed equipment storage vaults	Defense Waste Processing Facility (S Area)	300 m^3		X					Two exist; DOE plans approximately 12 additional vaults.
Glass waste storage buildings	Defense Waste Processing Facility (S Area)	2,286 canisters[f]		X					One exists and is expected to reach capacity in 2005; a second is planned to accommodate canister production from 2005 to 2015.
Hazardous waste storage facility	Building 710-B Building 645-N Building 645-4N Waste Pad 1 (between 645-2N and 645-4N) Waste Pad 2 (between 645-4N and 645-N) Waste Pad 3 (east of 645-N)	4,557 m^3					X		Currently in use. No additional facilities are planned, as existing space is expected to adequately support the short-term storage of hazardous wastes awaiting treatment and disposal.
Transuranic waste storage pads	E Area	(g)			X	X		X	19 pads exists; additional pads will be constructed as necessary.

m^3 = cubic meters, SRTC = Savannah River Technology Center.
a. Sources: DOE (1994, 1995), WSRC (1998, 1999a).
b. Sanitary waste is not stored at SRS, thus it is not addressed in this table.
c. Currently, alpha waste is handled and stored as transuranic waste.
d. As of April 1998, there were approximately 660,00 gallons of space available in each of the HLW tank farms.
e. Twenty-four of these tanks do not meet secondary containment requirements and have been scheduled for closure.
f. Usable storage capacity of 2,159 canisters due to floor plug problems.
g. Transuranic waste storage capacities depend on the packaging of the waste and the configuration of packages on the pads.

EC

Table 3.9-3. Planned and existing waste treatment processes and facilities.[a]

Waste Treatment Facility	Waste Treatment Process	Waste type: Low-level	High-level	Transuranic	Alpha[b]	Hazardous	Mixed Low-level	Sanitary	Status
Consolidated Incineration Facility	Incineration	X				X	X		Began treating waste in 1997.
Offsite facility[c]	Incineration	X				X	X		Currently operational.
Offsite facility	Compaction	X							Currently operational.
Offsite facility	Supercompaction	X							Currently operational.
Offsite facility	Smelting	X							Currently operational.
Offsite facility	Repackaging	X							Currently operational.
Defense Waste Processing Facility	Vitrification		X						Currently operational.
Saltstone Manufacturing and Disposal Facility	Stabilization						X		Currently operational.
Replacement High-Level Waste Evaporator[d]	Volume Reduction		X						Planned to replace existing evaporators in December 1999.
M-Area Vendor Treatment Facility	Vitrification						X		Treatment of design basis wastes completed in February 1999.
Hazardous Waste/Mixed Waste Containment Building	Macroencapsulation					X	X		Plan to begin operations in 2006.
Treatment at point of waste stream origin	Decontamination Macroencapsulation						X		As feasible, based on waste and location.
Non-Alpha Vitrification Facility	Vitrification	X				X	X		Under evaluation as a potential process.
DOE Broad Spectrum Contractor	Amalgamation/ Stabilization/ Macroencapsulation						X		DOE is considering use of the Broad Spectrum Contract.
Offsite facility	Offsite Treatment and Disposal					X			Currently operational.
Offsite facility	Decontamination						X		Begin treating waste onsite in December 1998. Plan to pursue treatment offsite in 2000, if necessary.
Various onsite and offsite facilities[e]	Recycle/Reuse	X				X	X	X	Currently operational.
High-activity mixed transuranic waste facility	Repackaging/size reduction			X	X				Planned to begin operations in 2012.
Low-activity mixed transuranic waste facility	Repackaging/size reduction/ supercompaction			X	X				Planned to begin operations in 2002.
Existing DOE facilities	Repackaging/ Treatment			X					Transuranic waste strategies are still being finalized.
F- and H-Area Effluent Treatment Facility	Wastewater Treatment	X					X		Currently operational.

a. Sources: DOE (1994, 1995); Sessions (1999); WSRC (1998, 1999a).
b. Currently, alpha waste is handled as transuranic waste. After it is surveyed and separated, most will be treated and disposed of as LLW or mixed LLW.
c. An offsite incinerator may be used as a back-up to the Consolidated Incineration Facility.
d. Evaporation precedes treatment at the DWPF and is used to maximize HLW storage capacity.
e. Various waste streams have components (e.g., silver, lead, freon, paper) that might be recycled or reused. Some recycling activities might occur onsite, while other waste streams are directed offsite for recycling. Some of the recycled products are released for public sale, while others are reused onsite.

EC

Table 3.9-4. Planned and existing waste disposal facilities.[a]

Disposal facility	Location	Capacity (m^3)	Original waste stream[b]: Low-level	High-level	Transuranic	Hazardous	Mixed Low-level	Sanitary	Status
Shallow land disposal trenches	E Area	(c)	X						Four have been filled; up to 58 more may be constructed.
Low-activity vaults	E Area	30,500/vault	X						One vault exists and one additional is planned.
Intermediate-activity vaults	E Area	5,300/vault	X						Two vaults exist and five more may be constructed.
Hazardous waste/mixed waste vaults	NE of F Area	2,300/vault				X	X		RCRA permit application submitted for 10 vaults. At least 11 additional vaults may be needed.
Saltstone Manufacturing and Disposal Facility	Z Area	80,000/vault[d]	X						Two vaults exist and approximately 13 more are planned.
Three Rivers Landfill	SRS Intersection of SC 125 and Rd. 2	NA						X	Current destination for SRS sanitary waste.
Burma Road Cellulosic and Construction Waste Landfill	SRS Intersection of C Rd. and Burma Rd	NA						X	Current destination for demolition/construction debris. DOE expects to reach permit capacity in 2008.
Waste Isolation Pilot Plant	New Mexico	175,600			X				EPA certification of WIPP completed in April 1998. RCRA permit expected to be finalized in fall of 1999.[e]
Federal repository	See Status	NA		X					Proposed Yucca Mountain, Nevada site is currently under investigation.

NA = Not Available, WIPP = Waste Isolation Pilot Plant.

a. Sources: DOE (1994, 1995, 1997); WSRC (1998, 1999a,b).

b. After alpha waste is assayed and separated from the transuranic waste, DOE plans to dispose of it as LLW or mixed LLW so it is not addressed separately here. EC

c. Various types of trenches exist including engineered low-level trenches, greater confinement disposal boreholes and engineered trenches, and slit trenches. The different trenches are designed for different waste types, are constructed differently, and have different capacities.

d. This is the approximate capacity of a double vault. One single vault and one double vault have been constructed. Future vaults are currently planned as double vaults.

e. SRS is scheduled for WIPP certification audit in summer 1999, after which WIPP could begin receiving SRS waste.

The sludge portion of the HLW is currently being transferred to the DWPF for immobilization in borosilicate glass. The saltcake and liquid portions of the HLW must be separated into high-radioactivity and low-radioactivity fractions before ultimate treatment. EC The process for separating HLW is the subject of a Supplemental EIS, *High-Level Waste Salt Disposition Alternatives at the Savannah River Site*. The high-radioactivity fraction would be transferred to the DWPF for vitrification. The low-radioactivity fraction would be treated and disposed at the Saltstone Manufacturing and Disposal Facility. Both treatment processes are described in the *Final Supplemental Environmental Impact Statement for the Defense Waste Processing Facility* (DOE 1994).

DOE has committed to complete closure by EC 2022 of the 24 HLW tank systems that do not meet the secondary containment requirements in the Federal Facility Agreement (WSRC 1998). L-4-16 Figure 3.9-1 presents the approved schedule for waste removal and closure of these 24 tanks. During waste removal, DOE will retrieve as much of the stored HLW as can be removed using the existing waste transfer equipment. The retrieved waste will be processed through the remaining tank systems and treated at either the DWPF Vitrification Facility or the Saltstone Manufacturing and Disposal Facility. The tank closure activities described in this EIS would occur after waste removal is completed.

3.9.1.4 Sanitary Waste

Sanitary waste is solid waste that is neither EC hazardous, as defined by RCRA, nor radioactive. It consists of salvageable material and material that is suitable for disposition in a municipal sanitary landfill. Sanitary waste streams include such items as paper, glass, discarded office material, and construction debris (DOE 1994).

Sanitary waste volumes have declined due to recycling and the decreasing SRS workforce. DOE sends sanitary waste that is not recycled or reused to the Three Rivers Landfill on SRS. The SRS also continues to operate the Burma Road Cellulosic and Construction Waste Landfill to dispose of demolition and construction debris.

3.9.1.5 Hazardous Waste

Hazardous waste is nonradioactive waste that SCDHEC regulates under RCRA and corresponding State regulations. Waste is hazardous if the EPA lists it is as such or if it exhibits the characteristic(s) of ignitability, corrosivity, reactivity, or toxicity. SRS hazardous waste streams consist of a variety of materials, including mercury, chromate, lead, paint solvents, and various laboratory chemicals.

At present, DOE stores hazardous wastes in three buildings and on three solid waste storage pads that have RCRA permits. Hazardous waste is sent to offsite treatment and disposal facilities and is also treated at the Consolidated Incineration Facility. DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons. Wastes remaining after treatment might be suitable for either shallow land disposal or disposal in the Hazardous/Mixed Waste Disposal Vaults (DOE 1995).

3.9.1.6 Transuranic and Alpha Waste

Transuranic waste contains alpha-emitting transuranic radionuclides (those with atomic weights greater than 92) that have half-lives greater than 20 years at activities exceeding 100 nanocuries per gram (DOE 1999). At present, DOE manages low-level alpha-emitting waste with activities between 10 and 100 nanocuries per gram, referred to as alpha waste, as transuranic waste at SRS.

WSRC (1999a) defines the future handling, treatment, and disposal of the SRS transuranic and alpha waste stream. Current SRS efforts consist primarily of providing continued safe storage until treatment and disposal facilities are available. Eventually, DOE plans to ship the SRS retrievably - stored transuranic and mixed transuranic waste to the Waste Isolation Pilot Plant in New Mexico for disposal.

Before disposition, DOE plans to measure the radioactivity levels of the wastes stored on the

L-4-16

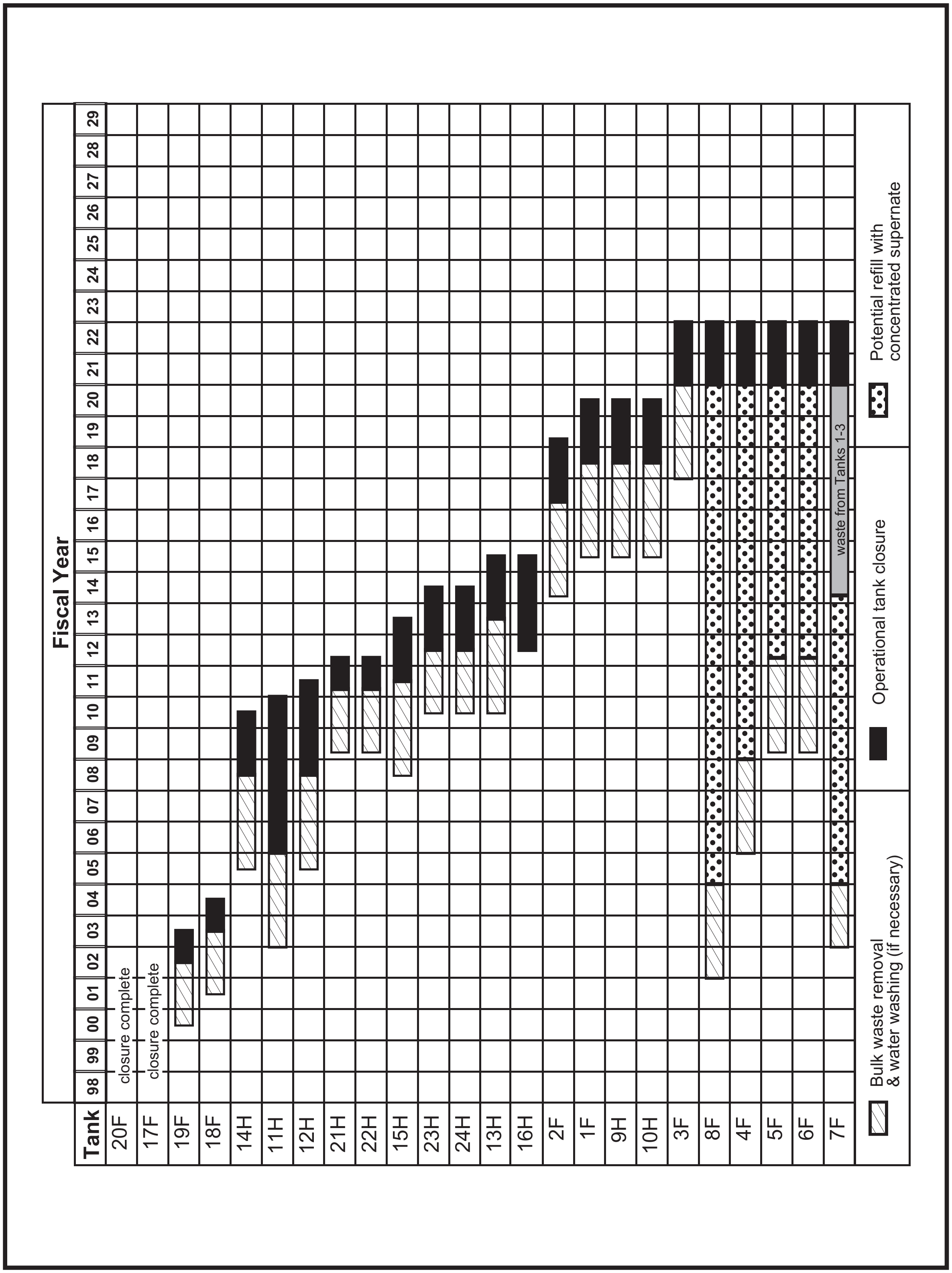

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Figure 3.9-1. Approved Federal Facility Agreement Waste Removal Plan and Schedule.

transuranic waste storage pads and segregate the alpha waste. A high-activity mixed transuranic waste facility could be constructed to process the higher activity SRS waste in preparation for shipment to the Waste Isolation Pilot Plant. This facility would use repackaging, sorting, and size reduction technologies. A low-activity mixed transuranic waste facility could also be constructed to process the lower activity SRS waste. The technology to process low-activity SRS waste is currently under development. A compactor could also be used to process lower activity mixed transuranic waste in preparation for shipment to the Waste Isolation Pilot Plant. After segregation and repackaging, DOE could dispose of much of the alpha waste as either mixed LLW or LLW.

3.9.2 HAZARDOUS MATERIALS

The *Savannah River Site Tier II Emergency and Hazardous Chemical Inventory Report* for 1998 (WSRC 1999c) lists more than 79 hazardous chemicals that were present at SRS at some time during the year in amounts that exceeded the minimum reporting thresholds (generally 10,000 pounds for hazardous chemicals and 500 pounds for extremely hazardous substances). Four of the 79 hazardous chemicals are considered extremely hazardous substances under the Emergency Planning and Community Right-to-Know Act of 1986. The actual number and quantity of hazardous chemicals present on the Site and at individual facilities changes daily as a function of use and demand.

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