CHAPTER 4. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

Chapter 1 of this environmental impact statement (EIS) introduces the River Water System, alternative actions related to the system, and actions connected to the Proposed Action to shut down the system and maintain it in standby; Chapter 2 describes the U.S. Department of Energy (DOE) purpose and need to implement actions on the River Water System; and Chapter 3 describes three reasonable alternative actions. This chapter describes the environment of the Savannah River Site (SRS) and the impacts of implementing the alternatives, including the Proposed Action. In addition, it provides the information and analysis for a comparison of the environmental impacts of the Proposed Action and the alternatives (see Section 3.4).

DOE determined that it could enhance the quality of the analysis and the clarity of the presentation by using an EIS format that was different from its standard format (40 CFR 1502.10). Rather than using the approach that presents the affected environment and impacts sections in separate chapters, DOE put both the affected environment and impacts in this chapter, so the description of the affected environment for a particular resource category (e.g., groundwater) precedes the description of the impacts of each alternative on that resource. Further, DOE has divided the sections by water body to emphasize the component that is most affected by implementation of the alternatives (L-Lake) and to also describe the component that has the least variability among the alternatives (Par Pond). DOE selected this order because only a few categories would be affected by the action and its alternatives, and it can describe the impacts of an alternative most easily by a comparison to the No-Action Alternative. This ordering of system components, resource categories, affected environment, and environmental impacts of each alternative is listed as follows.

Chapter 4. Affected Environment and Environmental Impacts

4.1 L-Lake

- 4.1.1 Geology and Soils
- 4.1.1.1 Affected Environment
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- 4.1.1.2.1 No Action
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- 4.1.1.2.3 Shut Down and Maintain

Other resources categories with same subheadings include Surface Water, Groundwater, Air Resources, Ecological Resources, Land Use, Aesthetics, and Occupational and Public Health.

4.2 SRS Streams (sequence matches 4.1)

4.3 Par Pond (sequence matches 4.1)

DOE has determined that this EIS will not address in detail the following topics because the Proposed Action and alternatives would cause minimal or no impacts in these areas:

- Socioeconomics – The River Water System would require a staff from one (Shut Down and Deactivate) to 7.8 (No Action) full-time equivalent personnel. Selection of one alternative over another will not affect socioeconomic factors in the region.
- Traffic and Transportation – Onsite traffic impacts would be minimal under each alternative due to the small number of personnel involved. The operation of the River Water System would involve minimal onsite transportation of materials and waste and no offsite transportation. Alternatives are not measurably different in terms of potential impacts of transportation activities.

- Cultural Resources – Because the alternatives, including the Proposed Action, would not require any construction, there would be little, if any, risk of damaging historic or archaeological resources or areas of cultural importance to Native American tribes.

This chapter evaluates the following environmental consequences that would be sitewide in nature and, therefore, could not be conveniently subdivided:

- Section 4.4, Environmental Justice (Executive Order 12898)
- Section 4.5, Cumulative Impacts [i.e., cumulative impacts that result "from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR 1508.7)]
- Section 4.6, Unavoidable Adverse Impacts [i.e., "adverse environmental effects which cannot be avoided should the proposal be implemented" (40 CFR 1502.16)]
- Section 4.7, Short-Term Uses and Long-Term Productivity [i.e., "the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity" (40 CFR 1502.16)]
- Section 4.8, Irreversible or Irretrievable Commitment of Resources [i.e., "any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented" (40 CFR 1502.16)].

4.1 L-Lake

DOE built L-Lake, a 1,000-acre (4-square-kilometer) reservoir (Figure 4-1), on the upper reaches of Steel Creek in 1984 and 1985 to receive heated effluent from L-Reactor. Before the construction of L-Lake, L-Reactor effluents discharged directly to Steel Creek. DOE formed L-Lake by building a 4,000-foot (1,200-meter) dam across the Steel Creek valley approximately 4.5 miles (7.5 kilometers) upstream of its confluence with the Savannah River. The lake has an average width of approximately 1,970 feet (600 meters) and an average depth of about 26 feet (8 meters), and extends for approximately 4.4 miles (7.0 kilometers) along the Steel Creek valley from the dam to the headwaters of the stream, just above SRS Road B (USACE 1987; Wike et al. 1994).

The L-Lake dam and intake structure maintain water level at a normal pool elevation of 190 feet (58 meters) above mean sea level. The top of the dam lies at about 200 feet (61 meters) above mean sea level. At normal pool, the reservoir storage volume is approximately 26,000 acre-feet (32 million cubic meters) (USACE 1987).

L-Lake flooded about 225 acres (0.9 square kilometer) of wetlands and 775 acres (3 square kilometers) of uplands in the Steel Creek corridor (Wike et al. 1994). During the construction of L-Lake, most of the vegetation in the area that became the lakebed was cut and hauled away or burned on the site. Two coves in the lower half of the lake and the area above Road B were left with standing timber to enhance fish and wildlife habitat. The shoreline was cleared to 3 to 5 feet (1 to 1.5 meters) above maximum pool elevation and seeded for erosion control. TC More than 30 reefs were built from tires, brush, cinder blocks, and log piles to improve fish habitat in shallow areas otherwise devoid of cover (Mattson et al. 1993a; Paller 1996).

Soil from the Steel Creek floodplain at the dam site contained an estimated 0.2 curie of cesium-137 activity, and the trees removed from along the floodplain contained 12 millicuries of cesium-137 activity (Du Pont 1984). The dam site material was moved to a deposit area approximately 0.25 mile (0.40 kilometer) above the dam site and within the lake area and covered with 5 feet (1.5 meters) of clean soil. During L-Lake construction, DOE cut the timber along the floodplain into manageable sizes and covered it with soil to prevent possible future floating or movement and subsequent control gate obstruction (Marter 1984). L-Lake overflight photographs show evidence of these activities.

After DOE completed the L-Lake Dam in 1985, the basin filled with rainfall, flow from the Steel Creek headwaters and watershed, and water pumped from the Savannah River and Par Pond. The impoundment reached full pool in October 1985. DOE brought L-Reactor on line and began discharging heated effluent into L-Lake in November 1985, took the reactor out of service in April 1988 for a scheduled maintenance outage (DOE 1990), and did not restart it.

Water moves from L-Lake to Steel Creek by overflow into a multigate, dual wet well intake structure, a 72-inch (183-centimeter) diameter concrete conduit embedded in the dam, and a stilling basin downstream of the dam. A system of eight gates in the intake structure regulates the reservoir level. DOE can open two intake gates 10 feet (3 meters) below the normal pool elevation and two intake gates near the bottom of the reservoir to enable water to enter the wet wells before releasing to the stilling basin. These intake gates are either fully opened or closed. Water passes through the intake tower, the wet wells, the conduit, and the stilling basin before flowing to Steel Creek. The volume of water discharged to Steel Creek is controlled by two service gates at the base of the intake tower wet wells. These gates can release flows ranging from 71 to 1,024 cubic feet per second (2.0 to 29.0 cubic meters per second). To release from 11 to 71 cubic feet per second (0.3 to 2.0 cubic meters per second), DOE opens two 18-inch (46-centimeter) diameter knife gates (Wike et al. 1994).

4.1.1 GEOLOGY AND SOILS

4.1.1.1 Affected Environment

This section describes the regional geologic setting in the vicinity of L-Lake; the description includes descriptive rock type, thickness, mineral and economic resources, and soil types. Figure 1-1 shows the location of the SRS, and Figure 4-2 shows the geologic provinces around the Site. Section 4.1.3 presents L-Lake hydrogeologic information. This EIS does not describe geologic structures such as folding and faulting because the alternatives would not affect these features.

The geology and soils of SRS are well documented (e.g., Aadland, Gellici, and Thayer 1995; WSRC 1996e). DOE has drilled a number of deep production, test, or monitoring wells near the areas potentially affected by the alternatives discussed in this EIS (Aadland, Gellici, and Thayer 1995).

Figure 4-3 is a topographic map of the area of interest between L-Lake, Par Pond, and nearby SRS streams. The geological cross-section (identified on Figure 4-3) is depicted on Figures 4-4a and 4-4b. The section extends from the northeast edge of Par Pond, to the southwest through L-Lake, and ending near Pen Branch (also see Aadland, Gellici, and Thayer 1995; WSRC 1996e). Prowell (1994) most recently describes the surface geology of the SRS region.

Geomorphology

The SRS is on the Aiken Plateau of the Atlantic Coastal Plain in west-central South Carolina, TE bounded by the Savannah River to the west, the Fall Line to the north, the Orangeburg Scarp to the south, and the Congaree River and Congaree TC Sand Hills to the east. The Aiken Plateau consists TE of a broad flat surface dissected by narrow steep-sided valleys. The plateau slopes from 650 feet (198 meters) above mean sea level at the Fall Line to approximately 250 feet

(76 meters) above mean sea level at the southeast edge of the site (DOE 1995c). The difference in elevation across the area of interest is approximately 240 feet (73 meters); the Savannah River floodplain is about 100 feet (30 meters) above mean sea level and the hills overlooking L-Lake are about 340 feet (104 meters) above sea level. The lake is centrally located on the SRS to the southeast of L-Area and southwest of Par Pond. It is in a narrow, slightly sloping valley incised by Steel Creek.

Tectonic Provinces

L-Lake is approximately 50 miles (80 kilometers) southeast of the Fall Line, which is the geographic feature that results from the contact between the Piedmont and the Atlantic Coastal Plain physiographic provinces. The Piedmont province consists of Pre-Cambrian and Paleozoic age crystalline rocks overlain by sediments of Cretaceous and younger age. Fault-controlled basins of Triassic age, filled with younger Coastal Plain sediments, are structurally imposed on the Piedmont rocks, and similar to the classic Triassic basins of New Jersey and New England. The Dunbarton Basin, over which L-Area is situated, is an example of these oldest SRS geologic structures (WSRC 1996e,f).

Stratigraphy

Overlying the Piedmont structures is a thick sequence of sediments that comprise the Atlantic Coastal Plain. These sediments, which are the primary focus of the affected environment, include silts, sands, conglomerates, limestones, and clays of both fluvial and marine origin.

The alternatives discussed in this EIS would affect the Tertiary (Eocene and Paleocene age) sediments (Figure 4-5) of the Atlantic Coastal Plain. The depositional environment is representative of a fluvial to marine shelf (prodeltaic) during alternating transgressions and regressions of the ocean. The thickness of the Tertiary section expands from the northern part of the SRS toward the southern boundary and onward to the coast. This thick sequence of sands, silts, and clays along the northern part of the SRS grades into a carbonate (limestone) sequence in the southern part of the site. The regional dip is to the southeast, ranging from 35 to 60 feet (11 to 18 meters) per mile. There are four groups of Tertiary sediments: the Black Mingo Group (the oldest), the Orangeburg Group, the Barnwell Group, and the Cooper Group (the youngest), which is the group of interest for this assessment. The following paragraphs briefly describe the individual formations within each group (see WSRC 1996e,f; Aadland, Gellici, and Thayer 1995). TE

The following formations are part of the Black Mingo Group:

- Ellenton Formation (also known as the Lang Syne/Sawdust Landing Formations) – primarily gray to dark gray micaceous sand; the thickness ranges from 40 to 100 feet (12 to 30 meters), usually poorly sorted; occasionally contains lignite interbedded with gray clays.
- Williamsburg Formation (also known as the Snapp Member or Formation) – primarily dark gray to black silty quartz sand (coarse to medium) with clay; 50 feet (15 meters) thick along the southern portion of the SRS and pinches out at the northernmost edge of the Site.
- Fishburne Formation (also known as the Fourmile Member or Formation) – This sedimentary sequence varies in thickness from 15 to 75 feet (5 to 23 meters). It is comprised of yellow, brown, orange, and tan clayey sand.

The following formations comprise the Orangeburg Group:

- Congaree Formation – fine to coarse quartz sand sequence, highly variable in color, ranging in thickness from 25 to 60 feet (8 to 18 meters); generally well sorted; thin clay beds and pebble zones are common throughout.
- Warley Hill Formation (also known as the "Green Clay" and in the past collectively known as the Warley Hill and Caw Caw Members of the Santee Formation) – usually a glauconitic fine-grained sand and clay; in the southern part of the Site, grades to a micritic clayey limestone or limy clay (Santee Limestone); north to south thickness ranges from 0 to 20 feet (6 meters).
- Santee Formation (also known as the "Tinker Formation," "McBean Formation," or a "member of the Lisbon Formation") – includes yellow to tan clays, marls, limestones, and calcareous sands; moderately sorted; thickness ranges from 40 to 80 feet (12 to 24 meters) across the Site.

The Barnwell Group consists of the following:

- Clinchfield Formation – This formation has two members:
  - Riggins Mill Member – sand member approximately 25 feet (8 meters) thick along the southern portion of SRS and pinched out at the northernmost parts of the Site; characterized by tan to green, medium to coarse, poorly to well-sorted quartz sand; the sand in well cuttings is difficult to discern at most locations unless it occurs between the carbonate layers of the overlying Dry Branch Formation and underlying Santee Formation.
  - Utley Member – a calcareous sand or sandy limestone with tan to white color variances.
- Dry Branch Formation – This formation has *three members:*
  - Twiggs Clay Member (also known as the "Tan Clay") – ranges in color from tan to brown to light gray; discontinuous occurrence; reaches a thickness of only as much as 12 feet (4 meters); generally dense and compact, somewhat plastic to crumbly in places; frequent iron staining; occurs at a depth of approximately 145 feet (44 meters) mean sea level in well LCO-5 northwest of L-Lake in L-Area (WSRC 1996g).
  - Griffins Landing Member – commonly occurs as a tan or green calcareous sandy clay or a calcareous sand; thickness as much as 50 feet (15 meters).
  - Irwinton Sand Member – consists of tan to orange moderately sorted quartz sand with interbedded clays; thickness ranges from 40 to 75 feet (12 to 23 meters).
- Tobacco Road Formation (sand) – consists of red, brown, purple, tan, or orange poorly to moderately sorted quartz sand; grain size varies from fine to coarse with pebble layers common; outcrops over a large portion of the Site.

The "upland unit" (also known as the Hawthorne Formation) is of unknown age (part of the Cooper Group and possibly Miocene in age). It is a conglomerate sequence of silts, clayey sands, and pebbly sands, with a variable thickness from 60 to 70 feet (18 to 21 meters). These are the primary surface sediments, probably fluvial in origin. Facies changes can occur radically.

Soils

The SRS soils map (USDA 1990) shows approximately 50 mapping units. Figures 4-6 through 4-9 show the surface soils distributions for selected areas near L-Lake, L-Area, Pen Branch and Steel Creek, the southwest side of

Par Pond, and Lower Three Runs drainage areas. Previously disturbed soils, which are mostly well drained, come from excavated areas, borrow pits, and other areas in which major land-shaping or grading activities occurred. These soils are beside and under constructed byways (i.e., sidewalks and parking lots). Their slopes generally range from 0 to 10 percent and they have moderate erosion hazard. These disturbed soils range from a consistency of sand to clay, depending on the source of the material (DOE 1995c).

In general, undisturbed soils at the SRS consist of sandy surface layers above a subsoil of silts, sands, and clays. These gently sloping to moderately steep (0 to 10 percent) soils have a slight erosion hazard (USDA 1990). Some soils on the uplands are nearly level, and those on the bottomlands along the major streams are level. Soils in small narrow drainage valleys are steep. Most upland soils are well drained to excessively drained; well-drained soils have a thick sandy surface layer that extends to a depth of 7 feet (2 meters) or more in some areas. The soils on the bottomlands range from well drained to very poorly drained. Some soils on the abrupt slope breaks have a dense brittle subsoil (DOE 1995c; Wike et al. 1994; USDA 1990).

There are two soil associations – Vaucluse-Ailey and Fuquay-Blanton-Dothan – in the area of interest. This assessment uses preimpoundment soil descriptions (USDA 1990). If the lake receded, the exposed soils would be different due to lake sediment deposition. DOE has not yet determined those soil types; however, an ongoing study at the lake will provide site-specific soil data.

The following is a list of the more common soil mapping units (shown in Figure 4-6) in the area west of L-Lake (USDA 1990):

- Ailey sand, 2- to 6-percent slopes (AeB)
- Blanton sand, 6- to 10-percent slopes (BaC)
- Dothan sand, 2- to 6-percent slopes (DoB)
- Fuquay sand, 2- to 6-percent slopes (FuB)
- Norfolk loamy sand, 2- to 6-percent slopes (NoB)
- Udorthents, firm substratum and Udorthents, friable substratum (used during L-Area construction)
- Vaucluse -Ailey Complex, 6- to 10-percent slopes (VeC)
- Vaucluse sandy loam, 2- to 6-percent slopes (VaB)

Mineral or Economic Resources

With the exception of sand and gravel, the known economic and mineral value of the geologic resources of the SRS is limited (see DOE 1984, 1987a, 1995c).

4.1.1.2 <u>Environmental Impacts</u>

In general, the character and conditions of the geology and soils in the area of interest would not change radically under any alternative in the EIS. TE If DOE decides to shutdown the River Water system it would develop a plan to maintain the stability of the dam and the outflow to TE Steel Creek during and after lake drawdown. Topographic changes resulting from the various alternatives are not likely, with the exception of a potentially slight and gradual alteration in the shape of the stream valleys. Elimination of L10-15 river water from the geologic system could not stimulate an earthquake (WSRC 1996f), would not affect economic or mineral resources, and would not induce faulting or cause noticeable geologic structures.

The overall lithologic character of sands and clays does not vary appreciably across the area of interest or the SRS and would probably remain constant under any alternative. The shut down alternatives would generally decrease the amount of stream surface water and subsequently alter the erosion rate. Impacts on groundwater are described in Sections 4.1.3, 4.2.3, and 4.3.3.

4.1.1.2.1 No Action

Maintenance of the River Water System and the lake level would not affect the geology or soils in the L-Lake area. The soils and geology in L-Area upgradient of the lake are contaminated at four Comprehensive Environmental Response, Compensation, Liability Act (CERCLA) sites, but there is no evidence that this alternative would exacerbate contaminant migration through the soils or geologic formations. Section 4.1.3.2.1 discusses the contaminant movement in groundwater. The outfall of the River Water System from L-Area to L-Lake is downgradient of the contaminated areas and is not a mechanism for contamination. The continued outfall of L-Area water would not foster contamination of soils or geology.

4.1.1.2.2 Shut Down and Deactivate

The lowering of the pool would not compromise geologic conditions or resources. Because no changes in the stability of the geologic formations are likely, this alternative should not compromise the structural competency of the L-Lake dam.

As the lake recedes, Steel Creek would resume a course similar to the old stream channel, but within recently deposited lacustrine deposits. Reestablished stream activity could remobilize soils contaminated by preimpoundment activities. Section 4.1.2.2 describes impacts related to the reemergence of Steel Creek. DOE studies indicate that higher concentrations of cesium contamination already exist below L-Lake (DOE 1984). Soils and exposed geological strata could become contaminated downstream of L-Lake during or after exposure. Potential resuspension of contaminated sediments and their redeposition to downstream areas would result in small increments of contamination. Contaminated soil resuspension should not occur if the recession is gradual (as expected) because grasses and other vegetation would overtake the area.

4.1.1.2.3 Shut Down and Maintain

Impacts resulting from this alternative would be similar to those described in Section 4.1.1.2.2 above. Maintenance of the dam would impede the transport of upstream soils and lacustrine deposits; thereby limiting potential downstream (Steel Creek) contamination.

4.1.2 SURFACE WATER

4.1.2.1 <u>Affected Environment</u>

Section 4.1 contains a description of L-Lake. The intake tower for L-Lake is offset to the east of the former Steel Creek stream bed. The intake tower includes two service and emergency gates near the bottom of the lake and two regulating gates 7 feet (2 meters) below the normal pool elevation, 190 feet (58 meters). Two service gates located at the base of each collective well regulate flows to Steel Creek. This intake tower design permits water flow regimes from the upper [177 feet (54 meters) to 183 feet (56 meters)] and/or lower [115 feet (35 meters) to 119 feet (36 meters)] regions of L-Lake.

Permitted Wastewater and Stormwater Discharges to L-Lake

The South Carolina Department of Health and Environmental Control (SCDHEC) has permitted three wastewater discharge outfalls (L-07, L-07A, and L-08), the effluents of which originate from point and area sources in L-Area, to discharge to L-Lake under National Pollutant Discharge Elimination System Permit No. SC0000175. Outfall L-07 discharges Savannah River water pumped from the L-Area water storage 186-Basin, sanitary effluent from Outfall L-07A, process sewer and L-Reactor building drains wastewater, and L-Area stormwater. This effluent flows to L-Lake through the lake's influent canal. DOE has based Outfall L-07 effluent water quality limitations on maximum and average flows of 132 million gallons