

4.0 AFFECTED ENVIRONMENT¹

4.1 GENERAL DESCRIPTION OF SITE AND SURROUNDINGS

4.1.1 General Site Description

The Savannah River Plant, located in South Carolina, occupies an approximately circular site of about 300 square mile area. The site is bounded on the southwest by the Savannah River and centered approximately 25 miles southeast of Augusta, Georgia. It occupies parts of three South Carolina counties (Aiken, Barnwell, and Allendale). Figure 4-1 shows the location of the site relative to population centers within a 150-mile radius.

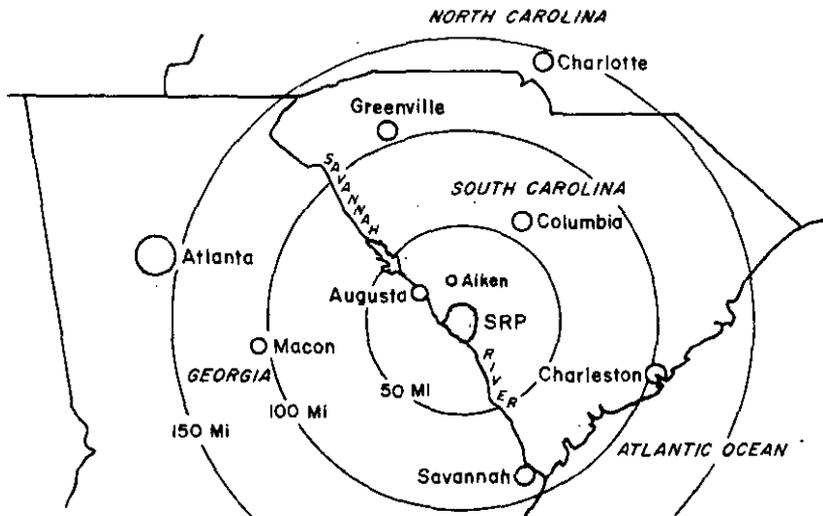


FIGURE 4-1. Location of SRP relative to Surrounding Population Centers

According to the 1970 census, major population centers within about 25 miles of the center of the plant are:

TABLE 4-1

Major Population Centers

<u>City*</u>	<u>Distance, miles</u>	<u>Direction From Plant</u>	<u>Population</u>
Augusta, GA	25	Northwest	59,864
N. Augusta, SC	25	Northwest	12,883
Aiken, SC	20	North	13,436
Williston, SC	15	Northeast	2,594
Barnwell, SC	15	East	4,439
Allendale, SC	26	Southeast	3,620
Waynesboro, GA	28	Southwest	5,530

* Includes incorporated suburban areas.

The plantsite lies on the Atlantic Coastal Plain physiographic province, and is underlain by the Tuscaloosa aquifer from which wells supply water to several operating areas. It has an elevation of between 90 and 360 feet above sea level, and all operating areas drain toward the Savannah River. The nominal elevation at the waste tank farm sites range from 290 to 310 feet above mean sea level.

The Savannah River Plant was constructed during the 1950's to produce the special nuclear materials for national defense. The plant facilities (Figure 4-2) consist of three operating production reactors (P, K, and C), two production reactors in standby condition (R and L), a small test reactor in standby condition (U), two separations areas for processing irradiated materials (F and H), a heavy water extraction and recovery plant (D), a fuel and target fabrication facility containing two test reactors (M), the Savannah River Laboratory (a process development laboratory to support production operations and containing two test reactors), the administrative facilities (A), and the many non-nuclear facilities necessary for plant operations.

The major waste storage areas for radioactive liquids, sludges, and crystallized salts are adjacent to the separations areas and consist of two tank farms linked to the separations areas and to each other by pipelines with secondary containment (Figure 3-1 and 3-2).

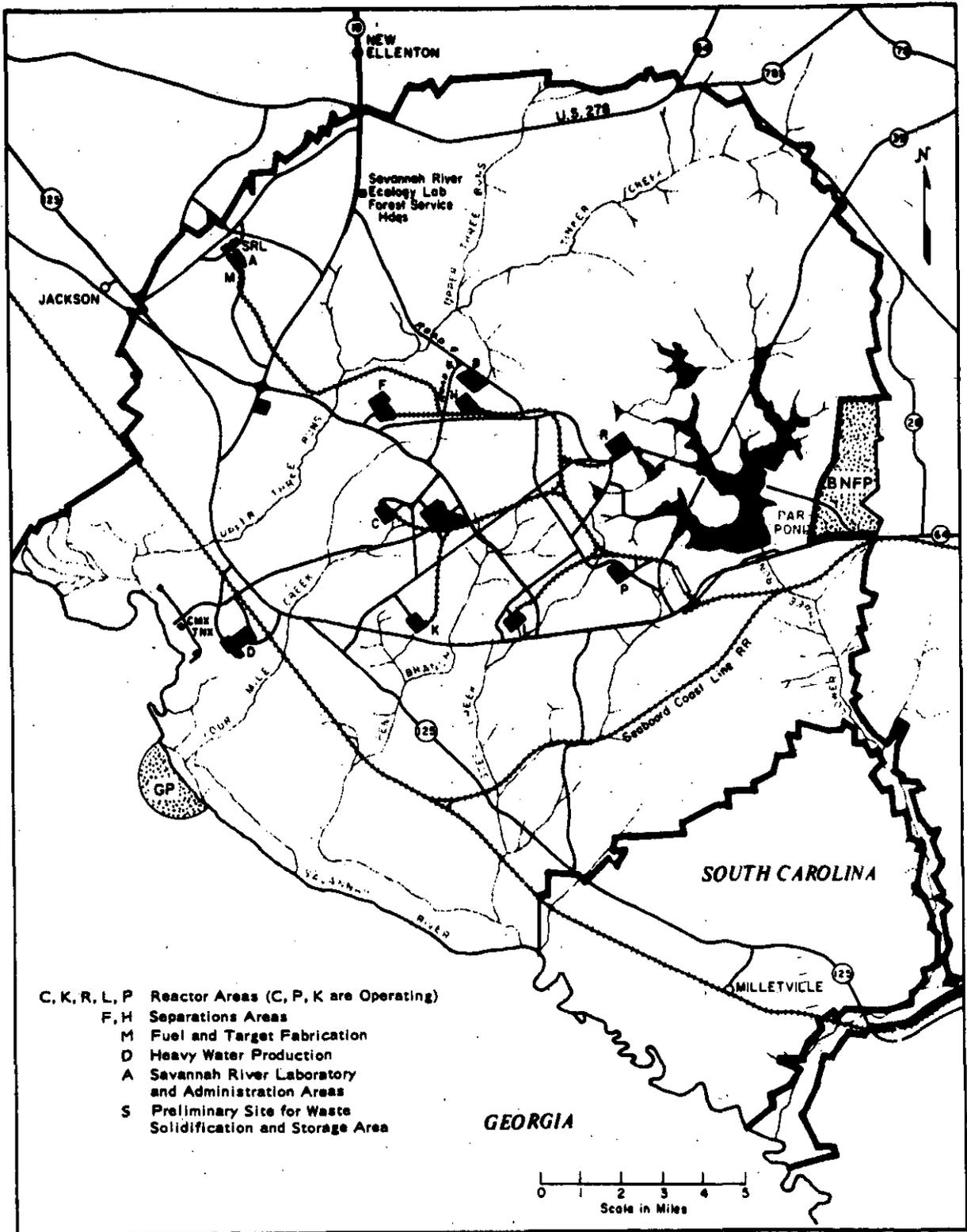


FIGURE 4-2. The Savannah River Plantsite

C | *Map includes United States Forestry Service areas.

In addition, a 195-acre burial ground area located between the F and H separations areas is used for controlled storage of solid radioactive wastes. The reactors, separations areas, and waste storage areas are at least 4 miles from the nearest plant boundary. Figure 4-3 is an aerial photograph of the waste storage areas and several of the major production facilities.

4.1.2 Site Characteristics

4.1.2.1 Introduction

Characteristics of the SRP site that are pertinent to the EIS include the geology, hydrology, meteorology, seismicity, biota, and background radiation. These characteristics are summarized below. A more detailed discussion may be found in ERDA-1537 and DP-1323.^{1,2}

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4.1.2.2 Geology

The plant is located in the Atlantic Coastal Plain geologic province. This province is characterized by flat, mostly unconsolidated sediment of Cretaceous age or younger. About 20 miles northwest of the plantsite is the lower edge of the Piedmont Plateau (the other main geologic province in South Carolina). The Piedmont Plateau is underlain by igneous and metamorphic rocks. The boundary between the two provinces is called the Fall Line. The Fall Line is not a sharp line of contact but a zone of transition from the typical land forms of one province to those of the other.

Geologic formations (Figure 4-4) beneath the Savannah River Plant are the Hawthorn of Miocene age, the Barnwell, McBean, and Congaree of Eocene age, the Ellenton and Tuscaloosa of the Cretaceous age, and bedrock (crystalline metamorphic rock and the Dunbarton Trassic Basin). The sediments that constitute the formations above bedrock are either unconsolidated or semiconsolidated.

The geologic formation that immediately overlies the basement rock is called the Tuscaloosa Formation, and it is 500 to 600 feet thick below the plant. This formation consists of sand and clay and contains several prolific water-bearing beds, which supply over 1000 gallons of water per minute to individual wells.

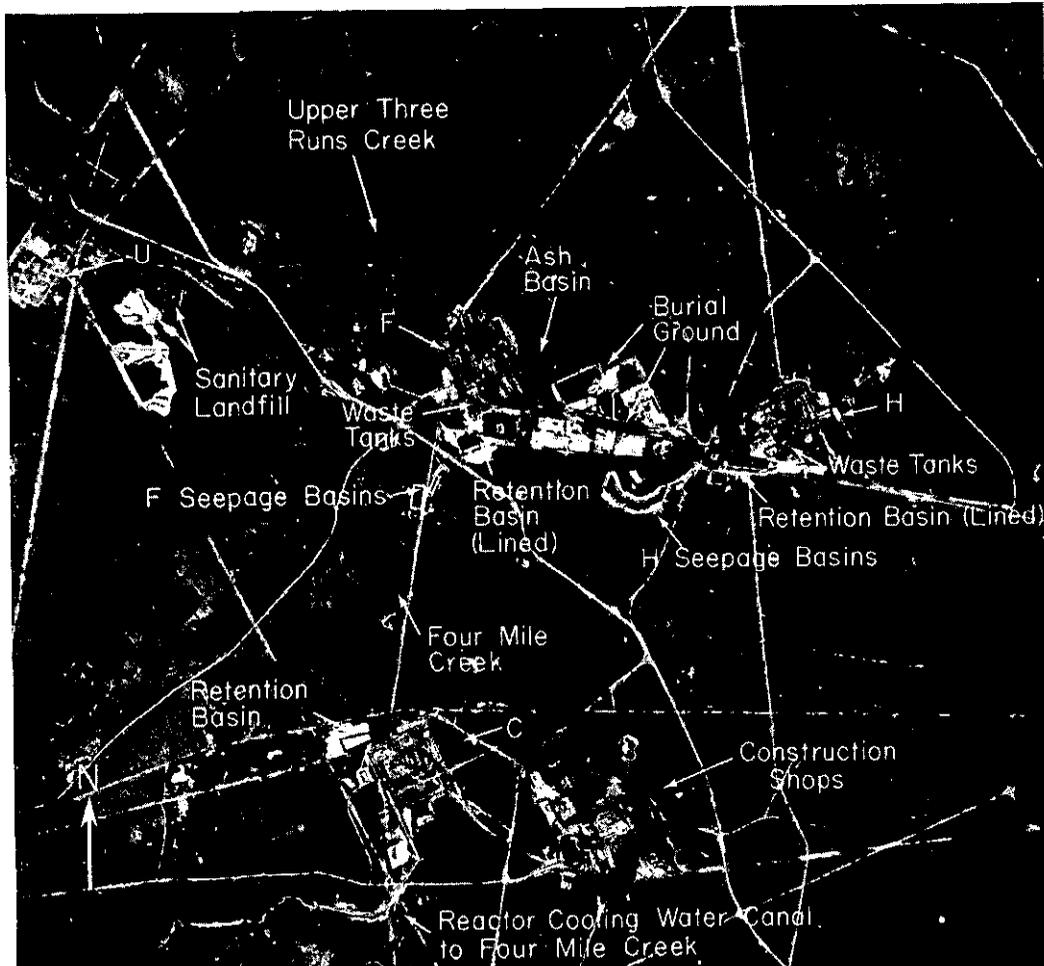


FIGURE 4-3. Main Waste Storage Areas and Surroundings

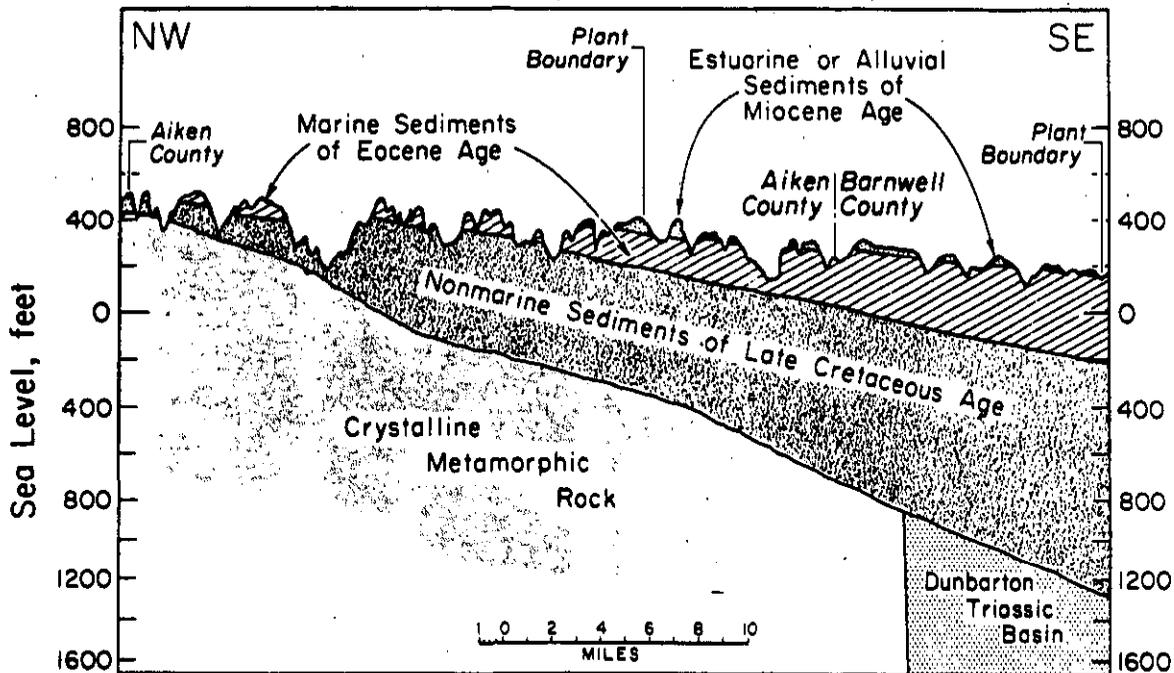


FIGURE 4-4. Profile of Geologic Formations Beneath the Savannah River Plant

Overlying the Ellenton and Tuscaloosa Formations of Cretaceous age are several formations of the Eocene and Miocene age. These formations have a combined thickness of about 350 feet in the central part of the plant. They consist predominantly of compact clayey sand and sandy clay with a few beds of sand and a few beds of hard clay.

4.1.2.3 Hydrology

The top of the new waste tanks in F Area will be at grade level, or 285 feet above mean sea level (MSL). Elevation of new tanks in H Area will be between about 321 feet (top) and 285 feet (bottom). Groundwater at the tank sites in F Area has ranged from a low of 228 feet to a high of 234 feet during the period 1964-1974. In H Area, the water table has ranged from 274 feet to 282 feet. The F Area tank site is near the water table divide between Upper Three Runs Creek and Four Mile Creek (Figure 4-2). Groundwater in this vicinity moves toward Four Mile Creek with an estimated travel time of about 200 years. Should the water table divide shift so that groundwater moves toward Upper Three Runs Creek, it is estimated that the travel time would also be about 200 years. In H Area, groundwater in the vicinity of the waste tank farm moves toward Upper Three Runs Creek with an estimated travel time of between 70 and 350 years.

The flow of the Savannah River at the SRP site averages 10,400 cubic feet per second (cfs) with a minimum flow of 6300 cfs. The elevation of the river rarely exceeds 100 feet (MSL) at flood stage. The location of the waste tank farms is substantially above any recorded flood in the history of this locale. The 100 year flood is less than 138-142 feet above MSL.

4.1.2.4 Local Climate and Meteorology

The climate in the SRP area is temperate with mild winters and long summers. Augusta temperatures average 48°F in the winter, 85°F in summer, and 65°F annually. The average relative humidity is 70%. The average annual rainfall at SRP is about 47 inches. The recorded maximum annual precipitation in Augusta occurred in 1929 (73.82 inches); the minimum occurred in 1933 (28.05 inches).

4.1.2.5 Storms

Two types of major storms, hurricanes and tornadoes, occur in South Carolina.

4.1.2.5.1 Hurricanes

Fully mature tropical cyclones, called hurricanes in the Atlantic and typhoons in the Pacific, are large rotating storms of extraordinary violence. Although hurricanes are neither the largest nor the most intense atmospheric storms, their considerable size and great intensity make them the most dangerous and destructive of all storms.

Thirty-eight hurricanes caused damage to South Carolina in the 275 years of record for an average frequency of 1 every 7 years. The occurrence of a hurricane along the coastal region does not generally mean that the Savannah River Plant will be subjected to winds of hurricane force because SRP is 100 miles inland. Winds of 75 mph were measured by anemometers mounted at 200 feet only once during the history of SRP during passage of Hurricane Gracie to the north of the plantsite on September 29, 1957.

4.1.2.5.2 Tornadoes

Tornadoes are normally characterized as violently rotating columns of air in contact with the ground. Less than 5% of all tornadoes which occur throughout the United States have wind speeds in excess of 200 mph.

The Savannah River Plant is in an area where occasional tornadoes are to be expected. National Weather Service records from 1916 to 1975 show that at least 300 tornadoes have occurred in South Carolina. In 1975, 12 tornadoes struck South Carolina and 22 struck in Georgia. The combined area of Georgia and South Carolina is struck by an average of 25 tornadoes per year.

The probability of a tornado with winds in excess of 250 mph striking a point within the SRP, is estimated to be less than 10^{-5} per year. During the history of SRP, there has been no tornado damage to any production facility. On two occasions, light damage such as displacement of light sheet metal roofing on non-production buildings, window breakage, and tree damage has occurred.

4.1.2.6 Seismicity

C | The Savannah River Plant is located in an area where moderate
C | damage might occur from earthquakes, based on earthquake risk pre-
dictions by the United States Coast and Geodetic Survey. On the
basis of three centuries of recorded history of earthquakes, an
earthquake of an intensity of VII or higher on the Modified
Mercalli (MM) scale would not be expected at the Savannah River
Plant. Average acceleration³ for an Intensity VII earthquake
corresponds to 0.13 g. The design basis earthquake (DBE) for SRP
incorporates an acceleration of 0.2 g as a safety factor, which is
between the VII and VIII MM values (Trifunac and Brady³ report
VIII MM as 0.256 g). Seismic monitors, which were installed in
SRP reactor buildings between 1952 and 1955, are set to alarm at
0.002 g (Intensity II) and have not indicated an earthquake shock
of this intensity since their installation.

4.1.2.7 Habitats - Vegetation

E | Plants, birds, and mammals must be considered because of
their ability to mobilize and concentrate radioactivity present in
the environment and thereby permit it to be dispersed and to enter
the food chain of man. The Savannah River plantsite provides a
wide variety of protected habitats; hence, the species diversity
and populations are both large. In general, the plantsite is a
natural preserve for biota typical of the southeastern Coastal
Plain. The production and support facilities occupy only a small
portion of the plantsite, and wildlife is little affected by them.
Radioactive releases are limited to low levels in limited areas
and have had no significant effect on the wildlife.

At the time of Government acquisition, about 67% of the land area was forested, and 33% was in croplands and pastures. Cotton and corn were the chief crops. Abandoned fields passed through the annual broadleaf vegetation stage into the perennial grass stage and gradually became more wooded. Most of these abandoned fields have subsequently been planted in pine.

Soils of the SRP site are mostly sandy and low in fertility. Fertility is much greater in the Atlantic Coastal Terrace sub-region than on the sandy soils of the Aiken Plateau. Fluvial belts of sandy loams occur along the several streams that cross the area. The soils support bottomland hardwoods on the Savannah River floodplain and along stream bottoms. Principal species in the Savannah River swamp are bald cypress, tupelo gum, black gum, and spanish moss. Hardwood forests, oaks, loblolly pine, and sweet gum occur on the drier bottomland sites. Understory vegetation consists of dogwood, red maple, switchcane, greenbrier, and palmetto bush. Longleaf pine and scrub oak occur over much of the dry upland sites on the Aiken Plateau. Understory wild plum, persimmon, broomsedge, and blackberry occur over the area.

The 166,000 acres of forest on the site are managed as productive woodland for DOE by the U.S. Forest Service. Forests on the site are subdivided into two major working groups: the pine group (108,000 acres) and the bottomland hardwood group (58,000 acres). The remaining 26,000 acres of the SRP site consist of production, service, and aquatic areas excluded from the forest management program.

4.1.2.8 Wildlife

4.1.2.8.1 Mammals

The populations of most species of mammals increased rapidly after the Savannah River Plant was officially closed to the public on December 14, 1952. Most notable expansion was in the deer herd, estimated to be about 20 animals in 1951. A virtual population explosion occurred; the present population is estimated to be greater than 20 deer per square mile or a total of about 5,000 to 8,000 deer on the plantsite.

With the exception of deer, feral hogs, and feral dogs, there is no wildlife predation by man. Small mammals such as mice, rats, and shrews are common in favorable habitats. Animals that are common (C) or abundant (A) on the plantsite are:

Gray fox	(C)	Opposum	(C)
Raccoon	(C)	Cottontail rabbit	(A)
Bobcat	(C)	Gray squirrel	(A)
Red fox	(C)	Fox squirrel	(C)
Striped skunk	(C)	Beaver	(C)

There are no endangered species of mammals on the Savannah River Plant.

4.1.2.8.2 Birds

Before acquisition of the plantsite by the Government, game birds, particularly quail and dove, were abundant due to extensive use of land for agriculture. The removal of land from agriculture did not immediately decrease the quail population; the population increased and probably reached a record high in the early 1960s, but is declining because the conversion of agricultural fields to forest reduced the carrying capacity of the land.⁴

Wild turkey, although present, were not numerous. The South Carolina Wildlife and Marine Resource Department initiated a stocking program in 1972 and current estimates are that the turkey population has increased to about 400 birds.

Waterfowl are abundant winter residents on Par Pond and in the swamp. Wood ducks are the common nesting water fowl.

Endangered species of birds that are protected on the SRP site are the bald eagle and the redcockaded woodpecker. Biologists have identified more than 200 species of birds on the plantsite.⁵ An annual bird census is conducted with the cooperation of the Augusta Audubon Society.

4.1.2.8.3 Reptiles and Amphibians

The SRP site, with its wide diversity of aquatic and terrestrial habitats, supports a diverse population of reptiles and amphibians.⁶ Species common to the southeastern Atlantic Coastal Plain are found by intensive sampling programs for ecological research at the site. Zoologists^{7,8} have identified 10 species of turtles, 10 species of lizards, 1 species of alligator, 31 species of snakes, 17 species of salamanders, and 26 species of frogs and toads. Alligators (endangered), once rare, are now commonly seen in Par Pond and, to a lesser extent, in some of the effluent streams.

4.1.2.8.4 Fish

Habitats for fish on the plantsite are numerous and diversified. They consist of both natural and thermally stressed flowing streams, ambient and thermally stressed reservoirs, Carolina Bays, abandoned farm ponds, swamp channels, and oxbow lakes. Fish are present throughout the thermally unaffected streams on the plantsite but are restricted to the lower reaches, near the Savannah River swamp and backwater pools, of streams carrying reactor cooling water. Species identified in streams number 36 in Upper Three Runs, 25 in Four Mile Creek, 16 in Pen Branch, 24 in Steel Creek, and 42 in Lower Three Runs.²

4.1.2.9 Environmental Park

The plant was designated as a National Environmental Research Park in June 1972. The various portions of the plantsite offer unusual opportunities for observing interactions between large industrial complexes and the environment. There are extensive areas of land protected from heavy traffic patterns, casual visitors, real estate development, and other disruptive influences. Because the land area is owned by the U.S. Government, long-term ecological research can be based at the Park with confidence in the continuation of the existing habitats. Several of the unusual opportunities offered are for observing and comparing the ecosystem changes brought about by heated water, flooding, atmospheric and aqueous emissions from fossil fuel power plants, uptake and retention of low levels of radioactive materials, forest management activities, and other stresses on the environment. Researchers from universities and government agencies are currently taking advantage of these opportunities for study.

4.1.2.10 Background Radiation

Background radiation is the base radiation level to which any dose from plant operations is added. Offsite environmental radiation measurements must take this radiation and its variation into account. Natural background radiation includes both cosmic and terrestrial sources. These sources vary with location but are assumed constant with time within the recorded span of human history.⁹ Local penetrating radiation from artificial origins, both fallout from nuclear detonations and prescribed medical exposures, varies with time for the population as a whole, and doses from the latter source vary from one individual to another. External exposure from radioactive fallout appears to be decreasing with time as a result of the nuclear test ban treaty.^{10,11}

The calculated annual background radiation dose received by the average person living in the vicinity of the Savannah River Plant is approximately 120 mrem from natural sources. An additional 100 mrem may be received by the average individual from medical x-rays. A breakdown is shown in Table 4-2. The wide range of exposures (excluding those incurred for medical reasons) results primarily from the geologic distribution of naturally radioactive elements near the surface in this region.

4.2 TANK LOCATIONS

F and H Areas are both located on relatively high ground between Upper Three Runs and Four Mile Creek. The locations of the F- and H-Area tank farms and the interarea waste transfer lines are indicated in Figure 4-5. The land contours are such that surface drainage from both F Area and H Area flows toward Four Mile Creek. The ground water table contours are such that drainage from the F-Area tank farm into the ground divides, some flowing toward Upper Three Runs and some flowing toward Four Mile Creek. Drainage from H Area into the ground flows toward Upper Three Runs.

The tank arrangements in each area are shown in Figures 3-1 and 3-2.

TABLE 4-2

Background Radiation Exposure Near SRP

<u>Natural</u>	<u>Estimated Whole Body Dose, mrem</u>	
	<u>Average^a</u>	<u>Range^b</u>
Cosmic Radiation	35	30-40
Terrestrial Deposits		
External	55	6-380
Ingested	<u>27</u>	<u>25-30</u>
Total Natural	117	61-450
<u>Artificial</u>		
Medical Diagnostic	101	c
Weapons Fallout		
External	1	
Ingested	<u>4</u>	<u>3-8</u>
Total Artificial	<u>106</u>	
Total Background	223	165-560

a. Central Savannah River Area (within 40 km of SRP perimeter).

b. Within 100 km of SRP perimeter.

c. Only the average used in total range because of high individual variability.

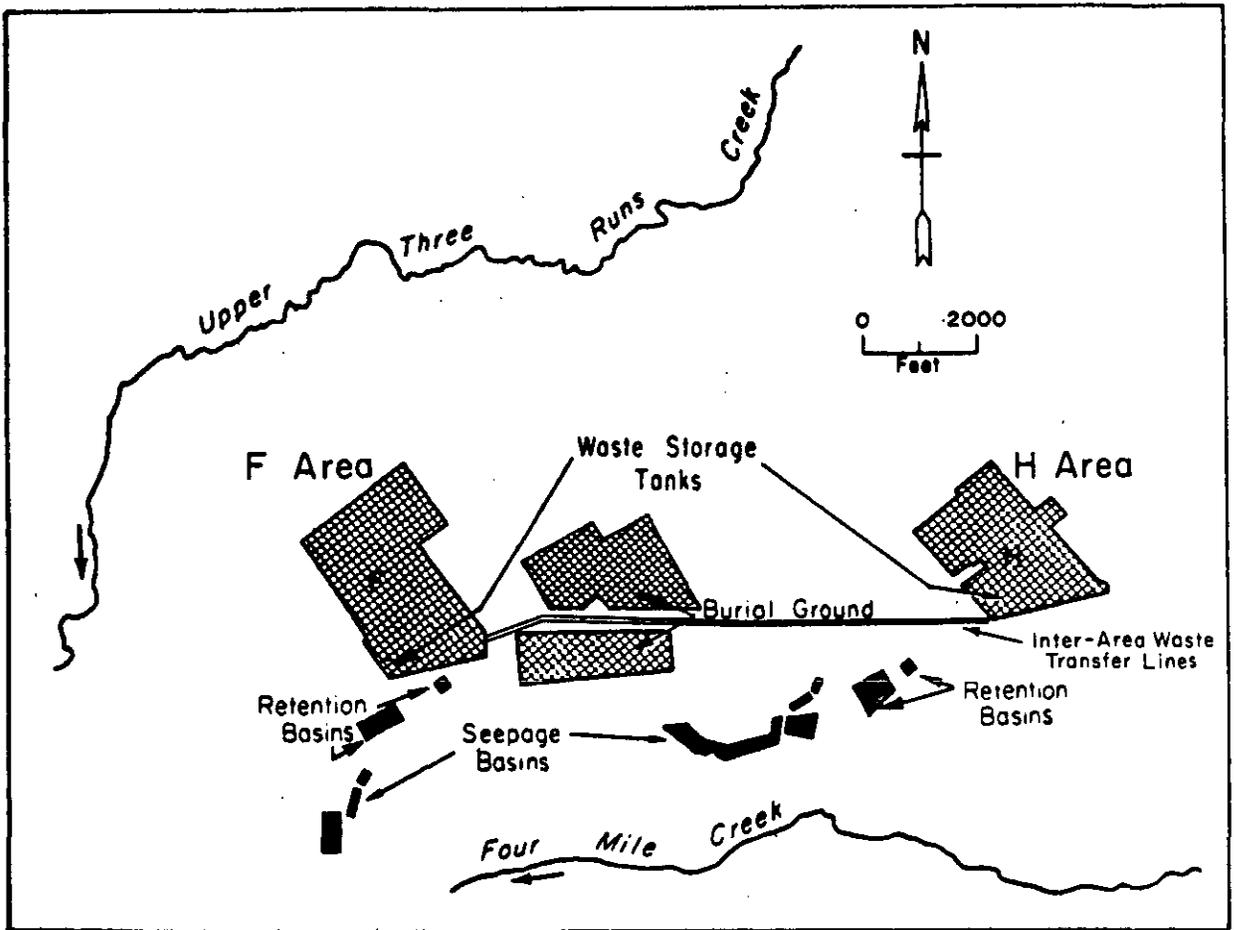


FIGURE 4-5. Relative Locations of Separations Areas and Associated Waste Handling Facilities

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