WSRC-TR-97-00322

Savannah River Site Environmental Report for 1997

by

M. Arnett

Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

A. Mamatey

DOE Contract No. **DE-AC09-96SR18500**

Savannah River Site

Environmental Report for 1997

Environmental Monitoring Section
Environmental Protection Department

Westinghouse Savannah River Company · Savannah River Site · Aiken, South Carolina

Front Cover—*Rhus copallina*, the winged sumac, is common throughout the Southeast and often is found along roadsides or other disturbed habitats. The plant in the cover photograph (made in the fall of 1997) was on the east bank of the Savannah River, near the Savannah River Site's D-Area boat ramp. The winged sumac is not poisonous but is a member of the anacardiaceae family, which includes poison ivy, poison oak, and poison sumac. The plant produces clusters of small red berries, and its leaves turn red in the fall. This attracts birds, which ultimately disperse its seeds across the landscape. Small and dry, the berries are of relatively poor quality as a food for the birds, but they are durable and can be used to make a tea. The photograph was taken by Al Mamatey of the Westinghouse Savannah River Company's Environmental Monitoring Section. The cover was designed by Eleanor Justice of the company's Multimedia/Network Publishing group.

For more information about this report, or to obtain additional copies, contact:

Bob Lorenz, Manager
Environmental Sampling and Reporting
Westinghouse Savannah River Company
Building 735–16A
Aiken, SC 29808
Telephone: 803–725–3556
E-mail address: robert.lorenz@srs.gov

WSRC-TR-97-00322

Savannah River Site
Environmental Report for 1997

Editors

Margaret W. Arnett
Albert R. Mamatey

Prepared for the U.S. Department of Energy
Under Contract No. DE-AC09-96SR18500
Westinghouse Savannah River Company
Savannah River Site, Aiken, SC 29808

Acknowledgments

- The editors acknowledge with deep appreciation the efforts of the following individuals, who, in addition to the authors, reviewed and/or contributed valuable resources, information, or technical data to the *Savannah River Site Environmental Report for 1997*:

Chike Amobi
Linda Basinger
Glenda Blystone
Palmer Bowen
Sandra Boynton
de'Lisa Bratcher
Bruce Cadotte
Joao Cardoso-Neto
Paul Carroll
Alan Carvo
Tim Coffield
Carl Cook
June Cooley
Steve Cowan
Joe D'amelio
Lou Davis
Alex Deleon
Tad Dickinson
Keith Dyer
Chuck Dynarski
Lynn Ehrke
Steve Etheridge
Natalie Ferguson
Dave Filler
Angie Fitzgerald
Ann V. Fletcher
Kristin Garrison
Lynne Geary
Steve Glover
Susie Grant
John Harley
Chuck Harvel
Chuck Hayes
Dawn Haygood
Doris Hoel
Dean Hoffman
Chuck Hunter
Bobby James
Greg Jansen
Paul Jones
Linda Karapatakis
Casey Knapp
Larry Koffman
Joan Lang
Nordette Lawrence
Dave Lester
Jeff Lintern
Anne Lovell
Nancy Lowry
Bart Marcy
Lynn Martin
Jack Mayer
Robyn McBeath
Janet McClearen
Marshall Miller
Tony Mills
Hal Morris
Phil Mottel
C.E. Murphy, Jr.
Barry Myers
Lindy Nowak
Vern Osteen
Happy Parker
Matt Parker
Priscilla Patterson
Fran Poda
Laurie Posey
Jesse Roach
Dan Rogers
Paul Rowan
Joe Shake
Barbara Smoak
Monte Steedley
Bob Steitler
Keith Stone
Tracey Tuberville
Helen Villasor
Gary Wein
Michele Wilson
George Wingard

Environmental Advisory Committee:
Dr. Edgar Berkey, Dr. Bernd Kahn, Dr. Milton Russell, Dr. Bernard Sweeney, and Dr. Gordon Wolman

- Listed below are those who provided expert publications support.

Bruce Boulineau and Byron Williams (photography)
Joan Toole (customer service)
Debbie Beckett, Cherry Glisson, Vivian McDuffie, and Claire Rogers (forms)
Yvonne Nixon, Michelle Norris, and Ann Scott (offsite printing)
Dennis Hendrix and Eleanor Justice (illustrating)

- A special thanks to Mary Langford for coordinating the DOE–SR review and approval process. This process requires dedication and support from both WSRC and DOE–SR.

Trish Baughman (WSRC)
Randy Collins (WSRC)
Tom Coughenour (WSRC)
Pat Dominey (WSRC)
Juli Hearn (WSRC)
Sharon Lybrand (WSRC)
Donna Nichols (WSRC)
Jeanne Sellers (WSRC)
Bob Shankle (WSRC)
Vernon Gardner (DOE–SR)
Ben Gould (DOE–SR)
Georgia Knight (DOE–SR)
Mina Perrin (DOE–SR)

- Thanks to Karl Bergmann, John Ellinger, and Tracey Humphrey for providing timely and effective computer support.

- Gratitude is expressed to the following for management, administrative, and other support:

Chris Arenz
Darryl Doman
Manley Grove
June Hall
Tim Hartley
Jim Heffner
Jay Hutchison
Bob Lorenz
Wayne Pippen
Mark Spires
Becky Sturdivant
Brenda Walker
Robin Young

Preface

The Savannah River Site (SRS) conducts environmental monitoring—consisting of effluent monitoring and environmental surveillance—to ensure the safety of the public and the well-being of the environment. U.S. Department of Energy (DOE) Order 231.1, "Environment, Safety and Health Reporting," requires that SRS submit an environmental report. The report's purpose is to document the impact of facility operations on public health and the environment, present summary environmental data that characterize site environmental management performance, confirm compliance with environmental standards and requirements, and highlight significant programs and efforts.

SRS has had an extensive environmental monitoring program in place since 1951 (before site startup). In the 1950s, data generated by the onsite environmental monitoring program were reported in site documents. Beginning in 1959, data from offsite environmental surveillance activities were presented in reports issued for public dissemination. SRS reported onsite and offsite environmental monitoring activities separately until 1985, when data from both programs were merged into one public document.

The *Savannah River Site Environmental Report for 1997* is an overview of effluent monitoring and environmental surveillance activities conducted on and in the vicinity of SRS from January 1 through December 31, 1997. It is prepared by the Environmental Monitoring Section (EMS) of Westinghouse Savannah River Company (WSRC). The "SRS Environmental Monitoring Plan" (WSRC-3Q1-2-1000) and the "SRS Environmental Monitoring Program" (WSRC-3Q1-2-1100) provide complete program descriptions and document the rationale and design criteria for the monitoring program, the frequency of monitoring and analysis, the specific analytical and sampling procedures, and the quality assurance requirements.

Variations in the environmental report's data content from year to year reflect changes in the routine program or difficulties encountered in obtaining or analyzing some samples. Examples of such problems include adverse environmental conditions (such as flooding or drought), sampling or analytical equipment malfunctions, and compromise of the samples in the preparation laboratories or counting room.

Unless otherwise indicated, the figures and tables in this report are generated using results from the regular monitoring program. No attempt has been made to include all data from environmental research programs. A more complete listing of data can be found in *Savannah River Site Environmental Data for 1997* (WSRC-TR-97-00324).

The following information should aid the reader in interpreting data in this report:

- Analytical results and their corresponding uncertainty terms generally are reported with up to three significant figures. The last significant figure of a result is determined by the quantification of the uncertainty term. EMS attempts to report the appropriate confidence in the result with the correct number of significant figures.
- The reported uncertainty of a single measurement reflects only the counting error—not other components of random and systematic error in the measurement process—so some results may imply a greater confidence than the determination would suggest.
- An uncertainty quoted with means represents the standard deviation of measurements about the mean value. This number is calculated from the results themselves and is not weighted by the uncertainties of the individual results.
- All values represent the weighted average of all acceptable analyses of a sample for a particular analyte. Samples may have undergone multiple analyses for quality assurance purposes or to determine if radionuclides are present. For certain radionuclides, quantifiable concentrations may be below the minimum detectable activity of the analysis, in which case the actual concentration value is presented to satisfy DOE reporting guidelines.
- The generic term "dose," as used in the report, refers to the committed effective dose equivalent (50-year committed dose) from internal deposition of radionuclides and to the effective dose equivalent attributable to penetrating radiation from sources external to the body.

Inquiries regarding this report should be made to

Bob Lorenz, Manager
Environmental Sampling and Reporting
Westinghouse Savannah River Company
Building 735-16A
Aiken, SC 29808 Telephone: 803-725-3556
E-mail address: robert.lorenz@srs.gov

Contents

List of Figures

List of Tables

Executive Summary

Appendix A Applicable Guidelines, Standards, and Regulations

Acronyms and Abbreviations

A

AEC – U.S. Atomic Energy Commission

ALARA – As low as reasonably achievable

AMEQ – Assistant Manager of Environmental Quality

ANSP – Academy of Natural Sciences of Philadelphia

ATTA – Advanced Tactical Training Area

B

BSRI – Bechtel Savannah River, Inc.

BTU – British Thermal Unit

C

CAA – Clean Air Act

CAAA – Clean Air Act Amendments of 1990

CAB – Citizens Advisory Board

CAS – Chemical abstract numbers

CDC – Centers for Disease Control and Prevention

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)

CFC – Chlorofluorocarbon

CFR – Code of Federal Regulations

CIF – Consolidated Incineration Facility

CMP – Chemicals, metals, and pesticides

COU – Catalytic oxidation units

CSRA – Central Savannah River Area

CSWTF – Central Sanitary Wastewater Treatment Facility

CWA – Clean Water Act

CX – Categorical exclusion

D

D&D – Deactivation and decommissioning

DCG – Derived concentration guide

DOE – U.S. Department of Energy

DOE/EML – U.S. Department of Energy Environmental Measurements Laboratory

DOE–HQ – U.S. Department of Energy-Headquarters

DOE–SR – U.S. Department of Energy-Savannah River Operations Office

DWPF – Defense Waste Processing Facility

DWS – Drinking water standards

E

EA – Environmental Assessment

EIS – Environmental Impact Statement

EMCAP – Environmental Monitoring Computer Automation Program

EMS – Environmental Monitoring Section of the Environmental Protection Department (of Westinghouse Savannah River Company)

EPA – U.S. Environmental Protection Agency

EPCRA – Emergency Planning and Community Right-to-Know Act

EPD – Environmental Protection Department (of Westinghouse Savannah River Company)

EQMD – DOE–SR's Environmental Quality & Management Division

ESCO – Energy Services Company

ETF – Effluent Treatment Facility

F

FFA – Federal Facility Agreement

FFCA – Federal Facility Compliance Agreement

FFCAct – Federal Facility Compliance Act

FONSI – Finding of No Significant Impact

G

GDNR – Georgia Department of Natural Resources

GPS/GIS – Global Positioning System/Geographic Information System

GOCO – Government-owned, contractor-operated

H

HBFC – Hydrobromofluorocarbon

HCFC – Hydrochlorofluorocarbon

HVAC – Heating, ventilation, and air conditioning

HWMF – Hazardous Waste Management Facility

I

ICRP – International Commission on Radiological Protection

ISO – International Organization for Standardization

ITPF – In-Tank Precipitation Facility

L

LDR – Land disposal restrictions

LETF – Liquid Effluent Treatment Facility

LLD – Lower limit of detection

LLRWDF – Low-Level Radioactive Waste Disposal Facility

M

MAP – Mitigation Action Plan

MDA – Minimum detectable activity

MDL – Minimum detectable limit

MRD – Mean relative difference

MWMF – Mixed Waste Management Facility

N

NASA – National Aeronautics and Space Administration

NCRP – National Council on Radiation Protection and Measurements

NEPA – National Environmental Policy Act

NESHAP – National Emission Standards for Hazardous Air Pollutants

NHPA – National Historic Preservation Act

NIST – National Institute of Standards and Technology

NISTRIP – National Institute of Standards and Technology Radiochemistry Intercomparison Program

NOV – Notice of Violation

NPDES – National Pollutant Discharge Elimination System

NRC – U.S. Nuclear Regulatory Commission

NSPS – New Standards of Performance for Stationary Sources

NWP – Nationwide permit

O

ODS – Ozone-depleting substances

OEA – Office of External Affairs of the U.S. Department of Energy-Savannah River Operations Office

P

PAR Pond – Pond constructed at Savannah River Site in 1958 to provide cooling water for P-Reactor and R-Reactor (P and R; hence, PAR)

Acronyms and Abbreviations

A

AEC – U.S. Atomic Energy Commission

ALARA – As low as reasonably achievable

AMEQ – Assistant Manager of Environmental Quality

ANSP – Academy of Natural Sciences of Philadelphia

ATTA – Advanced Tactical Training Area

B

BSRI – Bechtel Savannah River, Inc.

BTU – British Thermal Unit

C

CAA – Clean Air Act

CAAA – Clean Air Act Amendments of 1990

CAB – Citizens Advisory Board

CAS – Chemical abstract numbers

CDC – Centers for Disease Control and Prevention

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)

CFC – Chlorofluorocarbon

CFR – Code of Federal Regulations

CIF – Consolidated Incineration Facility

CMP – Chemicals, metals, and pesticides

COU – Catalytic oxidation units

CSRA – Central Savannah River Area

CSWTF – Central Sanitary Wastewater Treatment Facility

CWA – Clean Water Act

CX – Categorical exclusion

D

D&D – Deactivation and decommissioning

DCG – Derived concentration guide

DOE – U.S. Department of Energy

DOE/EML – U.S. Department of Energy Environmental Measurements Laboratory

DOE–HQ – U.S. Department of Energy-Headquarters

DOE–SR – U.S. Department of Energy-Savannah River Operations Office

DWPF – Defense Waste Processing Facility

DWS – Drinking water standards

E

EA – Environmental Assessment

EIS – Environmental Impact Statement

EMCAP – Environmental Monitoring Computer Automation Program

EMS – Environmental Monitoring Section of the Environmental Protection Department (of Westinghouse Savannah River Company)

EPA – U.S. Environmental Protection Agency

EPCRA – Emergency Planning and Community Right-to-Know Act

EPD – Environmental Protection Department (of Westinghouse Savannah River Company)

EQMD – DOE–SR's Environmental Quality & Management Division

ESCO – Energy Services Company

ETF – Effluent Treatment Facility

F

FFA – Federal Facility Agreement

FFCA – Federal Facility Compliance Agreement

FFCAct – Federal Facility Compliance Act

FONSI – Finding of No Significant Impact

G

GDNR – Georgia Department of Natural Resources

GPS/GIS – Global Positioning System/Geographic Information System

GOCO – Government-owned, contractor-operated

H

HBFC – Hydrobromofluorocarbon

HCFC – Hydrochlorofluorocarbon

HVAC – Heating, ventilation, and air conditioning

HWMF – Hazardous Waste Management Facility

I

ICRP – International Commission on Radiological Protection

ISO – International Organization for Standardization

ITPF – In-Tank Precipitation Facility

L

LDR – Land disposal restrictions

LETF – Liquid Effluent Treatment Facility

LLD – Lower limit of detection

LLRWDF – Low-Level Radioactive Waste Disposal Facility

M

MAP – Mitigation Action Plan

MDA – Minimum detectable activity

MDL – Minimum detectable limit

MRD – Mean relative difference

MWMF – Mixed Waste Management Facility

N

NASA – National Aeronautics and Space Administration

NCRP – National Council on Radiation Protection and Measurements

NEPA – National Environmental Policy Act

NESHAP – National Emission Standards for Hazardous Air Pollutants

NHPA – National Historic Preservation Act

NIST – National Institute of Standards and Technology

NISTRIP – National Institute of Standards and Technology Radiochemistry Intercomparison Program

NOV – Notice of Violation

NPDES – National Pollutant Discharge Elimination System

NRC – U.S. Nuclear Regulatory Commission

NSPS – New Standards of Performance for Stationary Sources

NWP – Nationwide permit

O

ODS – Ozone-depleting substances

OEA – Office of External Affairs of the U.S. Department of Energy-Savannah River Operations Office

P

PAR Pond – Pond constructed at Savannah River Site in 1958 to provide cooling water for P-Reactor and R-Reactor (P and R; hence, PAR)

PCB – Polychlorinated biphenyl

PEIS – Programmatic Environmental Impact Statement

pH – Measure of the hydrogen ion concentration in an aqueous solution (acidic solutions, pH from 0–6; basic solutions, pH > 7; and neutral solutions, pH = 7

PVC – Polyvinyl chloride

Q

QA – Quality assurance

QAD – Quality Assurance Division (Environmental Protection Agency)

QAP – Quality Assurance Program (Department of Energy)

QA/QC – Quality assurance/quality control

QC – Quality control

R

RBOF – Receiving Basin for Offsite Fuel

RCRA – Resource Conservation and Recovery Act

RFI/RI – RCRA Facility Investigation/Remedial Investigation

ROD – Record of Decision

RQ – Reportable quantity

RTF – Replacement Tritium Facility

S

SARA – Superfund Amendments and Reauthorization Act

SCDHEC – South Carolina Department of Health and Environmental Control

SDWA – Safe Drinking Water Act

SEIS – Supplemental Environmental Impact Statement

S&HO – Safety and Health Operations

SIRIM – Site Item Reportability and Issues Management

SRARP – Savannah River Archaeological Research Program

SREL – Savannah River Ecology Laboratory (University of Georgia)

SRFS – Savannah River Forest Station

SRI – Savannah River Natural Resource Management and Research Institute (formerly the Savannah River Forest Station)

SRP – Savannah River Plant

SRS – Savannah River Site

SRTC – Savannah River Technology Center

SUD – Site Utilities Division of Westinghouse Savannah River Company

SWDF – Solid Waste Disposal Facility

T

TDS – Total dissolved solids

TLD – Thermoluminescent dosimeter

TRAIN – Training Records and Information System

TRI – Toxic Release Inventory

TSCA – Toxic Substances Control Act

TSP – Total suspended particulate matter

TSS – Total suspended solids

U

USGS – U.S. Geological Survey

W

WIND – Weather Information and Display

WSI – Wackenhut Services Inc.

WSRC – Westinghouse Savannah River Company

Sampling Location Abbreviations

Abbreviation	Location Name/Other Applicable Information
4M	Four Mile
4MC	Four Mile Creek
681–5G	Georgia Department of Natural Resources and Environmental Monitoring Section sampling location
A–14	Road A–14
AAP	Aiken Airport
ATTA	Advanced Tactical Training Area
AUG L&D	Augusta Lock and Dam
ALLEN	Allendale Gate
BARN	Barnwell Gate
BDC	Beaver Dam Creek
BG	Burial Ground
BGN	Burial Ground North
BGS	Burial Ground South
CSWTF	Central Sanitary Wastewater Treatment Facility
DARK H	Dark Horse
E TAL	East Talatha
FM	Four Mile
FMC	Four Mile Creek (Fourmile Branch)
GR PND	Green Pond
HP	HP (sampling location designation only; not an actual abbreviation)
IBG	Indian Burial Ground
IGB	Indian Grave Branch
JACK	Jackson
L3R	Lower Three Runs
LSB	L-Area Seepage Basin
LTR	Lower Three Runs
PB	Pen Branch
PATT MR	Patterson Mill Road
PMR	Patterson Mill Road
PSB	P-Area Seepage Basin
RM	River Mile
SATA	Small Arms Training Area (pistol range)
SAV 1	Savannah 1
SAV 2	Savannah 2
SC	Steel Creek
TB	Tims Branch
TCR	Tabernacle Church Road

Abbreviation	Location Name/Other Applicable Information (continued)
TNX	Multipurpose Pilot Plant Campus
U3R	Upper Three Runs
UTR	Upper Three Runs
WIND	Windsor Road
W JACK	West Jackson

Sample Locations Known By More Than One Abbreviation
Beaver Dam Creek; 400–D
Four Mile Creek–6; FM–6; 4MC–6; Four Mile Creek at Leigh Road
Four Mile Creek at Road A7; FM–A7; 4M–A7
Lower Three Runs–2; L3R–2; L3R Creek and Patterson Mill
River Mile–0/8 Savannah River Mouth; Highway 17A Bridge Area; RM–0/8
River Mile 120; RM–120; River 10; R–10
River Mile 140; RM–140; R–8A
River Mile 160; RM–160; River 2; R–2
Steel Creek–4; SC–4; Steel Creek–4 at Road A; SC and Highway 125
Tinker Creek at Kennedy Pond; TC/KP; TC–1
Upper Three Runs–4 at Road A; U3R–4; U3R–Rd A
Vogtle Discharge; River 3B; R–3B

Executive Summary

THE mission at the Savannah River Site (SRS) has changed from the production of nuclear weapons materials for national defense to the management of waste, restoration of the environment, and the development of industry in and around the site. SRS—through its prime operating contractor, Westinghouse Savannah River Company (WSRC)—continues to maintain a comprehensive environmental monitoring program.

In 1997, effluent monitoring and environmental surveillance were conducted within a 31,000-square-mile area in and around SRS that includes neighboring cities, towns, and counties in Georgia and South Carolina and extends up to approximately 100 miles from the site. Though the environmental monitoring program was streamlined in 1997—to improve its cost-effectiveness without compromising data quality or reducing its overall ability to produce critical information—thousands of samples of air, rainwater, surface water, drinking water, groundwater, food products, wildlife, soil, sediment, and vegetation were collected and analyzed for radioactive and/or nonradioactive contaminants.

Potential Radiation Doses

Table 1 shows the 1997 potential radiation doses from SRS releases compared with the applicable federal dose standards and with estimated doses from naturally occurring background radiation. All potential radiation doses attributed to SRS in 1997 were below applicable regulatory standards.

Liquid Pathway

For 1997, the potential dose to the maximally exposed individual from liquid releases of radioactivity to the Savannah River was estimated at 0.13 mrem (0.0013 mSv). This dose is 0.13 percent of the U.S. Department of Energy (DOE) 100-mrem all-pathway dose standard for annual exposure.

The dose was about 7 percent lower than the 1996 dose of 0.14 mrem (0.0014 mSv)—primarily because of reductions in cesium-137 and tritium oxide releases.

The major contributors to the 1997 potential dose were (1) tritium oxide (40 percent); (2) cesium-137 (36 percent); and (3) unidentified alpha emitters, which are conservatively accounted for as plutonium-239 releases in the dose calculations (17 percent).

The 1997 collective dose from liquid releases was estimated to be 2.4 person-rem (0.024 person-Sv).

Drinking Water Pathway

Offsite doses were calculated for persons consuming drinking water from two water treatment plants located downriver of SRS near Beaufort, South Carolina, and Port Wentworth, Georgia. The maximum doses from both facilities were 0.07 mrem (0.0007 mSv). These doses are 1.75 percent of the drinking water standard of 4 mrem per year (0.04 mSv per year). Tritium oxide in the drinking water represents about 74 percent of the dose.

Airborne Pathway

For 1997, the potential dose to the maximally exposed individual from airborne releases of radioactive materials was 0.05 mrem (0.0005 mSv), which was the same as the 1996 dose. This dose is 0.5 percent of the 10-mrem per year (0.1-mSv per year) limit for exposure to airborne releases from a DOE facility.

Tritium oxide comprised approximately 71 percent of the potential airborne pathway dose.

The collective dose (population dose) to the 620,100 persons living within 80 kilometers (50 miles) of the center of the site was estimated to be 2.2 person-rem (0.022 person-Sv), which is less than 0.01 percent of the collective dose received from naturally occurring sources of radiation (about 186,000 person-rem).

All Pathway

To demonstrate compliance with the DOE Order 5400.5 all-pathway dose standard of 100 mrem per year (1.0 mSv per year), SRS conservatively combines the maximally exposed individual airborne pathway and liquid pathway dose estimates, even though the two doses are calculated for hypothetical individuals residing at different geographic locations.

For 1997, the potential maximally exposed individual all-pathway dose was 0.18 mrem (0.0018 mSv) (0.05 mrem from airborne pathway plus 0.13 mrem from liquid pathway). This dose is about 5 percent lower than the 1996 all-pathway dose of 0.19 mrem (0.0019 mSv), mainly because of the decreases in tritium and cesium-137 liquid releases during 1997. A history (since 1988) of SRS maximum potential all-pathway doses to the maximally exposed individual is depicted in figure 1.

Table 1 1997 Potential Radiation Doses from SRS Releases Compared with Applicable Dose Standards and Estimated Doses from Naturally Occurring Radiation

Maximally Exposed Individual Doses

Exposure Pathway	Maximum Potential Dose from 1997 Releases[a]	Applicable Dose Standard[b]	Percent of Standard	Percent of Natural[c]
Airborne Releases				
Total Airborne	0.05 mrem	10 mrem[d]	0.50	0.02
Liquid Releases				
Total Liquid	0.13 mrem	NA[e]	NA[e]	0.04
All Pathways[f]	**0.18 mrem**	100 mrem	0.18	0.06
Treated Drinking Water				
Beaufort-Jasper	0.07 mrem	4 mrem[g]	1.8	0.02
Port Wentworth	0.07 mrem	4 mrem[g]	1.8	0.02
Special-Case Exposure Scenarios				
Sportsman Dose				
Deer and hog consumption				
Onsite hunter	26 mrem	100 mrem	26	8.7
Offsite hunter	14 mrem	100 mrem	14	4.7
Fish consumption				
Steel Creek fish	0.65 mrem	100 mrem	0.65	0.20
Goat Milk Consumption Dose				
Max. individual	0.05 mrem	10 mrem	0.50	0.02
Irrigation Pathway Dose				
Max. individual	0.11 mrem	100 mrem	0.11	0.04

Population (Collective) Doses

Exposure Pathway	Maximum Potential Dose from 1996 Releases[a]	Applicable Dose Standard[b]	Percent of Standard	Percent of Natural[c]
Airborne Releases				
Total Airborne	2.2 person-rem	NA[e]	NA[e]	0.01
Liquid Releases				
Total Liquid	2.4 person-rem	NA[e]	NA[e]	0.01

a Committed effective dose equivalent.

b All the standards listed are given in DOE Order 5400.5, February 8, 1990, "Radiation Protection of the Public and the Environment."

c Estimate of average dose received from naturally occurring radiation is 300 mrem per year [NCRP, 1987]. The population (collective) dose due to naturally occurring radiation is estimated to be about 186,000 person-rem.

d The standard for airborne effluents applies to the sum of the doses from all airborne pathways: inhalation, submersion in a plume, exposure to radionuclides deposited on the ground surface, and consumption of foods contaminated as a result of the deposition of radionuclides.

e Not applicable; there is no separate standard for population dose or for all liquid pathways alone; liquid releases are included in the 100-mrem standard for all pathways.

f The total airborne and liquid exposure pathways are added in order to compare maximum calculated doses from SRS releases with the DOE "all pathways" standard. This total includes the maximum airborne pathway dose of 0.05 mrem (0.0005 mSv) and the maximum liquid pathway dose of 0.13 mrem (0.0013 mSv).

g The drinking water standard applies to public drinking water systems and to drinking water supplies operated by DOE or DOE contractors.

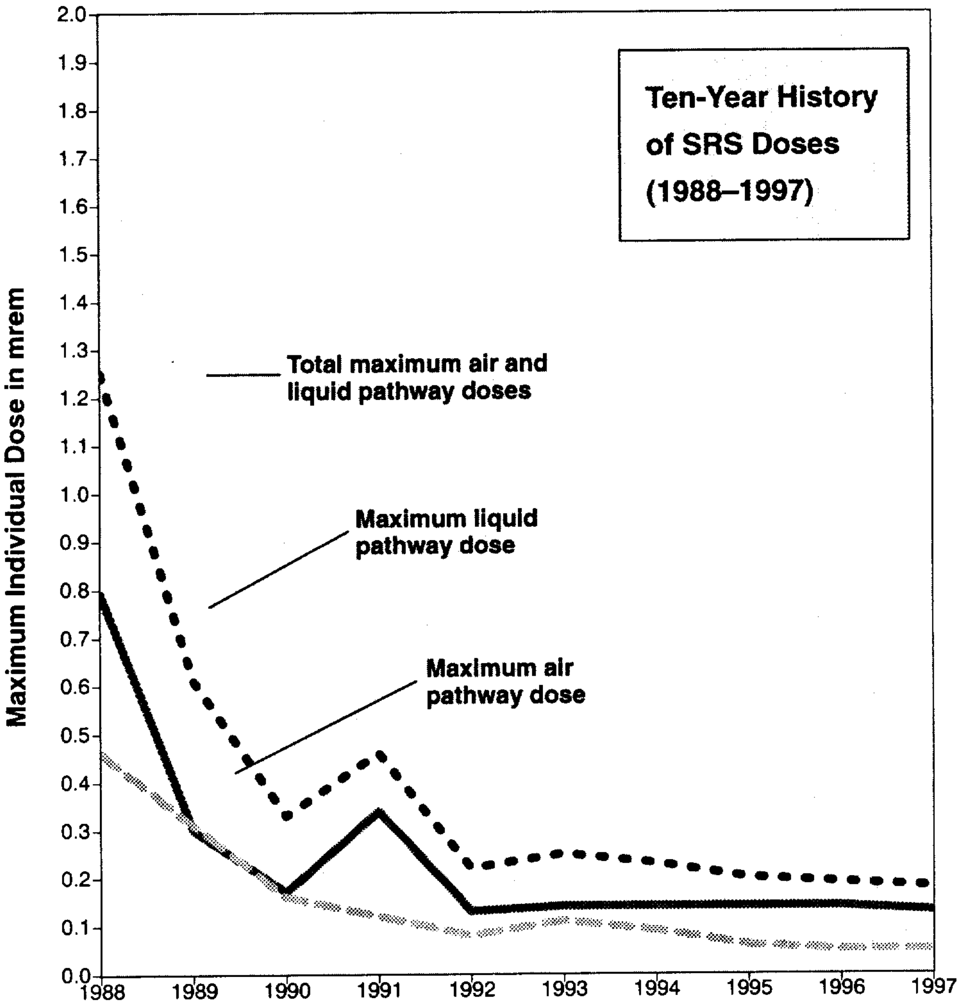


Figure 1 SRS Maximum Potential Doses to the Maximally Exposed Individual

Ileaf Graphic

Sportsman

In 1997, the maximum potential dose to an actual onsite hunter was 26 mrem (0.26 mSv), which is 26 percent of DOE's 100-mrem all-pathway dose standard. During the onsite deer hunts, this individual harvested nine animals—the edible portion totaled about 163 kilograms (359 pounds)—and was assumed to have eaten all the meat.

If a hypothetical offsite hunter living near the site boundary consumed 81 kg (179 pounds) of meat—the annual maximum adult consumption rate for meat—taken from deer living on site prior to being harvested, the individual's maximum dose could have been 14 mrem (0.14 mSv). This dose was based on the average concentration of cesium-137 measured in animals harvested at SRS during 1997.

The potential maximum dose for a recreational fisherman was based on the consumption of 19 kg (42 pounds)—the maximum adult consumption rate for fish—of Savannah River fish having the highest measured concentrations of radionuclides. In 1997, bass caught at the mouth of Steel Creek had the highest concentrations. Consumption of these bass could have resulted in a dose of 0.65 mrem (0.065 mSv).

Compliance Activities

A major goal at SRS continues to be positive environmental stewardship and full regulatory compliance, with zero violations. The site's employees maintained progress toward achievement of this goal in 1997, as a vast majority of their efforts were successful. For example, under the Clean Water Act (CWA), the site's National Pollutant Discharge Elimination System (NPDES) compliance rate was 99.9 percent, and under the Clean Air Act (CAA), the compliance rate was 100 percent.

Compliance with environmental regulations and with DOE orders related to environmental protection is an integral part of the operations at SRS. Management of the environmental programs at SRS is a significant activity, and assurance that onsite processes do not impact the environment adversely is a top priority. All site activities are overseen by one or more regulatory agencies, including the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC).

A systematic effort is in place to identify and address all evolving regulatory responsibilities that concern SRS. As part of the process, communications are maintained with all appropriate regulatory agencies to emphasize the site's commitment to environmental compliance. SRS received four Notices of Violation (NOVs) from SCDHEC in 1997 and none from EPA.

SRS operations in 1997 continued to involve a wide variety of processes and chemicals subject to compliance with an increasing number of environmental statutes, regulations, policies, and permits. (For example, SRS had 675 construction and operating permits in 1997 that specified operating levels for each permitted source.) Compliance with all requirements helps to ensure that the site, the public, and the surrounding environment are protected from adverse effects that could result from SRS operations. This section offers an overview of some of the environmental compliance issues with which the site was involved during 1997.

High-Level Radioactive Waste Tank Closure

The mission of SRS high-level waste tank closures at the F-Area and H-Area tank systems is to close out tanks in a way that ensures protection of human health and the environment, and in a technically and economically prudent manner. The "Industrial Wastewater Closure Plan for F- and H-Area High-Level Waste Tank Systems," approved in July 1996 by EPA and SCDHEC, outlines the SRS protocol for closing all 51 high-level waste tanks on site [DOE, 1996b].

Tank 20F, a 1.3-million-gallon, single-shelled, carbon steel vessel, was closed July 31. Tank 17F, with the same capacity, was closed December 15. Prior to the initiation of closure activities, all but approximately 1,000–2,000 gallons of waste were removed from each tank and further processed.

National Pollutant Discharge Elimination System

The CWA created the NPDES program, which is regulated by SCDHEC under EPA authority. The program is designed to protect surface waters by limiting all nonradiological releases of effluents into streams, reservoirs, and other wetlands. (Radiological effluents are covered under other acts.) Discharge limits are set for each facility to ensure that SRS operations do not impact aquatic life adversely or degrade water quality.

SRS had five NPDES permits for most of 1997—one permit for industrial wastewater discharge (SC0000175), one general permit for utility water discharge (SCG250162), two general permits for stormwater discharge (SCR000000 for industrial and SCR100000 for construction), and one permit for land application (ND0072125). Permit SC0000175 regulated 37 active and inactive NPDES outfalls at SRS until June 1997, when it was modified because of the elimination of outfall C–04.

All results of monitoring for compliance with the industrial wastewater discharge permit and the new general permit for utility water discharge were reported to SCDHEC in the monthly Discharge Monitoring Reports, as required by the permits.

Title V Operating Program

The CAA provides the basis for protecting and maintaining air quality. Some types of SRS air emissions, such as ozone-depleting substances (ODS), are regulated by EPA, but most are regulated by SCDHEC, which must ensure that its air pollution regulations are at least as stringent as the CAA's. This is accomplished through SCDHEC Regulation 61–62, "Air Pollution Control Regulations and Standards."

Under the CAA, and as defined in federal regulations, SRS is classified as a "major source" and, as such, is assigned one permit number (0080–0041) by SCDHEC. SRS holds operating and construction permits from SCDHEC's Bureau of Air Quality, which regulates nonradioactive toxic and criteria pollutant emissions from approximately 194 point sources. Of these point sources, 153 operated in some capacity during 1997. The remaining 41 either were under construction or were being maintained in a "cold standby" status.

NESHAP Asbestos Removal Program

SRS began an asbestos abatement program in 1988 and continues to manage asbestos-containing material by "best management practices." Site compliance in this area also falls under South Carolina and federal regulations.

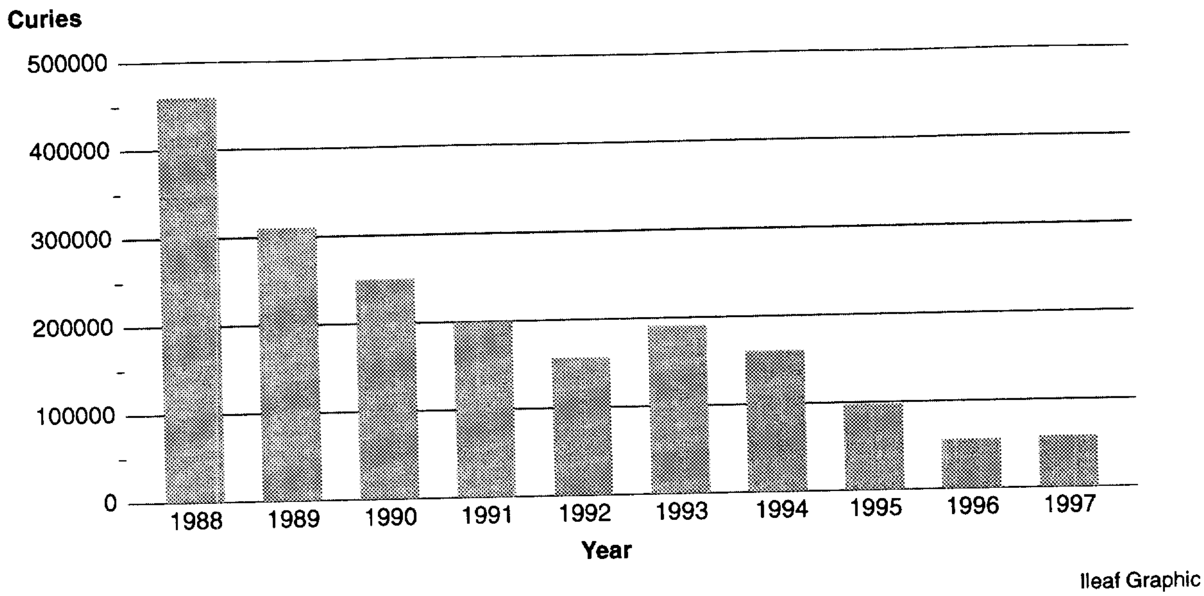


Figure 2 Ten-Year History of SRS Annual Atmospheric Tritium Releases

During 1997, short-term, subcontracted demolition and NESHAP projects accounted for the removal of approximately 5,200 linear feet of friable asbestos-containing material (a form that can be crumbled or pulverized with hand pressure when dry) and 120,200 square feet of nonfriable asbestos-containing material. Demolition and NESHAP projects performed by SRS employees accounted for the removal of approximately 1,800 linear feet of friable and 58,500 square feet of nonfriable asbestos-containing material in 1997.

Radiological Effluent Monitoring

During 1997, SRS collected and analyzed more than 4,200 effluent samples to quantify radiological releases to the environment from site operations. Tritium again was the major contributor to air and liquid releases, accounting for most of the total radioactivity released in 1997.

Airborne Emissions

Approximately 58,000 Ci (2.2E+15 Bq) of tritium were released. This compares with 55,300 Ci (2.1E+15 Bq) released in 1996. Figure 2 shows a 10-year history (1988–1997) of SRS tritium releases. Since 1995, because of changes in the site's missions and the existence of the Replacement Tritium Facility, the total amount of tritium released has been less than 100,000 Ci per year.

Liquid Discharges

Tritium accounts for most of the radioactivity released to the Savannah River from direct process discharges and from seepage basin and Solid Waste Disposal Facility (SWDF) migration discharges. The amount of tritium released directly from SRS process areas (i.e., reactor, separations, heavy water rework) to site streams during 1997 was 1,570 Ci (5.81E+13 Bq), which was 65 percent greater than the 1996 total of 949 Ci (3.51E+13 Bq). This is attributed to production increases at the Effluent Treatment Facility and at D-Area.

During 1997, however, the total amount of tritium released to the Savannah River from the site (i.e., direct liquid discharges plus seepage basin and SWDF migration releases) was about 5 percent less than the amount released during 1996—8,550 Ci (3.16E+14 Bq) in 1997 versus 8,950 Ci (3.31E+14 Bq) in 1996.

Radiological Environmental Surveillance

The radiological environmental surveillance program at SRS surveys and quantifies any effects routine and nonroutine operations may have had on the site, the surrounding area, and those populations living in or near the site. Sampled media include air, rainwater, site streams, the Savannah River, drinking water, seepage basins, food products, fish, deer, hogs, turkeys, beavers, soil, sediment, and vegetation.

In 1997, approximately 10,000 radiological analyses were performed on approximately 5,000 samples, and measurements of gamma radiation levels were made at 131 locations on and off site. Activity levels generally were consistent with 1996 levels.

Activity levels of radionuclides such as tritium, cesium, and strontium were at or slightly above their nominal lower limits of detection (LLD) and were consistent with observed historical levels in sampled media. In air and surface water, some onsite activity levels were, as expected, slightly higher than observed in offsite media. Because of production slowdown, most tritium transport in site streams, which has been decreasing in recent years, was attributed to the outcropping at stream banks of contaminated groundwater from retired seepage basins.

Nonradiological Effluent Monitoring

Nonradioactive airborne emissions released from SRS stacks—including sulfur dioxide, oxides of nitrogen, carbon monoxide, total particulate matter less than 10 microns, and various toxic air pollutants—were within applicable (SCDHEC) standards in 1997.

SRS maintained its NPDES compliance rating for liquid releases above 99 percent for the 12th straight year. Results from only seven of the 5,758 analyses performed in 1997 exceeded permit limits. This resulted in a compliance rating of 99.9 percent—again higher than the DOE-mandated rate of 98 percent.

Nonradiological Environmental Surveillance

The nonradiological environmental surveillance program at SRS involves sampling and analyzing surface waters (site streams and the Savannah River), drinking water, sediment, groundwater, and fish. In 1997, more than 6,300 analyses for specific chemicals and metals were performed on more than 1,200 samples, not including groundwater.

The 1997 water quality data showed normal fluctuations expected for surface water. A comparison of the 1997 data with published historical data for site surface water monitoring did not indicate any abnormal deviations from past monitoring data except for one anomaly at the Four Mile-2 sampling location during July. Analyses for pesticides and herbicides yielded four positive results at four different locations for the herbicide 2,4–D. All other results were below the detection limit for the analyses.

All SRS drinking water systems complied with SCDHEC chemical, bacteriological, lead and copper, synthetic organic, and volatile organic water quality standards in 1997 except for two total-coliform analysis results at the Advanced Tactical Training Area and two at the Central Sanitary Wastewater Treatment Facility. Samples subsequently collected at these locations after disinfection and flushing tested negative for total coliform.

In Savannah River and site stream sediment samples, no pesticides or herbicides were found to be above the practical quantitation limits in 1997. All sample results were below the LLD of the EPA analytical procedures used.

The mercury concentrations in fish analyzed from onsite waters ranged from a high of 2.82 µg Hg/g in a Lower Three Runs Creek bass to lows below the LLD at several locations. Mercury concentrations in offsite fish ranged from a high of 1.30 µg Hg/g in a bass from the mouth of Steel Creek to lows below the LLD at several locations.

Groundwater

SRS monitors groundwater for radioactive and nonradioactive constituents to identify contamination that may have occurred because of site operations. Groundwater beneath 5 to 10 percent of the site has been contaminated by industrial solvents, tritium, metals, or other constituents used or generated by SRS operations. This report describes groundwater monitoring results for approximately 1,350 wells in 92 locations within designated areas at SRS. In 1997, approximately 50,500 radiological analyses and 344,100 nonradiological analyses were performed on groundwater samples.

Eight new sites were monitored during the year, and additional wells were installed at several more sites to improve detection monitoring and plume definition. Also, numerous wells were abandoned to accommodate closure activities in and around the chemicals, metals, and pesticides pits and the R-Area reactor seepage basins.

Special Surveys

In addition to routine sampling and special sampling during nonroutine environmental releases, special sampling for radiological and nonradiological surveys is conducted on and off site. Both short- and long-term radiological and nonradiological surveys are used to monitor the effects of SRS effluents on the site's environment and in its immediate vicinity.

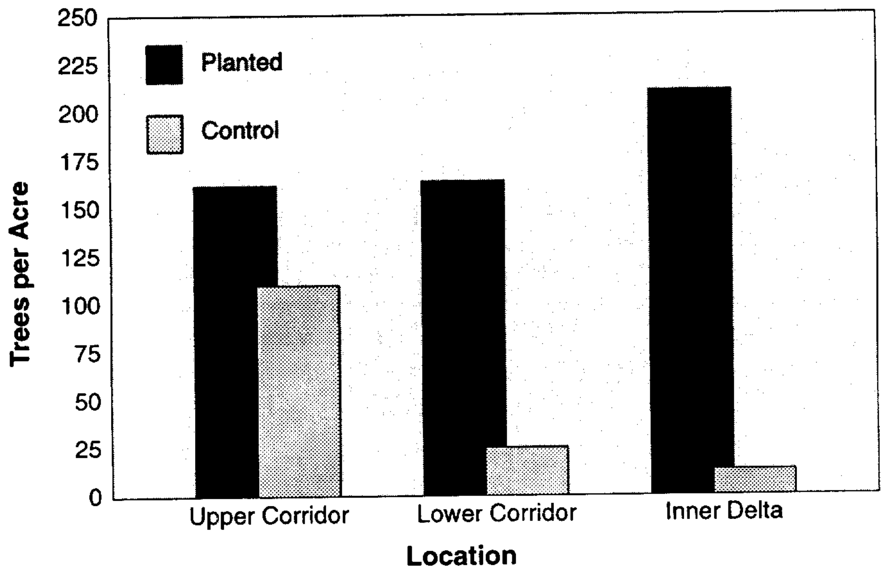


Figure 3 Pen Branch Seedling Stocking
A regeneration survey was conducted in 1997 to establish current stocking levels of desirable species of seedlings in different areas of the Pen Branch corridor and delta regions. Survey results indicate that sufficient numbers of seedlings are present in all the planted areas.

Ileaf Graphic

Mitigation Action Plan for Pen Branch Reforestation

The final Environmental Impact Statement for the continued operation of K-Reactor, L-Reactor, and P-Reactor at SRS predicted several unavoidable impacts to the site's wetlands. This resulted in the development of a Mitigation Action Plan (MAP) that documented the DOE approach to mitigating these impacts [DOE, 1990]. The section on "Mitigation for Wetlands Adversely Impacted by Operations" in the original MAP remains as the only active program element.

Natural revegetation has been occurring in the Pen Branch delta since K-Reactor last operated for an extended period of time (1988). K-Reactor thermal discharges were determined by a 1992 survey to have caused canopy loss or vegetation damage to 583 acres in the corridor, swamp, and marsh areas.

During 1995, an extensive survey of natural regeneration of forest species was conducted around the outer perimeter of the delta region of Pen Branch. Results of that survey indicated that approximately 100 acres of the delta had sufficient bald cypress seedlings and saplings to consider the area reforested. Stocking tallies taken in 1997 quantified these high densities and the vigor of this natural regeneration.

The Pen Branch corridor and delta are being reforested by planting with indigenous wetlands species. The seeds were planted and grown at a State of Georgia nursery during 1993–1995 for use in the Pen Branch seedling planting program. These seedlings—of species appropriate to the area being reforested—subsequently were transplanted to the Pen Branch wetland areas. The reforested areas will be managed until successful reforestation has been achieved. This is the preferred method of mitigation for the Pen Branch corridor and delta because of the brief restoration time allowed by DOE.

A regeneration survey was conducted in 1997 to establish the current stocking levels of desirable species in the different areas of the Pen Branch corridor and delta regions. Results of the survey, shown in figure 3, indicate that sufficient numbers of seedlings are present in all the planted areas. Some mortality will continue to occur over time, but the number of seedlings available in planted areas is considerably above what would be present in a normal undisturbed bottomland hardwood or swamp forest. It is anticipated, therefore, that these stocking levels will provide sufficient numbers of trees to ensure reforestation success.

Academy of Natural Sciences of Philadelphia River Quality Surveys

The Patrick Center for Environmental Research of the Academy of Natural Sciences of Philadelphia (ANSP) has been conducting biological and water quality surveys of the Savannah River since 1951. These surveys are designed to assess potential effects of SRS contaminants and warm water discharges on the general health of the river and its tributaries.

The 1996 and 1997 surveys included biweekly (1996) to monthly (1997) diatometer monitoring throughout the year, cursory sampling (1996) in the vicinity of SRS (algae, aquatic macrophytes, insects, and fish), and comprehensive sampling near Georgia Power Company's Vogtle Electric Generating Plant and SRS

(1997–algae, aquatic macrophytes, noninsect macroinvertebrates, insects, and fish). Sample analyses are complete for 1996 and under way for 1997.

Results of the 1996 ANSP studies were not reported by the Academy in the *SRS Environmental Report for 1996* because a new contract based on recommendations of the 1996 "Rock Hill Initiative #2" review had not been finalized [WSRC, 1996]. It was expected that data analysis results from both 1996 and 1997 would be published in the *SRS Environmental Report for 1997*. Because 1997 analyses were not completed in time, however, only the 1996 results appear in this document. Beginning with the *SRS Environmental Report for 1998*, complete results of the previous year's studies and a description of the present year's program will be presented.

Based on the results available for this progress report, most of the study elements in the 1996–1997 ANSP river quality surveys found no significant difference between biological communities upstream and downstream of the SRS, or upstream and downstream of Plant Vogtle. Thus, there is no evidence that SRS or Plant Vogtle have detrimental impacts on water quality in the Savannah River.

Chapter 1

Introduction

Margaret Arnett
Environmental Protection Department

To Read About . . . See Page . . .

1997 Highlights

- The first full year of DOE's new contract with WSRC and its partners was completed. Under this contract, WSRC is responsible for nuclear facility operations; operation of SRTC; and environment, safety, health, and quality assurance. Bechtel Savannah River, Inc., is responsible for environmental restoration, projects management, engineering, and construction activities. Babcock & Wilcox Savannah River Company is responsible for facility decontamination and decommissioning, and British Nuclear Fuels Savannah River Corporation is responsible for the site's solid waste program.
- NASA launched the Cassini spacecraft October 13 on its unmanned expedition to the planet Saturn. Plutonium-238 from SRS is being used to supply electricity aboard the spacecraft.

THE Savannah River Site (SRS), a facility in the U.S. Department of Energy (DOE) complex, encompasses approximately 310 square miles in South Carolina and is adjacent to the Savannah River.

The site was established by the U.S. Atomic Energy Commission (AEC) in 1950 to produce plutonium and tritium for national defense and additional special nuclear materials for other government uses and for civilian purposes. Production of these materials continued for more than 40 years, and the site came to have an integral economic and cultural influence on surrounding areas in South Carolina and Georgia.

When the Cold War ended in 1991, DOE responded to changing world conditions and national policies by refocusing its missions. The site's priorities shifted toward waste management, environmental restoration, technology transfer, and economic development.

This chapter includes general information on the site's history; location, demographics, and environmental setting; mission; and areas and operations.

Site History

Responding to a 1950 directive from President Harry S. Truman to the AEC, E.I. du Pont de Nemours and Company and the commission negotiated a contract whereby Du Pont would design, construct, and operate what was to become the Savannah River Plant (SRP).

On November 22 of that year, the AEC approved the present site and purchased the land for approximately $19 million. By February 1, 1951, construction had begun. The first facility to begin operating, the heavy water plant, started up August 17, 1952, and the first of five production reactors achieved operating status December 28, 1953. All five reactors had achieved operating status by March 1955. [Bebbington, 1990].

Until it was disbanded by the Energy Reorganization Act of 1974, the AEC oversaw and regulated site activities. In 1975, its functions were transferred to two newly established agencies—the Energy Research and Development Administration (overseeing government operations) and the Nuclear Regulatory Commission (overseeing commercial operations). By 1977, the Energy Research and Development Administration had evolved into DOE, which has overseen all facility activities since that time.

Du Pont operated SRP until March 31, 1989. On April 1, 1989, Westinghouse Savannah River Company (WSRC) became the prime operating contractor, and SRP became SRS.

Beginning October 1, 1996, the site was operated under a new contract by an integrated team led by WSRC. Under this contract, WSRC is responsible for SRS's nuclear facility operations; Savannah River Technology Center (SRTC; more about SRTC can be found on page 11); environment, safety, health, and quality assurance; and all the site's administrative functions. Bechtel Savannah River, Inc., is responsible for environmental restoration, project management, engineering, and construction activities. Babcock & Wilcox Savannah River Company is responsible for facility decontamination and decommissioning, and British Nuclear Fuels

Savannah River Corporation is responsible for the site's solid waste program.

Site Locale

In 1950, the site was selected by applying the criteria developed to select the most suitable location in the country to carry out President Truman's directive:

- a large land area for safety and security
- a buffer zone large enough to provide land around each operating facility for protection of human health and the environment
- land somewhat isolated yet near communities that could handle construction and operations personnel
- access to adequate transportation
- land not subject to floods and major storms
- the availability of millions of gallons of water, low in mineral content, for cooling and process use
- suitable terrain and topography

Du Pont, the AEC, and the U.S. Army Corps of Engineers considered 114 sites in 18 states before recommending the current site, which met all the established criteria.

Location

SRS covers 198,344 acres in Aiken, Allendale, and Barnwell counties of South Carolina and borders the Savannah River. The site is approximately 12 miles south of Aiken, South Carolina, and 25 miles southeast of Augusta, Georgia (figure 1–1). It is included within the Central Savannah River Area, which is comprised of 18 counties surrounding Augusta.

The average population density in the counties surrounding SRS is 85 people per square mile, with the largest concentration in the Augusta metropolitan area. Based on 1990 U.S. Census Bureau data, the population within a 50-mile radius of SRS is approximately 620,100. About 70 percent of the site's employees live in South Carolina—primarily Aiken County—and 30 percent in Georgia.

Various industrial, manufacturing, medical, and farming operations are conducted near the site. Major industrial and manufacturing facilities in the area include textile mills, polystyrene foam and paper products plants, chemical processing facilities, and a commercial nuclear power plant. Farming is diversified and includes crops such as cotton, soybeans, corn, and small grains.

Typical Climate at SRS

- **Summer**
  Hot and humid
  Temperatures reach upper 90s (°F)
  33 percent of annual rainfall
- **Fall**
  Cool mornings, warm afternoons
  Temperatures range from 50 to 76 °F
  19 percent of annual rainfall
- **Winter**
  Mild; lasting November through March
  Temperatures normally above 32 °F
  21 percent of annual rainfall
- **Spring**
  Most variable; cold snap often in March
  Temperatures average 65 °F
  27 percent of annual rainfall

Climate

SRS has a relatively mild climate, with an average frost-free season of approximately 246 days. The average annual rainfall, about 48 inches, is fairly evenly distributed throughout the year. There is no strong prevailing wind direction; however, there is a relatively high frequency of east-through-northeast winds during the summer and fall and of south-through-northwest winds during the late fall, winter, and spring [Hunter, 1990]. Except for the Savannah River, no unusual topographic features significantly influence the general climate.

Geology and Hydrology

SRS is on the Upper Coastal Plain of South Carolina. Coastal Plain deposits at SRS consist of 500 to 1,400 feet of sands, clays, and limestones of Tertiary and Cretaceous age. These sediments are underlain by sandstones of Triassic age and by older metamorphic and igneous rocks.

The sandy sediments of the Coastal Plain contain several productive aquifers, separated by clay-rich units, that drain into the Savannah River, its tributaries, and the Savannah River Swamp. The older, underlying rocks are nearly impermeable and are not a major water source.

Water Resources

SRS, bounded on its southwestern border by the Savannah River for about 35 river miles (as measured from the upriver boundary of the site, near Jackson, South Carolina, to the Lower Three Runs Creek corridor), is approximately 160 river miles from the

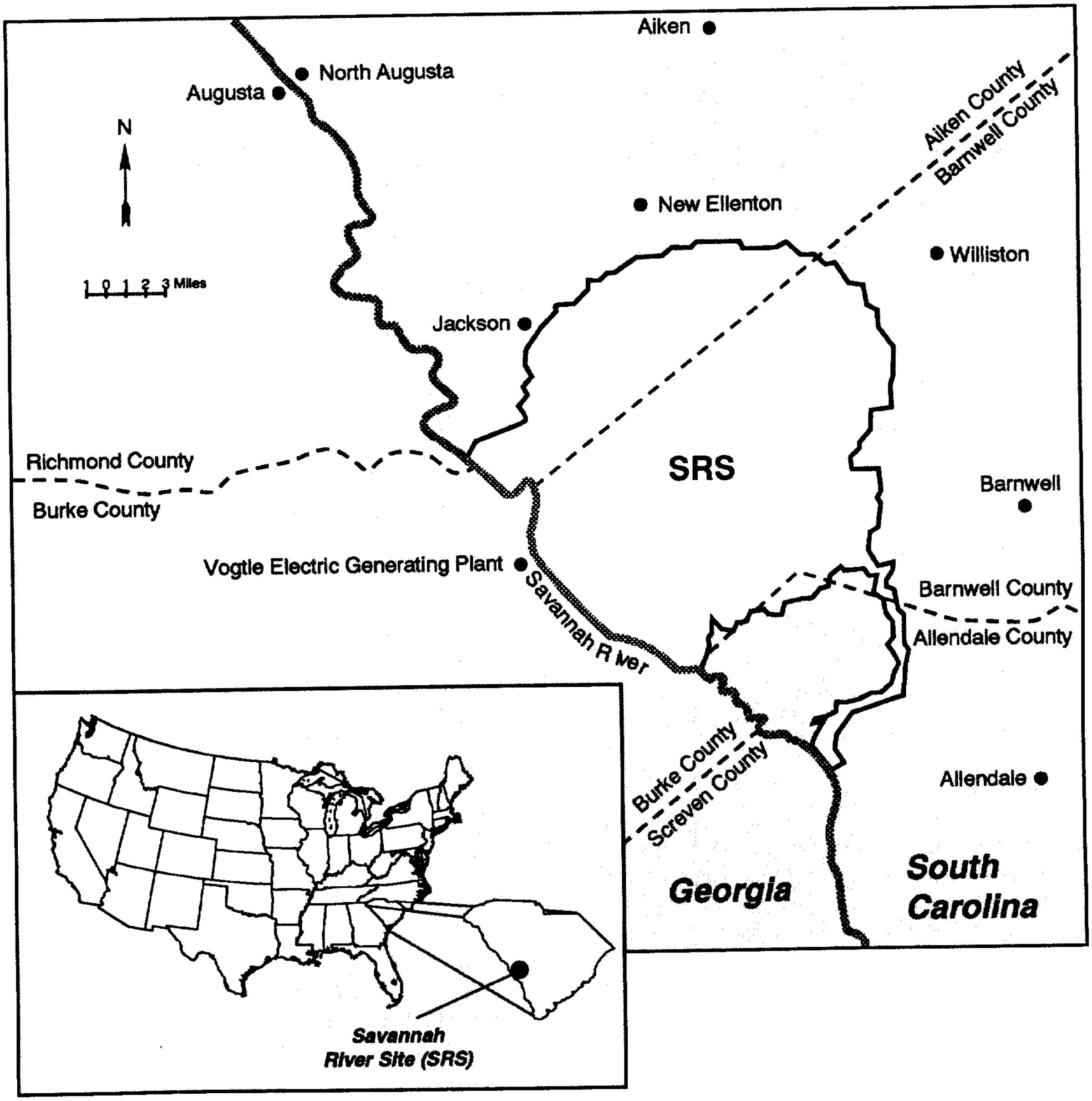


Figure 1–1 Regional Location of SRS

SRS is about 12 miles south of Aiken, South Carolina, and 25 miles southeast of Augusta, Georgia. The site, approximately 310 square miles in area, covers about 1 percent of the state of South Carolina.

Atlantic Ocean. Five major SRS streams feed into the river: Upper Three Runs Creek, Four Mile Creek (also referred to as Fourmile Branch), Pen Branch, Steel Creek, and Lower Three Runs Creek. These streams, which receive effluents from various onsite operations, are not commercial water sources.

The two main bodies of water on site, PAR Pond and L-Lake, are manmade. PAR Pond, constructed in 1958 to provide cooling water for P-Reactor and R-Reactor (hence the name PAR Pond), covers 2,640 acres and is approximately 60 feet deep. The 1,000-acre L-Lake was constructed in 1985 to receive heated cooling water from L-Reactor.

The Savannah River is used as a drinking water supply for approximately 56,000 residents downriver of SRS in Port Wentworth, Georgia, and near Beaufort, South Carolina (Beaufort and Jasper counties) [Fledderman, 1995]. The City of Savannah Industrial and Domestic Water Supply Plant intake, at Port Wentworth, is approximately 130 river miles from SRS; the Beaufort-Jasper Water Treatment Plant intake, near Beaufort, is approximately 120 river miles from SRS. The Savannah River also is used for commercial and sport fishing, boating, and other recreational activities. There is no known use of the river for irrigation by farming operations downriver of the site [Hamby, 1991]. SRS uses water from the river for some of its operations.

Approximately 200 Carolina bays exist on SRS, ranging in size from about 0.2 acre to 125 acres. Carolina bays are unique, naturally occurring wetlands found only on the southeastern Coastal Plain. They are elliptical in shape and oriented northwest to southeast along their long axes; their origin is unknown. Carolina bays are shallow and may dry up seasonally. At SRS, they provide important habitat and refuge for many plants and animals.

Land Resources

The SRS region is part of the Southern Bottomland Hardwood Swamp region, which extends south from Virginia to Florida and west along the Gulf of Mexico to the Mississippi River drainage basin. The main features are river swamps, rarely more than 5 miles wide.

Plant and Animal Life

In 1972, SRS was designated as the first National Environmental Research Park. These parks are used by government and university-related scientists as outdoor laboratories to study the impact of human activity on the environment. This designation has created a unique environment for preserving and studying vegetation and wildlife.

The site provides refuge for approximately 50 endangered, threatened, and sensitive species of plants and animals, such as the red-cockaded woodpecker, the southern bald eagle, the smooth purple coneflower, the Bachman's sparrow, the American alligator, the wood stork, the shortnose sturgeon, and the bog spice bush. Many site research projects are designed to protect and increase the populations of these species.

Vegetation

Most of the site's environs are rural. Approximately 40 percent of the countryside is forested with longleaf and loblolly pines and sweet gum, maple, birch, and various oak-hickory hardwood trees.

Major plant communities at SRS include cypress-gum and lowland hardwood swamps, sandhills, and old agricultural fields, as well as aquatic and semiaquatic areas. These habitats range from very sandy, dry hilltops to continually flooded swamps.

Wildlife

SRS is populated with more than 50 species of mammals, including deer, feral hogs (hogs that have reverted to the wild state from domestication), beavers, rabbits, foxes, raccoons, bobcats, river otters, and opossums. In 1952, there were fewer than three dozen white-tailed deer on site. Since then, however, the population has increased dramatically, and the site now is home to several thousand white-tailed deer [SRFS, 1982]. Since 1965, managed public deer hunts have been held annually on site to reduce the number of animal-vehicle accidents and to maintain the health of the herd.

Savannah River Site: A Unique Outdoor Laboratory

In 1972, the federal government designated SRS as the nation's first National Environmental Research Park. The park provides a unique outdoor laboratory to study the interaction between managed and natural systems. Research activities are conducted through the site environmental organizations described in this chapter.

The Savannah River Swamp is 7,500 acres of natural swampland adjacent to the Savannah River. In the deep water areas of the swamp, two types of trees are dominant: the bald cypress and the water tupelo. These trees cover 50 percent of the swamp. The other 50 percent consists of islands that support bottomland hardwood forests, including oaks, red maples, and sweet gum trees. The swamp also is home to waterfowl and alligators. Studies conducted at the swamp track subtle long-term effects of land use changes on ecosystems.

SRS serves as a refuge for endangered species such as the southern bald eagle, a subspecies of the bald eagle. When fully mature, it is about 40 inches long with dark brown plumage, a white head and tail, and yellow eyes, beak, and feet. Eagles reach full maturity in 3 to 7 years. They are monogamous, mate for life, and tend to use the same nest every year.

More than 100 species of reptiles and amphibians—including turtles, alligators, lizards, snakes, frogs, and salamanders—and more than 200 species of birds also inhabit the site.

Site Mission

While the changing world has caused a downsizing of the site's original defense mission, environmental activities in SRS's future lie in (1) managing, stabilizing, and treating nuclear materials and (2) continuing to clean up the site and manage the waste it has produced. Environmental activities related to SRS missions are discussed briefly in the remainder of this chapter.

Site Areas and Operations

SRS was constructed to produce basic materials used in nuclear weapons, primarily tritium and plutonium-239. Five reactors were built to produce these materials by irradiating target materials with neutrons; support facilities also were built, including two chemical separations plants, a heavy water extraction plant, a nuclear fuel and target fabrication facility, and waste management facilities.

The production process began with the manufacture of fuel and target assemblies produced from a variety of nuclear and other materials such as enriched uranium and aluminum. The assemblies were transported to the reactor, where they were loaded into the reactor core and used to produce a series of controlled nuclear reactions. During the reaction, neutrons from the fuel bombarded the target assemblies to produce the desired products.

The irradiated target assemblies and spent fuel assemblies then were moved to one of the chemical separations facilities—known as "canyons"—where the desired products were separated and waste products were processed.

After refinement, nuclear materials were shipped to other DOE sites for incorporation into nuclear weapons. SRS produced about 36 metric tons of plutonium from 1953 to 1988.

SRS has adjusted to meet declining defense requirements. All five reactors are now shut down, a result of the end of the Cold War. However, recycling and reloading of tritium to maintain the nation's supply of nuclear weapons is a continuing site mission [Fact Sheet, 1996a]. Options for new tritium production are discussed on page 8.

SRS is divided into several areas, based on production and other functions (figure 1–2):

- reactor materials area (M)
- reactor areas (C, K, L, P, and R)
- heavy water reprocessing area (D)
- separations areas (F and H)
- waste management areas (E, F, H, S, and Z)
- administration area (A)
- other areas (B, N, G, and TNX)

In addition, environmental activities are conducted by SRTC, the Savannah River Ecology Laboratory (SREL), the Savannah River Natural Resource Management and Research Institute (SRI, formerly the Savannah River Forest Station), and the Savannah River Archaeological Research Program (SRARP).

Reactor Materials Area

The reactor materials area (M-Area) consists of a fuel and target fabrication facility, three analytical laboratories, and the Liquid Effluent Treatment Facility (LETF).

The fuel fabrication facility produced fuel and target assemblies to be used in the reactors. Control rods and other reactor components also were manufactured in the facility.

The LETF treated wastewater generated by various M-Area processes and consolidated low-radioactivity residues from M-Area processes for eventual disposal.

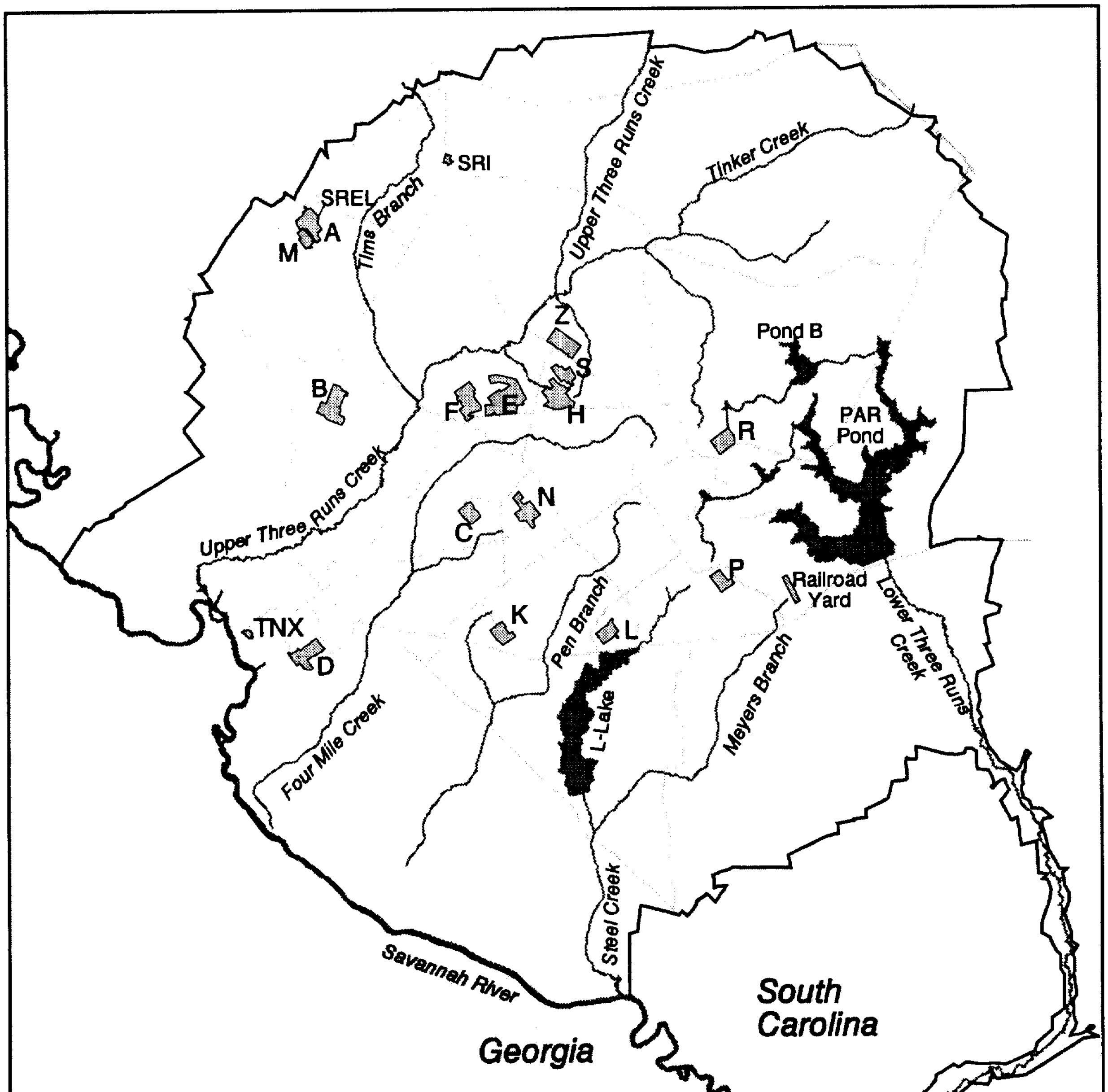
Reactor Areas

Production reactors are in five areas: C, K, L, P, and R. Each area houses one of the site's five heavy water reactors. The basis for the design of the reactors was derived in large part from experience and data generated at the Argonne National Laboratory in Argonne, Illinois. Argonne, the focal point for heavy water reactor research and development, had built and operated two such reactors by 1950 [Bebbington, 1990].

All five production reactors, (R-Reactor, P-Reactor, L-Reactor, K-Reactor, and C-Reactor) have been placed in cold shutdown.Although the areas are being used, as for moderator and fuel storage, no effort is being expended to maintain the reactors.

R-Reactor achieved operating status in December 1953 and was shut down permanently in 1964.

P-Reactor was started in February 1954 and was shut down in August 1988 for maintenance. In February 1991, it was placed in cold standby and was



A	Administrative Area
B	Engineering Complex
C, K, L, P, R ...	Reactor Areas
D	Heavy Water Reprocessing Areas
E, F, H, S, Z ...	Waste Management Areas
F, H	Separations Areas
M	Reactor Materials Area
N	Central Shops
TNX..........	Multipurpose Pilot Plant Campus

EPD/GIS Map

Figure 1–2 The Savannah River Site
SRS includes nuclear materials production areas, which are primarily in the interior of the site, and several operating areas. SREL and SRI (formerly SRFS) also are located on site.

to be used to provide spare parts for L-Reactor and K-Reactor. This potential use was eliminated by the subsequent permanent shutdown of L-Reactor and K-Reactor; therefore, P-Reactor has been shut down permanently.

L-Reactor achieved operating status in August 1954 and was placed in cold standby in 1968. It was restarted in October 1985, after upgrading, and was shut down for maintenance and safety upgrades in August 1988. It was placed in warm standby in December 1991 to be put into operation as a backup to K-Reactor, if necessary, but since has been shut down permanently.

C-Reactor achieved operating status in March 1955 and was shut down in 1985 for maintenance. It was placed in cold standby in 1987, when cracking was observed in the reactor vessel. C-Reactor has been shut down permanently.

K-Reactor achieved operating status in October 1954 and was shut down in August 1988 for maintenance. Initial steps to restart K-Reactor began in December 1991. Successful power ascension testing was completed in July 1992. Following ascension testing, the reactor was taken offline to allow for the tie-in of a cooling tower. The tie-in was completed, and the operating permit was issued in December 1992. In 1993, the cooling tower was tested; however, the reactor was never restarted. K-Reactor was placed in cold standby, but the official status was changed in 1996 to cold shutdown.

Heavy Water Reprocessing Area

A heavy water production plant in D-Area began operations in 1953 to produce heavy water to moderate and cool the site's reactors. The plant separated heavy water, present in small amounts in all water, from Savannah River water. The existing plant was the finishing plant for the huge extraction plant that discontinued operations in 1981 because of a sufficient supply of heavy water and was shut down.

Facilities operating in D-Area include a coal-fired power plant (leased by DOE to the South Carolina Electric and Gas Company effective in 1995), laboratory facilities to analyze the heavy water process samples, and the Heavy Water Facility. Although no reactor operations are ongoing, the degraded heavy water is a legacy from normal reactor operations and other DOE sites' activities. This degraded water is reworked to remove the light water and other impurities, increasing the heavy water purity to 99.75 percent.

Funding fluctuations caused interruptions in the rework operations during fiscal years 1996 and 1997. However, operations to remove the light water and consolidate the purified heavy water for storage in fewer drums have resumed in D-Area. This heavy water possibly will be sold.

Separations Areas

Separations

Two large chemical separations facilities (F-Canyon and H-Canyon, so called because of their long, narrow shapes) and their associated liquid-waste treatment and storage facilities are located in F-Area and H-Area. In these areas, irradiated fuel and targets are reprocessed. Irradiated materials are dissolved, and the products of interest are chemically separated and purified from waste products.

In addition to processing special nuclear materials for defense purposes, H-Canyon was equipped to recover plutonium-238 for use in power systems for deep space exploration [Fact Sheet, 1996d]. In 1995, the facility completed a 5-year campaign for the National Aeronautics and Space Administration (NASA) to supply plutonium-238 for the Cassini mission, an unmanned expedition to the planet Saturn. NASA successfully sent the Cassini spacecraft into space October 13, 1997.

Spent Fuel

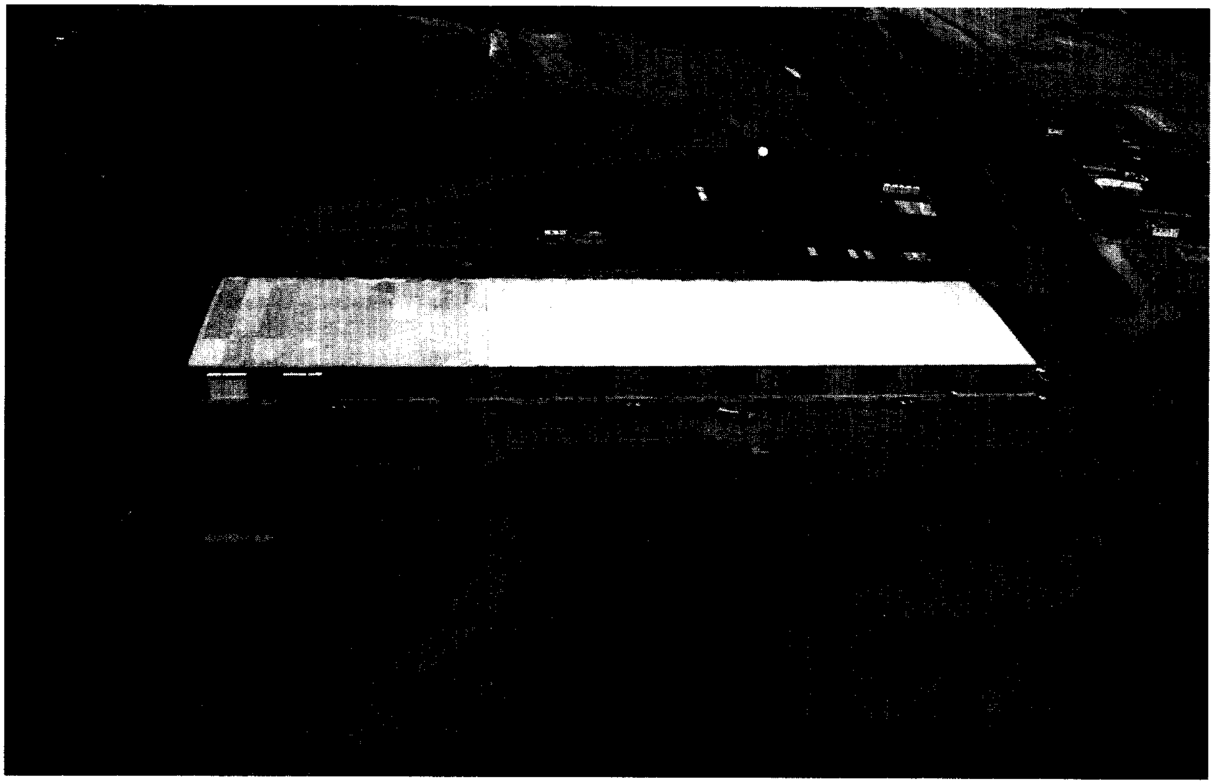
Operations in the separations areas also include receipt of offsite fuel for processing and tritium processing. Facilities include the canyon buildings, the FB-Line and the HB-Line (located atop the canyons), the Receiving Basin for Offsite Fuel (RBOF), and the Replacement Tritium Facility (RTF).

Spent fuel elements from offsite sources are stored and packaged in the RBOF. This facility receives and stores irradiated spent fuel, primarily from domestic and foreign research reactors. The spent fuel is repackaged for extended storage and/or shipment to an onsite or offsite facility. More about this spent fuel can be found on page 9.

Tritium

Tritium, one of the materials produced by the site for national defense, has a half-life of 12.5 years and must be replenished. SRS is the nation's only facility for recycling tritium from nuclear weapons reservoirs returned from service. This recycling allows the United States to use its tritium supplies efficiently.

The SRS tritium facilities in H-Area consist of four main process buildings designed and operated to



Byron Williams Photo (97–1472–04)

Among the facilities in waste management areas designed to store or treat wastes generated from onsite operations are the E-Area Vaults. Most low-level wastes, formerly buried in SWDF, are stored or disposed of in these vaults. Examples of low-level wastes include protective clothing, tools, and rags.

process tritium. The newest building is the one-acre-sized underground RTF. The main mission of the tritium facilities is to purify and maintain existing inventories of tritium for defense purposes.

With the SRS production reactors shut down, DOE began a search for a new source for tritium. The department is evaluating two options for tritium production: using an existing commercial reactor and constructing a linear accelerator. The preferred alternative is expected to be selected in 1998 and designated the primary method of tritium production.

If the linear accelerator is selected, it will be constructed at SRS to take advantage of the site's long-standing expertise and capabilities in handling tritium. In either case, tritium extraction and loading will continue to be a site mission [Fact Sheet, 1996a].

Waste Management Areas

Waste management activities are conducted in the following areas: E, F, H, S, and Z. E-Area, between F-Area and H-Area, includes most of the site's disposal and storage facilities.

Weapons material production at SRS has generated unusable byproducts, such as highly radioactive waste. About 34 million gallons of this high-level radioactive waste is stored in tanks on site [Fact Sheet, 1996a]. In addition, other wastes at the site include low-level solid and liquid radioactive wastes; transuranic waste (which contains alpha-emitting isotopes that have decay rates and concentrations exceeding specified levels); hazardous waste (which is any toxic, corrosive, reactive, or ignitable material that could negatively affect human health or the environment); mixed waste (which contains both hazardous and radioactive components); and sanitary waste (which is neither radioactive nor hazardous). How the site manages this waste is discussed in chapter 4, "Environmental Restoration and Waste Management."

Facilities in waste management areas are designed to store or treat the waste generated from onsite operations. These facilities include the Solid Waste Disposal Facility (SWDF); the E-Area Vaults; the Effluent Treatment Facility (ETF); the high-level waste storage tanks in F-Area and H-Area ("tank farms"); the Extended Sludge Processing Facility; the

In-Tank Precipitation Facility; the Defense Waste Processing Facility (DWPF); the Saltstone Facility; and the Consolidated Incineration Facility (CIF).

SWDF is a disposal site for such items as protective clothing, tools, and equipment contaminated with small amounts of radioactive material. Most solid low-level waste is disposed of permanently in the engineered concrete E-Area Vaults, which provide significantly more protection for the environment. Soil and debris may be disposed of in engineered trenches.

Historically, seepage basins were used to dispose of wastewater from the separations facilities in F-Area and H-Area. The ETF, located in H-Area, treats the low-level radioactive wastewater formerly sent to the seepage basins. The ETF removes radioactive and nonradioactive contaminants, except tritium, from process effluents and allows the water to discharge to Upper Three Runs Creek.

The F-Area and H-Area waste tank farms consist of large underground storage tanks that hold high-level liquid radioactive waste. The waste is contained in 29 tanks in H-Area and 22 tanks in F-Area. Sludge and saltcake must be removed from the tanks so the wastes can be processed for ultimate disposal.

The Extended Sludge Processing Facility washes the sludge to remove excess aluminum and salts before the sludge is ready to be fed to the DWPF. The In-Tank Precipitation Facility in H-Area separates the highly radioactive portion ("precipitate") of the saltcake from the low-level radioactive portion ("filtrate").

The DWPF, located in S-Area, immobilizes the high-level waste sludge and the precipitate by "vitrifying" it into a solid glass waste form. A component of the DWPF, the Saltstone Facility, treats and disposes of the filtrate by stabilizing it in a solid, cement-based waste form [Fact Sheet, 1996c].

The CIF, located adjacent to H-Area, was designed to safely burn certain hazardous, low-level radioactive, and mixed (both hazardous and radioactive) wastes.

Administration Area

The administration area (A-Area) contains organizations that provide direct support for SRS operations. DOE's Savannah River Operations Office and WSRC's administrative offices are located in A-Area, as are SRTC and SREL.

Other Areas

Other onsite and offsite facilities support SRS operations. Onsite areas include an engineering complex (B-Area); Central Shops (N-Area); and TNX (now called the Multipurpose Pilot Plant Campus), a research and development area. Locations not within areas designated for specific purposes are called G-Area, or general area. Activities conducted off site are administrative and do not involve radioactive or hazardous materials.

Site Activities and Functions

Spent Fuel

Beginning in the 1950s, as part of the "Atoms for Peace" program, the United States provided nuclear technology to foreign nations for peaceful applications in exchange for their promise to forego development of nuclear weapons. A major element of this program was the provision of research reactor technology and the highly enriched uranium needed in the early years to fuel the research reactors. Research reactors play a vital role in important medical, agricultural, and industrial applications. However, the uranium initially used in the fuel elements for these reactors also could be used in production of nuclear weapons. Therefore,the used fuel elements ("spent nuclear fuel") were transported to the United States, where they were chemically separated to extract the uranium still remaining in the fuel. In this way, the United States maintained control over disposition of the highly enriched uranium that it provided to other nations.

For years, it was routine for the foreign researchers to return this U.S.-origin spent fuel to the United States—first, under bilateral agreements, and then, (from 1964 until 1988) under the "Off-Site Fuels Policy." The "Off-Site Fuels Policy" expired in 1988, and shipments no longer were accepted by the United States. The decision to return to this practice was made in 1996 [DOE, 1996], and the first shipment from foreign research reactors arrived on site in September of that year [Fact Sheet, 1996a].

Spent nuclear fuel is managed in several locations at the site. Most of the spent nuclear fuel remaining from SRS reactor operations is in water-filled concrete storage basins, which originally were intended as interim storage facilities. Fuel from domestic and foreign research reactors is stored in the RBOF (discussed on page 7). Storage will be a major issue for fuels that are not processed or that arrive after SRS reprocessing facilities are phased out. Many of the original storage facilities were not designed for the long interim storage period that may be required pending disposition. DOE is developing an integrated, long-term spent fuel management program that will address storage and treatment of all spent fuel until an ultimate disposition is determined.

Facilities Deactivation and Decommissioning

Because of the ending of the Cold War and the change in missions, many SRS facilities are no longer needed to produce or process nuclear materials. Many of them contain materials that could be hazardous, and the site faces a major task in the cleanup, reuse, safe storage, and demolition of these facilities. Deactivation and decommissioning activities are discussed in chapter 4, "Environmental Restoration and Waste Management."

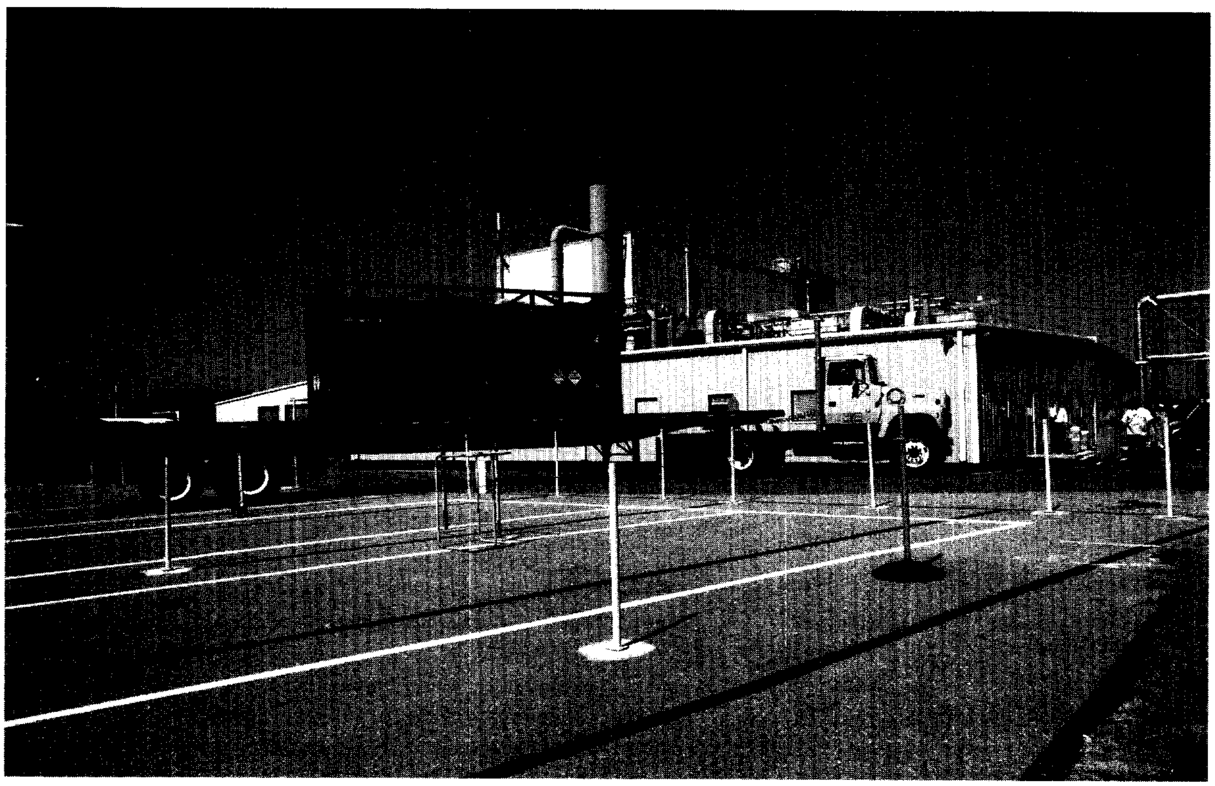
Environmental Restoration

In 1981, SRS began inventorying waste sites (referred to as "units") for eventual restoration; there are about 477 waste units and sites to be addressed through the site's environmental restoration program. Waste units and sites range in size from a few square or cubic feet to tens of acres and include basins, pits, piles, burial grounds, landfills, tanks, and groundwater contamination areas.

Of the 500 acres to be addressed in the environmental restoration program, about 280 have been or are being remediated. Also, billions of gallons of groundwater have been treated to remove hundreds of thousands of pounds of solvents. Even though the site has had success in cleaning up some areas, a significant amount of environmental restoration work remains [Fact Sheet, 1996a]. More about environmental restoration can be found in chapter 4, "Environmental Restoration and Waste Management."

Environmental Monitoring

Onsite and offsite radiological and nonradiological environmental monitoring is conducted by the Environmental Monitoring Section (EMS) of WSRC's Environmental Protection Department (EPD). The environmental monitoring program is discussed briefly in chapter 3, "Environmental Program Information," and more thoroughly in chapters 5, ("Radiological Effluent Monitoring"), 6 ("Radiological Environmental Surveillance"), 8



Byron Williams Photo (96–1551–221)

Spent fuel from foreign research reactors is unloaded at the RBOF in H-Area. This fuel was brought by sea to Charleston, South Carolina, and was transported by train to SRS. It then was loaded onto the truck and taken to the RBOF for storage.

("Nonradiological Effluent Monitoring"), and 9 ("Nonradiological Environmental Surveillance").

Also, the Division of Environmental Research of the Academy of Natural Sciences of Philadelphia has performed biological and water quality surveys of the Savannah River since 1951. More about the academy's surveys can be found in chapter 12 ("Special Surveys and Projects").

Research and Development

SRTC is SRS's applied research and development laboratory, providing technical support for the site's missions and working in partnership with the site's operating divisions, as well as with other government and private research organizations. In recent years, SRTC's role has expanded and includes providing related support to other DOE sites, other federal agencies, and other customers. SRTC is active in transferring technology to American industry and establishing partnerships with industry and academia.

In the past, the technology center focused on processes for producing nuclear materials. Responding to the nation's changing priorities, however, the center now focuses on developing, testing, and demonstrating equipment and techniques for

- processing nuclear materials
- cleaning up and protecting the environment
- processing and stabilizing waste
- decontamination and decommissioning
- minimizing the global nuclear danger

Recently added activities include work in support of the proposed accelerator discussed on page 8 and advanced technologies for spent nuclear fuel packaging.

Other Environmental Research

Savannah River Ecology Laboratory

SREL is operated by The University of Georgia and funded by DOE to conduct research related to the impact of site operations on the environment. Research programs are organized into four main categories—radioecology, environmental chemistry, ecotoxicology, and ecosystem health.

Radioecology research assesses the distribution, fate, and ecological risk associated with radionuclides in the environment, including the genetic effects on flora and fauna at SRS and more contaminated sites such as the Chernobyl site in the Ukraine. Environmental chemistry research addresses the physical, chemical, and biological processes controlling the mobility of organic and inorganic contaminants in the environment, particularly in soils and water of SRS and other DOE sites. Research in ecotoxicology seeks to measure or predict bioaccumulation of contaminants in natural populations of organisms. The program also seeks to evaluate genetic and demographic markers in various species for use as possible indicators of responses to environmental contaminants. Objectives of the ecosystem health research are to identify patterns of biodiversity on the site and to understand the natural and anthropogenic processes that maintain or change them.

Additional studies are conducted on the site's deer herd, fish, reptiles, amphibians, waterfowl, and endangered species, such as the wood stork. Other studies evaluate the potential of various experimental approaches for remediating contaminated soils, Carolina bays, and other habitats.

Information about SREL's outreach program can be found in chapter 3. More information about all programs can be obtained by contacting SREL at 803–725–0156.

Savannah River Natural Resource Management and Research Institute

SRI manages the natural resources at SRS. In 1952, the Atomic Energy Commission and the U.S. Department of Agriculture Forest Service formed an interagency agreement to create an onsite natural resources management organization at SRS. Because the site had been farmland, an early task of the Forest Service was to play a major role in planting millions of trees to help establish a buffer around the facilities being constructed. Forest Service practices since have created a unique refuge for a variety of plants and animals, including six endangered species and more than 40 sensitive species. Today, major responsibilities include the following:

- SRI provides administrative support for more than 90 forest research projects in cooperation with Forest Service and site organizations, universities, and research laboratories.
- Soil, water, and air personnel provide support to other groups on site involved in erosion and sediment control projects.
- Wildlife and botany personnel maintain and improve a variety of habitats that will support native plants and animals.
- Each year, SRI sells about 25 million board feet of sawtimber (timber large enough to be sawed into lumber) and roundwood products (wood not big enough for lumber but useful for making

paper, etc.). At the same time, it plants more than 1,000 acres of new seedlings.

- Fire management personnel control-burn about 15,000 acres each year to protect site facilities and improve a variety of forest resources. They are responsible for suppressing any wildfires on site.
- Engineers maintain all secondary roads and exterior boundaries.

Information about SRI's education outreach program can be found in chapter 3. Information about other programs can be obtained by contacting SRI at 803–725–0237.

Savannah River Archaeological Research Program

SRARP was formed in 1973 under a cooperative agreement with DOE and the South Carolina Institute of Archaeology and Anthropology, University of South Carolina. Its primary purpose is to make compliance recommendations to DOE that will facilitate the management of archaeological resources at SRS. Other functions include compliance activities involving reconnaissance surveys, specific intensive surveys, data recovery, coordination with major land users, and reconstruction of the environmental history of the site. More information can be obtained by contacting SRARP at 803–725–3623.

Chapter 2

Environmental Compliance

Mary Dodgen, Pete Fledderman, Phillip Miller, and Greg Peterson
Environmental Protection Department

To Read About . . . See Page . . .

1997 Highlights

- Underground storage tank regulations require that all regulated existing tanks be closed or upgraded to comply with new tank standards by December 22, 1998. In 1997, WSRC closed nine tanks by removal, replaced four tanks, and performed tightness tests on 13 tanks and their connective piping. Every tested tank passed.
- Two high-level waste tanks were closed at SRS—tank 20F on July 31 and tank 17F on December 15. Each of the single-shelled carbon steel vessels had a capacity of 1.3 million gallons.
- SRS's 1997 RFI/RI activities included the submittal to EPA and SCDHEC of nine RODs, 24 site evaluations, seven RFI work plans, six field starts, two "applied-standards corrective action design" combined documents, and six statements of basis/proposed plans.
- SRS submitted its Toxic Chemical Release Inventory report for 1996 to EPA ahead of the July 1, 1997, deadline. Seven chemicals, with releases totaling 24,268 pounds, were reported for 1996—compared with six chemicals (60,503 pounds) reported for 1995 and eight chemicals (85,658 pounds) reported for 1994.
- SRS became the first site in the DOE complex to implement an integration process for NEPA and CERCLA compliance programs. This process represented the culmination of site efforts to comply with DOE Order 5440.1 and with the NEPA secretarial policy—to minimize document preparation time and reduce costs.
- SRS achieved a compliance rate of 100 percent and received no NOVs under the CAA. Under the CWA, the site received four NOVs but still had a NPDES compliance rate of 99.9 percent—higher than the DOE-mandated rate of 98 percent.
- SRS notified regulatory agencies of three CERCLA-reportable releases. This compares with two such releases in 1996, four in 1995, and two in 1994.
- Of the 597 SIRIM-reportable events in 1997, 35 were categorized as primarily environmental. Of the 35 events, none were classified as emergencies, four were classified as unusual occurrences, and 31 were classified as off-normal occurrences.

SAVANNAH River Site (SRS) operations in 1997 continued to involve a wide variety of processes and chemicals subject to compliance with environmental statutes, regulations, and policies. Such compliance ensures that SRS, the public, and the surrounding environment are protected from any adverse effects generated by site operations. This chapter addresses environmental compliance issues with which the site was involved during 1997.

SRS's goal—and that of the U.S. Department of Energy (DOE)—is positive environmental stewardship and full regulatory compliance, with zero violations. The site's employees maintained progress toward achievement of this goal in 1997, as demonstrated by examples in this chapter.

A systematic effort is in place to identify and address all evolving regulatory responsibilities that concern SRS. As part of the process, communications are maintained with all appropriate regulatory agencies to emphasize the site's commitment to environmental compliance.

The site's compliance efforts achieved a very high level of success in 1997. For example, under the Clean Water Act (CWA), 5,758 analyses were performed during the year to demonstrate compliance with the site's National Pollutant Discharge Elimination System (NPDES) permits; the site's

Some of the Key Regulations SRS Must Follow

Legislation	What it Requires/SRS Compliance Status
RCRA Resource Conservation and Recovery Act (1976)	♦ The management of hazardous and nonhazardous wastes and of underground storage tanks containing hazardous substances and petroleum products—in compliance
FFCAct Federal Facility Compliance Act (1992)	♦ The development by DOE of schedules for mixed waste treatment to avoid waiver of sovereign immunity and to meet LDR requirements—in compliance
CERCLA; SARA Comprehensive Environmental Response, Compensation, and Liability Act (1980); Superfund Amendments and Reauthorization Act (1986)	♦ The establishment of liability, compensation, cleanup, and emergency response for hazardous substances released to the environment—SRS placed on National Priority List in December 1989
CERCLA/TITLE III (EPCRA) Emergency Planning and Community Right-to-Know Act (1986)	♦ The reporting of hazardous substances used on site (and their releases) to EPA, state, and local planning units—in compliance
NEPA National Environmental Policy Act (1969)	♦ The evaluation of the potential environmental impact of federal activities and alternatives; in 1997, WSRC conducted 304 reviews for new proposed actions—in compliance
SDWA Safe Drinking Water Act (1974)	♦ The protection of public drinking water systems; enacted in 1974, amended in 1980, 1986—in compliance
CWA; NPDES Clean Water Act (1977); National Pollutant Discharge Elimination System	♦ The regulation of liquid discharges at outfalls (e.g., drains or pipes) that carry effluents to streams—in compliance
CAA; NESHAP Clean Air Act (1970); National Emission Standards for Hazardous Air Pollutants	♦ The establishment of air quality standards for hazardous air emissions, such as radionuclides and benzene—in compliance
TSCA Toxic Substances Control Act (1976)	♦ The regulation of use and disposal of PCBs—nation has inadequate disposal capacity for radioactive PCBs generated and currently stored at SRS

compliance rate was 99.9 percent, calculated by dividing the number of analyses not exceeding limits for the year (5,751) by the total number of analyses. Even with this success, however, the site received four notices of violation (NOVs) from the South Carolina Department of Health and Environmental Control (SCDHEC), as described later in this chapter.

Under the Clean Air Act (CAA), the 1997 compliance rate was 100 percent. Some key regulations with which the site must comply—and its compliance status on each—are noted in the chart above.

Compliance Activities

Compliance with environmental regulations and with DOE orders related to environmental protection is a critical part of the operations at SRS. Assurance that onsite processes do not impact the environment adversely is a top priority, and management of the environmental programs at SRS is a major activity. All site activities are overseen by one or more regulatory bodies, including the U.S. Environmental Protection Agency (EPA) and SCDHEC. Significant effort and funding have been dedicated to ensuring that site facilities and operations comply with all requirements.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) was passed in 1976 to address the problem of solid and hazardous waste management. The law requires that EPA regulate the management of solid and hazardous wastes, such as spent solvents, batteries, and many other discarded substances deemed potentially harmful to human health and the environment. Amendments to RCRA regulate nonhazardous solid waste and some underground storage tanks.

Under RCRA, hazardous waste generators are responsible for managing every aspect of the generation, treatment, storage, and disposal of the waste; this is referred to as "cradle-to-grave" management. Hazardous waste generators, including SRS, must follow specific requirements for handling these wastes. For many waste management activities, RCRA requires permits for owners and operators of operating or post-closure-care hazardous waste management facilities.

EPA is responsible for all hazardous waste regulations. However, EPA can delegate this authority to a state when the state passes laws and regulations that meet or exceed the EPA hazardous waste regulations. The state plan then must be approved by EPA. The agency has approved South Carolina's plan and delegated RCRA authority to SCDHEC. Similarly, the Federal Facility Compliance Act (FFCAct) gives the state authority to enforce land disposal restrictions (LDRs)/treatment standards for mixed wastes. Mixed wastes contain both hazardous and radioactive wastes. Also, SCDHEC has been authorized by the FFCAct to play the key role in the implementation of FFCAct statutes and was the lead regulatory agency for implementation of the SRS Site Treatment Plan (STP), which addresses storage and treatment of mixed waste. More information on waste management at SRS can be found in chapter 4, "Environmental Restoration and Waste Management."

Federal Facility Compliance Act

The FFCAct was signed into law in October 1992 as an amendment to the Solid Waste Disposal Act to add provisions concerning the application of certain requirements and sanctions to federal facilities. With respect to federal agencies, the FFCAct waives sovereign immunity from all civil and administrative penalties and fines; this includes waivers for both coercive and punitive sanctions for violations of the Solid Waste Disposal Act. For mixed waste, the FFCAct provided a 3-year delay (until October 1995) in the imposition of fines and penalties so that DOE sites could investigate mixed waste volumes in storage, evaluate treatment capacities, and develop STPs with schedules for mixed waste treatment for approval by their state or federal regulatory agencies.

Westinghouse Savannah River Company (WSRC) submitted a mixed waste inventory report January 13, 1993, and DOE Headquarters (DOE–HQ) issued a complexwide report—*U.S. Department of Energy Interim Mixed Waste Inventory Report: Waste Streams, Treatment Capacities, and Technologies*—April 21, 1993, to state governors and to regulatory agencies in states that host DOE sites. This was followed by a comment period for the regulators and states. DOE–HQ provided an update to the mixed waste inventory report in April 1994.

On March 30, 1995, DOE's Savannah River Operations Office (DOE–SR) submitted an STP—developed with State of South Carolina involvement—that addressed the development of capacities and technologies for treating SRS mixed wastes in accordance with LDRs, as required by the FFCAct. This plan was approved with modifications, and the FFCAct consent order was issued September 29, 1995. DOE–HQ and SRS prepare regular updates of the mixed waste inventory report every September to support the STP.

Land Disposal Restrictions

The 1984 RCRA amendments established LDRs, often referred to as "land ban." LDRs do not allow storage of restricted hazardous wastes, except for the purpose of accumulating such quantities as are necessary to facilitate proper recovery, treatment, or disposal. The amendments require that, prior to land disposal, all wastes meet treatment standards based on the "best demonstrated available technology."

The same restrictions apply to mixed wastes, which are composed of a mixture of radioactive and hazardous wastes. Because SRS did not have the capability to comply with the applicable LDR requirements, a Federal Facility Compliance Agreement (FFCA) was signed in March 1991 between DOE–SR and EPA Region IV (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee). The goal of the FFCA was to address SRS mixed waste compliance with LDRs. Effective September 29, 1995, commitments made under an amended FFCA allowed for a smooth transition to the STP and the STP Consent Order, which enforced the STP commitments.

As required by the STP Consent Order, SRS issued an annual update to the STP by April 30, 1997. The update called for changes in the mixed waste treatment status, including the addition of new mixed waste streams. Information for STP updates was supplied in part from a Mixed Waste Inventory Report completed in September 1996. STP updates will continue to be produced annually unless the consent order is modified.

Treatability variances are an option available to facilities for particular waste streams that either cannot be treated at the level specified in regulations—the appropriate treatment technology may not be available—or for which the treatment technology is inappropriate for the waste. SRS has identified some mixed waste streams that are potential candidates for a treatability variance. One variance—for in-tank precipitation filters—was granted in October 1993 by EPA Region IV. The STP references two additional treatability variances for mixed wastes with special problems that prevent treatment according to LDR standards. These two variances, completed and sent to EPA headquarters September 30, 1997, were for tritiated water with mercury and for silver saddles (silver nitrate-coated ceramic devices designed to take up iodine gas).

Underground Storage Tanks

Underground storage tanks at SRS house petroleum products—such as gasoline and diesel fuel—and hazardous substances, as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). All such tanks are regulated under Subtitle I of RCRA.

Underground storage tank regulations require that all regulated existing tanks be closed or upgraded to meet or comply with new tank standards by December 22, 1998. In 1997, WSRC closed nine tanks by removal, replaced four tanks, and performed tightness tests on 13 tanks and their connective piping. Every tank that was tested passed.

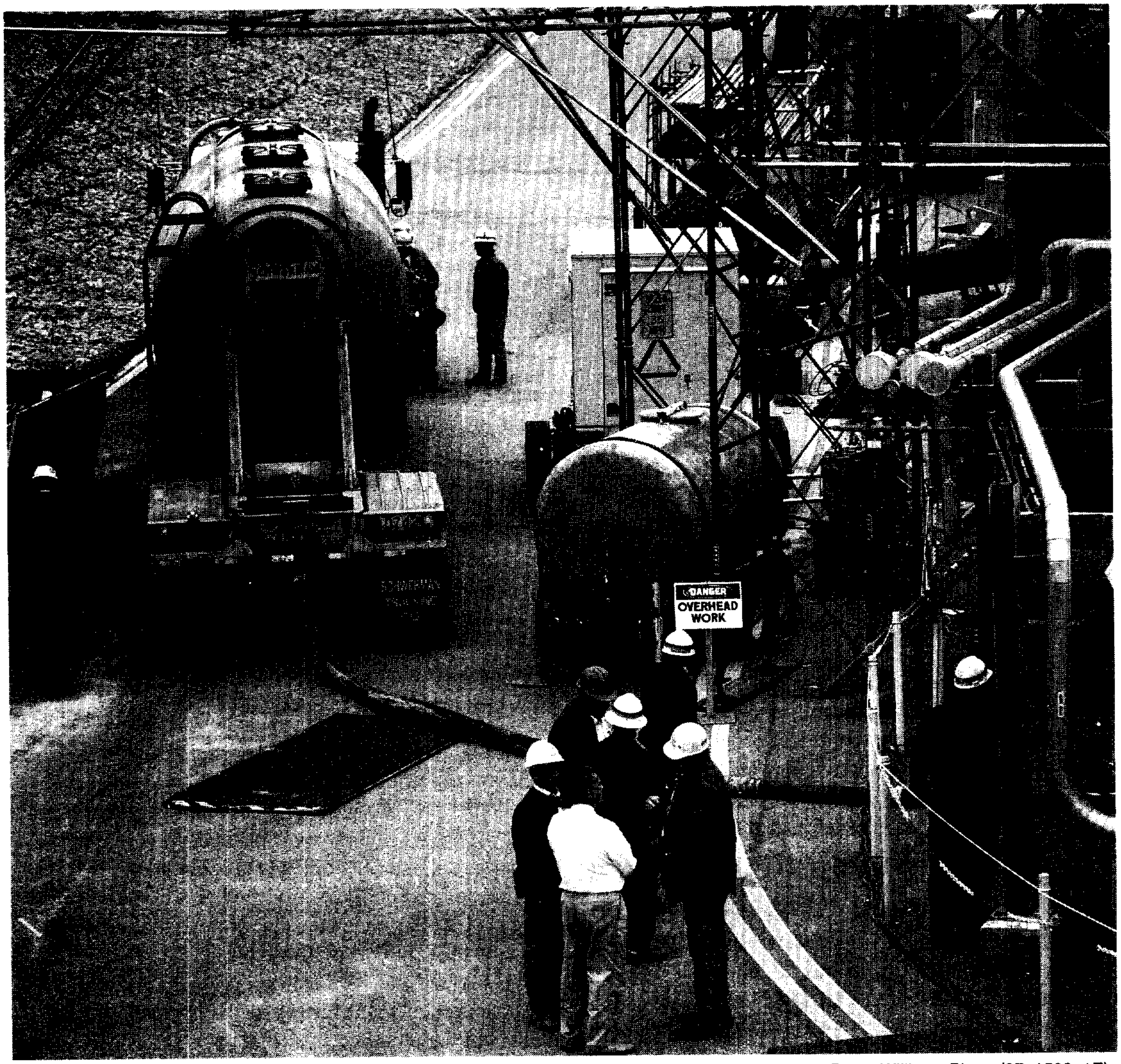
The regulations set standards for upgrading existing tanks based on their age. Existing tanks must be monitored for leaks, and records must be kept for inventory control. In areas where underground tanks are still needed, WSRC will replace single-walled tanks with double-walled tanks that have leak/spill/overfill detection systems. During 1997, of the 24 total operational petroleum storage tanks at SRS, 22 met the new tank standards, and the remaining two are to be closed by the December 1998 deadline.

High-Level Radioactive Waste Tank Closure

As they did in 1996, Environmental Protection Department (EPD) personnel participated during 1997 in a team effort with High-Level Waste Division personnel as writers/reviewers for the "Industrial Wastewater Closure Plan Modules for F- and H-Area High-Level Waste Tanks 17 and 20" documents. EPD will continue to be a part of this process as individual tank system closure modules are developed for closure of operational groupings of the SRS tank systems. Department personnel also will help develop a revised waste removal plan and schedule.

The primary regulatory goal of SRS's waste tank closure process at the F-Area and H-Area high-level tank farms is to close the tank systems in a way that protects public health and the environment in accordance with South Carolina Regulation R.61–82, "Proper Closeout of Wastewater Treatment Facilities." This must be accomplished in compliance with the requirements of RCRA and CERCLA, under which the high-level waste tank "farms" eventually will be remediated. A general tank closure plan presents the environmental regulatory standards and guidelines pertinent to closure of the waste tanks and describes the process for evaluating and selecting the closure configuration (the residual source term and method of stabilizing the tanks' residual waste material). The plan also describes the integration of existing commitments with high-level waste farm closure activities. These commitments involve removal of waste from the tanks before closure and remediation of the entire area (including soils and groundwater) surrounding the tank farms.

Tank 20F, a 1.3-million-gallon, single-shelled, carbon steel vessel, was closed July 31, 1997. Tank 17F, with the same capacity, was closed December 15, 1997. Prior to the initiation of closure activities, all but approximately 1000–2000 gallons of waste were removed from each tank and further processed. The closure configuration included filling the tanks with a "sandwich" of grouts. The first layer consisted of a minimum of 30 inches of a chemically reducing grout, which was formulated with chemical properties that retard the movement of some radionuclides and chemical constituents from the closed tank. On top of the reducing grout is a layer of controlled



Byron Williams Photo (97–1508–1E)

SRS workers prepare to pump grout from a tanker truck to tank 17F. The 1.3-million-gallon tank, located in F-Area, was one of two high-level radioactive waste tanks closed at the site during 1997.

low-strength material, a self-leveling concrete filler that provides sufficient strength to support the overbearing weight. This concrete-filler layer is about 32 feet thick and reaches within 12 inches of the top of the vertical wall of the tank. The final layer is a strong, free-flowing grout similar in strength to normal concrete (withstands 2,000 pounds per square inch). The purpose of this top layer of grout is to eliminate voids around the tank's risers and to discourage intruders from accessing the waste.

The assessment of soils and groundwater around the waste tanks will be deferred until complete closure of a geographical grouping of tank systems and their associated support services. The tank 17F and tank 20F systems cannot be isolated practically from other operational systems for the purpose of assessing potential remedial actions.

A revised waste removal plan and schedule calls for SCDHEC and EPA approval in 1998. SCDHEC had requested a revised waste removal plan and schedule that is consistent with the three-party consensus tank closure strategy outlined in the high-level waste tank closure program plan. Appendix C of this plan is used by SRS as a tool for managing high-level waste tank system closures. Its schedule supersedes the original waste removal plan and schedule, submitted to SCDHEC and EPA in November 1993.

RCRA 3004(u) Program

The hazardous waste permit issued to SRS in September 1987 requires that the site institute a program for investigating and, if necessary, performing corrective actions at solid waste management units under RCRA 3004(u). The RCRA 3004(u) requirements have been integrated with CERCLA requirements in the Federal Facility Agreement (FFA). The integration of RCRA and CERCLA regulatory requirements is expected to provide a more cost-effective and focused investigation and remediation process. The RCRA/CERCLA program status is detailed under the CERCLA section of this chapter.

Waste Minimization Program

The SRS Waste Minimization Program, a comprehensive plan to prevent pollution and minimize waste from all SRS operations, is designed to meet the requirements of RCRA, of DOE orders, and of applicable executive orders. The program focuses on source reduction and recycling strategies and on increasing employee awareness of and participation in pollution prevention. Since SRS initiated its formal Waste Minimization Program in 1991, the site's solid radioactive and hazardous waste generation volumes have decreased by about 71 percent. Also, more kinds of materials now are collected for recycling and for sale as salvageable materials. Since the first of fiscal year 1997, for example, more than 2,400 tons of scrap materials have been diverted into the recycling market. During the same period, 148,000 pounds of chemicals considered "excess" were disbursed by the SRS Chemical Commodity Management Center to be put to use at SRS. More information on the Waste Minimization Program can be found in chapter 3, "Environmental Program Information," and chapter 4.

Comprehensive Environmental Response, Compensation, and Liability Act

SRS was placed on the National Priority List in December 1989, under the legislative authority of CERCLA (Public Law 96–510), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA, Public Law 99–499). CERCLA assigns liability and provides for compensation, cleanup, and emergency response for hazardous substances released to the environment.

In accordance with Section 120 of CERCLA, DOE, EPA Region IV, and SCDHEC entered into the FFA, which became effective August 16, 1993. Declaration of the effective date results in the FFA being an enforceable agreement. The FFA, which sets the milestones for environmental remediation at SRS, consolidates site cleanup activities into one comprehensive strategy.

The FFA also identifies more than 300 site evaluation units for which investigations are required. Site evaluation reports were submitted to EPA and SCDHEC for 28 areas in 1994 and for 24 areas each year from 1995 to 1997.

Releases or potential releases from RCRA/CERCLA waste management units are evaluated under the FFA. Work plans detailing the proposed investigations for the RCRA/CERCLA units must be approved by both EPA and SCDHEC prior to implementation.

Remediation under CERCLA imposes requirements in addition to existing RCRA requirements. CERCLA requires remedial decisions to be based on the results of a baseline risk assessment, which examines present and future risk to human health and the environment from the waste unit, using conservative, EPA-approved exposure scenarios.

CERCLA also requires public participation in the selection of remediation alternatives. A significant step in this process is the development of a Proposed Plan, which highlights key aspects of the remedial investigation and feasibility study. The plan also provides a brief analysis of remedial alternatives that were considered, identifies the preferred alternatives, and tells the public how it can participate in the remedy selection process. After consideration of public comments and further analysis, decisions are made and documented in a Record of Decision (ROD), which presents the selected remedy and provides the rationale for that selection. Also included in this process is the establishment of an administrative record file that documents the remediation alternatives and provides for public review of them.

SRS's 1997 RCRA Facility Investigation/Remedial Investigation (RFI/RI) activities included the submittal to EPA and SCDHEC of

- nine RODs
- 24 site evaluation reports
- seven RFI/RI work plans
- six field starts
- five RFI/RI baseline risk assessments
- two "applied-standards corrective action design" combined documents

- six statements of basis/proposed plans

The site also signed nine RODs, initiated and completed seven interim actions, and met 12 other FFA milestones.

Table 2–8, beginning on page 37, includes

- examples of approximately 470 waste units and potential waste units at SRS
- units that are RCRA-regulated and for which interim-action or final RODs have been issued

Emergency Planning and Community Right-to-Know Act

Within the span of 4 years, two related federal acts were enacted to help protect the public and the environment. The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 was enacted as a freestanding provision of SARA. EPCRA requires facilities to notify state and local emergency planning units about their hazardous chemical inventories and to report releases of hazardous chemicals. The Pollution Prevention Act of 1990 expanded the Toxic Chemical Release Inventory report to include source reduction and recycling activities. SRS has reported pollution prevention information annually since 1991.

Tier II Inventory Report

Under Section 312 of EPCRA, SRS completes an annual Tier II Inventory Report for all hazardous chemicals present at the site in excess of specified quantities during the calendar year. Hazardous chemical storage information is submitted to state and local authorities by March 1 for the previous calendar year.

Toxic Chemical Release Inventory Report

Under Section 313 of EPCRA, SRS must file an annual Toxic Chemical Release Inventory report by July 1. SRS calculates chemical releases to the environment for each regulated chemical, then reports, on Form R of the report, the total release for each chemical that exceeds its established threshold.

Form R for 1996 was submitted to EPA in June 1997. Seven chemicals, with releases totaling 24,268 pounds, were reported to EPA for 1996. This compares with six chemicals (60,503 pounds of releases) reported for 1995 and eight chemicals (85,658 pounds of releases) for 1994. Through 1996, total toxic chemical releases had been reduced by about 99 percent compared to 1988, with the sharpest drop occurring between 1988 and 1989. Figure 2–1 shows the overall reduction in total toxic chemical releases at SRS for the period 1987–1996. Several factors have contributed to this reduction. Pollution prevention programs have exerted downward pressure on the use and release of toxic chemicals, resulting in significant decreases for chemicals such as chlorine, lead, Freon 113, and 1,1,1-trichloroethane. Two primary reasons for the dramatic decline in reported totals during the late 1980s were as follows:

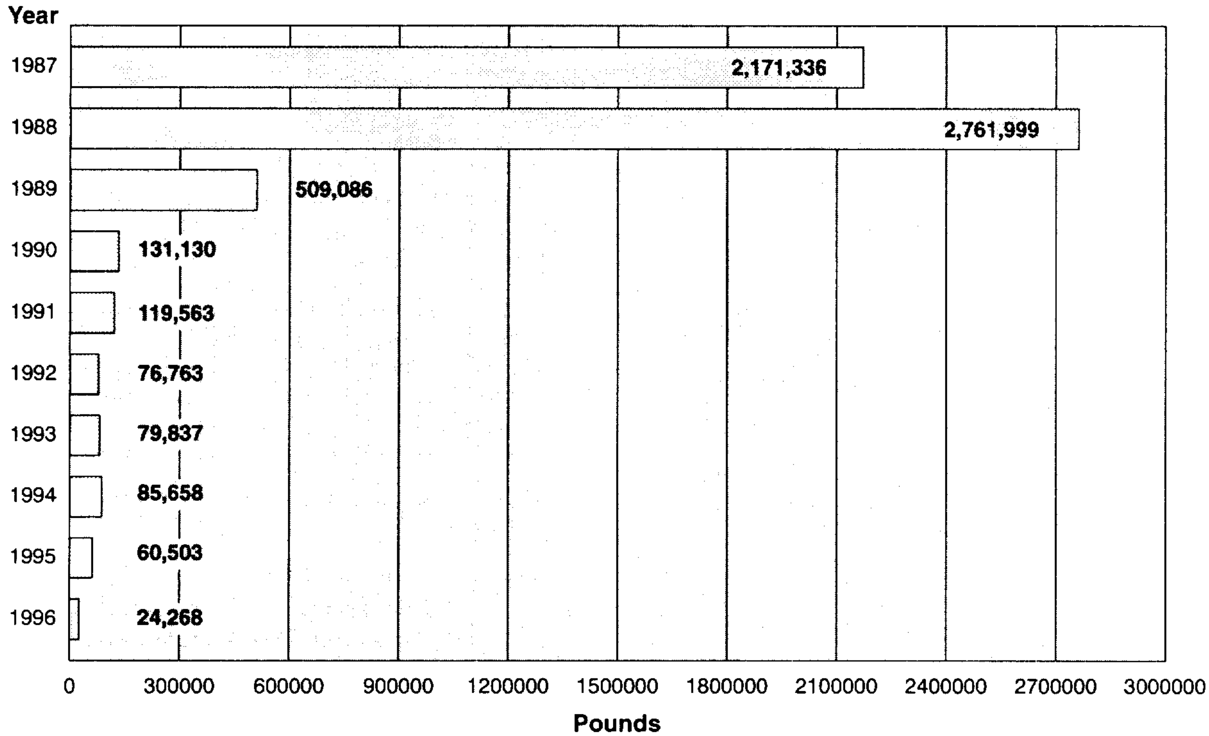
- EPA initially identified chemicals for reporting that did not meet the toxic criteria later developed for EPCRA Section 313. For example, EPA delisted nontoxic chemicals such as sodium sulfate; this resulted in a decline in reported releases for SRS.
- DOE curtailed nuclear production operations at SRS in 1989.

A breakdown of the comparison of toxic chemical releases from 1994 through 1996 is presented in table 2–1. Nitrate compounds released to water made the largest 1996 contribution to the site total. Some nitrate compounds may be exempt under EPCRA reporting requirements, but all nitrate compounds detected in water sampling results were reported. Lead represented a significant portion of the 1995 total, as indicated in the table; its share of the 1996 total, however, was considerably smaller. The reported totals for lead deserve special attention because 99 percent of the lead reported for 1995 was sent off site for recycling or disposal and was identified as an offsite transfer on Form R. Form R treats offsite transfers as releases, but they actually are transfers of waste to EPA-approved facilities for further treatment or for storage, disposal, or recycling.

33/50 Pollution Prevention Program

In September 1992, DOE became the first federal agency to agree formally to participate in EPA's 33/50 Pollution Prevention Program. Under the agreement, DOE voluntarily adopted program goals that are expected to reduce the use and release of 17 priority chemicals. The first goal, which called for a 50-percent reduction by the end of 1995, applied to SRS and other contractor-operated facilities that already were reporting the releases under EPCRA in 1992. The second goal, which called for a 33-percent reduction by the end of 1997, applied to the other contractor-operated facilities that met the reporting criteria in 1992 but had not previously reported the releases under EPCRA.

By 1993, the DOE complex already had met its 50-percent reduction goals. With this achievement of the 33/50 goals, the complex began to focus on



Ileaf Graphic

Figure 2–1 Total Toxic Chemical Releases at SRS, 1987–1996

Through 1996, total toxic chemical releases have been reduced by about 99 percent when compared to 1988. The sharpest drop occurred between 1988 and 1989, when EPA delisted nontoxic chemicals that did not meet toxic criteria for EPCRA Section 313.

reducing all toxic chemical releases, as identified in Executive Order 12856.

Executive Order 12856

Executive Order 12856 requires that all federal facilities comply with right-to-know laws and pollution prevention requirements. The order requires that federal facilities meet EPCRA reporting requirements and develop voluntary goals to reduce releases of toxic chemicals 50 percent on a DOE complexwide basis by the end of 1999. SRS complies with the applicable requirements for EPCRA, as indicated in table 2–2, and the site incorporates all the toxic chemicals on the Toxic Chemical Release Inventory report into its pollution prevention efforts.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) establishes policies and goals for the protection, maintenance, and enhancement of the human environment in the United States. NEPA's purpose is to provide the federal government with a process for implementing these goals. The act requires consideration of environmental factors during the planning process for all major federal activities that could significantly affect the quality of the environment. In practice, NEPA provides a means to evaluate the potential environmental impact of such proposed federal actions and to examine alternatives to those actions. Although implemented on site by the Energy Research and Development Administration during the 1970s, a formal management and operation contractor NEPA compliance group was not established at SRS until 1982. The ongoing mission of this group is to make recommendations regarding the level of NEPA review of site-proposed actions and to prepare draft documentation in support of DOE compliance with NEPA at SRS. In 1997, 304 reviews of new proposed actions were conducted at SRS and formally documented through Categorical Exclusions (CXs), Notices of NEPA Approval, or Environmental Assessments (EAs). WSRC also provided technical support to DOE–SR for the preparation of Environmental Impact Statements (EISs), Supplemental Environmental Impact Statements (SEISs), and Programmatic Environmental Impact Statements (PEISs).

Table 2–1 Releases and Offsite Transfers of Toxic Chemicals (in Pounds) by SRS During 1994, 1995, and 1996 Reporting Years (Reported Under EPCRA Section 313)

1994

Chemical	Air Emissions	Water Discharges	Land Disposal	Offsite Transfers	Total
Benzene	5,878	0	4	9,276	15,158
Chlorodifluoromethane	19,500	0	5	0	19,505
Lead	8	172	10,000	2	10,182
Manganese compounds	31	53	1,499	23	1,606
Nitric acid	32,050	0	120	168	32,338
Sulfuric acid	0	0	0	15	15
Toluene	1,780	0	7	440	2,227
Xylene	3,950	0	17	660	4,627
Totals	**63,197**	**225**	**11,652**	**10,584**	**85,658**

1995

Chemical	Air Emissions	Water Discharges	Land Disposal	Offsite Transfers	Total
Benzene	7,600	0	0	1,724	9,324
Formic acid	33	0	0	0	33
Lead	1	13	240	43,426	43,680
Nitrate compounds	2	7,240	0	0	7,242
Nitric acid	224	0	0	0	224
Sodium nitrite	0	0	0	0	0
Totals	**7,860**	**7,253**	**240**	**45,150**	**60,503**

1996

Chemical	Air Emissions	Water Discharges	Land Disposal	Offsite Transfers	Total
Formic acid	56	0	0	0	56
Lead	5	83	150	234	472
Naphthalene	50	0	0	192	242
n-Hexane	54	0	0	96	150
Nitrate compounds	12	20,768	0	50	20,830
Nitric acid	2,840	0	4	0	2,844
Sodium nitrite	0	0	9	25	34
Totals	**3,017**	**20,851**	**163**	**597**	**24,628**

The types and numbers of NEPA activities conducted at SRS during 1997 are presented in table 2–3. Among the specific activities were the following:

- On April 16 and October 31, DOE issued third and fourth RODs, respectively, related to the Interim Management of Nuclear Materials EIS. The third ROD describes DOE's decision to stabilize the remaining Taiwan Research Reactor spent fuel rods. The fourth ROD describes DOE's decision to select alternatives for processing and storing 120 containers of plutonium-238 that is unsuitable for programmatic purposes without isotopic enrichment.

Table 2–2 SRS Compliance with Executive Order 12856

EPCRA Citation	Activity Regulated	Applicable Requirement
302–303	Planning Notification	No
304	Extremely Hazardous Substances Release Notification	No
311–312	Material Safety Data Sheet/ Chemical Inventory	Yes
313	Toxic Release Inventory Reporting	Yes

- The final PEIS on the DOE waste management programmatic document was issued in May. Based on the results of public workshops, multiple RODs for this document are expected to be issued in 1998.
- The final EIS on the shutdown of the SRS river water system was issued May 16. The proposed action would have ended river water input to L-Lake and PAR Pond, formerly used as sources of cooling water for three site reactors. However, DOE signed a ROD for this EIS December 23 (page 35).
- The final EA and Finding of No Significant Impact (FONSI) on the expansion and operation of the Central Shops borrow pit at SRS were issued March 13. The EA assesses the potential impacts associated with the proposed enlargement and continued use of an existing SRS borrow pit located near N-Area.

Table 2–3 Types/Numbers of NEPA Activities at SRS During 1997

Type of NEPA Documentation	Number
Categorical Exclusion (CX) Recommendation	3
Sitewide Categorical Exclusion/ Routine Insignificant Actions	242
Tiered by Previous NEPA Documentation	12
Environmental Assessment (EA)	8
Environmental Impact Statement (EIS)	7
Supplemental Environmental Impact Statement (SEIS)	1
Programmatic Environmental Impact Statement (PEIS)	2
Total	275

- A draft EIS on the Accelerator for the Production of Tritium at SRS was issued December 19. Public hearings on this document are scheduled to be held in mid-January 1998. The Accelerator for Production of Tritium EIS evaluates the potential impacts associated with the construction and operation of a linear accelerator for the production of tritium for nuclear stockpile purposes at SRS.
- After being postponed for 8 months, the preparation of an EIS on the construction and operation of a proposed Tritium Extraction Facility at SRS was resumed in July. This facility would extract tritium gas from targets irradiated in either a commercial light water reactor or an accelerator. Publication of the draft EIS is projected for February 1998, and the final EIS and ROD are scheduled for August 1998.
- A revised FONSI was approved by DOE October 15 for a change in scope of the proposed action described in the EA on the construction and operation of the Environmental Monitoring Laboratory at SRS (DOE/EA–1010). This scope change involved the incorporation of the activities planned for the Health Physics Site Support Facility into the proposed Environmental Monitoring Laboratory. The Health Physics Site Support Facility had been proposed as a separate facility and was analyzed in an EA (DOE/EA–1022). The new combined Regulatory Monitoring and Bioassay Laboratory would be less costly than the two original facilities, with reduced potential impacts.
- The preliminary draft EIS on spent nuclear fuel activities at SRS was completed and in review at DOE–HQ as of December. Initiated by decisions made on the PEIS prepared by DOE on the spent

Table 2–4 SRS Project NEPA Documentation Activities During 1997

Project Name	Level of NEPA Documentation
DOE Waste Management	PEIS
Storage and Disposition of Weapons-Usable Fissile Materials	PEIS
Accelerator for the Production of Tritium at SRS	EIS
Disposition of Rocky Flats Plutonium Residues and Scrub Alloy	EIS
Interim Management of Nuclear Materials	EIS
Shutdown of the the SRS River Water System	EIS
SRS Spent Nuclear Fuel	EIS
SRS Waste Management	EIS
Tritium Extraction Facility at SRS	EIS
Disposal of Transuranic Waste at the Waste Isolation Pilot Plant	SEIS
Construction, Operation, and Decommissioning of the Waste Segregation Facility	EA
DOE Permission for Off-Loading and Transportation of Commercial Low-Level Radioactive Waste Across SRS	EA
Construction and Operation of the Radiological Monitoring and Bioassay Laboratory	EA
Expansion and Operation of the Central Shops Borrow Pit	EA
Implementation of the SRS Wetland Mitigation Bank Program	EA
Privatization of the Multipurpose Pilot Plant Campus (Formerly TNX) at SRS	EA
Transportation of Radioactive Materials on and from SRS	EA
Tritium Facility Modernization and Consolidation Project	EA

Key: *PEIS* —*Programmatic Environmental Impact Statement*
EIS — *Environmental Impact Statement*
SEIS — *Supplemental Environmental Impact Statement*
EA — *Environmental Assessment*

nuclear fuel issue, this site-specific EIS would address alternatives related to SRS facilities to support the management of both domestic and foreign research reactor spent nuclear fuel.

Table 2–4 contains a complete list of NEPA documentation activities at SRS during 1997.

Four new department NEPA coordinators completed the SRS certification program during 1997. SRS has 37 certified department NEPA coordinators within the various contractor organizations on site.

SRS has the DOE-approved use of 53 CXs for sitewide routine insignificant actions on site. These CXs require approval only at the department NEPA coordinator level in the field prior to project implementation. SRS was the first site in the DOE complex to be granted such authority within the NEPA compliance process. The NEPA level (CX, EA, EIS) determinations are made utilizing a database-driven checklist with sitewide access. The checklist includes electronic signature capability for both the contractor and DOE. The database also is used for monthly reporting of NEPA determinations to DOE.

SRS continues to improve its computerized database/tracking system for both completed and ongoing site NEPA documentation. The database was developed for reporting and analysis purposes. An SRS NEPA Home Page is available to offsite computer users by means of the Internet at the following address: http://www.srs.gov/general/sci-tech/nepa/NEPA.HTML.

In 1997, SRS became the first site in the DOE complex to develop and implement an integration process for the NEPA and CERCLA compliance programs. This process represented the culmination of SRS efforts to comply with DOE Order 5440.1 ("National Environmental Policy Act Compliance Program") and with the NEPA secretarial policy—to minimize document preparation time and reduce costs. The integrated process is accomplished through a decision-based path designed to minimize scheduling and funding conflicts while achieving efficiency and cost savings.

As a result of implementing several initiatives to streamline the site NEPA compliance process, SRS produces NEPA documents more quickly and cost-effectively than any other DOE site, according to "Lessons Learned; National Environmental Policy Act," a U.S. DOE Quarterly Report published September 2, 1997.

Safe Drinking Water Act

The federal Safe Drinking Water Act (SDWA)—enacted in 1974 to protect public drinking water systems—was amended in 1980, 1986, and 1996. The SRS drinking water supply is from groundwater sources, which supported 26 domestic water systems in 1996. Completion in July 1997 (2 months ahead of schedule) of a water system consolidation project, however, has reduced the number of domestic systems to 18. Three of the systems on site regularly serve more than 25 people each and meet the requirements for nontransient, noncommunity systems, which are regulated by SCDHEC. The remaining 15 systems, each of which serves fewer than 25 people, receive a lesser degree of regulatory oversight.

SRS provides drinking water to the majority of its employees through the three nontransient, noncommunity systems. The system consolidation project was completed in accordance with the SRS Domestic Water Consolidation Preliminary Engineering Report, issued by SCDHEC in May 1993. The report recommended upgrading—including the replacement of area distribution piping—and consolidating the major site drinking water systems into three systems through the construction of

- a K-Area water system (an elevated storage tank and a treatment facility)
- a D-Area water system (two wells, an elevated storage tank, and a treatment facility), which supplies D-Area and TNX-Area
- an A-Area water system (three elevated storage tanks and a treatment facility), which supplies A-Area, B-Area, F-Area, H-Area, S-Area, N-Area, C-Area, and Forestry Area

Because of a new mission in L-Area, the system there was added to the consolidation project and now is tied into the K-Area system.

During 1997, lead and copper compliance sampling was performed under a revised reduced-monitoring plan—approved by SCDHEC—for the D-Area and K-Area consolidated systems. The D-Area and K-Area systems qualified in 1997 for future sampling under an ultrareduced monitoring plan, but will not have to undergo lead and copper sampling until the year 2000. The A-Area consolidated system already had been approved for ultrareduced monitoring; as a result, lead and copper sampling will not be required there until 1998.

Neither the D-Area nor the K-Area systems exceeded the lead and copper action levels in the 90th percentile during 1997. The National Primary Drinking Water Regulations specify that treatment technique requirements are triggered by exceedances of the lead and copper action levels measured in the 90th percentile.

Notices of Violation (SDWA)

SRS received two NOVs from SCDHEC during 1997 for exceedance of the maximum contaminant level for total coliform in a pubic drinking water system.

SCDHEC issued a domestic water NOV to WSRC July 3, 1997, for exceedance of the maximum contaminant level for total coliform at the Advanced Tactical Training Area water system during the June 1997 monitoring period. Following WSRC's June 26 notification of the violation to SCDHEC, the well and piping system were disinfected and flushed. SCDHEC resampled this system and reported the results as total coliform negative July 1. Bottled water is used for drinking purposes in this area and well water is used for hand washing and toilets; therefore, WSRC contends that neither public health-related concerns nor environmental threats are posed. No fines or penalties are being assessed as a result of this violation. Corrective actions have been implemented.

SCDHEC issued an NOV to WSRC September 17, 1997, for exceedance of the maximum contaminant level for total coliform at the Central Sanitary Wastewater Treatment Facility drinking water system during the September 1997 monitoring period. Corrective actions have been implemented.

Clean Water Act

National Pollutant Discharge Elimination System

The CWA of 1972 created the NPDES program, which is administered by SCDHEC under EPA authority. The program is designed to protect surface waters by limiting releases of effluents into streams, reservoirs, and wetlands. Radiological effluents are limited under DOE orders. Discharge limits are set for each facility to ensure that SRS operations do not adversely impact water quality.

SRS had five NPDES permits for most of 1997—one permit for industrial wastewater discharge (SC0000175), one general permit for utility water discharge (SCG250162), two general permits for stormwater discharge (SCR000000 for industrial and SCR100000 for construction), and one permit for land application (ND0072125). Permit SC0000175 regulated 37 active and inactive NPDES outfalls at SRS until June 1997, when it was modified because of the elimination of outfall C–04. Permit SCG250162 did not discharge during 1997. Both general permits for stormwater discharge expired in September 1997. A notice of intent was filed in August with SCDHEC, as required by the expired permits, to

- apply for coverage under two new general permits for stormwater discharge, which were in the approval process at the end of 1997
- retain coverage under the old permits

NPDES Permit ND0072125 regulates the sampling of outfall ND–1.

More information about the NPDES permits can be found in chapter 8, "Nonradiological Effluent Monitoring."

All results of monitoring for compliance with the industrial wastewater discharge permit and the new general permit for utility water discharge were reported to SCDHEC in the monthly Discharge Monitoring Reports, as required by the permits.

In October 1997, SCDHEC personnel conducted a 2-week audit in which SRS wastewater facilities were inspected and the permitted NPDES outfalls were sampled. All the facilities passed the operations/maintenance part of the audit, and no significant findings were noted at the audit closeout meeting (in October). Sample analytical results subsequently indicated that the facilities had no problems.

All monitoring for compliance with the industrial stormwater discharge permit was evaluated and recorded in the pollution prevention plan for each outfall, as required by that permit. The individual outfall pollution prevention plans were combined to form a site pollution prevention plan, which was developed and implemented in 1993 and updated in 1996 for identified stormwater outfalls. The site plan identifies facility areas where "best management practices" and/or "best available technology" should be implemented to prevent or mitigate the release of pollutants with stormwater runoff.

A list of exceedances—including outfall locations, probable causes, and corrective actions—can be found in chapter 8 (table 8–5).

The industrial stormwater discharge permit (SCR000000) was expanded at the beginning of 1997 because of implementation of the industrial wastewater discharge permit (SC0000175). Because this expansion resulted in an increase in the number of outfalls covered by the permit (from 48 to 52), the number of outfalls monitored was increased from 11 to 13 as representative of the 52 outfalls. The outfalls represent a wide range of SRS activities and/or sites, including

- storage, use, or disposal of EPCRA Section 313 chemicals
- land disposal units
- steam electric generation
- chemical and allied product manufacturing
- borrow pits

All construction activity that would result in a land disturbance of 5 or more acres must be permitted; the 15 land areas associated with industrial activity from construction are permitted as required under SCR100000. Four projects in this category were closed in 1997. The pollution prevention plan for this permit also requires a sediment reduction and erosion control plan.

Under the Code of Federal Regulations (CFR) Oil Pollution Prevention regulation (40 CFR 112), SRS must report petroleum product discharges of 1,000 gallons or more into or upon the navigable waters of the United States, or petroleum product discharges in harmful quantities that result in oil sheens. Two such incidents occurred at the site during 1997 and were reported appropriately.

SRS has an agreement with SCDHEC to report petroleum product discharges of 25 gallons or more to the environment. Two such incidents in this category also occurred at the site during 1997 and were reported appropriately.

Notices of Violation (NPDES)

SRS's 1997 compliance rate for NPDES under the CWA was 99.9 percent, though the site did receive two NPDES-related NOVs from SCDHEC.

SCDHEC issued an NOV to WSRC January 7, 1997, for violation of the monitoring and reporting requirements of NPDES Permit SC0000175. The agency cited a failure to have valid test results for acute toxicity at outfall G–10 and fecal coliform at outfall P–14 during the November 1996 monitoring period. Corrective actions have been implemented.

SCDHEC issued an NOV to WSRC September 10, 1997, for violation of the monitoring and reporting requirements of NPDES Permit SC0000175 (industrial wastewater discharge). The agency cited a failure to have valid test results for total lead at outfall F–03 in June 1997 and for total mercury at outfall A–01 in July 1997. Because explanations and corrective actions for the violation were submitted in monthly reports, SCDHEC indicated that a written response to the NOV would not be required.

Dredge and Fill; Rivers and Harbors

The CWA, Section 404, "Dredge and Fill Permitting," as amended, and the Rivers and Harbors Act, Sections 9 and 10, "Construction Over and Obstruction of Navigable Waters of the United States," protect U.S. waters from dredging and filling and construction activities by the permitting of such projects. Dredge and fill operations in U.S. waters are defined, permitted, and controlled through implementation of federal regulations in 33 CFR and 40 CFR. In 1997, three projects were permitted under 33 CFR 330 (a general permit under Section 404) of the nationwide permit (NWP) program:

- The area used for access to a bridge over Lower Three Runs Creek at Road B, which will be used by Chem-Nuclear Systems (operator of a low-level waste disposal facility near Barnwell, South Carolina) to transport steam generators, was permitted under NWP 26, "Headwaters and Isolated Waters Discharges."
- Section 404 and Section 10 permits were obtained to widen the boat ramp at river mile 157.8 on the Savannah River to allow a barge to dock and offload the steam generators for Chem-Nuclear Systems.
- Also permitted under NWP 26 was a small wetland near TNX-Area that was filled to provide stable footing for well sampling.

Construction in Navigable Waters

SCDHEC Regulation 19–450, "Permit for Construction in Navigable Waters," protects the state's navigable waters through the permitting of any dredging, filling, construction, or alteration activity in, on, or over state navigable waters, in or on the beds of state navigable waters, or in or on land or waters subject to a public navigational servitude. The only state navigable waters at SRS are Upper Three Runs Creek (through the entire site) and Lower Three Runs Creek (upstream to the base of the PAR Pond Dam). In 1997, two SRS projects were permitted under Regulation 19–450. On Lower Three Runs Creek, a permit was obtained for construction of a bridge near Road B—downstream of the road's regular traffic bridges—to be used to convey heavy loads traversing SRS enroute to Chem-Nuclear Systems. Also permitted under this state regulation was the boat ramp widening required to accommodate the offloading of such loads (such as the steam generators).

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act restricts the application of pesticides through a state-administered certification program. SRS's pesticide procedure provides guidelines for pesticide use and requires that applicators be state certified. A pesticide-use task group evaluates planned pesticide programs to ensure that they are acceptable and that appropriate pesticides are used, so that any impact on the environment is minimal. The task group also

- maintains records of pest control activities
- assists in disseminating pesticide-use information to site contractors

SRS pesticide programs typically include such activities as the maintenance of roadways, gravel areas, and fence lines through the use of herbicides.

Clean Air Act

Regulation, Delegation, and Permits

The CAA provides the basis for protecting and maintaining air quality. Some types of SRS air emissions, such as radioactive sources and ozone-depleting substances (ODSs), are regulated by EPA, but most are regulated by SCDHEC, which must ensure that its air pollution regulations are at least as stringent as the CAA's. This is accomplished through SCDHEC Regulation 61–62, "Air Pollution Control Regulations and Standards."

Under the CAA, and as defined in federal regulations, SRS is classified as a "major source" and, as such, is assigned one permit number (0080–0041) by SCDHEC. In this permit, each emission source is identified by the area designation, by a point identification number, and by a source description. SRS holds operating and construction permits from SCDHEC's Bureau of Air Quality, which regulates nonradioactive toxic and criteria pollutant emissions from approximately 194 point sources, several of which have specific emission limits. As of May 1994, SCDHEC had completed renewal of all SRS operating permits, which are valid for 5 years. Of the 194 point sources, 153 operated in some capacity during 1997. The remaining 41 either were under construction or were being maintained in a "cold standby" status.

During 1997, SCDHEC conducted compliance inspections of 64 permitted sources at SRS, reviewing 193 permitted parameters. The inspections included

- biennial stack tests
- initial operation inspections following completion of construction
- annual compliance inspections

As indicated earlier, the site achieved a compliance rate of 100 percent—and received no NOVs—under the CAA in 1997.

National Emission Standards for Hazardous Air Pollutants

The National Emission Standards for Hazardous Air Pollutants (NESHAP) is a CAA-implementing regulation that sets air quality standards for air emissions containing hazardous air pollutants, such as radionuclides, benzene, and asbestos. The NESHAP regulations found in 40 CFR 61 are divided into subparts based on specific hazardous pollutant categories, such as Subpart H for radionuclides and Subpart M for asbestos. The Clean Air Act Amendments (CAAA) of 1990 revised the original list of hazardous air pollutants. The revised list of 189 air pollutants includes all radionuclides as a single item. Regulation of these pollutants, except for radionuclides, has been delegated to SCDHEC; EPA Region IV regulates radionuclides.

SRS, like most South Carolina industrial complexes, uses a number of chemicals identified by SCDHEC as toxic air pollutants and by EPA as hazardous air pollutants. These include many common consumer products—e.g., off-the-shelf bug sprays, correction fluids, paints, sealers, janitorial cleaning supplies, gasoline for vehicles—as well as a number of typical industrial chemicals, such as degreasers, solvents, metals, batteries, and diesel fuel. But SRS has at least one category, radionuclides, not found in typical industrial settings. During the course of normal operations, some radionuclides are released to the air.

NESHAP Radionuclide Program The SRS NESHAP radionuclide program continues to change to incorporate sampling, monitoring, and dose assessment practices that meet or exceed the requirements of 40 CFR 61, Subpart H. This radionuclide subpart for the FFCA was signed October 31, 1991. An amendment to the subpart—signed by EPA Region IV August 16, 1993—provided SRS an extension of the original FFCA through February 10, 1995, to accomplish monitoring equipment upgrades to several additional sources. These upgrades were completed on time, and the FFCA was officially closed by EPA Region IV May 10, 1995.

During 1997, the maximally exposed individual effective dose equivalent, calculated using the NESHAP-required CAP88 computer code, was estimated to be 0.05 mrem (0.0005 mSv), which is 0.5 percent of the 10-mrem-per-year (0.10-mSv-per-year) EPA standard (chapter 7, "Potential Radiation Doses").

NESHAP Nonradionuclide Program SRS uses many chemicals identified as toxic or hazardous air pollutants, but most of these chemicals are not regulated under the CAA or under federal NESHAP regulations. Except for asbestos, SRS facilities and operations do not fall into any of the "categories" listed in the subparts. Under Title III of the federal CAAA of 1990, EPA in December 1993 issued a final list of hazardous air pollutant-emitting source categories potentially subject to maximum achievable control technology standards. These standards are being developed and issued over a 10-year period that will end in the year 2000, based on a schedule arranged according to

- the effects of each pollutant
- the industry group source category
- the abatement technology available

In an attempt to regulate hazardous or toxic air pollutants in South Carolina, SCDHEC established Air Pollution Control Regulation 61–62.5, Standard No. 8, "Toxic Air Pollutants," in June 1991. To demonstrate compliance with this standard, SRS completed and submitted an air emissions inventory and air dispersion modeling data for all site sources in 1993. The submitted data demonstrated compliance by computer modeling the accumulated ambient concentration of individual toxic air pollutants at the boundary line and comparing them to the Standard No. 8 maximum allowable concentrations. To ensure continued compliance with Standard No. 8, new sources of toxic air pollutants must be permitted, which requires submittal of appropriate air permit applications and air dispersion modeling. Sources with emissions below a threshold of 1,000 pounds per month of any single toxic air pollutant may be exempted from permitting requirements. During 1997, three sources of toxic air pollutants either were issued a construction permit or exempted from permitting requirements.

NESHAP Asbestos Removal Program Asbestos is a naturally occurring mineral. Because of its availability, low cost, and unique properties, the U.S. construction industry used asbestos extensively from after World War II through the mid 1970s. The construction of SRS began in the early 1950s, and asbestos-containing material can be found throughout the site. The danger from exposure to airborne asbestos fibers was virtually unknown during the early years at the site. Today, however, it is well established that unprotected exposure to airborne asbestos fibers can lead to asbestosis, lung cancer, mesothelioma, and other diseases.

SRS began an asbestos abatement program in 1988 and continues to manage asbestos-containing material by "best management practices." Site compliance in this area also falls under South Carolina and federal regulations, including SCDHEC Regulation R.61–86.1 ("Standards of Performance for Asbestos Projects") and 40 CFR 61, Subpart M ("National Emission Standards for Asbestos").

Many site demolition, renovation, and maintenance projects require the removal of asbestos-containing material. During 1997, short-term subcontracted demolition and NESHAP projects accounted for the removal of approximately 5,200 linear feet of friable asbestos-containing material (a form that can be crumbled or pulverized with hand pressure when dry) and 120,200 square feet of nonfriable asbestos-containing material. Demolition and NESHAP projects performed by SRS employees accounted for the removal of approximately 1,800 linear feet of friable and 58,500 square feet of nonfriable asbestos-containing material in 1997. SRS employees also removed approximately 1,000 linear feet and 1,000 square feet of friable and approximately 900 linear feet and 9,000 square feet of nonfriable asbestos-containing material while performing other projects during the year.

All radiological asbestos waste at SRS is disposed of on site, while employee-generated nonradiological asbestos waste is disposed of at the Hickory Hill Landfill near Hilton Head Island. Nonradiological asbestos waste generated by short-term subcontracted organizations is disposed of at various SCDHEC-permitted landfills off site.

Other CAA Requirements Only a few of the major sections of the CAA and its 1990 amendments and regulations have had—or are expected to have—a significant impact on SRS sources and facilities. These include Title V, "Operating Permit Program," and Title VI, "Stratospheric Ozone Protection." The other regulations impacting SRS facilities are implemented primarily in SCDHEC Regulation 61–62 and in existing operating or construction permits.

Air Emissions Inventory SCDHEC Regulation 61–62.1, Section III ("Emissions Inventory"), requires compilation of an air emissions inventory for the purpose of locating all sources of air pollution and defining and characterizing the various types and amounts of pollutants. To demonstrate compliance, SRS personnel conducted the 1993 comprehensive air emissions inventory, compiling source information from as far back as 1985. Guidelines and procedures were written to

- ensure that all radiological and nonradiological sources had been accounted for
- ensure documentation of all vents and stacks for each building
- better characterize emission points from site processes
- calculate emissions based on design capacity, maximum potential emissions, and actual emissions for a selected period of time
- provide consistency in recording appropriate data

The inventory identified approximately 5,300 radiological and nonradiological air emission sources. Source operating data and calculated emissions from 1990 were used to establish the SRS baseline emissions and to provide data for air dispersion modeling that had been required for compliance with Regulation 61–62.5, Standard No. 2 ("Ambient Air Quality Standards") and Standard No. 8. The regulation also requires that inventory data be updated and *recorded* annually and *reported* every other year. Data from 1996 were *reported* to SCDHEC in 1997 (table 55, *SRS Environmental Data for 1997*, WSRC–TR–97–00324). Compilation of 1997 data will be completed and reported in 1998. Finally, the information from the inventory database for all emission sources also was used in 1996 as part of SRS's Title V Operating Permit application.

Title V Operating Program As previously indicated, the CAAA of 1990 also include, under Title V, a major new permitting section expected to have a significant impact on the site. The primary purpose of this permitting program is to establish federally enforceable operating permits for major sources of air emissions. The implementation plan for this program was submitted to EPA in 1993 by the State of South Carolina and subsequently approved by EPA in June 1995. SRS then submitted an extensive application package for site air emission sources by the March 15, 1996, deadline set forth in the implementation plan.

Ozone-Depleting Substances Title V of the CAAA of 1990 addresses stratospheric ozone protection. This law requires that EPA establish a number of regulations to phase out the production and consumption of ODSs. The substances commonly are used as refrigerants in air conditioning and cooling systems; as degreasers and cleaners; as spray can propellants; as fire suppressants (Halon); as laboratory extractions; and in many other common consumer products.

Several sections of Title VI of the CAAA of 1990, along with recently established EPA regulations, apply to the site. The ODSs are regulated in two general categories: Class I substances—chlorofluorocarbons (CFCs), Halon, carbon tetrachloride, methyl chloroform, methyl bromide, and hydrobromofluorocarbons (HBFCs)—and Class II substances, or hydrochlorofluorocarbons (HCFCs). Class I ODSs are about 10 times more ozone-depleting than HCFCs and thus are more strictly regulated. As required by the CAAA of 1990, most Class I Halon was phased out of production by January 1, 1994, and other Class I ODSs were phased out by January 1, 1996. This means that several very important refrigerants (CFC–11, –12, –114, and –502) used on site essentially may become unavailable for purchase. Many of the large chillers on site that use these refrigerants are being scheduled for total replacement or for retrofits that will use HCFCs or other chemical substitutes. The site also is scheduling fire suppression (Halon) system replacements. Many common degreasers are Class I ODSs and have been targeted for replacement. Most major degreasing applications already have been eliminated or replaced with non-ODSs. Smaller ODS-degreasing applications, such as those used in maintenance and electrical shops, are being targeted for phaseout. ODSs used in laboratory extraction procedures will be replaced when EPA approves newly developed processes that use non-ODSs.

The SRS CAAA of 1990 Title V air permit application includes ODS emission sources. All large (greater than or equal to 50-pound charge) heating, ventilation, and air conditioning/chiller systems for which there are recordkeeping requirements are included as fugitive emission sources.

In 1994, the site formed a CFC steering committee of participants from all the major users of these substances to provide initial direction in the phaseout of Class I ODSs on the site. A number of technical subcommittees also were initiated at that time to address particular applications, such as refrigeration, fire suppression, degreasers, laboratory applications, and environmental compliance. The ODS Subcommittee of the Central Environmental Committee was created in 1995 to communicate to site organizations—through field representatives—any changes in Title VI regulations that could affect established programs. The "Savannah River Site Refrigerant Management Plan," completed and issued in September 1994, provides guidance to assist SRS and DOE in the phaseout of CFC refrigerants and equipment.

The site has

- purchased certified recycling equipment
- trained and certified technicians where required
- implemented required recordkeeping and leak-tracking for large cooling systems
- implemented proper labeling and other recordkeeping requirements

In 1996, SRS let a subcontract for the offsite reclamation of used refrigerants. The site also eliminated the use of CFC–114 by completing replacement of the 789–A chiller plant with a new plant that uses a non-CFC refrigerant. Plans are to sell the 55,000 pounds of CFC–114 as part of a decontamination and decommissioning contract. Additionally, Executive Order 12856 requires a 50-percent reduction in CFC usage by the end of 1999, based on 1993 data. SRS surpassed the 21,116-pound 1999 goal in 1996 by reducing CFC refrigerant usage to 12,570 pounds.

Five other plant projects to replace CFC refrigerant systems were in various stages of implementation during 1997, including

- tritium facility upgrades
- a central chiller facility for F-Canyon and associated support labs
- upgrades for H-Canyon, 299–H, and 235–F refrigerant systems

The tritium project is scheduled for completion in early 1998. Completion of these and other projects will further reduce the site's dependence on Class I ODSs.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) gives EPA comprehensive authority to identify and control chemical substances manufactured, imported, processed, used, or distributed in commerce in the

United States. Reporting and recordkeeping are mandated for new chemicals and for any chemical that may present a substantial risk of injury to human health or the environment. EPD and Industrial Hygiene personnel coordinate reporting and recordkeeping requirements under TSCA.

Polychlorinated biphenyl (PCB) chemicals have been used in various SRS processes. They were used on site in pre-1979 electrical equipment in the form of transformers, small capacitors, and fluorescent light ballasts. These organic chemicals are specifically regulated under 40 CFR 761 of TSCA, and the site has a well-structured PCB program that complies with the TSCA regulation, DOE orders, and WSRC policies. The 1996 PCB Annual Document Log was completed prior to the July 1, 1997, deadline in full compliance with these requirements. The disposal of PCBs routinely generated at SRS is conducted at EPA-approved facilities within the regulatory time frame.

In August 1993, PCBs were confirmed to be present as a component of dense nonaqueous phase liquids in samples from two groundwater monitoring wells around the M-Area hazardous waste management facility. Regulators were notified, and a modification to the RCRA Part B Permit Application to address the discovery of PCBs was submitted to SCDHEC in December 1993. Any waste generated was handled in accordance with the appropriate TSCA and RCRA requirements. Savannah River Technology Center personnel (SRTC) continue to study ways to remediate the dense nonaqueous phase liquids.

Certain PCB waste generated by SRS during the late 1970s and early 1980s was radioactively contaminated. Most of the radioactively contaminated waste resulted from a 1978 spill of PCBs from a failed electrical capacitor inside a nuclear materials processing area. TSCA regulations call for annual disposal of PCB waste, but there is insufficient capacity for offsite disposal of radioactive PCB waste. A request to conduct a treatability study on this waste was approved by EPA in August 1995, and work continued on the study from late 1995 until May 1996. The study included the evaluation of three chemical dechlorination technologies and one thermal desorption/vacuum extraction technology. The chemical dechlorination technologies were unsuccessful in treating the waste below TSCA thresholds. The test of the thermal desorption/vacuum extraction process was terminated prior to its conclusion because of vendor equipment malfunction and the shutdown of the vendor facility. The residuals from the study subsequently were returned to SRS for storage. SRS now is working to ship the waste to DOE's Oak Ridge TSCA incinerator, but this process is not expected to be completed until 1998 at the earliest.

In 1996, PCBs were detected in certain painted surfaces and electrical cables at the Heavy Water Components Test Reactor. The materials were analyzed as part of the predemolition characterization of the building. Subsequently, varying amounts of PCBs were detected in painted surfaces in two other site facilities. Prior to this discovery, the use of PCBs in paints and other solid items at SRS was unrecognized.

In 1997, the issue of PCBs in painted surfaces was the highest priority TSCA/PCB compliance issue at SRS, which conducted extensive research on the use of PCBs in solids—particularly in coatings used prior to the passage of TSCA. The site learned that PCBs had been used for certain coating products formulated for special purposes such as waterproofing and chemical and fire resistance. PCBs also were used in certain pigments, although these are not believed to be a major PCB contributor to most paints. SRS tested numerous painted surfaces for PCBs during 1997. The testing included measures of transferable PCB surface contamination, during which it was consistently demonstrated that PCBs in dried paint remained bound up in the coating and did not leach. It was concluded, therefore, that these PCBs did not pose a dermal exposure hazard to employees or to others who came into contact with them.

As discoveries of PCBs in paints were made, SRS worked closely with EPA on related TSCA compliance issues. Current TSCA regulations prohibit the use and distribution in commerce of PCBs in solids other than paints that contain more than 2 parts per million (ppm) of PCBs. In May 1997, however, EPA granted an SRS request to consider painted items to be "excluded PCB products" under TSCA regulations; as a result, painted items at concentrations of greater than 2 ppm but less than 50 ppm now may be used and distributed in commerce—not only by SRS, but nationwide. EPA is considering revisions to fully authorize the use of PCBs in dried paints and other nonliquids; however, these regulatory changes are expected no earlier than late 1998.

SRS obtained an Enforcement Discretion Letter from EPA in June 1997 that allowed the site to sell some excess metal-working equipment considered critical to the startup of a new manufacturing plant expected to employ 1,000 people. SRS will continue to work with EPA as related compliance issues arise.

As a result of site evaluation work completed in early 1997, PCBs greater than 50 ppm were discovered in an underground tank that collected wastewater from the Ford Building in N-Area [WSRC 1997]. The building had been shut down for a number of years, and the tank no longer was being used. Its removal, via the CERCLA program, was begun in December 1997.

Also, PCBs were detected in August 1997 inside the Ford Building on some old machinery and on the floor near the machinery. SRS notified EPA and began evaluating cleanup options for this facility.

Endangered Species Act

The Endangered Species Act of 1973, as amended, provides for the designation and protection of wildlife, fish, and plants in danger of becoming extinct. The act also protects and conserves the ecosystems on which such species depend.

Several threatened and endangered species exist at SRS. The site conducts research on the wood stork, the red-cockaded woodpecker, the bald eagle, the shortnose sturgeon, and the smooth purple coneflower. Programs designed to enhance the habitat of such species are in place.

NEPA documentation was prepared and reviewed for several new projects at SRS in 1997 to ensure protection of threatened and endangered species. Biological assessments were conducted to evaluate potential impacts of future activities at

- the proposed Accelerator for the Production of Tritium and Tritium Extraction Facility sites
- the area around TNX
- a borrow pit near Road C
- the SRS boat ramp on the Savannah River
- the Road B bridge at Lower Three Runs Creek

None of these activities were found to have had any significant potential impact on threatened and endangered species.

A biological assessment for the river water system shutdown EIS concluded in 1996 that the proposed action could affect the bald eagle, the alligator, and the wood stork. Resulting SRS consultations with U.S. Fish and Wildlife Services personnel continued in 1997, as pursuant to Section 7, "Interagency Cooperation," of the Endangered Species Act.

National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, Section 106, governs the protection and preservation of archaeological and historical resources. SRS ensures that the site is in compliance with this act through the site-use process. All sites being considered for activities such as construction are evaluated by the University of South Carolina's archaeology group to ensure that archaeological or historic sites are not impacted. Reviews of timber compartment prescriptions include surveying for archaeological concerns and documenting areas of importance with regard to historic and prehistoric significance.

NEPA reviews were conducted for numerous new projects at SRS in 1997, and most were found to have no activities of significant impact in terms of the NHPA. However, one of the NEPA reviews determined that the proposed Plutonium Immobilization Plant location includes a site that could be subject to such impact. The site has been nominated for the National Register of Historic Places; a determination on the nomination still must be made by the South Carolina historic preservation officer. Plutonium Immobilization Plant sites that cannot be avoided will be mitigated.

The Three Rivers Landfill Project had been determined in 1996 to have NHPA impact in that it contained four sites eligible for nomination to the National Register of Historic Places. The landfill was located so that impacts to three of the four sites could be avoided; the fourth site still was being excavated at the end of 1997 to preserve artifacts; results are expected to be compiled and issued in 1999.

Floodplains and Wetlands

Under DOE General Provisions, 10 CFR, Part 1022 ("Compliance with Floodplains/Wetlands Environmental Review Requirements"), establishes policies and procedures for implementing DOE's responsibilities in terms of compliance with Executive Orders 11988 ("Floodplain Management") and 11990 ("Protection of Wetlands"). Part 1022 includes DOE policies regarding the consideration of floodplains/wetlands factors in planning and decision making. It also includes DOE procedures for identifying proposed actions involving floodplains/wetlands, providing early public reviews of such proposed actions, preparing floodplains/wetlands assessments, and issuing statements of findings for actions in floodplains.

Executive Order 11988, "Floodplain Management"

Executive Order 11988, "Floodplain Management," was established to avoid long- and short-term impacts associated with the occupancy and modification of floodplains. The evaluation of impacts to SRS floodplains is ensured through the NEPA Evaluation

Checklist and the site-use system. Site-use applications are reviewed for potential impacts by WSRC, DOE–SR, the Savannah River Natural Resource Management and Research Institute (SRI, formerly the Savannah River Forest Station), and the Savannah River Ecology Laboratory (SREL), as well as by professionals from other organizations. NEPA reviews of new projects at SRS in 1997 found no activities of significant impact with respect to Executive Order 11988.

Executive Order 11990, "Protection of Wetlands"

Executive Order 11990, "Protection of Wetlands," was established to mitigate adverse impacts to wetlands caused by the destruction and modification of wetlands and to avoid new construction in wetlands wherever possible. Avoidance of impact to SRS wetlands is ensured through the site-use process, various departmental procedures and checklists, and project reviews by the SRS Wetlands Task Group. Many groups and individuals, including scientists at SRTC, SREL, and EPD, review site-use applications to ensure that proposed projects do not impact wetlands. NEPA reviews of new projects at SRS in 1997 found no activities of significant impact with respect to Executive Order 11990. DOE–SR signed a ROD December 23, 1997, on the river water system shutdown EIS. The decision is in line with DOE's policy of "no net loss" of wetlands. More information about the river water system shutdown project appears in the "Other Major Issues and Actions" section of this chapter, beginning on page 35.

Environmental Release Response and Reporting

Response to Unplanned Releases

Environmental Monitoring Section (EMS) personnel respond to unplanned environmental releases—both radiological and nonradiological—upon request by area operations personnel.

A number of unplanned environmental releases occurred in 1997, but area operations personnel did not require the sampling and analysis services of EMS. If the services of EMS personnel are requested, the samples collected are given priority in preparation and, if radiological in nature, priority in the counting room. Data are validated, and a determination is made as to whether there has been an actual release. If there has been, then consequences to the public and the environment are determined.

Occurrences Reported to Regulatory Agencies

"Federally permitted" releases comply with legally enforceable licenses, permits, regulations, or orders. Under the Atomic Energy Act, for example, releases of SRS radionuclides are federally permitted as long as public dose standards in DOE orders are not exceeded.

If a nonpermitted release to the environment of a reportable quantity (RQ) or more of a hazardous substance (including radionuclides) occurs, CERCLA requires notification of the National Response Center. Also, the CWA requires that the National Response Center be notified if an oil spill causes a "sheen" on navigable waters, such as rivers, lakes, or streams. Oil spill reporting was reinforced with liability provisions in CERCLA's National Contingency Plan.

Other CERCLA provisions allow exemptions from reporting a release of an RQ or more of a hazardous substance if the release is federally permitted or covered by a continuous-release notification. A continuous-release notification provides an exemption from reporting each release of a specific hazardous substance greater than an RQ. The site submitted two continuous-release notifications in 1992—for ethylene glycol and for asbestos, each of which had a statutory RQ of 1 pound. SRS withdrew the request for continuous-release notification status for ethylene glycol in 1995, when EPA made an adjustment to that RQ. The asbestos continuous-release notification request is still active.

During 1997, SRS notified regulatory agencies of three CERCLA reportable releases—one later was determined to be non-CERCLA reportable)—which are described in table 2–5. This performance compares with two such releases reported during 1996, four during 1995, and two during 1994.

Fourteen other notifications—not required by CERCLA—were made by the site to regulatory agencies during 1997. Eight of these were made to inform the agencies, principally SCDHEC, of events such as permit exceedances. The other six were the result of an agreement to notify SCDHEC about sewage and petroleum product releases. The agreement requires reporting of sewage releases "equal to or greater than 100 gallons" and of petroleum product releases "equal to or greater than 25 gallons" unless the releases come in contact with "waters of the state." In these cases, releases in any amount are to be reported—whether for sewage or for petroleum products. Five of the six agreement-based notifications were for sewage releases and the other was for a petroleum product release.

Table 2–5
CERCLA Releases Reported to Regulatory Agencies in 1997

Date	Applicable Regulation/ Reason for Notification	Agencies Notified	Description
March 8	Exceeded RQ of .01 Curie	EPA/SCDHEC	Aqueous spill containing plutonium and curium occurred during closure of tank 29
July 27	Spill caused sheen	EPA/SCDHEC	Fuel leak from H-Area diesel generator caused sheen on waterway
Nov. 3	Exceeded RQ of 10 pounds	EPA/SCDHEC	Emissions of oxides of nitrogen occurred at Receiving Basin for Offsite Fuels (courtesy call—later determined to be non-CERCLA reportable)

EPCRA (40 CFR 355.40) requires that reportable releases of extremely hazardous substances or CERCLA hazardous substances be reported to any local emergency planning committees and state emergency response commissions likely to be affected by the release. No EPCRA reportable releases occurred in 1997.

It is SRS policy to notify SCDHEC and the Georgia Department of Natural Resources (GDNR) of any occurrence that may interest state regulatory agencies. Although not required by law, these "courtesy notifications" enhance environmental protection objectives. In July 1997, SRS expanded the plan for the courtesy notifications in response to a request by local governments. The expanded notification plan includes such occurrences as shelter alarms and stack monitoring alarms, even though they may be false alarms.

Site Item Reportability and Issues Management Program

The Site Item Reportability and Issues Management (SIRIM) program, mandated by DOE Order 232.1 (which superceded DOE Order 5000.3B), "Occurrence Reporting and Processing of Operations Information," is designed to ". . . establish a system for reporting of operations information related to DOE-owned or operated facilities and processing of that information to provide for appropriate corrective action. . . ." It is the intent of the order that DOE be ". . . kept fully and currently informed of all events which could: (1) affect the health and safety of the public; (2) seriously impact the intended purpose of DOE facilities; (3) have a noticeable adverse effect on the environment; or (4) endanger the health and safety of workers."

The SIRIM program at SRS is designed to meet the requirements of DOE Order 232.1 by ensuring that

- all occurrences specified are identified in a timely manner, categorized, and reported
- proper corrective actions are taken in a timely manner
- all reportable occurrences are reviewed to assess significance and root causes
- occurrence reports to DOE operations are disseminated to prevent the recurrence of similar events

All SIRIM events are classified in one of the following categories: (1) facility condition; (2) environmental; (3) personnel safety; (4) personnel radiation protection; (5) safeguards and security; (6) transportation; (7) value-based reporting; (8) facility status; or (9) cross-group items. The impact—or the anticipated impact—of each event is categorized as follows (based on criteria in site procedures):

- *Emergency* – the most serious event; requires increased alert status for onsite and, in specific cases, offsite authorities
- *Unusual occurrence* – a nonemergency event that has significant impact or potential for impact on safety, environment, health, security, or operations
- *Off-normal occurrence* – an abnormal or unplanned event or condition that deviates from established standards or specifications

In 1997, of the 597 SIRIM-reportable events, 35 were categorized as primarily environmental. Of these 35 events, none were classified as emergencies, four were classified as unusual occurrences, and 31 were classified as off-normal occurrences. Table 2–6 lists

Table 2–6
Environmentally Related Unusual Occurrences Reported Through SIRIM in 1997

Discovery Date	Occurrence	Report No. (SR–WSRC–)	Cause/Explanation[a]
Jan. 21	About 2,100 gallons of spilled sewage (mostly domestic water) reached A–001 outfall	POD–1997–0002	Caused by clogged valve between 735–A and 774–A and by stuck-open toilet valve
July 27	Oil sheen observed downstream of outfall H–2	TRIT–1997–0011	Heavy rains caused less than 2 gallons of diesel fuel to underwash oil/grease absorbent booms that had contained previous day's spill from 234–H standby diesel generator
Sept. 8	Suspected underground diesel tank leak confirmed	FCAN–1997–0034	Transfer-line leak detected with helium check
Dec. 11	About 11,000 gallons of sewage released to environment of Upper Three Runs Creek and associated wetland	POD–1997–0012	Sixteen-inch ductile iron force main accidentally cracked during construction activity

a SRS takes followup corrective actions to minimize the impact on the environment.

the four unusual occurrences reported through SIRIM in 1997.

Assessments/Inspections

The SRS environmental program is overseen by a number of organizations, both outside and within the DOE complex. In 1997, the WSRC environmental appraisal program consisted of self and independent assessments. The program employs total-quality management concepts that support the site's four imperatives of safety, disciplined operations, continuous improvement, and cost effectiveness. It also ensures recognition of noteworthy practices, identification of performance deficiencies, and initiation and tracking of associated corrective actions until they are satisfactorily completed. The primary objectives of the WSRC assessment program are to ensure compliance with regulatory requirements and to foster continuous improvement.

In addition to the WSRC assessment program, DOE–SR's Environmental Quality & Management Division (EQMD) ensures—through independent reviews of SRS environmental protection programs and activities—that SRS contractors comply with federal and state environmental regulations, applicable DOE orders, and accepted industry standards.

EQMD operates under the administrative requirements of Savannah River Implementation Procedure 400, Chapter 450.1, "SR Environmental Protection Program." During 1997, EQMD used its Comprehensive Environmental Protection Assessment Program to identify proficiencies and deficiencies in SRS environmental protection programs and activities in accordance with DOE Order 5482.1B, "Environment, Safety, and Health Appraisal Program," and other environmental requirements. Scheduled assessments have met with positive results; routine 1997 assessments promoted improvement and helped ensure the adequacy of environmental programs and operations at SRS. The assessments—programmatic and sitewide in scope—are the functional equivalent of appraisals, as defined in DOE Order 5482.1B.

An improvement initiative jointly entered into by WSRC and DOE will combine the development and execution of the site environmental program self-assessment plan activities as an integrated effort. This process, piloted late in the 1997 program self-assessment cycle, will be implemented for fiscal year 1998.

Among the environmental activities assessed by EQMD in 1997 were

- environmental restoration materials control and accountability

- NEPA documentation
- spill prevention control and countermeasures and best management practices
- waste management—offsite shipments and receipt
- contractor self-evaluation programs
- effluent monitoring and environmental surveillance assessment

SCDHEC also inspects the SRS environmental program for regulatory compliance. Agency representatives performed three comprehensive compliance inspections in 1997, as follows:

- During the period April 21–30, annual air compliance inspections were conducted for 54 of the site's 153 operating permitted air emission sources. The air emission sources were in compliance.
- The 1997 Comprehensive Monitoring Evaluation (a RCRA inspection) of SRS was conducted April 21–25 by EPA and SCDHEC. Although a few deficiencies were cited during the closeout meeting, EPA representatives noted that "Your waste handling is very good, and it is obvious that you spend a great deal of energy on training and compliance." The EPA inspection report cited potential violations in four categories: inadequate hazardous waste storage aisle spacing, RCRA training violations, 1-year storage limit exceedance at the Defense Waste Processing Facility's organic waste storage tank, and time of day not being noted on hazardous waste inspection reports. The EPA report was issued in October 1997 to the SCDHEC Enforcement Division for resolution, but no enforcement action had been taken by the end of 1997. SRS and SCDHEC representatives are expected to meet on these issues upon notification by SCDHEC.
- During the period October 13–23, annual CWA/NPDES operation and maintenance inspections were performed at SRS wastewater treatment facilities, and grab and composite samples were collected at site NPDES discharge points. No deficiencies were noted at the time of the inspection, but SCDHEC is expected to issue a final report—including category ratings—in early 1998.

SCDHEC also performed monthly compliance inspections during the year, with no deficiencies noted.

Environmental Permits

SRS has 675 construction and operating permits that specify operating levels for each permitted source. This compares with 668 such permits in 1996, 643 in 1995, 608 in 1994, and 567 in 1993. Table 2–7 summarizes the permits held by the site during the past 5 years. Appendix D ("SRS Environmental Permits") of this report provides a comprehensive list of the permits, including the permit number, type of permit, and permitted source.

Environmental Training

The site's environmental training program identifies training activities to teach job-specific skills that protect the employee and the environment while satisfying regulatory training requirements. Chapter 3 contains more information about the training program.

Facility Decommissioning

With the rapidly declining need for a large nuclear weapons stockpile, many SRS facilities no longer are needed to produce or process nuclear materials. They have become surplus and must be dispositioned safely and economically. Many of them are large and complex and contain materials that, if improperly handled or stored, could be hazardous. SRS faces a major task in the cleanup, reuse, safe storage, and demolition of these facilities. The Facilities Decommissioning Division was established in 1996 to meet this challenge. The site's 1997 deactivation and decommissioning activities are discussed in chapter 4.

Other Major Environmental Issues and Actions

DOE–SR signed a ROD December 23, 1997, on the final EIS for the SRS river water system shutdown. Based on the environmental information found in the EIS, and on economic and regulatory considerations, DOE–SR has decided to continue to operate and maintain the river water system for the immediate future. This means that the water in L-Lake—a 1,000-acre, manmade lake created in 1985 to disperse and cool water from L-Reactor—will be maintained at its current level. PAR Pond—a 2,640-acre lake created in 1958 to disperse and cool water from P-Reactor and R-Reactor—also is supplied by the river water system, but its level is adequately maintained through rainfall and groundwater seepage.

The river water system was constructed in the late 1950s to pump cooling water from the Savannah

Table 2–7
SRS Construction and Operating Permits, 1993–1997

Type of Permit	Number of Permits				
	1993	1994	1995	1996	1997
Air	172	189	200	196	198
U.S. Army Corps of Engineers 404	1	1	0	0	1
Army Corps of Engineers Nationwide Permit	a	a	a	8	6
Domestic Water	146	152	165	178	186
Industrial Wastewater	79	83	90	87	84
NPDES–Discharge	2	2	2	2	1
NPDES–General Utility	0	0	0	0	1
NPDES–No Discharge	1	1	1	1	1
NPDES–Stormwater	2	2	2	2	2
RCRA	1	1	1	1	1
Sanitary Wastewater	120	133	133	135	137
SCWRC 401	1	1	1	1	2
SCDHEC Navigable Waters	a	a	a	4	4
Solid Waste	6	6	6	6	5
Underground Injection Control	6	7	13	18	17
Underground Storage Tanks	31[b]	31[b]	29[b]	29	29
Totals	567	608	643	668	675

a Formal tracking of these permits was initiated in 1996.
b Additional underground storage tank permits not previously reported were identified in 1996.

River to the site's five nuclear material production reactors. At the reactor areas, the water passed through heat exchangers to absorb heat from the reactor cores. Though the reactors no longer are operational, the river water system continues to be used to support fire protection efforts and the sanitary waste treatment plant and to maintain L-Lake's water level.

The EIS process was initiated to study cost savings and environmental impacts associated with operation and maintenance of the river water system. The EIS evaluated three options:

- continuing operation of the system
- shutting down the system but maintaining it for potential restart
- shutting down and deactivating the system, with no maintenance for potential restart

Shutting down the system eventually would have lowered the level of L-Lake.

The river water system will continue to operate while DOE–SR conducts a characterization of L-Lake under CERCLA; the characterization work is expected to begin by the year 2000. DOE has an agreement with EPA and SCDHEC that provides a commitment and schedule for the comprehensive remediation of contamination at SRS, including that at site streams and lakes. Sediments that contain low-level radionuclides remain under the lake—primarily in the former Steel Creek stream bed. The contaminated sediments were deposited prior to creation of the lake.

Continued operation of the river water system while the characterization efforts are being completed is expected to enable DOE–SR to determine the best ultimate course of action for the system.

Table 2–8 RCRA and RCRA/CERCLA Units at SRS – 1997

Page 1 of 5

Unit and Location	Building or Identification Number(s)	Additional Information
A-Area and M-Area		
A-Area Burning/Rubble Pits	731–A, –1A, –2A	Field start initiated 6/28/94
A-Area Coal Pile Runoff Basin	788–3A	
A-Area Miscellaneous Rubble Pile	731–6A	
A-Area Stormwater Outfalls	A–001, –002, –024, A–013	
716–A Motor Shop Seepage Basin	904–101G	
M-Area Hazardous Waste Management Facility (HWMF), including	904–51G, 904–112G	RCRA-regulated
A/M Groundwater Portion	904–110	RCRA-regulated; interim-action ROD issued
M-Area HWMF Settling Basin Inactive Process Sewers to Manhole 1	081–M	RCRA-regulated
M-Area HWMF Vadose Zone		RCRA-regulated; interim-action ROD issued
M-Area West	631–21G	Final ROD issued 9/29/95
Met Lab Basin/Carolina Bay	904–110	RCRA-regulated; interim-action ROD issued
Miscellaneous Chemical Basin/ Metals Burning Pits	731–4A, –5A	Field start initiated 8/26/94
Silverton Road Waste Site	731–3A	Final ROD issued 4/22/97
SRL Seepage Basins	904–53G1, –53G2, –54G, –55G	Field start initiated 9/25/96
SRL 904–A Process Trench	904–A	Time-critical removal initiated in fiscal year 1997
C-Area		
C-Area Burning/Rubble Pit	131–C	Field start initiated 8/22/95
C-Area Coal Pile Runoff Basin	189–C	Time-critical removal completed in fiscal year 1997 Final ROD planned for fiscal year 1998
C-Area Reactor Seepage Basins	904–066G, –067G, –068G	Time-critical removal initiated in fiscal year 1997
C-Area Stormwater Outfall	C–004	
Tank 105–C		RCRA-regulated; final ROD issued 9/23/94
General Separations and Waste Management Areas (E-, F-, H-, S-, Y-, and Z-)		
Burial Ground Complex comprised of		
Low Level Radioactive Waste Disposal Facility (nonhazardous portion)	643–7E	RCRA-regulated
Mixed Waste Management Facility	643–28E	RCRA-regulated; final ROD issued 9/23/93

Table 2–8 RCRA and RCRA/CERCLA Units at SRS – 1997

Page 2 of 5

Unit and Location	Building or Identification Number(s)	Additional Information
Old Radioactive Waste Burial Ground	643–E	Interim-action ROD issued 5/30/96
Solvent Tanks S01–S22		
Burial Ground Complex Groundwater		
Burma Road Rubble Pit	231–4F	Final ROD issued 7/8/96
211–FB Pu–239 Release	081–F	
F-Area Acid/Caustic Basin	904–47G	RCRA-regulated
F-Area Burning/Rubble Pits	231–F, –1F, –2F	Final ROD issued 4/22/97
F-Area Canyon Groundwater		
F-Area Coal Pile Runoff Basin	289–F	Time-critical removal completed in fiscal year 1997 Final ROD planned for fiscal year 1998
F-Area Groundwater		
F-Area Hazardous Waste Management Facility	904–41G, –42G, –43G	RCRA-regulated; final ROD issued
F-Area Inactive Process Sewer Lines from Building to Security Fence	081–1F	
F-Area Retention Basin	281–3F	RCRA permit modification not required
F-Area Seepage Basin Groundwater Operable Unit	904–44F	RCRA-regulated; interim-action ROD issued
F-Area Tank Farm Groundwater Operable Unit		
H-Area Acid/Caustic Basin	904–75G	RCRA-regulated
H-Area Coal Pile Runoff Basin	289–H	
H-Area Ditch to Outfall H–012	H–012	
H-Area Groundwater		
H-Area Hazardous Waste Management Facility	904–44G, –45G, –46G, –59G	RCRA-regulated; final ROD issued
H-Area Inactive Process Sewer Lines from Building to the Security Fence	081–H	
H-Area Retention Basin	281–3H	RCRA permit modification not required
H-Area Seepage Basin Groundwater Operable Unit		RCRA-regulated; interim-action ROD issued
H-Area Stormwater Outfall H–013	H–013	
H-Area Tank Farm Groundwater Operable Unit		
Old F Area Seepage Basin	904–49G	Final ROD issued 6/19/97

Table 2–8 RCRA and RCRA/CERCLA Units at SRS – 1997

Page 3 of 5

Unit and Location	Building or Identification Number(s)	Additional Information
Warner's Pond	685–23G	RCRA permit modification not required
K-Area		
K-Area Acid/Caustic Basin	904–080G	RCRA-regulated
K-Area Bingham Pump Outage Pit	643–1G	Field start initiated 12/13/94 Final ROD planned for fiscal year 1998
K-Area Burning/Rubble Pit	131–K	
K-Area Coal Pile Runoff Basin	189–K	Time-critical removal completed in fiscal year 1997 Final ROD planned for fiscal year 1998
K-Area Reactor Seepage Basin	904–65G	RCRA permit modification not required
K-Area Rubble Pile	631–20G	
K-Area Sludge Land Application Site	761–4G	
K-Area Stormwater Outfall	K–011	
K-Area Tritium Anomaly		RCRA permit modification not required
L-Area		
Chemicals, Metals, and Pesticides Pits	080–17G, –17.1G, –18G, –19G, –18.1G, –18.2G, –18.3G	Field start initiated 9/29/94 Final ROD planned for fiscal year 1998
Gas Cylinder Disposal Facility	131–2L	Time-critical removal initiated in fiscal year 1997
L-Area Bingham Pump Outage Pits	643–2G, –3G	Final ROD planned for fiscal year 1998
L-Area Burning/Rubble Pits	131–L, –3L	Field start initiated 11/3/97 Time-critical removal initiated in fiscal year 1997
L-Area Hot Shop	717–G	
L-Area Oil/Chemical Basin and L-Area Acid/Caustic Basin	904–83G, –77G	Final ROD planned for fiscal year 1998
L-Area Rubble Pits	131–1L, –4L	
L-Area Southern Groundwater		
L-Area Stormwater Outfall	L–012	
N-Area (Central Shops)		
Central Shops Burning/Rubble Pits	631–G, –3G, –5G	
Central Shops Burning/Rubble Pits	631–6G	Final ROD issued 6/19/97
Central Shops Sludge Lagoon	080–24G	

Table 2–8 RCRA and RCRA/CERCLA Units at SRS – 1997

Page 4 of 5

Unit and Location	Building or Identification Number(s)	Additional Information
P-Area		
P-Area Acid/Caustic Basin	904–78G	RCRA-regulated
P-Area Bingham Pump Outage Pits	643–G	RCRA permit modification not required Final ROD planned for fiscal year 1998
P-Area Burning/Rubble Pit	131–P	
P-Area Coal Pile Runoff Basin	189–P	Time-critical removal completed in fiscal year 1997 Final ROD planned for fiscal year 1998
P-Area Stormwater Outfall	P–010	
R-Area		
Overflow Basin	108–4R	Field start initiated 9/28/95
PAR Pond (including pre–cooler ponds and canals)	685–G	Interim-action ROD issued 2/16/95
PAR Pond Sludge Land Application Site	761–5G	
R-Area Acid/Caustic Basin	904–79G	
R-Area Bingham Pump Outage Pits	643–8G, –9G, –10G	Final ROD planned for fiscal year 1998
R-Area Burning/Rubble Pits	131–R, –1R	
R-Area Reactor Seepage Basins	904–57G, –58G, –59G, –60G –103G, –104G	Final ROD planned for fiscal year 1998
R-Area Rubble Pile	631–25G	
Sanitary Landfill		
Sanitary Landfill	740–G	Portions RCRA-regulated
Sanitary Landfill Groundwater		RCRA-regulated
TNX and D-Areas		
D-Area Oil Seepage Basin	631–G	Interim-action ROD issued 2/16/95
D-Area Ash Basin	488–D	
D-Area Burning/Rubble Pits	431–D, –1D	Final ROD issued 4/22/97
D-Area Coal Pile Runoff Basin	489–D	
D-Area Waste Oil Facility	484–D	
New TNX Seepage Basin	904–102G	
Old TNX Seepage Basin	904–076G	
TNX Burying Ground	643–5G	
TNX Groundwater	082–G	Interim-action ROD issued 11/16/94

Table 2–8 RCRA and RCRA/CERCLA Units at SRS – 1997

Page 5 of 5

Unit and Location	Building or Identification Number(s)	Additional Information
West of SREL "Georgia Fields" Site	631–19G	
Other		
Fire Department Hose Training Facility	904–113G	
Ford Building Seepage Basin	904–91G	
Ford Building Waste Site	643–11G	Time-critical removal completed in fiscal year 1997
Fourmile Branch Integrator Operable Unit		
G-Area Oil Seepage Basin	761–13G	
Grace Road Site	631–22G	Final ROD issued 4/22/97
Gunsite 113 Access Road	631–24G	Final ROD issued 4/22/97
Gunsite 218 Rubble Pile	631–23G	Final ROD planned for fiscal year 2012
Gunsite 720 Rubble Pit	631–16G	Final ROD issued 4/22/97
Hydrofluoric Acid Spill	631–4G	RCRA permit modification not required
Lower Three Runs Integrator Operable Unit		
Pen Branch Integrator Operable Unit		
Road A Chemical Basin	904–111G	
Savannah River Integrator Operable Unit		
Savannah River Floodplain Swamp Integrator Operable Unit		
SRL Oil Test Site	080–16G	
Steel Creek Integrator Operable Unit		
Steel Pond		
Upper Three Runs Integrator Operable Unit		
X–001 Outfall Drainage Ditch	X–001	

Chapter 3

Environmental Program Information

Mary Dodgen and Greg Peterson
Environmental Protection Department

To Read About . . . Turn to Page . . .

1997 Highlights

- SRS was granted ISO 14001 certification in recognition of its environmental programs and performance. The SRS Environmental Management Systems Policy provides the basis for environmental programs and emphasizes vigilance in protecting human health and ecological or natural resources.
- A thorough critical pathways analysis for radioactive materials released from SRS was completed. The analysis identified tritium and cesium-137 as the primary contributors to offsite exposure. Also, in late 1996 and early 1997, critical pathways analyses were conducted for nonradioactive materials released from SRS operations. Arsenic and benzene were identified as the primary potential contributors to offsite exposure.
- Solid waste generators identified more than 143 waste reduction initiatives with potential to reduce forecasted waste generation by more than 120,000 cubic feet on an annualized basis. The decrease is attributed largely to waste minimization efforts, but also to changing site missions.
- Sanitary waste volumes were reduced by recycling initiatives. In fiscal year 1997, more than 2,445 tons of nonradioactive materials were recycled at SRS, including 818 tons of paper, cardboard, and aluminum cans.
- Reducing the demand for energy in turn reduces emissions and conserves resources associated with energy production. From 1985 through 1997, the consumption of energy per gross square foot dropped by 80 percent. This decrease is attributed to a comprehensive energy conservation program and changes in site mission.
- Each year, WSRC employees are involved in many programs designed to bring science and mathematics to local teachers and students. For the 1996–1997 school year, an estimated 48,000 contacts were made with students in surrounding communities through these programs. One educational initiative was the Research Intern Program, which placed 134 students, teachers, and faculty members in research intern positions.

Beginning with preconstruction in the early 1950s, the Savannah River Site (SRS) has been a good steward of the environment through its policies, procedures, and performance. Through the years, environmental programs have evolved to complement site missions. Policies related to these programs were formalized in recent years in the SRS Environmental Management System Policy, which emphasizes vigilance in protecting human health and ecological or natural resources. The full text of this policy is provided in appendix A, "Applicable Guidelines, Standards, and Regulations." In 1997, the site's environmental programs and performance were recognized when the site was granted International Organization for Standardization (ISO) 14001 certification.

Information in this chapter exemplifies SRS's adherence to this policy. Included are

- a general overview of environmental programs, including monitoring. Two goals of the environmental monitoring program are to measure concentration or quantity of contaminants (both radiological and nonradiological) released from site operations and to provide a technical basis for any needed corrective action. Also, the data generated provides evidence as to whether or not applicable federal, state, and local standards, as well as U.S. Department of Energy (DOE) orders, are being met.
- an overview of the SRS Dose Reconstruction Study, which is an evaluation of historical monitoring data and other site records. An objective of this study is to provide an independent assessment of potential human health risk to populations exposed to radioactive materials and chemicals released into the

surrounding environment since site operations began in the 1950s.

- a description of the site's pollution prevention program. The goal of this program is to reduce the impact of site operations on the environment by focusing on source reduction, on recycling, and on increasing employee awareness of—and participation in—waste minimization.
- descriptions of activities—such as employee training, information exchange, and public outreach—that offer ways to provide job-related knowledge and develop job-related skills; to share information about site operations, programs, and objectives; and to address public concerns.

Various site operating groups have environmental programs. These groups include Westinghouse Savannah River Company's (WSRC) Environmental Protection Department (EPD); Safety and Health Operations (S&HO), formerly known as Radiological Control Operations; Savannah River Technology Center (SRTC); Savannah River Ecology Laboratory (SREL); Savannah River Natural Resource Management and Research Institute (SRI), formerly known as Savannah River Forest Station; and Savannah River Archaeological Research Program (SRARP). SRTC, SREL, SRI, and SRARP are discussed briefly in chapter 1, "Introduction." However, the education outreach programs of SREL, SRI, and SRARP, as well as that of WSRC, are discussed in this chapter.

ISO 14001

The ISO is composed of standards groups from 120 member countries. Founded in 1947, ISO has set international standards for things as varied as paper sizes and automotive parts. Currently, more than 70,000 firms have made ISO registration an important part of their international business strategy.

ISO 14000 is a series of standards—a family of voluntary environmental management standards and guidelines. ISO 14001 is the Environmental Management System Standard within the 14000 Series. Application of the ISO 14001 environmental management principles will increase cost effectiveness and environmental compliance efficiency.

ISO 14001 certification provides evidence to stakeholders that SRS is committed to an environmentally safe site, to pollution prevention, to environmental compliance, and to continual improvement. SRS is the largest multiorganizational and multifunctional operating nuclear site in the United States to achieve ISO 14001 certification. Certification was granted following an audit of SRS performed by independent investigators with international management system expertise.

Environmental Monitoring

SRS environmental monitoring, which includes both onsite and offsite activities, is the responsibility of EPD's Environmental Monitoring Section (EMS). Also, the Division of Environmental Research of the Academy of Natural Sciences of Philadelphia has performed biological and water quality surveys of the Savannah River since 1951.

The two components of environmental monitoring are effluent monitoring and environmental surveillance. Additional environmental monitoring information in this report is provided in chapters dealing specifically with

- radiological effluent monitoring (chapter 5)
- radiological environmental surveillance (chapter 6)
- nonradiological effluent monitoring (chapter 8)
- nonradiological environmental surveillance (chapter 9)

Effluent Monitoring and Environmental Surveillance

Per DOE Order 5400.5, "Radiation Protection of the Public and the Environment":

Effluent monitoring is the collection and analysis of samples or measurements of liquid and gaseous effluents for purposes of characterizing and quantifying contaminants, assessing radiation exposure to members of the public, and demonstrating compliance with applicable standards.

Environmental surveillance is the collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media from DOE sites and their environs and the measurement of external radiation for purposes of demonstrating compliance with applicable standards, assessing radiation exposures to members of the public, and assessing the effects, if any, on the local environment.

Monitoring occurs at the point of discharge, such as an air stack or drainage pipe; surveillance involves looking for contaminants in the environment.

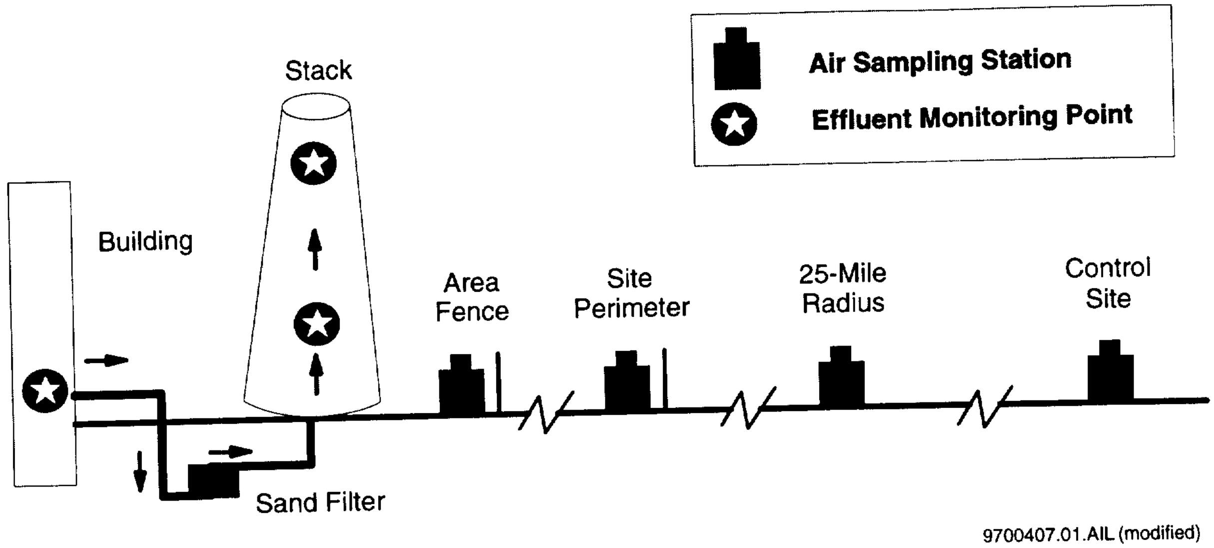


Figure 3–1 Typical Airborne Effluent Monitoring and Environmental Surveillance
Effluents are monitored at points of discharge. Released materials of concern are tracked in the environment.

- groundwater monitoring (chapter 10)
- special surveys and projects (chapter 12)

Effluent Monitoring

Effluent monitoring is conducted by collecting and analyzing onsite samples of liquid and airborne effluents taken at or very near their points of discharge to the environment. Radiological effluent monitoring meets regulatory requirements and provides source terms for calculating potential offsite radiation doses. More information about these calculations can be found in chapter 7, "Potential Radiation Doses." In 1997, more than 4,200 samples were taken at 87 points of discharge.

S&HO and EMS share the responsibility for radiological effluent monitoring. S&HO collects and screens air and liquid samples from regulated (radiologically controlled) areas and maintains monitoring equipment on stacks and at some liquid effluent discharge points. EMS collects and analyzes most liquid effluent samples. Following validation, results of these analyses are recorded in a monthly radioactive releases report. Data from the monthly reports are summarized in an annual data publication (in 1997, *SRS Environmental Data for 1997*, WSRC–TR–97–00324).

SRS handles plutonium, tritium, and other special nuclear materials. Therefore, one focus of the environmental program is to detect possible releases of these radioactive materials from routine operations. This is done by collecting and analyzing samples of airborne and liquid effluents. A typical setup for airborne effluent monitoring is illustrated in figure 3–1. As shown, radioactive materials are monitored at their points of discharge, and air monitoring stations are located strategically to track—and to quantify—the dispersion of any released material into the surrounding environment. Monitoring may be performed at any or all of the identified locations as determined by the rationale discussed on page 47.

Data generated from monitoring nonradioactive contaminants in airborne effluents at SRS provide evidence as to whether or not requirements of permits issued by the South Carolina Department of Health and Environmental Control (SCDHEC) are being met. These permits are discussed further in chapter 2, "Environmental Compliance," and listed in appendix D, "SRS Environmental Permits."

The major nonradiological airborne emissions of concern from SRS stacks include sulfur dioxide, oxides of nitrogen, particulate matter, and toxic air pollutants, such as tetrachloroethylene, perchloroethylene, benzene, and hydrochloric acid. As part of a network associated with the federal Clean Air Act, Georgia and South Carolina environmental agencies verify permit compliance by monitoring ambient air quality near SRS. Clean Air Act Amendments, implemented in 1990, require federal facilities, such as SRS, to comply with provisions of the act.

Nonradioactive liquid effluents generally are sampled at National Pollutant Discharge Elimination System (NPDES) outfalls (points of discharge) and reported to SCDHEC in a monthly discharge monitoring report, as required by the Clean Water Act. Monitoring requirements for liquids may vary at each outfall, depending on the type of facility and the known characteristics of the wastewater. A typical setup for liquid effluent monitoring is shown in figure 3–2.

Environmental Surveillance

Environmental surveillance is conducted by collecting and analyzing onsite and offsite samples taken at various distances from points of discharge. In 1997, approximately 10,000 radiological analyses were performed on approximately 5,000 samples (not including groundwater). Data from radiological environmental surveillance are evaluated to

- determine the effects, if any, of SRS releases
- provide a way to verify dose calculations and predictions from mathematical models

Because most contaminants are released in such small amounts that they cannot be readily measured in environmental samples, SRS uses mathematical models to estimate contaminant concentrations in environmental media. The data obtained at the point of discharge (e.g., stack, pipe, or outfall)—where the concentration would be highest if a contaminant were present—is used to calculate the estimated contaminant concentration in sampled media, such as water, soil, or vegetation. More information about modeling can be found in chapter 7.

Nonradiological environmental surveillance is conducted by collecting and analyzing samples from site streams and the Savannah River to verify the outfall sampling data and to ensure the detection and characterization of materials that could adversely affect the environment. Adverse conditions resulting from the presence of such materials are identified and evaluated to provide a basis for corrective action.

Policy

SRS policy requires an environmental monitoring program designed to

- establish effluent and ambient levels of radionuclides and other discharges
- determine trends in these releases
- provide a basis for assessment of dose to humans and the environment
- provide information needed to detect and correct problems

SRS is committed to sharing this information with the public and its representatives.

Objectives

One purpose of environmental regulations is to protect human health and the environment. In support of this purpose, the SRS environmental monitoring objectives are to

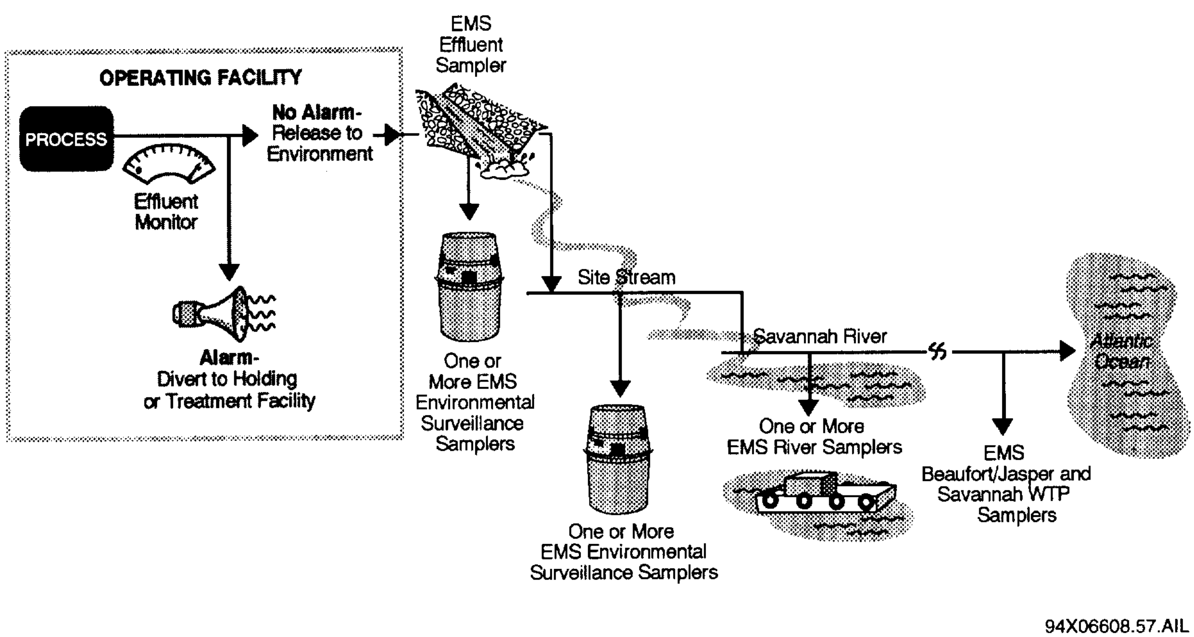


Figure 3–2 Typical Liquid Effluent Monitoring and Environmental Surveillance
Effluents are monitored at points of discharge. Released materials of concern are tracked in the environment.

- assess actual or potential exposures of radioactive and nonradioactive materials to critical groups and populations from normal site operations or from accidents
- demonstrate compliance with authorized limits and regulatory requirements or need for corrective action
- verify the adequacy of each facility in containing radioactivity and controlling effluents
- notify appropriate officials of unusual or unforeseen conditions and, if necessary, to activate a special environmental monitoring program
- communicate accurate and effective EMS monitoring results to DOE, to other government agencies, and to the general public
- maintain an accurate and continuous record of the effects of SRS operations on the environment
- determine concentrations of radioactive and nonradioactive contaminants in environmental media for the purpose of assessing the immediate and long-term consequences of normal and accidental releases
- distinguish between environmental contamination and effects from SRS operations and those from other sources
- evaluate and revise the environmental monitoring program in response to changing conditions in transport pathways and to the site's changing mission
- provide site-specific data for risk assessment and uncertainty analyses for human populations near SRS
- assess the validity and effectiveness of models used to predict the concentration of pollutants in the environment
- conduct scientific studies on the transport pathways of radioactive and nonradioactive contaminants in the environment

These objectives incorporate the recommendations of the International Commission on Radiological Protection ("Principles of Monitoring for the Radiation Protection of the Public," ICRP Publication 43), of DOE Order 5400.1 ("General Environmental Protection Program"), and of DOE/EH–0173T ("Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance").

As a result of the environmental monitoring program, SRS seeks to

- determine any long-term buildup of—and predict environmental trends from—site-released contaminants
- establish baselines of environmental quality so that trends in the physical, chemical, and biological condition of environmental media can be characterized
- identify and quantify new or existing environmental quality problems, then assess the need for corrective actions or mitigation measures
- pinpoint exposure pathways in which contaminants are accumulated and transmitted to the public

Rationale

Many factors are considered in the determination of monitoring activities at SRS, including responsible environmental stewardship. Sampling locations, sample media, sampling frequency, and types of analysis are selected on the basis of environmental regulations, exposure pathways, public concerns, and measurement capabilities. More detailed information about the site's environmental monitoring program is documented in sections 1101–1111 (SRS EM Program) of the *SRS Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1. This document is reviewed annually and updated every 3 years.

Environmental Regulations

Environmental monitoring at SRS is designed to meet state and federal regulatory requirements for radiological and nonradiological programs. These requirements are stated in DOE orders 5400.1 and 5400.5 ("Radiation Protection of the Public and the Environment"); in the Clean Air Act—for example, National Emission Standards for Hazardous Air Pollutants (NESHAP); in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA—also known as the Superfund); in the Resource Conservation and Recovery Act (RCRA); and in the Clean Water Act—for example, NPDES. SCDHEC, the U.S. Environmental Protection Agency (EPA), and DOE conduct audits to verify that the site complies with environmental regulations. Chapter 2 summarizes the site's compliance status for 1997.

Exposure Pathways

Materials released from SRS reach the environment and people in a variety of ways. The routes that materials follow to get from an SRS facility to the environment and then to people are called exposure pathways. Some potential exposure pathways are

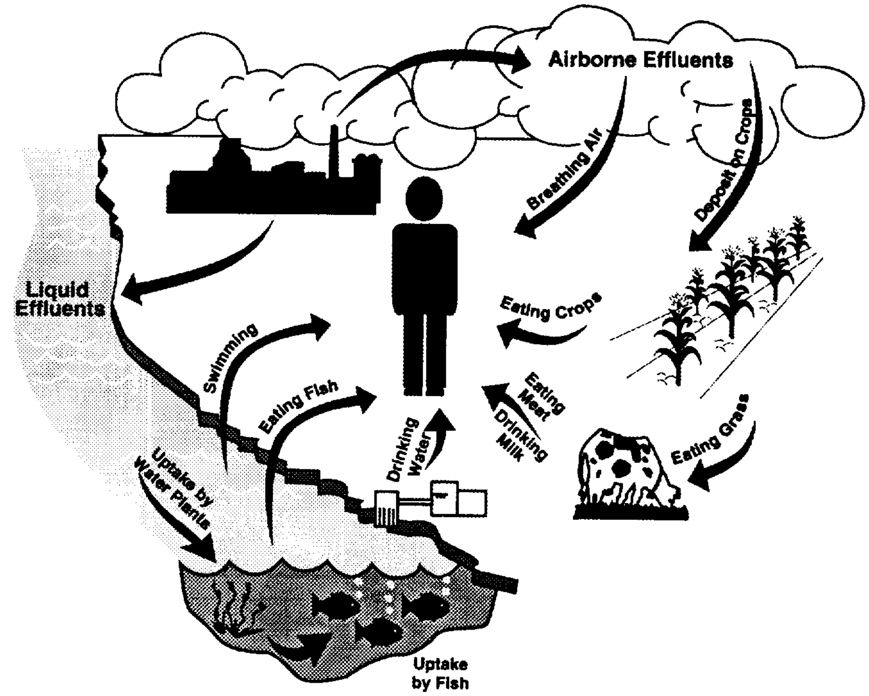


Figure 3–3 Some Potential Exposure Pathways
Airborne and liquid materials released from SRS operations can reach people in a variety of ways. These ways, or routes, are called exposure pathways.
98X00342.01.AIL

illustrated in figure 3–3, which shows that materials released into the air may be taken into a human body when a person breathes air or eats food grown near the site—for example, vegetables or beef products. Similarly, materials released into site streams may be taken into the body if a person drinks Savannah River water or eats fish taken from the river. However, the released amounts of radioactive and nonradioactive materials from SRS meet—and are significantly below—all regulatory standards. Thus, they present no known danger to the environment, to site workers, or to the public.

The method used to determine exposure pathways is called a critical pathways analysis. A thorough critical pathways analysis for radioactive materials released from SRS operations was done in April by SRTC's Environmental Analysis Section [Jannik, 1997]. This work was conducted in response to a request from DOE's Savannah River Operations Office (DOE–SR). The analysis identified tritium and cesium-137 as the primary contributors to offsite exposures. As expected, potential exposure pathways for tritium released into air were through breathing air and eating food, whereas potential exposure pathways for tritium and cesium-137 released into site streams were through drinking river water and eating fish from the river.

Also, in late 1996 and in 1997, critical pathway analyses were done for nonradioactive materials released from SRS operations. Arsenic and benzene were identified as the primary potential contributors to offsite exposure. Exposure to arsenic and benzene may occur by breathing the air [Stewart, 1997] and to arsenic by drinking water and eating fish from the river [Chen, 1996].

Critical pathways analysis results are used as part of the site's environmental monitoring activities to make decisions about sampling locations, sample media, and sampling frequency. Results from modeling exposure pathways can help

- verify that sampling programs perform as required
- make the best use of sampling and analysis resources

Public Concerns

Public concerns influence the site's environmental monitoring activities. The public wants to know about releases and their potential health effects. One aspect of environmental monitoring that addresses a public concern is the placement of thermoluminescent dosimeters (TLDs) in offsite locations. These devices, used to measure external gamma radiation, provide a quick, reliable method of determining the dose from gamma-emitting radionuclides in the event of an unplanned release of radioactive material.

Measurement Capabilities

Many materials released from SRS exist in such low concentrations in the environment that they cannot be readily measured. Thus, the ability to measure low levels of concentrations becomes a significant factor in the rationale for monitoring certain materials. In these cases, modeling with nationally accepted computer programs is used to predict or estimate concentration levels. More information on modeling can be found in chapter 7, and more on measurement capabilities can be found in tables 1–3 in *SRS Environmental Data for 1997*.

1997 Program Changes

The types, frequencies, and locations of environmental measurements are reviewed annually to determine how best to continue an effective monitoring program. If a clear rationale for a measurement no longer exists, the measurement is deleted from the program. Likewise, as new sampling/analytical methods evolve or needs identified, new measurements are added to the program.

Following completion of the critical pathways analysis for radioactive materials released from SRS operations in April (described on page 48), EMS initiated a comprehensive review of environmental monitoring programs to validate program integrity and ensure best use of sampling and analysis resources. Changes resulting from this review will be made in early 1998. Other specific programmatic changes made in 1997 are detailed in subsequent chapters of this report.

Dose Reconstruction Study

SRS has conducted environmental monitoring of radioactive materials and chemicals released to the environment since the beginning of site operations in the early 1950s. Historical data from this environmental monitoring and from site operations are being evaluated independently by the federal Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, as part of the SRS Dose Reconstruction Study, to determine the effects these materials may have had on people living near the site.

Phase I of the study—the location and review of records—was completed in 1995 and is discussed briefly in the *SRS Environmental Report for 1996* (WSRC–TR–97–0171). During Phase II of the study, which began in September 1995, the CDC will estimate the amount of materials released (the source term) since SRS began operations in 1952 and will reconstruct—through pathways analyses and dose assessments—the doses that the public has received from these materials. This information will be used to assess the possibility of health effects, attributable to site operations, in the population around the site. Phase II is expected to be completed in 1998.

Inquiries can be made about the study by writing to Centers for Disease Control and Prevention, 4770 Buford Highway NE, MS F35, Atlanta, GA 30341–3724; by calling 770–488–7040; or by faxing 770–488–7044.

Pollution Prevention

Pollution prevention at SRS is designed to reduce the impact of site operations on the environment, reduce operational costs, and reduce employee exposure to hazardous materials. Pollution prevention at the site includes

- source reduction activities
- recycling of potential wastes and pollutants
- reduction in the use of materials, energy, water, and other resources
- protection of human health and of natural resources through conservation or more efficient use
- disposal of waste in an environmentally safe manner

Pollution prevention programs are a major focus of many activities, organizations, and implementation teams. Improvements in the coordination of and communication between these program areas are ongoing, and employee awareness of—and management emphasis on—pollution prevention is increasing. Highlights of some of the 1997 SRS pollution prevention activities are discussed in the following paragraphs.

Waste Minimization

The SRS Waste Minimization Program continued in 1997 to reduce the generation of solid wastes that require costly treatment, storage, and disposal. The annualized radioactive and hazardous solid waste generation volumes decreased by about 71 percent, or almost 694,000 cubic feet, from 1991 to 1997. (In calendar year 1991, 972,751 cubic feet of radioactive and hazardous solid waste was generated. In fiscal year 1997, 278,795 cubic feet of radioactive and hazardous solid waste was generated.)

The decrease is attributed largely to waste minimization efforts initiated as a site program in 1991, but also is the result of changing site missions. In 1997, solid waste generators identified more than 143 waste reduction initiatives with potential to reduce forecasted waste generation by more than 120,000 cubic feet on an annualized basis. Key initiatives included incorporation of commercial radioactive waste reduction practices; emphasis on reduction in the size of radioactive contamination areas; increased use of recyclable—versus disposable— materials for radioactive jobs; and the surveying, decontaminating, and subsequent free-release of previously contaminated materials.

Solid Waste Recycling

Sanitary waste volumes were reduced by recycling initiatives. In fiscal year 1997, more than 2,445 tons of nonradioactive materials were recycled at SRS, including 818 tons of paper, cardboard and aluminum cans.

Energy Conservation

Reducing site demand for energy in turn reduces emissions and conserves resources (e.g., coal) associated with energy production. A comprehensive energy conservation program and site mission changes helped drive down facility energy consumption in British Thermal Units (BTU) per gross square foot by more than 80 percent from 1985 (baseline year) through 1997.

The primary focus during 1997 was the initiation of a sitewide Energy Savings Performance Contract. Under this contracting mechanism, an Energy Services Company (ESCO) incurs the cost of implementing energy savings measures, including—but not limited to—performing energy audits and studies; designing, acquiring, and installing equipment; and training personnel. The ESCO is required by federal law to guarantee a minimum cost savings resulting directly from implementation of such measures during the term of the contract and is at risk to ensure that this minimum guarantee is achieved. In exchange for providing these services, the ESCO receives a percentage of the cost savings. This contract should be initiated during the first quarter of fiscal year 1998.

Energy Management Award

SRS received a DOE Energy Management Award for its In-House Energy Management Program at the 18th Annual DOE Energy Management Awards Ceremony in Washington, D.C., October 22, 1997. This award was based on the site's completing in September 1996 a $1.06 million energy efficiency upgrade of 43 administrative buildings. This three-phase project, completed in just 10 months, is expected to save more than $241,000 annually (3.1 million kilowatts per year) and has a simple payback of 4.4 years.

Reduction of Chemical Releases

Under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA), SRS has filed Toxic Chemical Release Inventory reports annually since 1987. The site calculates chemical releases to the environment and reports aggregate quantities for each regulated chemical that exceeds threshold amounts. Between 1987 and 1996, reportable release quantities declined by 99 percent. More about Toxic Chemical Release Inventory reports can be found in chapter 2.

Affirmative Procurement of Recycled Products

The SRS Affirmative Procurement Program —implemented as part of federal Executive Order 12873, "Federal Acquisition, Recycling and Waste Prevention," and RCRA Section 6002—promotes the purchase of products made from recycled materials to help conserve natural resources. The program is based on DOE guidelines for implementing affirmative procurement requirements at federal facilities. The fiscal year 1997 program continued to expand recycled product purchasing in several areas, including paper, retread tires, office supplies, and construction and building materials. More than $2 million worth of recycled products were purchased by SRS in fiscal year 1997.

Excess-Chemical Management

The Chemical Commodity Management Center was created and staffed in 1994 to ensure environmentally sound, safe, and cost-effective acquisition, distribution, and reuse of chemicals/excess chemical products for the site. An "excess chemical product" is defined as any reusable material that can be sold, donated, or redistributed on site, that requires a material safety data sheet, and that is in its original form and concentration as received as a stock supply item from a supplier. Some accomplishments included implementing reviews of all chemical procurement requests prior to purchase, coordinating the site's annual EPCRA Tier II chemical inventory (chapter 2), and developing a sitewide chemical management program. In 1997, procedures were written and implemented in support of this program. In addition, an excess chemical sales program was implemented, and a "return to manufacturer" program was written and is currently under review.

During 1997, the Chemical Commodity Management Center received 90,000 pounds of excess chemicals and disbursed more than 150,000 pounds of excess chemicals. The disbursements were made to offsite institutions as part of the site's community outreach effort. Thus, the institutions received usable products, and the site avoided substantial waste disposal costs.

Ozone-Depleting Substances

The Clean Air Act Amendments of 1990 require that EPA publish a number of regulations to phase out the production and consumption of ozone-depleting substances. SRS has produced an internal guidance document designed to assist the site in the phaseout of these substances. The main objective of the plan is to reduce the use of chlorofluorocarbon (CFC) refrigerants by replacement and retrofit of CFC equipment, by sound refrigerant containment practices (such as by reducing leaks), and by controlling distribution of refrigerants from inventories.

In 1997, refrigerant usage continued to decrease primarily because of management awareness and maintenance practices. Current and future projects to replace or retrofit 37 major refrigerant units and some intermediate-sized units will eliminate the site's dependency on CFC refrigerants. More about ozone-depleting substances can be found in chapter 2.

Employee Training

SRS environmental training programs help achieve environmental goals at the site. SRS is committed, as a matter of policy, to maintaining its facilities and conducting its operations in full compliance with all applicable laws and regulations for the protection of the environment and of the health and safety of its employees and the general public. The training program identifies training activities to teach job-specific skills that protect the environment and satisfy regulatory requirements.

Environmental training at SRS addresses good environmental stewardship, which includes compliance with federal and state regulations. The focus is on required training and recommended education courses for employees (based on responsibility) involved with environmental oversight, hazardous materials, and waste management at the site.

Environmental training activities in 1997 included the following:

- Site environmental protection coordinators (14) were trained in responsibilities for reporting occurrences having environmental consequences. Training also was provided for DOE and environmental coordinator representatives.
- Site workers (220) received and/or maintained water/wastewater certification.
- More than 65 persons attended environmental training through subcontracted courses.
- Site workers (585) attended Hazardous Waste Operations courses (29 CFR 1910.120), which provide health and safety training in hazardous-waste cleanup activities and in working at RCRA treatment, storage, and disposal facilities.
- Site workers (1,569) attended RCRA training. (SRS identified isolated incidences of workers who had failed to obtain initial RCRA training within the required time period and who had not taken the required annual RCRA update training. Measures were implemented to help prevent reoccurrences.)
- More than 15,500 site workers took the Consolidated Annual Training course to meet general training requirements, including some environmental training.
- More than 438 persons attended a variety of environmental training courses dealing with topics such as asbestos, laws/regulations, and occurrence reporting.

Information Exchange

SRS has opened several avenues of exchange with state and federal regulators, other government-owned, contractor-operated (GOCO) facilities, and scientists to improve and update its environmental monitoring and research programs.

DOE–SR representatives attend DOE Headquarters (DOE–HQ)-sponsored technical information exchange workshops, which provide a way to enhance the exchange of technical information among DOE sites.

Environmental awareness and information exchange tours are conducted for many special-interest groups, including environmental activists and representatives of other GOCOs, of DOE–HQ, of Westinghouse Electric Corporation, of EPA, and of SCDHEC. Tours are designed to meet the needs of a particular group. For example, EPA and SCDHEC tours might focus on regulatory issues, while tours for other GOCOs might cover activities applicable to their programs.

Initiated in 1996, the Interagency Information Exchanges are public forums that enable state and federal regulators and SRS to address environmental compliance issues. At these forums, EPA, SCDHEC, and SRS representatives discuss cleanup plans and draft RCRA permit changes while soliciting public comments. Public input is considered by the agencies and used to develop final remedial approaches.

The Citizens Advisory Board (CAB) for SRS provides recommendations to DOE, EPA, and SCDHEC on environmental remediation, waste management, and related issues. More information about the CAB and its 1997 recommendations can be found on page 55.

The Environmental Advisory Committee, which is comprised of nationally recognized consultants from the fields of biology, ecology, hydrogeology, health physics, environmental restoration, and economics, meets quarterly to review site environmental programs and make recommendations. In 1997, this group formally reviewed the *SRS Environmental Report for 1996* (WSRC–TR–97–0171) and *SRS Environmental Data for 1996* (WSRC–TR–97–0077).

The Central Savannah River Area Radiological Environmental Monitoring Program is a data exchange program involving representatives of SCDHEC, the Georgia Department of Natural Resources, Georgia Power Company, Chem-Nuclear Systems, DOE, and WSRC. This group has met semiannually since 1987 to share technical environmental program information and data. These meetings provide an open forum in which to review and possibly improve each organization's monitoring program.

Public Outreach

Communications

SRS public outreach activities—such as public meetings, the Visitors Program, the Speakers Bureau, and the Traveling Lecturers Program—provide communication channels between the site and the public. Local newspaper, television, and radio advertisements also inform the public about environmental activities. More information can be obtained by contacting the WSRC Media and Community Relations Department at 800–603–0970.

When topics involve unusually complex issues, DOE may conduct workshops that give special-interest groups or citizens the opportunity to meet with site representatives.

Environmental Justice

Two grants have been awarded to incorporate environmental justice principles (set forth in Executive Order 12898, "Environmental Justice Strategy") in the design of community-specific risk communication programs and their delivery to the targeted audience. Researchers from two United Negro College Fund schools, which had conducted a fish subsistence/consumption survey in 1996 with the first grant, reported its findings to the CAB and EPA and gave a final report to DOE–SR October 9, 1997. The *Savannah River Site (SRS) Fish Subsistence Study (FSS)* identified approximately 1.5 percent of the targeted population as being subsistence-level fish consumers. However, the study did not yield additional conclusive results because of limited response to the survey and recall bias by the people being surveyed.

The second grant was awarded to the Medical University of South Carolina in Charleston for researchers to determine concerns of people living near SRS (first phase). Some concerns identified were quality of air and water and incidences of cancer. The second phase of this study involved Medical University of South Carolina researchers working with site personnel to design and deliver programs that addressed specific health and environmental concerns identified in the four communities surveyed. Major tasks of this phase were selecting and training a risk communication team and conducting four community meetings. Results of this research were presented to the CAB, and the final report (*Savannah River Site Environmental Justice Risk Communication Project – Phase II*) was presented to DOE–SR July 28, 1997.

Additional information on the studies or SRS environmental justice activities can be obtained by calling the DOE–SR Office of Environmental Quality Public Accountability Specialist at 803–725–5351.

Public Notice Requirements

Various regulations require that SRS notify the public of its environmental plans and activities. RCRA, CERCLA, the National Environmental Policy Act (NEPA), and the Clean Water Act have public notice requirements. SRS meets these requirements by using various community involvement tools, including notices to contiguous landowners, to media, to local and state government agencies, and to any other interested stakeholders. Such notices—and the status of documentation—typically are sent in a monthly newsletter called the *Environmental Bulletin* and in separate mailings, as required. NEPA documentation generated by SRS and various construction and operating permits held by SRS are available to the public. Chapter 2 lists 1997 SRS project NEPA documentation activities, and appendix D of this report lists the construction and operating permits held by SRS.

Education

Westinghouse Savannah River Company

WSRC assists in conducting competitions such as the Central Savannah River Area Science and Engineering Fair and the DOE Savannah River Regional Science Bowl to encourage student interest in engineering, science, and mathematics. In partnership with the Ruth Patrick Science Education Center, WSRC offers the Traveling Science Demonstration Program, which provides hands-on science kits demonstrated by working scientists and engineers to local elementary, middle, and high schools. Other education initiatives include the Research Intern Program, which placed 134 students, teachers, and faculty members in research intern positions in fiscal year 1997 and the School-to-Work Program, which provided 165 high school and postsecondary students with work-based learning experiences at SRS. In 1997, WSRC provided about 150 teacher resource kits and miscellaneous materials to assist teachers in a variety of environmental areas. Tabulations on the 1996–97 school year show that WSRC programs had more than 48,000 contacts with students in the surrounding communities through various programs and events in science and mathematics.

Savannah River Natural Resource Management and Research Institute

SRI made more than 40,000 contacts with people through outreach programs in 1997, including about 25,000 contacts made through community events and participation in the Visitors Program mentioned on page 52. Other outreach activities are as follows:

- The Natural Resources Science, Math, and Engineering Education Program allows students in grades 3 through 12 from throughout the Central Savannah River Area to have an opportunity to learn science, mathematics, and engineering principles in a hands-on setting. In 1997, the program had more than 15,000 student-visits. The program also sponsors teacher workshops, summer camps, and a graduate course for teachers.
- The Savannah River Environmental Sciences Field Station provides hands-on, field-oriented experiences for undergraduates from 18 regional historically black colleges and universities.
- SRI provides natural resource research opportunities for federal and state agencies, universities, industrial/private landowners, and conservation organizations from throughout the region.
- The fire management program helps local communities control wildland fires, provides help to other states during the summer fire season, brings Smokey Bear's fire prevention message to more than 1,400 children in South Carolina, and has responded to numerous natural disasters in the region, such as hurricanes and floods.
- SRI provides several training classes and workshops for both onsite and offsite groups on a variety of topics, including erosion control technologies, constructed wetlands, ecosystem management, GPS/GIS (Global Positioning System/Geographic Information System), and controlled burning and wildfire suppression.
- SRI administers U.S. Department of Agriculture Natural Resource Conservation Education grants to local schools to defray the costs of curriculum development, supplies, and teacher training.
- SRI provides planning and other assistance to local rural communities to develop natural resource assets.

More information about SRI outreach can be obtained by calling 803–725–2441.

Savannah River Ecology Laboratory

SREL's Environmental Outreach and Education Program educated people through an estimated 96,500 contacts during 1997. The program emphasizes the importance of environmental awareness in decision making regarding ecological problems. Environmental awareness is promoted through tours of the laboratory; lectures to students and civic and special interest groups; teacher workshops; and various exhibits [Fact Sheet, 1996b]. Presentation topics include animal ecology, outdoor safety, plants and wetlands, the environment, conservation, and careers in ecology and research. More information can be obtained by contacting SREL at 803–725–0156.

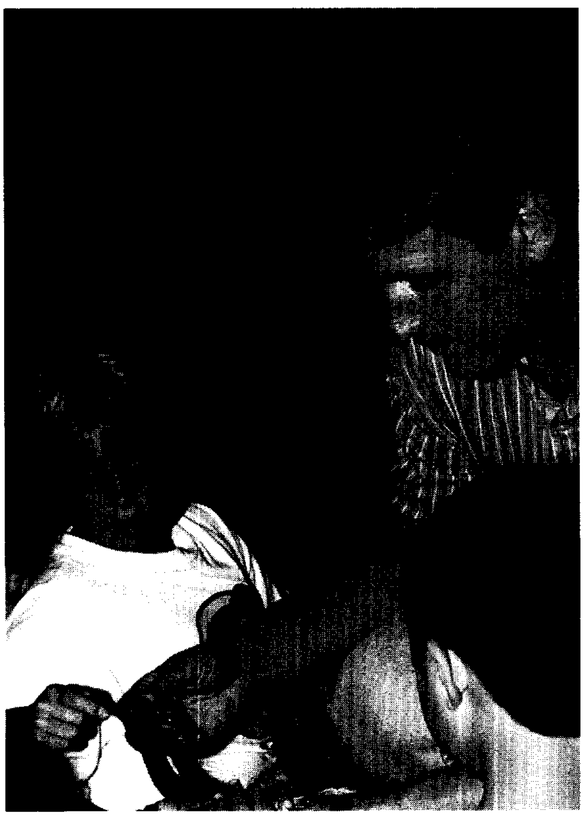
Savannah River Archaeological Research Program

SRARP continued its heritage education activities in 1997 with a full schedule of classroom education, public outreach, and onsite tours. Volunteer excavations at SRS's George Bush historical site were conducted with the Augusta Archaeological Society and other avocational groups participating, while offsite excavations provided a variety of opportunities for field experience. Some 71 presentations, displays, and tours were provided for schools, historical societies, civic groups, and environmental and historical awareness day celebrations. Also, SRARP personnel taught four anthropology courses at area colleges. More information can be obtained by contacting SRARP at 803–725–3623.

Public Involvement

DOE considers public involvement a fundamental component in program operations, planning activities, and decision making in DOE. The public is entitled to play a role in DOE decision making. Public involvement is a major focus in every operational division at SRS and is established annually as one of the major goals in the site's strategic plan.

Stakeholder involvement at SRS follows the legal requirements of NEPA, RCRA, and CERCLA, but also reaches beyond to provide opportunities on the site's budget, future-use activities, and complex-wide issues.



Lindy Nowak Photo (98X00275–01)

The SREL Outreach and Education Program involves teaching people in surrounding communities about many aspects of ecology and the environment. Here an SREL employee introduces a hognose snake to children at Gibbs Library in Evans, Georgia.

Environmental Restoration

Within the environmental restoration program, the public is consulted frequently about decisions on closure of waste sites. In 1997, approximately 30 participation opportunities were provided. Specifically, public comment periods and notifications were held for

- four RCRA/CERCLA proposed plans
- five CERCLA removal actions
- Record of Decisions (RODS) for eight waste units (one combined public notice for all eight)

Some of the larger-scale stakeholder activities included creation of a public focus group to evaluate remediation options for the Savannah River Laboratory (SRL) seepage basins and public meetings on proposed cleanup actions for the L-Area Oil and Chemical Basin, A-Area burning/rubble pits and the Central Shops Burning/Rubble Pit.

Material and Facility Stabilization

Stakeholders participated in decision making within the site's program that is responsible for storage, stabilization, and disposition of legacy defense nuclear materials. In 1997, stakeholders provided comments on

- DOE's intent to develop an Environmental Impact Statement (EIS) on storage and stabilization of spent nuclear fuel
- the scope of a nonproliferation study on chemical processing of spent fuel
- a study initiated by DOE to evaluate all surplus nuclear materials in the DOE complex and identify the best disposition path
- an EIS being developed that includes the possibility of transporting plutonium residues from Rocky Flats Environmental Technology Site in Colorado to SRS for stabilization in the SRS canyons

The site also supported a series of plutonium disposition and spent nuclear fuel workshops organized by the Citizens for Environmental Justice and aimed at minority communities. Also, the National Research Council (the operating arm of the National Academy of Sciences) and a presidential committee, the Nuclear Waste Technical Review Board, held meetings open for public comment. Both groups will provide recommendations to DOE, Congress, and the President on final disposition activities of DOE spent nuclear fuel and other nuclear materials.

Accelerated Cleanup Plan: Focus on 2006

The Accelerated Cleanup Plan, formerly the Ten-Year Plan, prompted one of the most concentrated public involvement efforts of the year. More than 20 meetings, workshops, and other activities were held in the predraft and draft phases of the document to gather early public input on DOE's goal to clean up and close as many DOE facilities as possible by 2006. SRS stakeholder input and comments received from other sites on the June 1997 National Discussion Draft Accelerated Cleanup Plan were incorporated to revise a draft Accelerated Cleanup Plan for 1998. Public comment on the national document ranged from a concern about data inconsistencies and remediation cost estimates to intersite transportation of materials.

Public involvement in the Accelerated Cleanup Plan will be a continual process. The document is updated about every six months to reflect changes in DOE's strategic goals and the national budget.

Citizens Advisory Board

The CAB is an independent organization officially chartered by DOE to provide recommendations and stakeholder insight on site activities to DOE, EPA, and SCDHEC. It provides SRS with ongoing counsel to help guide decisions consistent with stakeholder values and opinions. Thus, it complements regulatory and program stakeholder input. The CAB is composed of 25 South Carolina and Georgia individuals who reflect the cultural diversity of the population affected by SRS. Membership applications are accepted year-round from stakeholders living in an area ranging from the Central Savannah River Area to Georgia and South Carolina coastal communities downriver of SRS. Applications are placed in membership categories representing labor, environmental, political, educational, and minority groups as well as the general public. Voting by ballot is held once a year at a full board meeting. Members serve a two-year term. They can serve two additional terms (six consecutive years) if elected.

The citizens group, nationally recognized as being one of the most productive site specific advisory boards in the DOE complex, provided 24 recommendations to the agencies in late 1996 and 1997. Some of the recommendations for the environmental restoration program included

- that the L-Lake river water system be put in a standby condition and that L-Lake be remediated using NEPA analyses for CERCLA coverage
- that an early remediation strategy be undertaken for closure of the SRL seepage basins
- that closure of high-level waste tanks associated with the 1F Evaporator be accelerated
- that some mixed wastes from other DOE facilities be treated at SRS, with equitable shipment of some SRS transuranic and low-level wastes to the Waste Isolation Pilot Plant and to the Nevada Test Site (these were recommendations associated with the Environmental Management Integration document)

Several recommendations developed by the CAB Nuclear Material Management subcommittee and approved by the full board supported using the existing chemical processing capability of the SRS canyons to stabilize vulnerable nuclear materials and aluminum-clad spent nuclear fuel from SRS and possibly from other DOE facilities in the complex. The CAB emphasized repeatedly that chemical processing be fairly evaluated against other new and proven technologies for stabilizing spent fuel and nuclear materials.

In its comments on the local and national Accelerated Cleanup Plan, the CAB included concerns about privatization; support for more comprehensive participation by site advisory boards on national plans; recommendations that DOE, despite budget constraints, refrain from reducing Defense Waste Processing Facility (DWPF) operations; and suggestions that the document be modified to convince the public and state and federal legislators of the importance of the plan.

More information about the CAB's 1997 recommendations can be obtained by calling the SRS Citizens Advisory Board administrator at 1-800-249-8155.

In addition to forming recommendations on site activities, the CAB continued its educational efforts by heading and cosponsoring a public forum on DOE-owned spent nuclear fuel. Other CAB activities included the development of a newsletter, support of the Citizens for Environmental Justice plutonium disposition and spent nuclear fuel workshops, and participation in numerous civic events and news shows.

The site's public involvement program offers a comprehensive approach to citizen participation as suggested by DOE policy. The ultimate goal is that the program be dynamic and accessible to any person or organization wishing to have a voice in site activities.

Chapter 4

Environmental Restoration and Waste Management

Candace N. Berry
Environmental Restoration Division

Dean Campbell and Ellen Smith
Public Relations Department

W.T. Goldston
Solid Waste Division

Craig McMullin
Facilities Decommissioning Division

To Read About . . . See Page . . .

1997 Highlights

- Environmental restoration accomplishments included the treatment of about 247 million gallons of contaminated groundwater, which removed approximately 100,000 pounds of volatile organic compounds, and the recycling and reuse—verses disposal—of the waste material contained in four inactive coal pile runoff basins, which resulted in a 92-month schedule acceleration.
- The Solid Waste Division accepted 658,256 cubic feet of low-level waste for storage or disposal in the E-Area vaults and shipped 30,812 cubic feet of newly generated or legacy hazardous waste off site for treatment, reducing the hazardous waste inventory by 28 percent.
- The High-Level Waste Division closed two 1.3-million gallon tanks in F-Tank Farm. These tanks were the first high-level radioactive process tanks in the DOE complex to be remediated and closed permanently.
- The successful processing of radioactive sludge at the DWPF continued, and a milestone was achieved in November as the facility marked the production of its millionth pound of glass from high-level waste sludge since it began radioactive operations in March 1996.

ENVIRONMENTAL restoration and waste management programs at Savannah River Site (SRS) made significant progress on environmental cleanup in 1997. This chapter provides a brief overview of the programs and describes some of their major milestones during the year. These programs represent the site's ongoing efforts to ensure the safety of its workers, the public, and the surrounding environment.

The U.S. Department of Energy (DOE) uses the term "environmental restoration" to mean the assessment and cleanup of inactive waste units and groundwater (remediation). "Cleanup" means actions taken to deal with the release or potential release of hazardous substances. This may refer to complete removal of a substance, or it may mean stabilizing, containing, or otherwise treating the substance so it will not affect human health or the environment [DOE EM, 1991]. Determining the most environmentally sound methods of cleaning up waste units is a major component of the SRS environmental restoration program.

DOE uses the term "waste management" to refer to the safe, effective management of various kinds of nonhazardous, hazardous, and radioactive waste generated on site. Identifying the need for appropriate waste management facilities and ensuring their availability have been major components of the SRS waste management program.

Regulatory Compliance

Two major federal statutes govern the site's environmental restoration and waste management activities, which were begun in 1981: the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). RCRA addresses the management of regulated hazardous waste and requires that permits be obtained for DOE facilities that treat, store, or dispose of hazardous or mixed waste. It also requires that DOE facilities perform appropriate corrective action. CERCLA (also known as Superfund) addresses releases of hazardous substances and the cleanup of inactive waste disposal sites. This act establishes a National Priority List of sites targeted for assessment and, if necessary, for remediation. SRS was placed on the list December 21, 1989 [Fact Sheet, 1995]. Complete information on SRS compliance activities can be found in chapter 2, "Environmental Compliance."

Additionally, DOE is complying with Federal Facility Compliance Act requirements for mixed waste—including high-level waste, most transuranic waste, and low-level waste with hazardous constituents. This act requires that DOE develop and submit site treatment plans to the U.S. Environmental Protection Agency (EPA) or state regulators for approval.

Environmental Restoration

SRS began its remediation program in 1981, before many of the regulations requiring environmental restoration were written. However, the site's current environmental restoration program was not officially established and developed until 1990. Since then, 477 inactive waste and contaminated groundwater sites have been identified. Figure 4–1 shows the program's activities.

During 1997, the SRS environmental restoration program was characterized by successful groundwater remediation efforts, the deployment of innovative technologies, a cost-effective approach to cleaning up the environment, and safe working conditions. Seventy-five percent of the program's funding was allocated toward remediation activities in 1997. The remediation phase is under way or has been completed on 69 waste sites, which contain approximately 80 percent of the site's known environmental and health risks. Since the program's inception, 280 of the 500 acres that potentially will require remediation already had been remediated or were in remediation by the end of 1997.

Accomplishments

Environmental restoration accomplishments and activities during 1997 included the following.

- **Laboratory and manufacturing areas** – About 247 million gallons of groundwater were remediated through the removal of approximately 100,000 pounds of volatile organic compounds.
- **Separations areas** – Thirty extraction wells and two reverse-osmosis water treatment facilities were installed and brought on line to treat groundwater containing radionuclides and metals.
- **Disposal areas** – An interim soil cover action was completed at the 76-acre Old Radioactive Waste Burial Ground; geosynthetic capping continued at the Low-Level Radioactive Waste Disposal Facility; and a geosynthetic cap cover was completed at the 55-acre Nonradioactive Waste Disposal Facility.
- **Reactor areas** – The recycling and reuse—versus disposal—of the waste materials contained in four inactive coal pile runoff basins resulted in a 92-month schedule acceleration.
- **Power and pilot plant areas** – The T–1 air stripper remediated more than 26.2 million gallons of solvent-contaminated groundwater. The GeoSiphon cell, an in situ technology designed for groundwater remediation, was deployed for demonstration at TNX in July.
- **Site evaluations** – The site evaluations program assessed 29 areas on site and recommended to EPA and SCDHEC regulators that no further action be taken on 25 of them.

The application of technologies such as airlift recirculation wells, Fenton's Chemistry, and the GeoSiphon cell (figure 4–2) helped reduce costs and accelerate remediation in 1997.

Two airlift recirculation wells designed to treat groundwater contaminated with chlorinated volatile organic compounds (CVOCs) began operation in the southern sector of A-Area/M-Area in December 1997. This "in well" air stripping technology consists of two concentric well pipes with upper and lower baffles and screens. Air is pumped down the center well, then travels upward in the outer well, creating an in situ air stripper. The upward airflow strips out the CVOC contamination. The rising aerated water in the center well causes a flow of water from the bottom of the outer well to the top of the inner well, creating a recirculating flow, which brings in more groundwater to be remediated. For every 1,000 gallons of water remediated, the cost is approximately $2.48 compared to $5.05 using conventional above-ground air stripping.

Fenton's Chemistry, an in situ chemical oxidation process, uses injection wells to treat soil and groundwater contaminated by VOCs and dense nonaqueous phase liquids. This method, being used in M-Area, employs hydrogen peroxide and other oxidizing agents to convert VOCs into harmless, natural compounds.

The GeoSiphon cell essentially is a large-diameter well that can be packed with treatment media such as

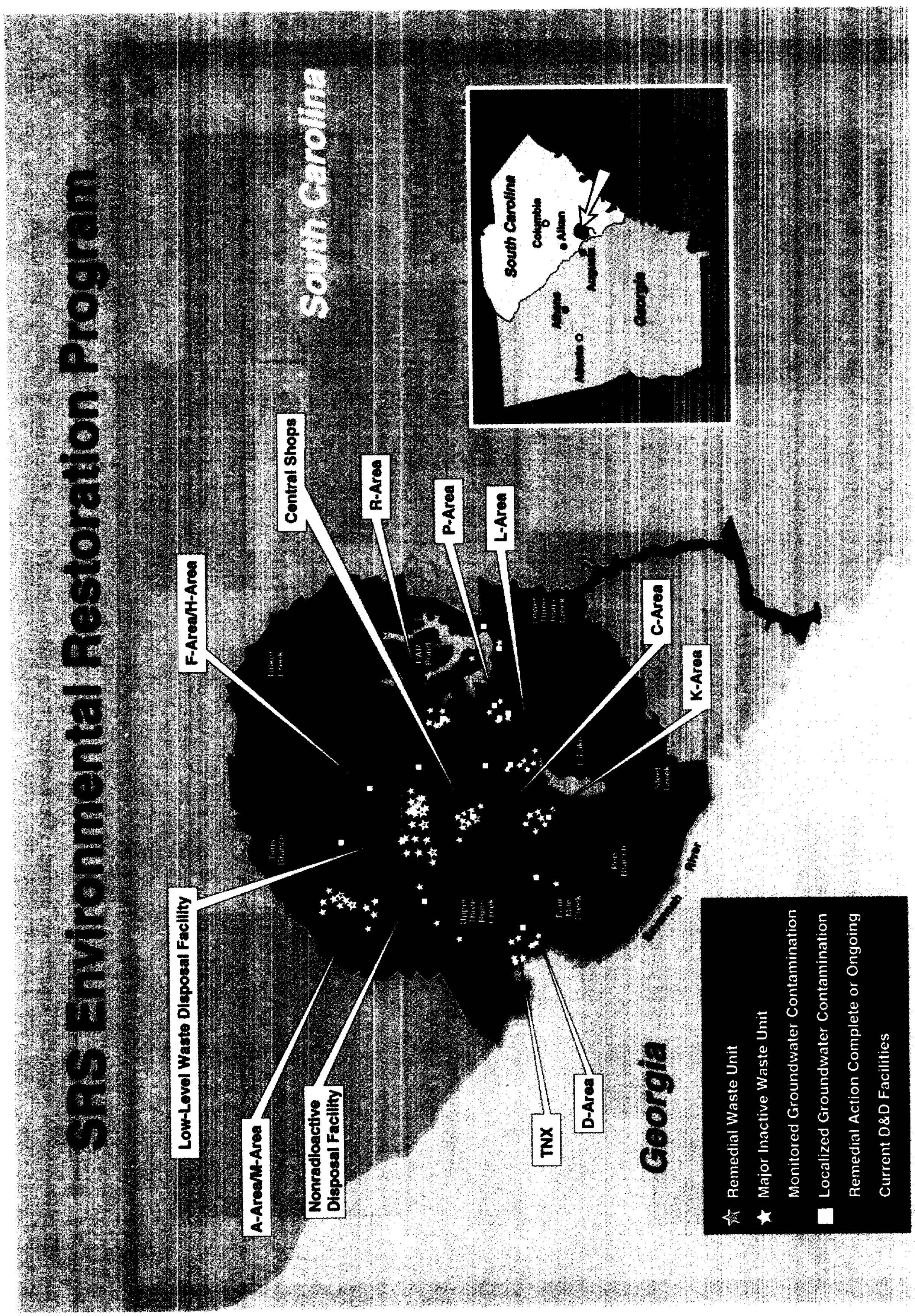
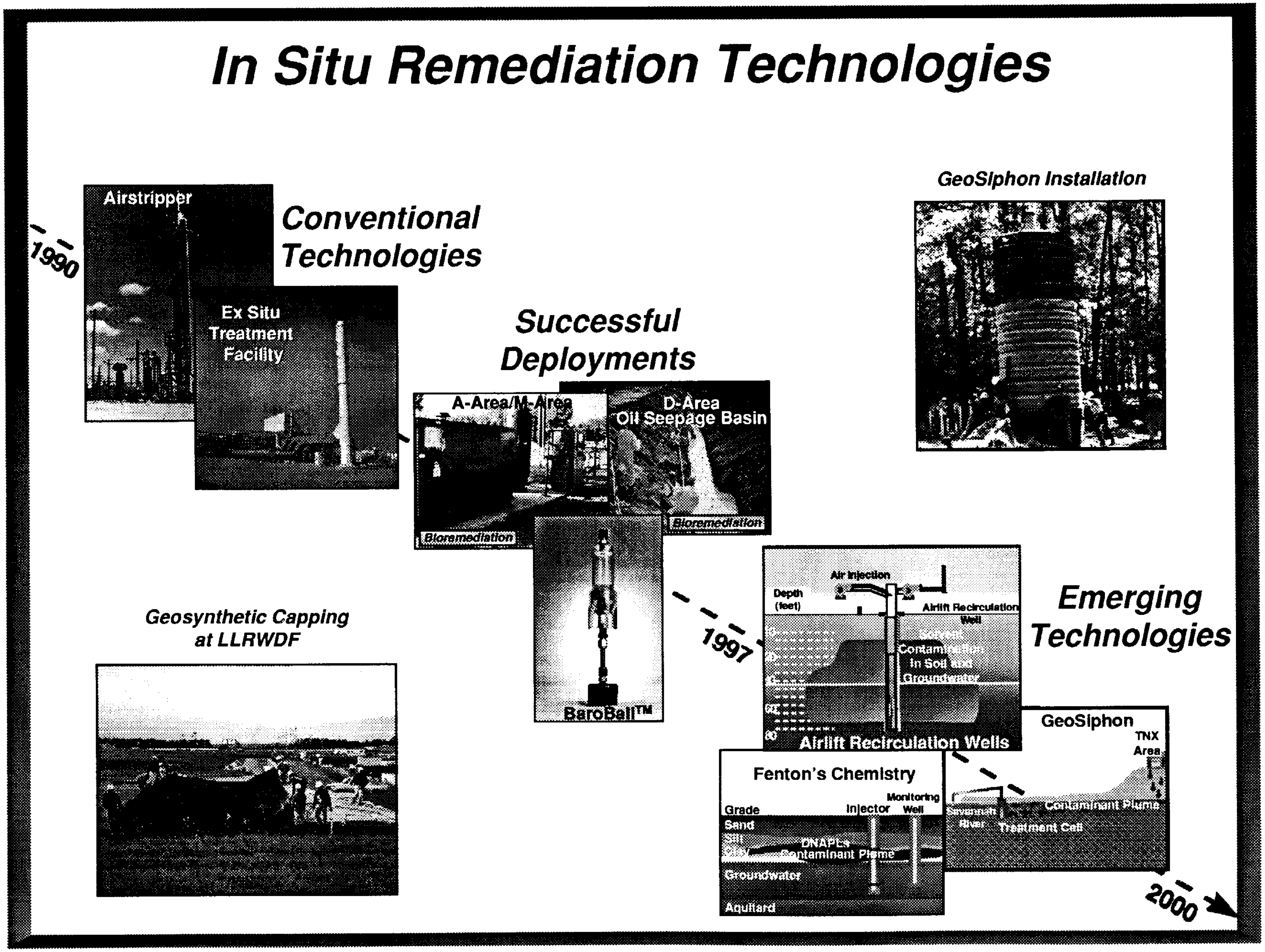


Figure 4–1 Environmental Program Map
The SRS environmental restoration program map identifies the site's major waste units, monitored and localized groundwater contamination, completed and ongoing remedial action, and some SRS facilities designated for decommissioning.



97X01859.01.AIL (modified)

Figure 4–2 Remediation Improvements
The SRS environmental restoration program has utilized in situ technologies to improve its soil and groundwater remediation processes.

Byron Williams Photo (97–1337–40)

A 45-ton pneumatic hammer was used to advance a 25-foot-long by 8-foot-diameter caisson to install the GeoSiphon cell at TNX-Area in July 1997.

granular cast iron, activated carbon, cation exchange resin, or zeolite. The treatment medium used at TNX is granular cast iron. Natural hydraulic pressure draws contaminated groundwater through the cell, where solvent contaminants are remediated to meet EPA's primary drinking water standards. Degradation products are ethane, methane, and chloride ions. Groundwater flow through the treatment cell is induced by the natural hydraulic head difference between the cell and the Savannah River. After treatment, the cleaned water is discharged into the river.

Phase I testing data from the GeoSiphon cell demonstration, which ended in December 1997, shows that treatment of groundwater containing concentrations of trichloroethylene in the range of 200–250 parts per billion reduced those concentrations to below 5 parts per billion on average. Phase II, which involves activation of the siphon and discharge unit, is slated to begin in late June 1998.

Other Progress

In 1997, reactor project team members determined that recycling coal left in four inactive basins could be accomplished at one-third the original estimate for landfill disposal. Coal and coal-laden sediments were removed and transported off site to be cleaned and reused in road base construction. This was the first time SRS released and recycled waste for public use from a CERCLA waste site.

A milestone was met at the Old Radioactive Waste Burial Ground in October 1997, when an engineered low-permeability soil cover was completed over the area. The cover is designed to reduce rainwater infiltration by 70 percent; additional potential remedial actions are being considered. Also in October, installation began on a drainage system consisting of more than 3,600 linear feet of pipe and

7,500 feet of drainage channel for the purpose of diverting rainwater runoff to newly modified sedimentation basins.

In September 1997, geosynthetic cap closure continued at the Low-Level Radioactive Waste Disposal Facility. The multilayered, impermeable geosynthetic caps are a combination of sandy clay and high-density polyethylene products. Geosynthetic capping has many advantages over the kaolin clay cap design, including added flexibility, reduction in cap height by 4 feet, ease of installation, reduced construction time. This cap closure technology expedites cleanup and reduces costs, and the caps provide greater protection of groundwater resources.

In addition, the Environmental Restoration Division submitted closure certification documentation to the South Carolina Department of Health and Environmental Control (SCDHEC) for the Nonradioactive Waste Disposal Facility in 1997. Geosynthetic capping began at this facility in 1996; this was the first geosynthetic capping system approved for a hazardous waste closure in South Carolina.

Solid Waste Management

SRS solid waste management facilities host a number of important waste management and environmental restoration efforts on site.

Accomplishments

The activities of solid waste management personnel during the year included

- the continued use of vendor-developed technology to vent and purge drums of transuranic waste
- the addition of a second vent and purge machine to increase transuranic processing rates
- two solvent tank closures
- startup of the Consolidated Incineration Facility (CIF)
- issuance of the final Waste Management Programmatic Environmental Impact Statement

The SRS solid waste program continues to support the site's transition from production to cleanup activities by managing large volumes of backlog wastes at various site facilities. Proper handling of the waste requires that the waste be categorized as sanitary, low-level, transuranic, hazardous, mixed, or high-level (high-level waste discussion begins on page 64).

Sanitary Waste

Sanitary waste includes office waste, food, garbage, refuse, and other solid wastes that can be disposed of in landfills. SRS has privatized the collection, hauling, and disposal of its sanitary waste, which consists primarily of food and office wastes. In 1997, 5,864 tons of sanitary waste were disposed of at a permitted offsite commercial facility, according to Solid Waste Certification and Minimization records. Previously, sanitary waste was disposed of at the Nonradioactive Waste Disposal Facility, which is slated for closure in 1999.

Low-Level Waste

Low-level waste is any radioactive waste not classified as high-level or transuranic waste. Examples of SRS low-level wastes include protective clothing, job control waste, equipment, tools, filters, rags, and papers. All wastes certified as low-level are stored or disposed of in the E-Area Vaults. During 1997, the Solid Waste Division's Solid Waste Management Department accepted 658,256 cubic feet of low-level waste for storage or disposal in these vaults, according to the site's Computerized Radioactive Waste Burial Records Analysis System and Waste Information Tracking System. The department also continued shipping low-level waste meeting certain criteria to an offsite vendor. This not only reduces waste volume but reserves space in the vaults for future disposition of wastes that may require these facilities.

Hazardous Waste

According to RCRA, hazardous waste is any toxic, corrosive, reactive, or ignitable material that could damage the environment or negatively affect human health. Examples of SRS hazardous wastes include oils, solvents, acids, metals, and pesticides. In 1997, the Solid Waste Management Department shipped 30,812 cubic feet of newly generated and legacy waste off site for treatment, reducing the hazardous waste inventory by 28 percent.

Mixed Waste

Mixed waste is both radioactive and hazardous and is subject to regulations governing both waste types. During 1997, the Solid Waste Management Department prepared 35,329 cubic feet of mixed waste for treatment at the CIF.

Transuranic Waste

Transuranic waste is radioactive waste contaminated with certain isotopes that have decay rates and activities exceeding defined levels. It contains manmade elements that are heavier than uranium and that decay slowly, thus requiring thousands of years of isolation. At SRS, transuranic wastes can include contaminated equipment, protective clothing, and tools. In 1997, 4,280 cubic feet of solid transuranic waste were accepted for storage on transuranic waste pads.

In 1997, SRS managed more than 350,000 cubic feet of transuranic and mixed transuranic waste generated by the site's former weapons production mission. An automated vent and purge system, a Savannah River Technology Center technology developed through a commercial vendor, was installed at SRS to provide

- sparkless puncturing of transuranic-waste drum lids
- analysis of headspace gases

This process safely releases combustible gas from the stored drums. SRS retrieved, inspected, and vented 2,474 of 8,809 transuranic-waste drums and moved them to covered storage pads at the Solid Waste Management Facility in preparation for shipment to the New Mexico Waste Isolation Pilot Plant for disposal.

The transuranic waste program also is using a passive active-neutron assay machine for the Solid Waste Division's Container Examination and Evaluation Program. During 1997, 2,623 drums were processed to segregate drums of low-level waste from those of transuranic waste.

Solvent Storage Tank Closures

Solvent tanks S29 and S30 (each 10.5 feet in diameter and 38 feet long, with a capacity of 25,000 gallons) were used, beginning in 1981, to store highly reactive Purex solvent from production processes. RCRA regulations established in 1988 required that all single-walled tanks used for storage of hazardous waste be upgraded with double-walled containment, or that the waste be removed no later than the 15th anniversary of the installation of the tanks. Solid Waste Division personnel built four new 30,000-gallon tanks for the storage of the Purex solvent. Construction of the tanks, which are located in H-Area, was completed in 1996.

Once the solvent was removed from tanks S29 and S30, a schedule was established to complete closure of the tanks by May 1, 1997. Closure consisted of triple-rinsing the tanks, removing rinsate, filling the tanks with grout, and placing an earthen cap over the tank site. All closure activities were completed by mid-April 1997.

Consolidated Incineration Facility

In 1997, the CIF met a major milestone in preparation for startup by successfully completing a trial burn. Preceding the trial burn, the CIF hosted independent readiness verifications, which confirmed that the facility was ready to proceed with trial burn and radioactive operations.

The trial burn involved the completion of nine separate steps over a period of 7 days to demonstrate the CIF's technical capabilities for EPA and SCDHEC. Results showed that the facility

- can operate within specified emission limits
- meets applicable state and federal permitting requirements.

The CIF began radioactive operations with the incineration of filter paper takeup rolls April 24, 1997—ahead of the Site Treatment Plan commitment date of June 30, 1997.

In 1997, the CIF processed 24,642 gallons of aqueous waste; 24,764 gallons of organic liquid waste; and 160,692 pounds of solid waste. This generated 98,054 pounds—or 11,999 gallons—of secondary waste (ash, blowdown liquid, and filtercake), which is stabilized in concrete and transported to either M-Area or N-Area for disposal.

Pollution Prevention/Waste Minimization

During DOE's 13th Annual Pollution Prevention Conference, held in Atlanta in August 1997, SRS received four national pollution prevention awards. Activities involving recycling, environmental restoration, radiological containments and contamination area (CA) rollbacks earned this recognition in 1996, but the awards were not presented until 1997.

CA rollbacks have reduced low-level waste generation and employee hazards while increasing productivity. This involves the reclamation of areas that have been radiologically contaminated by past operations. During 1997, 113,217 square feet of CA space was restored to "clean" or "buffer area" status; this eliminated more than 13,000 cubic feet of low-level waste.

Additionally, several programmatic tools were developed to facilitate the CA rollbacks across the site. In accordance with the DOE Enhanced Work Planning process, a *CA Rollback Handbook* was published and an economics-based CA Prioritization Model was developed and used in preparing the site's 1998 CA Rollback Plan. These approaches—combined with tools developed through partnerships between the Solid Waste Division, the Nuclear Materials Stabilization Program and Radiological Control Operations—helped DOE earn a second vice presidential "reinventing government" award in 1997.

High-Level Waste Management

"High-level waste" is highly radioactive waste material that results primarily from the reprocessing of spent nuclear fuel. It contains liquid waste produced directly in reprocessing, any solid waste derived from that liquid, and both transuranic waste and fission products in concentrations requiring permanent isolation from the environment.

High-level waste from the F-Area and H-Area canyons is segregated according to radionuclide and heat content. High-heat waste, generated primarily during the first extraction cycle in these canyons, contains a major portion of the radioactivity. Low-heat waste is generated primarily from the second and subsequent canyon extraction cycles.

The major waste streams in the F-Area and H-Area tank farms include transfers from the canyons, receipts from the Receiving Basin for Offsite Fuels, and a recycle stream from the Defense Waste Processing Facility (DWPF).

SRS continues to manage approximately 34 million gallons of high-level liquid radioactive waste (about 498 million curies), which is stored in 49 massive storage tanks grouped into two "tank farms." Twenty-nine tanks are located in the H-Area Tank Farm and 20 in the F-Area Tank Farm, where two tanks were officially closed in 1997. All SRS tanks are built of carbon steel inside reinforced concrete containment vaults.

High-Level Waste Facilities

Each tank farm has one operating evaporator system used to concentrate high-level waste received from the canyons. These evaporators reduce the waste to about 25 percent of its original volume. SRS has successfully conducted this dewatering operation in the tank farms since 1960, when the first evaporator facilities began operation; approximately 108 million gallons of space have been reclaimed during this time.

Without these evaporator systems, SRS would have required 85 additional waste storage tanks—at $50 million apiece—to store waste produced over the site's lifetime. A new evaporator, the replacement high-level waste evaporator, is under construction; it will enable the tank farms to process future waste loads. The new evaporator will have twice the processing capacity of the two existing evaporators.

The Extended Sludge Processing Facility, one of two DWPF pretreatment operations in the High Level Waste Division, will "wash" approximately 3 million gallons of the heavy metal solids (known as sludge) that drop out of the radioactive waste sent to the tank farms. The washed sludge will be sent to DWPF for vitrification.

The In-Tank Precipitation Facility (ITPF), the second pretreatment operation for DWPF, will process the majority (about 90 percent) of the "liquid salt" waste in tanks, splitting that waste into two distinct streams. The highly radioactive portion, called "precipitate," will go to DWPF for vitrification, while the remainder, called "filtrate" (about 90 percent of the salt waste), will be low-level waste that will be grouted into a solid form at the Saltstone Facility.

Additionally, sludge (unsettled insoluble waste) is washed of impurities that affect DWPF glass quality. This washed and decanted sludge is transferred to DWPF as part of "sludge only" vitrification operations.

DWPF then treats the sludge from the original waste and the highly radioactive material removed from the salt cake by combining them with glass. The mixture is heated until it melts and then poured into stainless steel canisters to cool. The solid that forms is easier to contain and handle. Another word for this process is "vitrification." The glass will be kept in the sealed canisters and will be stored at SRS until a federal repository is established.

A component of DWPF, the Saltstone Facility treats and disposes of low-level radioactive salt solutions that are the byproduct of the high-level waste treatment process at SRS.

After the salt solutions are received at the facility, they are mixed with cement, fly ash, and furnace slag to form a grout, which then is pumped into a large concrete vault divided into sections, or cells. There, it cures into a stable form called "saltstone." After it is filled, the vault will be capped with clean grout to isolate it from rain and weathering. Final closure of the vault disposal area will include covering each vault with a clay cap and backfilling it with earth.

Accomplishments

In 1997, SRS continued to manage its high-level waste facilities in support of the integrated high-level waste removal program. DWPF produced 196 canisters of immobilized high-level waste during 1997, bringing the total to 287 canisters since radioactive processing began in March 1996.

Tank Farms

The tank farm evaporators recovered more than 2.5 million gallons of tank space in 1997 through evaporation of the watery "supernate" that floats atop the sludge in the tanks. The 242–16H evaporator system recovered more than 1.5 million gallons while the 242–16F evaporator system recovered more than 900,000 gallons. The 900,000-gallon figure represents more space recovered during 1997 than in any of the previous 9 years in the 242–16F evaporator. The key to this achievement was an interarea line used to transfer waste from H-Area to F-Area via a 2-mile underground system. Approximately 500,000 gallons of radioactive waste were transferred via the interarea line during 1997.

Modifications were made to the evaporator systems and tank farms during 1997 to enhance safe operations without affecting productivity.

Waste Tank Closure

The High-Level Waste Division closed two 1.3-million-gallon tanks in F-Tank Farm during 1997. These tanks were the first high-level radioactive process tanks in the DOE complex to be remediated and closed permanently and officially. Both were filled with grout of different specifications designed to ensure structural integrity and residual waste containment. Permanent markers were installed to provide long-term notification of the presence and nature of the contained materials.

In-Tank Precipitation

Progress continued in 1997 toward developing a better understanding of a excess-benzene-generation problem identified during startup of the ITPF in 1995. Excess benzene had been successfully removed from the facility in 1996, when generation rates were stabilized at lower levels.

The Defense Nuclear Facility Safety Board recommended in August 1996 that operation and testing in the ITPF should not proceed without an improved understanding of benzene generation, retention, and release. DOE subsequently developed an implementation plan designed to satisfy the board's recommendation. This plan involved development of a formal chemistry program—carried out during 1997—to further evaluate the benzene characteristics. As the program neared completion, however, data indicated that the safety of existing processes and systems as currently configured could become an issue of concern. Finally, in December 1997, WSRC began evaluating options for redirection of the ITPF design and configuration.

DWPF

The successful processing of radioactive sludge continued during 1997. A milestone was reached in November, when DWPF marked the production of its millionth pound of glass from high-level waste sludge since it began radioactive operations in March 1996. Several 1997 improvements streamlined this waste processing to provide for the cost effective and timely replacement of critical parts.

DWPF will continue processing sludge until the "precipitate" from ITPF—or from a project that serves a similar function—is available. Approximately 200 canisters of glass are expected to be produced in 1998.

Saltstone Facility

Radioactive operations began at the Saltstone Facility in June 1990; through the end of 1997, the facility had processed approximately 2.2 million gallons of salt solutions, creating about 3.6 million gallons of "saltstone."

Facility Decommissioning

Babcock & Wilcox joined the WSRC management team October 1, 1996, establishing B&W Savannah River Company and providing three senior managers for WSRC's new Facilities Decommissioning Division (FDD).

The new division manages SRS excess facilities—from completion of operations shutdown through final disposition—in a manner that minimizes life cycle costs without compromising health, safety, or environmental quality. FDD has developed a Deactivation and Decommissioning (D&D) program that reduces the environmental and safety risks of surplus facilities at SRS. The D&D program

- seeks cost-effective solutions
- prioritizes facility and environmental risks and hazards
- complies with all regulatory requirements
- utilizes stakeholder involvement
- develops expertise to achieve more efficient decommissioning efforts
- uses subcontract support to leverage site resources.

Accomplishments

One major D&D project completed in 1997 was the safe decommissioning of 232–F, the world's first full-scale tritium production facility. The

17,000-square-foot facility, including its concrete foundation, was dismantled and removed. The 3-year project was completed in June at a cost of $6.3 million—one-third less than original estimate.

Decommissioning of the Heavy Water Components Test Reactor continued in 1997. The heavy water-moderated reactor had operated to test fuel assemblies from 1961 to 1964. Decommissioning activities began in 1994; those completed through the end of 1997 include

- the demolition of four auxiliary buildings
- the decontamination and reclassification of 90 percent of the reactor building from a contaminated area to a radiological buffer area
- the removal of all asbestos thermal insulation from systems inside the Heavy Water Components Test Reactor containment building
- the demolition and removal of the control building

Powerhouse Decommissioning

In 1997, WSRC proposed an innovative approach to funding the decommissioning of some surplus facilities: trade the equipment within the facility for demolition services. Two facilities, the C-Area and P-Area powerhouses, were packaged together for sale in exchange for decommissioning services. This enables DOE to remove surplus powerhouses at little or no cost; the contractor receives valuable assets; and the final user gets reliable used equipment at reasonable prices.

The decommissioning of these two powerhouses is slated for completion by the end of 1998. Some of the large components, including the cooling tower at the P-Area facility, have been dismantled and reassembled at other industrial sites.

Decontamination Facility

The new Decontamination Facility in C-Area uses several technologies to decontaminate equipment and materials for reuse or salvage, including CO_2 blasting, vacuum blasting, plastic blasting, and chemical decontamination. The technologies are frequently used inside stainless steel containments with custom-designed ventilation systems.

The Decontamination Facility was used to process 32,876 cubic feet of low–level contaminated material in 1997.

Waste Stabilization

Wastewater sludge stored in the M-Area Process Waste Interim Treatment/Storage Facility and in the Mixed Waste Storage Shed is being treated with a vitrification process. The Vendor Treatment Facility uses a vitrification process developed by GTS Duratek, Inc., to convert the sludge into a durable glass form, which minimizes leaching of hazardous contaminants into the groundwater. This process reduces volume by at least 81 percent from initial waste form to the final glass product.

GTS Duratek, Inc., began operating in October 1996 but suspended operations in March 1997—after the stabilization of approximately 50,000 gallons of sludge—because of excessive refractory wear and corrosion. The melter was redesigned and rebuilt during the 9-month outage that followed the operations suspension (operations resumed in December 1997). About 46,000 gallons of sludge was stabilized during calendar year 1997.

Accelerated Facility Disposition

As a result of the short-term availability of unprogrammed financial resources, the Environmental Restoration Division of DOE's Savannah River Operations asked FDD in June 1997 to select, plan, and mobilize several disposition projects according to an accelerated schedule. Project identification was initiated in July, and the projects had to be completed before the end of September.

FDD selected projects based on risk reduction, mortgage reduction, potential economic development, and the availability of interdivisional support. A total of 190 engineers, technicians, mechanics, and operators were used. The effort required about 6 weeks and cost approximately $630,000.

The eight accelerated project activities completed in 1997 were the

- P-Area gasoline tank removal
- R-Area disassembly basin sampling
- C-Area deionizer pad decontamination
- A-Area and B-Area domestic water tank removal
- 311–M tank unloading station demolition and removal
- 704–R demolition
- C-Area contaminated-facilities rollback
- Ford Building characterization and rollback

Excess Facility Disposition Plan

Management Policy 5.24, "Excess Facility Disposition," was implemented in September 1997. This directive formally assigns to FDD the responsibility for coordination and integration of SRS facility disposition activities and establishes this work scope as part of WSRC policy.

Approved excess facility disposition planning procedure FD1.01 implements the program-level, mandatory requirements of Management Policy 5.24. The procedure provides requirements for the systematic planning of dispositioning activities in a cost effective manner through scheduling, execution, and documentation to ensure (1) the health and safety of workers and the public and (2) the protection of the environment. Implementation of the procedure integrates sitewide planning to provide clear descriptions of roles and responsibilities, to minimize life cycle costs, and to reduce facility and environmental hazards.

Chapter 5

Radiological Effluent Monitoring

Brian Crandall and Mary Dodgen
Environmental Protection Department

Timothy Jannik
Savannah River Technology Center

To Read About . . . **See Page . . .**

1997 Highlights

- Of the more than 4,200 radiological effluent samples collected and analyzed, 23 (0.5 percent) were not collected and/or analyzed because of sample equipment failure or inadvertent loss of—or damage to—the sample media. The radioactive releases attributed to these samples were accounted for in the annual release totals by either using historic process knowledge or less sensitive online monitoring results.
- Tritium in elemental and oxide forms accounted for most of the total radioactivity released to the atmosphere from SRS operations. About 58,000 Ci (2.15E+15 Bq) of tritium was released from SRS, compared to about 55,300 Ci (2.05E+15 Bq) in 1996.
- Tritium also accounted for most of the radioactivity released to the Savannah River from the site. About 8,550 Ci (3.16E+14 Bq) of tritium, compared with 8,950 Ci (3.31E+14 Bq) in 1996, were released to the Savannah River. Of the 1997 amount, 1,570 Ci (5.81E+13 Bq) were directly released from process areas, compared to 949 Ci (3.51E+13 Bq) for 1996.

THIS chapter describes the Savannah River Site (SRS) radiological effluent monitoring program and summarizes the 1997 effluent monitoring data results. Objectives and rationale for the SRS radiological effluent monitoring program are discussed in chapter 3, "Environmental Program Information."

Radiological effluent monitoring results are a major component in determining compliance with applicable dose standards, which can be found in chapter 7, "Potential Radiation Doses," and in appendix A, "Applicable Guidelines, Standards, and Regulations." Also, SRS management philosophy is that potential exposures to members of the public be kept as far below regulatory standards as is reasonably achievable. This philosophy is known as the "as low as reasonably achievable" (ALARA) concept.

SRS airborne and liquid effluents that potentially contain radionuclides are monitored at their points of discharge by a combination of direct measurement and/or sample extraction and analysis. Safety and Health Operations (S&HO), formerly known as Radiological Control Operations, and the Environmental Protection Department's Environmental Monitoring Section (EMS) share most of the radiological effluent monitoring responsibilities. S&HO personnel collect and screen air and liquid samples from regulated (radiologically controlled) areas and maintain monitoring equipment on stacks and at some liquid effluent discharge points. EMS personnel collect and analyze most liquid effluent samples. Results of these analyses are compiled and reported in monthly radioactive releases reports.

Of the more than 4,200 radiological effluent samples collected and analyzed during 1997, 23 (0.5 percent) were not collected and/or analyzed because of sampling equipment failure or inadvertent loss of—or damage to—the sample media. The radioactive releases attributed to these samples were accounted for in the annual release totals by using either historical process knowledge or less sensitive online monitoring results.

A complete description of the EMS sampling and analytical procedures used for radiological effluent monitoring can be found in sections 1102 and 1103 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1 (SRS EM Program). A summary of data results is presented in this chapter; however, more detailed data can be found in *SRS Environmental Data for 1997* (WSRC–TR–97–00324).

Airborne Emissions

Process area stacks that release or have the potential to release radioactive materials are monitored continuously by applicable online monitoring and/or sampling systems [SRS EM Program, 1995]. Filter paper samples, used to collect radioactive particles, generally are gathered daily and screened initially for radioactivity by S&HO personnel. Charcoal canisters, used to collect radioiodines, are gathered weekly. S&HO personnel routinely transfer the filter paper samples and charcoal canisters weekly to EMS sampling personnel for transport to, and analysis in, the EMS laboratories.

Depending on the processes involved, discharge stacks also may be monitored with "real-time" instrumentation by area operations and/or S&HO personnel to determine instantaneous and cumulative atmospheric releases to the environment. Tritium is one of the radionuclides monitored with continuous real-time instrumentation.

Description of Monitoring Program

Sample Collection Systems

Sample collection systems vary from facility to facility, depending on the nature of the radionuclides being discharged. Generally, S&HO personnel are responsible for ensuring that the sampling systems are maintained and for collecting the filter papers and charcoal filter samples.

The following effluent sampling and monitoring changes were made during 1997:

- In January, tritium facilities began reporting the amount of tritium released from their individual stacks (232–H, Lines 1 and 2 Stack; 232–H, Line 3 Stack; 233–H Stack; 234–H Stack; 238–H Stack). In previous years, the amount of tritium released from individual stacks in the tritium facilities had been protected because of national security considerations.
- In February—with approval of the Environmental Protection Agency (EPA)—sampling frequency for air emissions from reactor disassembly basins in P-Area, L-Area, K-Area, and C-Area changed from weekly to annually.
- Beginning with April data, tritium facilities designated the "Forms monitors" as the "monitors-of-record" for tritium emissions in air effluent from tritium facilities stacks. The "Forms monitors," which are capable of analyzing for tritium in both elemental and oxide forms, are more "state-of-the-art" monitoring equipment than the "stack monitors" previously used.
- Air emissions sampling of 320–M and 322–M building stacks in M-Area was discontinued following cessation of operations in these buildings.
- The 253–H Waste Compactor Facility was shut down and air emissions sampling discontinued in March.
- Monthly sampling of air effluent from Building 247–F was discontinued in May because facility operations, including vent systems, were shut down.
- The M-Area Vendor Treatment Facility (in Building 341–8M) was identified as a potential source of radiological air emissions in late 1995; the first sample result from this location was reported in June 1996. Because of equipment problems, operation of this facility was discontinued in April of 1997; after corrective action was taken, facility operations resumed December 10, 1997.
- Modification of the C-Area Decontamination Facility air monitoring system began in mid-1996. Three new release points replaced "C-Area Decon Facility Stack," which was retired in August 1996. EMS picked up the first sample from the "Port. CO2 Blast. Decon Exhaust" release point in March and from the "105–C Stack Decon Exhaust release point in November. The "105–C Crane Maint. Dec Exhaust" release point was still inactive at year–end.

Continuous Monitoring Systems

SRS reactor and tritium facilities use real-time instrumentation to determine instantaneous and cumulative atmospheric releases of tritium and noble gas radioisotopes. All other monitored radionuclides are sampled using filter papers, charcoal filters, or other air effluent sampling media.

Laboratory Analysis

EMS provides most of the necessary radioanalytical laboratory services required to conduct the site airborne effluent monitoring program. However, the Savannah River Technology Center (SRTC) environmental laboratory performs iodine-129 and carbon-14 analyses on certain air effluent samples because they have the sensitive instrumentation capable of detecting low levels of these radionuclides.

Effluent Flow Rates

Stack effluent flows generally are determined with hot-wire anemometers, Pitot tubes, or fan capacity calculations. Sample line flow rates usually are determined with in-line rotameters or hot-wire anemometers. Flow rates are used to determine the total quantity of radioactive materials released.

Diffuse and Fugitive Sources

An estimate of radionuclide releases from unmonitored diffuse and fugitive sources also is included in the SRS radioactive release totals. These unmonitored sources include ponds, contaminated land areas, and structures without ventilation—or with ventilation but without well-defined release points. The sources were included in the overall SRS source terms for the first time in 1991, as required by the U.S. Department of Energy (DOE).

Monitoring Results

The total amount of radioactive material released to the environment is quantified by using data obtained from continuously monitored airborne effluent releases points and estimates of diffuse and fugitive sources in conjunction with calculated release estimates of unmonitored radionuclides from the separations areas. These unmonitored radionuclides are fission product tritium, carbon-14, and isotopes of krypton. Because these radionuclides cannot be measured in the effluent streams, the values are calculated on an annual basis. Total SRS atmospheric releases for 1997 are shown by source in table 5–1, page 80 (and in table 4, *SRS Environmental Data for 1997).*

The data in table 5–1 are a major component in the determination of offsite dose estimations from SRS operations. The calculated individual and collective doses from atmospheric releases are presented in chapter 7, as is a comparison of these offsite doses to EPA and DOE dose standards.

Beta- and Alpha-Emitting Radionuclides

For dose calculation purposes, values for unidentified beta- and alpha-emitting radionuclides in airborne releases are summed with the values reported for strontium-89,90 and plutonium-239, respectively. Accounting for the unidentified beta- and alpha-emitting radionuclides in this way, a conservative approach, generates an overestimated dose attributable to releases from SRS because

- strontium-89,90 and plutonium-239 have the highest dose factors among the common beta- and alpha-emitting radionuclides
- a part of the unidentified activity probably is not from SRS operations but is from naturally occurring radionuclides, such as potassium-40 and radon-222 progeny

In 1997, because this methodology was used, unidentified beta-emitting radionuclides accounted for 99 percent of the reported total strontium-89,90 and unidentified alpha-emitting radionuclides accounted for 93 percent of the reported total plutonium-239.

Tritium

Tritium in elemental and oxide forms accounts for most of the total radioactivity released to the atmosphere from SRS operations. As an isotope of hydrogen, tritium acts the same as hydrogen chemically and physically and thus is extremely difficult to remove from air effluent streams. During 1997, about 58,000 Ci (2.15E+15 Bq) of tritium was released from SRS, compared to about 55,300 Ci (2.05E+15 Bq) in 1996. This 5 percent increase is due, not to operational or process changes, but to the changeover to using "Forms monitor" data as the emissions data of record in the tritium facilities.

Because of improvements in facilities, processes, and operations and because of changes in the site's mission, the amount of tritium (and other atmospheric radionuclides) released has been reduced throughout the history of SRS. During the early years at SRS, large quantities of tritium were discharged to the atmosphere. The maximum yearly release of 2.4 million Ci (8.9E+16 Bq) of tritium occurred during 1958. From 1988 through 1992, the amount of tritium released from SRS decreased approximately 20 percent per year (figure 5–1). In recent years, because of the changes in the site's missions and the existence of the Replacement Tritium Facility, the total amount of tritium released has been less than 100,000 Ci per year.

Comparison of Average Concentrations in Airborne Emissions to DOE Derived Concentration Guides

Average concentrations of radionuclides in airborne emissions are calculated by dividing the yearly release total of each radionuclide from each stack by the yearly stack flow quantities. These average concentrations then can be compared to the DOE derived concentration guides (DCGs), which are found in DOE Order 5400.5, "Radiation Protection of

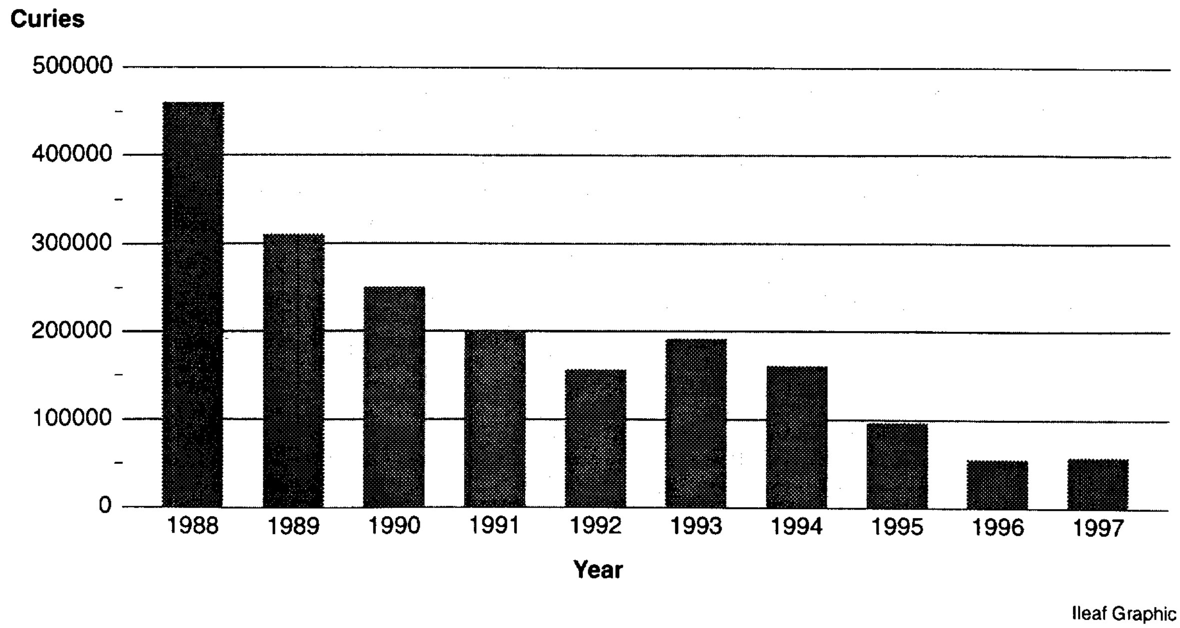


Figure 5–1 Ten-Year History of SRS Annual Atmospheric Tritium Releases

the Public and the Environment," for each radionuclide.

DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. Based on a 100-mrem exposure, DCGs are applicable at the point of discharge (prior to dilution or dispersion) under conditions of continuous exposure (assumed to be an average inhalation rate of 8,400 cubic meters per year). This means that the DOE DCGs are based on the highly conservative assumption that a member of the public has direct access to—and continuously breathes, or is immersed in—the actual air effluent 24 hours a day, 365 days a year. However, because of the distance between most SRS operating facilities and the site boundary, and because the wind rose at SRS shows no strong prevalence (chapter 7), this scenario is improbable.

Average annual radionuclide concentrations in SRS air effluents can be referenced to DOE DCGs as a screening method to determine if existing effluent treatment systems are proper and effective. The 1997 atmospheric effluent 12-month average concentrations, their comparisons against the DOE DCGs, and the quantities of radionuclides released are provided, by discharge point, in table 5, *SRS Environmental Data for 1997*.

Most of the SRS radiological stacks/facilities release small quantities of radionuclides at concentrations below the DOE DCGs. However, certain radionuclides—tritium (in the oxide form) from the heavy water rework facilities, the reactor facilities, and the tritium facilities; americium-241 in F-Area at 6.4 Dissolver; plutonium-239 in H-Area at 244–H Vessel Vent Exhaust—were emitted at concentration levels above the DCGs. Because of the extreme difficulty involved in removing tritium and because of current facility designs, site missions, and operational considerations, this situation is unavoidable. However, the offsite dose consequences from all atmospheric releases during 1997 remained well below the DOE and EPA annual atmospheric pathway dose standard of 10 mrem (0.1 mSv) (chapter 7).

Liquid Discharges

Each process area liquid effluent discharge point that releases or has potential to release radioactive materials is sampled routinely and analyzed for radioactivity [SRS EM Program, 1995]. The radiological liquid effluent sampling locations at SRS are shown, along with the surface water surveillance sampling locations, in chapter 6, "Radiological Environmental Surveillance" (page 90, figure 6–3).

Site streams also are sampled upstream and downstream of seepage basins to obtain data to calculate the amount of radioactivity migrating from the basins. These results are important in calculating the total amount of radioactivity released to the Savannah River as a result of SRS operations.

Description of Monitoring Program

Sample Collection Systems

Liquid effluents are sampled continuously by automatic samplers at, or very near, their points of discharge to the receiving streams. EMS personnel normally collect the liquid effluent samples weekly and transport them to the EMS laboratory for analysis.

The following effluent sampling and monitoring changes were made during 1997:

- H–004 became the official point-of-discharge for Consolidated Incineration Facility liquid effluent releases when production operations began in April.
- Continuous sampling at the U3RF–3 Naval Fuels Effluent liquid discharge point was discontinued in June because of facility shutdown. Samples now are collected at this location only when there is "flow" due to rainfall.

Continuous Monitoring Systems

Depending on the processes involved, liquid effluents also may be monitored by area operations and/or S&HO personnel with real-time instrumentation to ensure that instantaneous releases stay within established limits. However, because of instrumentation detection capabilities, on-line monitoring systems are not used to quantify liquid radioactive releases from SRS.

Laboratory Analysis

EMS provides most of the necessary radioanalytical laboratory services required to conduct the site liquid effluent monitoring program. However, specific low-level analyses for certain radionuclides such as iodine-129 may be performed by SRTC environmental laboratory personnel. In 1997, because of technical problems, measured iodine-129 results for liquid releases were not available from SRTC. For dose calculation, the value measured in 1996 was used. This value is reported in table 5–2 on page 82 of this chapter and in tables 6 and 8, *SRS Environmental Data for 1997*.

Flow Rate Measurements

Liquid effluent flows generally are determined by one of four methods: U.S. Geological Survey flow stations, stream velocity measurements, Isco sampler flow meters, or pump capacity calculations. Effluent flow rates are used to determine the total radioactivity released.

Monitoring Results

Data from continuously monitored liquid effluent discharge points are used in conjunction with site seepage basin and Solid Waste Disposal Facility (SWDF) migration release estimates to quantify the total radioactive material released to the Savannah River from SRS operations. SRS liquid radioactive releases for 1997 are shown by source in table 5–2, page 82, and in table 6, *SRS Environmental Data for 1997).*

The data in this table are a major component in the determination of offsite dose consequences from SRS operations. The calculated individual and collective doses from site liquid releases are presented in chapter 7, as is a comparison of these offsite doses to EPA and DOE dose standards.

Beta- and Alpha-Emitting Radionuclides

As with airborne releases, values for unidentified beta- and alpha-emitting radionuclides in liquid discharges are summed with the values reported for strontium-89,90 and plutonium-239, respectively.

In 1997, because this methodology was used, unidentified beta-emitting radionuclides accounted for about 50 percent of the reported total strontium-89,90 and unidentified alpha-emitting radionuclides accounted for more than 99 percent of the reported total plutonium-239.

Direct Discharges of Liquid Effluents

Direct discharges of liquid effluents are quantified at the point-of-release to the receiving stream, prior to dilution by the stream. The release totals are based on measured concentrations and flow rates.

The quantities of radionuclides released during 1997 are provided, by discharge point, in table 7, *SRS Environmental Data for 1997.*

Tritium accounts for most of the radioactivity discharged in SRS liquid effluents. The total amount of tritium released directly from process areas (i.e., reactor, separations, heavy water rework) to site streams during 1997 was 1,570 Ci (5.81E+13 Bq), which was 65 percent more than the 1996 total of 949 Ci (3.51E+13 Bq). This can be attributed to increased operations at the Effluent Treatment Facility and in D-Area.

Direct releases of tritium to site streams for the years 1988–1997 are shown in figure 5–2.

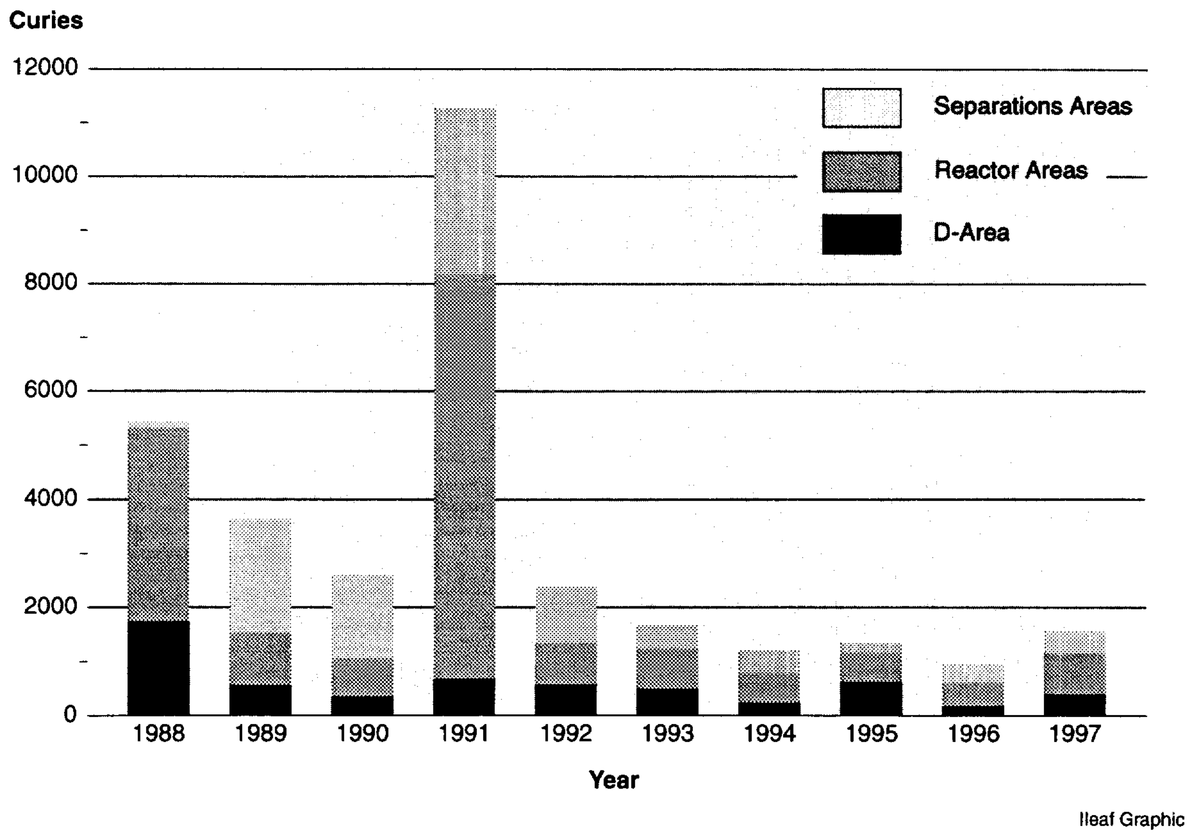


Figure 5–2 Direct Releases of Tritium to SRS Streams, 1988–1997
The 1991 total includes an accidental release in December of 5,700 Ci from K-Reactor.

Comparison of Average Concentrations in Liquid Releases to DOE Derived Concentration Guides

In addition to dose standards, DOE Order 5400.5 imposes other control considerations on liquid releases. These considerations are applicable to direct discharges but not to seepage basin and SWDF migration discharges. The DOE order lists DCG values for most radionuclides. DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. These DCG values are not release limits but screening values for "best available technology" investigations and for determining whether existing effluent treatment systems are proper and effective.

According to DOE Order 5400.5, exceedance of the DCGs at any discharge point may require an investigation of "best available technology" waste treatment for the liquid effluents. Tritium in liquid effluents is specifically excluded from "best available technology" requirements; however, it is not excluded from other ALARA considerations. DOE DCG compliance is demonstrated when the sum of the fractional DCG values for all radionuclides detectable in the effluent is less than 1.00, based on consecutive 12-month average concentrations.

DCGs, based on a 100-mrem exposure, are applicable at the point of discharge from the effluent conduit to the environment (prior to dilution or dispersion). They are based on the highly conservative assumption that a member of the public has continuous direct access to the actual liquid effluent and consumes 2 liters of the effluent every day, 365 days a year. However, because of security controls and the distance between most SRS operating facilities and the site boundary, this scenario is improbable.

For each site facility that releases radioactivity, EMS compares the monthly liquid effluent concentrations and 12-month average concentrations against the DOE DCGs. The 1997 liquid effluent 12-month average concentrations, their comparisons against the DOE DCGs, and the quantities of radionuclides released are provided, by discharge point, in table 7, *SRS Environmental Data for 1997*.

The data show that the U3R–2A ETF outfall at the Road C discharge point exceeded the DCG guide for 12-month average tritium concentrations during 1997. However, as noted previously, DOE Order 5400.5 specifically exempts tritium from "best available technology" waste treatment investigation requirements. This is because there is no practical technology available for removing tritium from dilute liquid waste streams. In 1992, in consideration of ALARA principles for tritium discharges and while reviewing, analyzing, and modifying the process for controlling liquid releases of radioactive effluents, SRS identified several options and alternatives to continuing with these discharges at the U3R–2A ETF outfall. None of these alternatives was considered viable on a cost/benefit basis. No other discharge points exceeded the DOE DCGs in 1997.

Seepage Basin and Solid Waste Disposal Facility Migration

To incorporate the migration of radioactivity to site streams into total radioactive release quantities, EMS monitors and quantifies the migration of radioactivity from site seepage basins and the SWDF. During 1997, tritium, strontium-89,90, and cesium-137 were detected in migration releases (table 8, *SRS Environmental Data for 1997*). As noted previously, measured iodine-129 results were not available from SRTC because of technical problems and the value measured in 1996 was used for dose calculation. This value is reported in table 5–2 on page 82 of this chapter and in tables 6 and 8, *SRS Environmental Data for 1997*.

Figure 5–3 is a graphical representation of releases of tritium via migration to site streams for the years 1988–1997. During 1997, the total quantity of tritium migrating from the seepage basins and SWDF was about 6,780 Ci (2.51E+14 Bq), compared to 6,610 Ci (2.45E+14 Bq) in 1996.

The total combined tritium releases in 1997 (direct discharges and migration from seepage basins and SWDF) were about 8,350 Ci (3.09E+14 Bq), compared to about 7,560 Ci (2.80E+14 Bq) in 1996 (table 10, *SRS Environmental Data for 1997*). More than 450 Ci of the total increase can be attributed to two suspect values of samples taken from the Steel Creek–4 location. An investigation of these values indicated that the samples may have been transposed in either the collection process or the analysis process. However, the values could not be confirmed

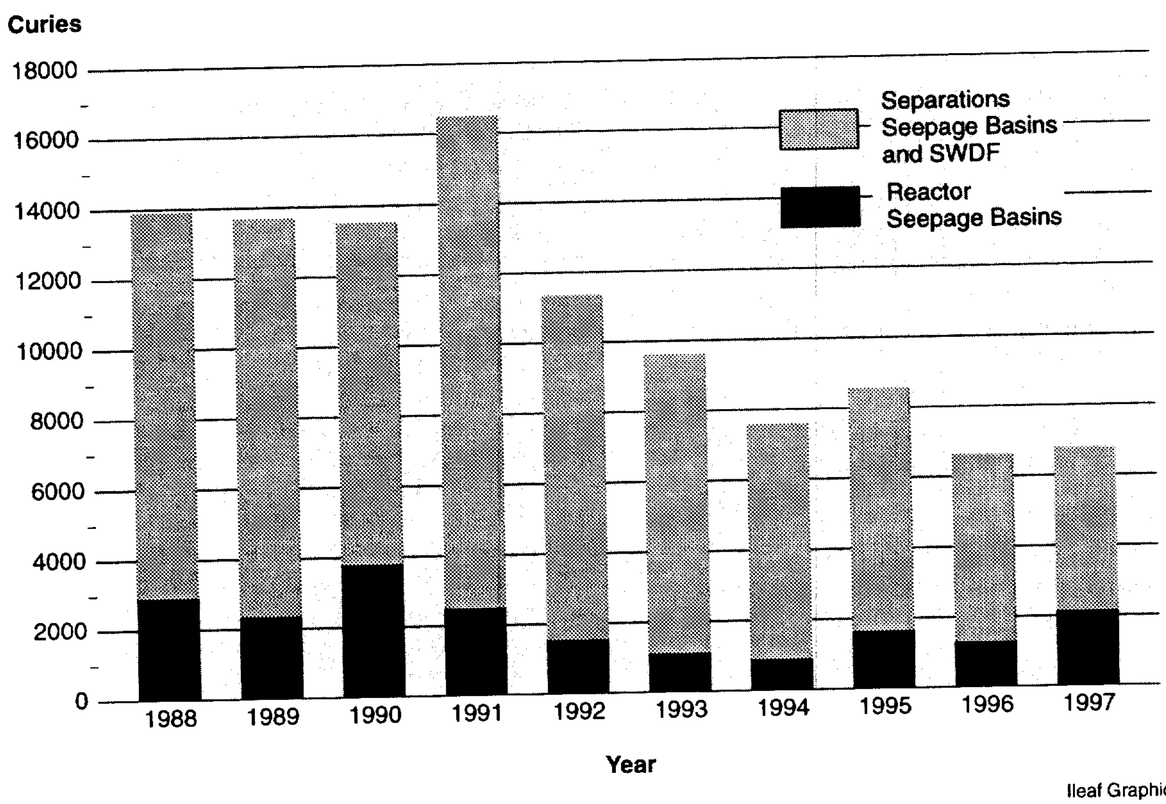


Figure 5–3 Tritium Migration from Seepage Basins and SWDF to SRS Streams, 1988–1997

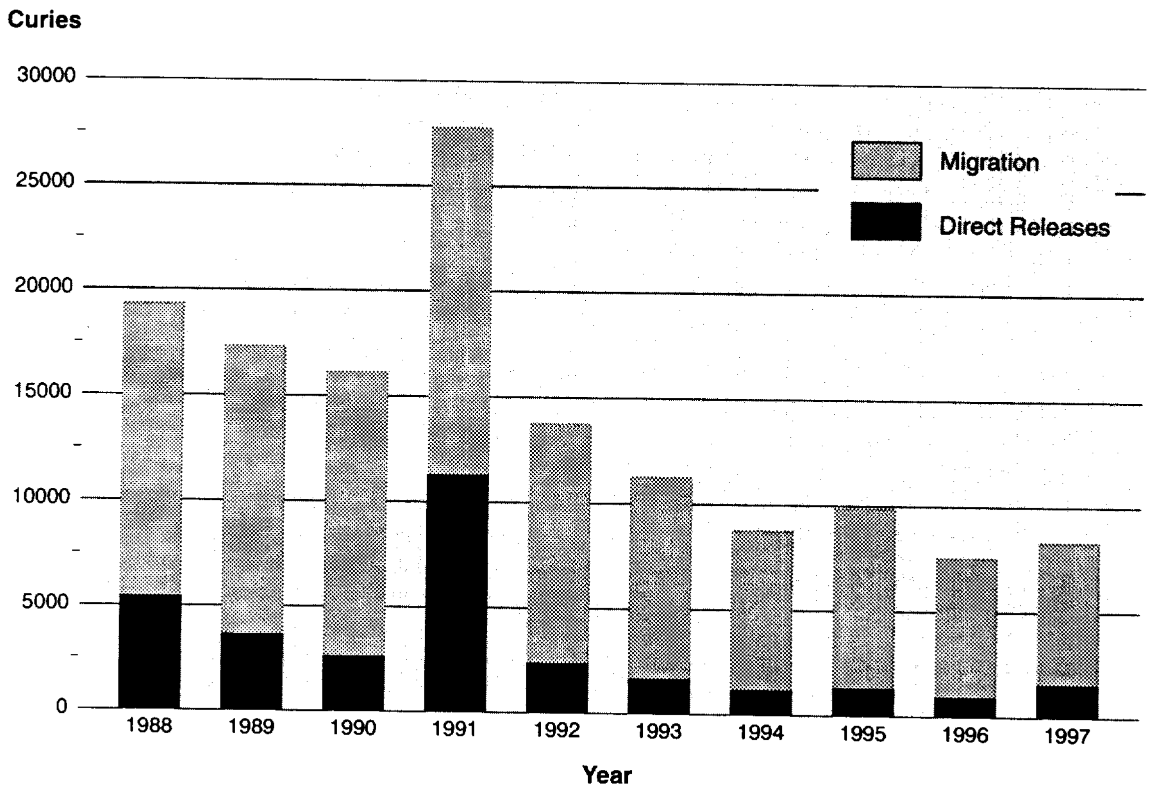


Figure 5–4 Total Tritium Releases to SRS Streams (Direct Discharges and Migration), 1988–1997, Based on Point-of-Release Concentrations and Flow Rates

because of disposal of the original sample. Figure 5–4 shows 1988–1997 total combined tritium releases.

For conservatism, in calculating dose (chapter 7), the slightly higher stream transport value of 8,550 Ci (3.16E+14 Bq) was used instead of the total combined tritium release figure. SRS tritium transport data for 1960–1997 are summarized in chapter 6 (page 95, figure 6–5).

K-Area Drain Field and Seepage Basin Liquid purges from the K-Area disassembly basin were released to the K-Area seepage basin in 1959 and 1960. Since 1960, purges from the K-Area disassembly basin have been discharged to a percolation field below the K-Area retention basin. A total tritium migration of 2,150 Ci (7.96E+13 Bq) was measured in Pen Branch during 1997. The sample location used to determine tritium migration from the K-Area seepage basin was changed in 1997 to PB–3. This location was determined to be the best location for capturing all migration from K-Area. The 1997 migration total represents a 67-percent increase from the 1,290 Ci (4.77E+13 Bq) recorded in 1996.

F-Area and H-Area Seepage Basins and SWDF Radioactivity previously deposited in the F-Area and H-Area seepage basins and SWDF continues to migrate via the groundwater and to outcrop into Four Mile Creek (also known as Fourmile Branch) and into Upper Three Runs.

Groundwater migration from the F-Area seepage basins enters Four Mile Creek between sampling locations FM–3A, FM–2B, and FM–A7. Most of the outcropping from H-Area seepage basins 1, 2, and 3 occurs between FM–1C and FM–2B. Outcropping from H-Area seepage basin 4 and part of SWDF occurs between FM–3 and FM–3A. Radioactivity from H-Area seepage basin 4 and SWDF mixes during groundwater migration to Four Mile Creek. Therefore, radioactivity from the two sources cannot be distinguished at the outcrop point. Four Mile Creek sampling locations are shown in chapter 6, (page 90, figure 6–3).

Measured migration of tritium from F-Area seepage basins was 1,000 Ci (3.70E+13 Bq) in 1997. This is nearly a 38 percent decrease from the 1996 total of 1,620 Ci (5.99E+13 Bq). The measured migration from H-Area seepage basin 4 and SWDF was

2,960 Ci (1.10E+14 Bq), an 8-percent decrease from the 1996 total of 3,200 Ci (1.18E+14 Bq). The measured migration from H-Area seepage basins 1, 2, and 3 was 400 Ci (1.48E+13 Bq), a 21-percent decrease from the 1996 total of 505 Ci (1.87E+13 Bq).

Past, current, and projected tritium migration releases from the F-Area and H-Area seepage basins and SWDF into Four Mile Creek are shown in figure 5–5. As shown, migration releases during 1997 were about 25 percent less than projected.

Generally, tritium migration from the F-Area and H-Area seepage basins, which were closed in 1988, has been declining and is projected to continue to decline [Looney, 1993]. Tritium migration from SWDF has fluctuated between 3,000 and 6,500 curies during the past 10 years. Based on recent assessments of the operational history of SWDF and the geology and hydrology of the site, it is anticipated that, with no corrective actions, SWDF tritium migration into Four Mile Creek is expected to continue, but slowly decrease for the next 20 to 25 years [Flach, 1996].

In 1997, EMS began accounting for tritium migration into Upper Three Runs. This migration is quantified by subtracting direct discharges (principally from the Effluent Treatment Facility) to Upper Three Runs from the stream transport location U3R–4. In the past, these migration releases were included in the stream transport total for Upper Three Runs. The measured migration from the north side of SWDF and the General Separations Area into Upper Three Runs was 267 Ci (9.88E+12 Bq), a 63-percent increase from the 1996 total of 164 Ci (6.07E+12 Bq). (The General Separations Area is in the central part of SRS and contains all waste disposal facilities, chemical separations facilities, associated high-level waste storage facilities, and numerous other sources of radioactive material.)

A ten-year history of tritium migration releases into Upper Three Runs is shown in figure 5–6. Except for the years 1989 through 1991, tritium migration into Upper Three Runs has remained between 150 and 500 Ci per year. However, a recent computer-modeled groundwater migration study predicts increased tritium migration to Upper Three Runs in the next 20 years [Cook, 1997]. This analysis

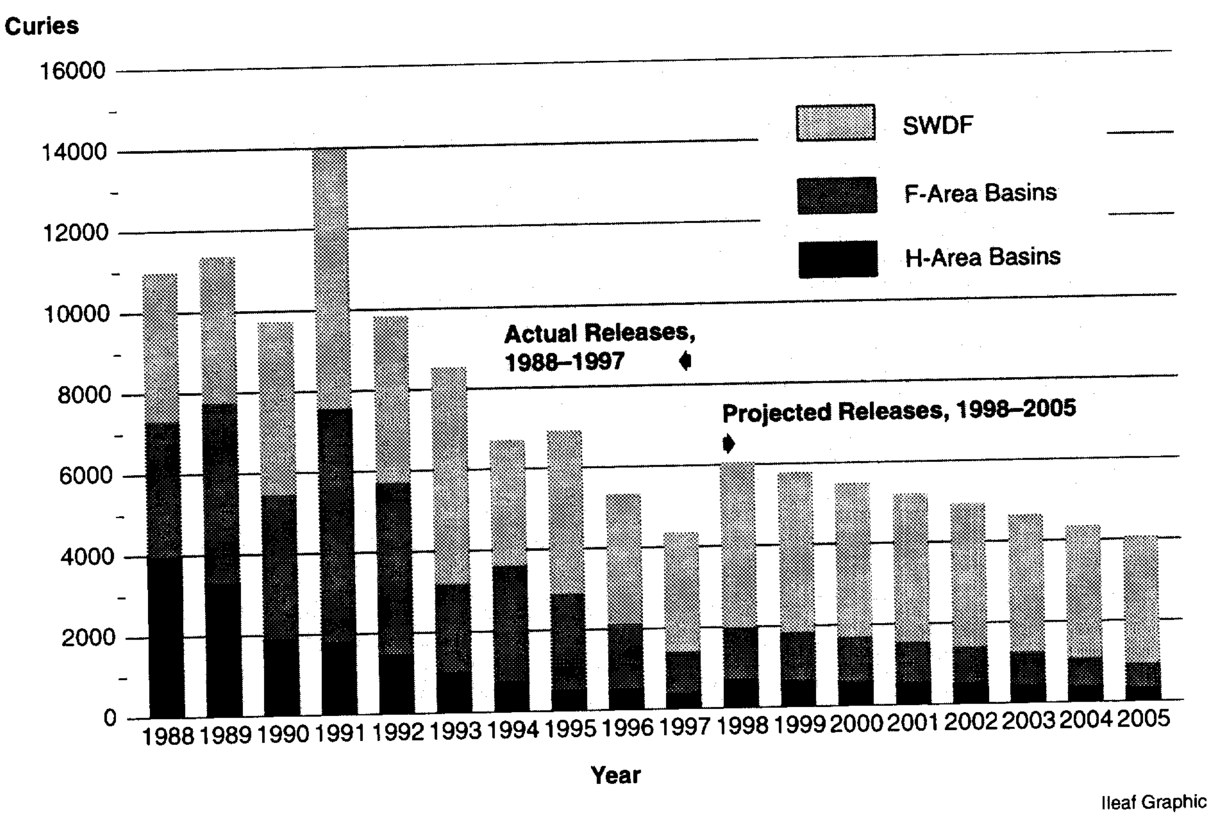


Figure 5–5 Past, Current, and Projected Tritium Migration Releases to Four Mile Creek from the F-Area and H-Area Seepage Basins and SWDF

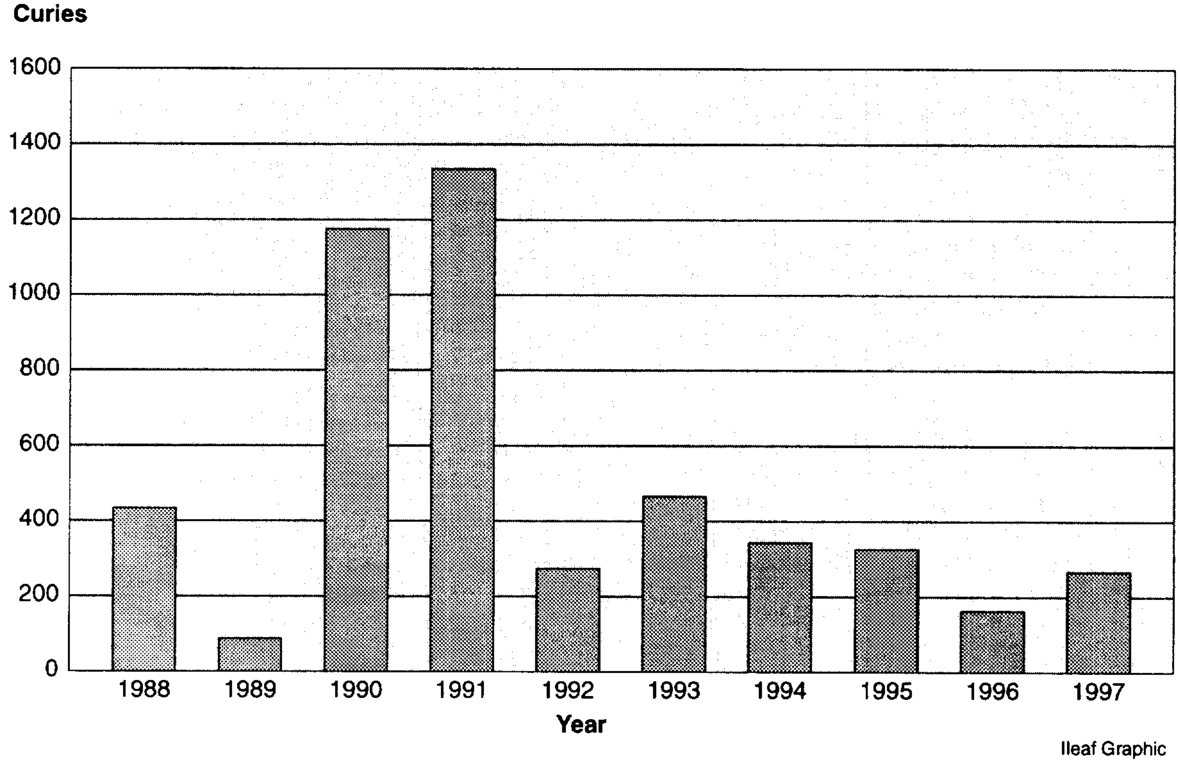


Figure 5–6 Tritium Migration Releases to Upper Three Runs from the General Separations Area and SWDF, 1988–1997

assumes all current and future tritium inventories will migrate relatively fast without considering past migration releases or potential corrective actions; these assumptions are considered to be very conservative. A complete and thorough assessment of tritium migration into Upper Three Runs that is based on measured groundwater concentrations and movement has not yet been completed.

As required by the Resource Conservation and Recovery Act (RCRA) Part B Permit, SRS is developing SWDF groundwater corrective action plans for South Carolina Department of Health and Environmental Control (SCDHEC) approval. Portions of SWDF also are regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA characterization and assessment continued in 1997. Reduction of tritium migration releases is one of the factors being considered during the development of these RCRA/CERCLA groundwater corrective action plans. Low-permeability caps, waste form stabilization, groundwater barriers, groundwater pump-treat-reinjection, and other technologies are under consideration, or are currently being implemented, as components of SWDF remediation. SWDF remediation is discussed in chapter 4.

The amount of strontium-89,90 entering Four Mile Creek from the F-Area seepage basins during 1997 was estimated to be 105 mCi (3.89E+09 Bq). This was a 93-percent increase from the 1996 level of 68 mCi (2.52E+09 Bq). In addition, 0.4 mCi (1.48E+07 Bq) of strontium-89,90 was estimated to have migrated from the H-Area seepage basins. This was a 99-percent decrease from the 1996 level of 31.3 mCi (1.16E+09 Bq).

In addition, a total of 78.2 mCi (2.89E+09 Bq) of iodine-129 and 11.4 mCi (4.22E+08 Bq) of cesium-137 was estimated to have migrated from the F-Area and H-Area seepage basins and from SWDF in 1997.

P-Area, C-Area, and L-Area Seepage Basins

Liquid purges from the P-Area, L-Area, and C-Area disassembly basins were released periodically to their respective seepage basins from the 1950s until 1970. Purge water was released to the seepage basins to allow a significant part of the tritium to decay before the water outcropped to surface streams and flowed into the Savannah River. The delaying action of the basins reduced the dose that users of water from downriver water treatment plants received from SRS tritium releases. Between 1970 and 1978, disassembly basin purge water was released directly to SRS streams. However, the earlier experience with seepage basins indicated that the extent of radioactive decay during the holdup was sufficient to recommend that the basins be used again in P-Area, L-Area, and C-Area, and the periodic release of liquid purges to the seepage basins was resumed. Because of SRS mission changes, however, these basins are no longer in service for receiving liquid purges from disassembly basins.

No radionuclide migration was attributed to the C-Area seepage basin in 1997. The failure of the Twin Lakes Dam in 1991 made the determination of migration more difficult in this area. Results from a sampler installed on Steel Creek above L-Lake indicated that 393 Ci (1.45E+13 Bq) of tritium migrated from the P-Area seepage basin during 1997, 28 percent more than the 320 Ci (1.18E+13 Bq) of tritium in 1996. No migration of radionuclides from the L-Area seepage basin was detected in site streams.

Transport of Actinides in Streams

In 1996, a new and more sensitive actinide method was implemented for the analysis of uranium, plutonium, americium, and curium. As a result of the increased sensitivity, trace amounts of uranium and plutonium were detected at the stream transport locations FM–6, PB–3, L3R–2, and U3R–4. Consequently, these small amounts were incorporated into the source term used for the calculation of the annual dose. Results (1996 and 1997) can be found in table 9, *SRS Environmental Data for 1997.*

Table 5–1 Radioactive Atmospheric Releases by Source

Page 1 of 2

Radio-nuclide	Half-life	Curies[a]						
		Reactors	Separa-tions[b]	Reactor Materials	Heavy Water	SRTC[c]	Diffuse and Fugitive[d]	Total
Notes: Blank spaces indicate no quantifiable activity; h = hour, d = day, y = year								
GASES AND VAPORS								
H-3 (oxide)	12.3 y	5.23E+03	3.34E+04		3.53E+02		1.53E+02	3.91E+04
H-3 (elem)	12.3 y		1.89E+04					1.89E+04
H-3 Total	12.3 y	5.23E+03	5.23E+04		3.53E+02		1.53E+02	5.80E+04
C-14	5.73E3 y		3.10E–02				1.85E–08	3.10E–02
Kr-85	10.73 y		9.62E+03					9.62E+03
I-129	1.57E7 y		7.08E–03				1.22E–07	7.08E–03
I-131	8.040 d		2.91E.05			2.98E–05		5.89E–05
I-133	20.8 h					4.92E–04		4.92E–04
PARTICULATES								
Na-22	2.605 y						1.11E–09	1.11E–09
Mn-54	312.2 d						4.80E–12	4.80E–12
Co-57	271.8 d		2.07E–07				1.04E–09	2.08E–07
Co-58	70.88 d						1.67E–12	1.67E–12
Co-60	5.271 y		3.45E–07				9.13E–07	1.26E–06
Ni-59	7.6E4 y						3.24E–10	3.24E–10
Ni-63	100. y						2.29E–09	2.29E–09
Zn-65	243.8 d						3.69E–12	3.69E–12
Se-79	6.5E4 y						2.15E–10	2.15E–10
Sr-89,90[e]	29.1 y	1.80E–03	2.20E–04	4.16E–05	1.83E–04		8.21E–05	2.33E–03
Zr-95	64.02 d						2.13E–05	2.13E–05
Nb-95	34.97 d						1.55E–15	1.55E–15
Tc-99	2.13E5 y						3.61E–08	3.61E–08
Ru-106	1.020 y						7.00E–02	7.00E–02
Sn-126	1E5 y						3.36E–15	3.36E–15
Sb-124	60.2d						3.36E–12	3.36E–12
Sb-125	2.758 y						5.93E–07	5.93E–07
Cs-134	2.065 y		1.43E–06				1.21E–09	1.43E–06
Cs-137	30.17 y	2.48E–04	4.17E–04		2.85E–06		4.19E–03	4.86E–03
Ba-133	10.53 y						3.00E–12	3.00E–12
Ce-144	284.6 d		4.22E–06				6.11E–06	1.03E–05

a One curie equals 3.7 E+10 Becquerels.
b Includes separations, waste management, and tritium facilities
c Savannah River Technology Center
d Estimated releases from minor unmonitored diffuse and fugitive sources
e Includes unidentified beta emissions

Table 5–1 Radioactive Atmospheric Releases by Source

Page 2 of 2

		Curies[a]						
Radio-nuclide	**Half-life**	**Reactors**	**Separa-tions[b]**	**Reactor Materials**	**Heavy Water**	**SRTC[c]**	**Diffuse and Fugitive[d]**	**Total**
Pm-144	360 d						1.34E–12	1.34E–12
Pm-147	2.6234 y						1.01E–08	1.01E–08
Eu-152	13.48 y						5.32E–09	5.32E–09
Eu-154	8.59 y		1.54E–07				6.42E–06	6.57E–06
Eu-155	4.71 y		4.93E–06				1.66E–06	6.59E–06
Ra-226	1.6E3 y						1.24E–08	1.24E–08
Ra-228	5.76 y						1.75E–10	175.E–10
Th-228	1.913 y						2.15E–10	2.15E–10
Th-230	7.54E4 y						2.03E–10	2.03E–10
Th-232	1.40E10 y						1.40E–10	1.40E–10
Th-234	24.10d						2.26E–10	2.26E–10
Pa-231	3.28E4 y						1.00E–09	1.00E–09
Pa-234	6.69h						2.26E–10	2.26E–10
U-233	1.592E5 y						2.11E–08	2.11E–08
U-234	2.46E5 y		8.03E–06	4.02E–06			1.45E–05	2.66E–05
U-235	7.04E8 y		6.25E–07	6.37E–07			4.84E–07	1.75E–06
U-236	2.342E7 y						4.84E–07	4.84E–07
U-238	4.47E9 y		1.94E–05	1.74E–06			3.45E–05	5.56E–05
Np-237	2.14E6 y						1.38E–09	1.38E–09
Np-239	2.35 d						2.17E–07	2.17E–07
Pu-238	87.7 y		3.30E–05	4.41E–09			3.55E–04	3.88E–04
Pu-239[e]	2.410E4 y	2.92E–04	5.12E–05	6.85E–06	2.28E–05	2.47E–06	6.92E–06	3.75E–04
Pu-240	6.56E3 y						1.11E–06	1.11E–06
Pu-241	14.4 y						5.16E–05	5.16E–05
Pu-242	3.75E5 y						3.66E–11	3.66E–11
Am-241	432.7 y		1.44E–05	1.18E–08			8.70E–07	1.53E–05
Am-243	7.37E3 y						1.76E–05	1.76E–05
Cm-242	162.8 d						8.19E–12	8.19E–12
Cm-244	18.1 y		2.49E–05	2.03E–10			1.28E–04	1.53E–04
Cm-245	8.5E3 y						1.88E–12	1.88E–12

a One curie equals 3.7 E+10 Becquerels.
b Includes separations, waste management, and tritium facilities
c Savannah River Technology Center
d Estimated releases from minor unmonitored diffuse and fugitive sources
e Includes unidentified alpha emissions

Table 5–2 Radioactive Liquid Releases by Source (Including Direct and Seepage Basin Migration Releases)

Page 1 of 1

		Curies[a]					
Radio-nuclide	**Half-life**	**Reactors**	**Separa-tions[b]**	**Reactor Materials**	**Heavy Water/TNX**	**Savannah River Technology Center**	**Total**
Notes: Blank spaces indicate no quantifiable activity; h = hour, d = day, y = year							
H-3 (oxide)	12.3 y	2.91E+03	5.24E+03		4.02E+02	1.82E+00	8.55E+03
Sr-89,90[c]	29.1 y	6.46E–02	1.40E–01		5.09E–03	4.10E–03	2.14E–01
I-129	1.6E7 y		7.82E–02[d]				7.82E–02[d]
Cs-137	30.2 y	2.86E–03	4.49E–02				4.78E–02
U-234	2.46E5 y	4.45E–03	2.30E–02	2.68E–05	1.52E–06	1.06E–04	2.76E–02
U-235	7.04E8 y	4.91E–05	7.23E–04		1.37E–07	3.44E–06	7.76E–04
U-238	4.47E9 y	3.83E–03	2.57E–02	5.71E–05	9.19E–06	1.11E–04	2.97E–02
Pu-238	87.7 y	4.24E–05	9.57E–04		7.68E–07	1.78E–06	1.00E–03
Pu-239[e]	2.410E4 y	1.10E–02	3.39E–02	1.14E–03	1.12E–03	3.38E–03	5.05E–02
Am-241	432.7 y		7.81E–06	2.11E–06			9.92E–06
Cm-244	18.1 y		2.93E–06	4.14E–07			3.34E–06

a One curie equals 3.7 E+10 Becquerels.
b Includes separations, waste management, and tritium facilities
c Includes unidentified beta emissions
d Measured iodine-129 results were not available for 1997 from the Savannah River Technology Laboratory. This value was measured in 1996.
e Includes unidentified alpha emissions

Chapter 6

Radiological Environmental Surveillance

Mary Dodgen, Pete Fledderman, Bill Littrell, and Stuart Stinson
Environmental Protection Department

To Read About . . . See Page . . .

1997 Highlights

- About 10,000 radiological analyses were performed on approximately 5,000 samples, not including the groundwater program.
- As in previous years, tritium-in-air values were highest at H-Area and D-Area. This is consistent with the operations at these facilities. The tritium concentration in air rapidly decreases as a function of distance from the source.
- Tritium is the predominant radionuclide detected above background levels in the Savannah River. The average concentration at RM–120, located at U.S. Highway 301 below SRS, was (1.10 ± 0.45)E+03 pCi/L—less than 6 percent of the 2.00E+04-pCi/L drinking water standard set by EPA for tritium in drinking water.
- No drinking water samples collected and analyzed by EMS exceeded the 2.00E+04-pCi/L EPA tritium limit. The average tritium concentration in finished water at Beaufort-Jasper in 1997, (9.17 ± 2.12)E+02-pCi/L, was 5 percent of the EPA drinking water limit, as was the average tritium concentration at Port Wentworth, (9.66 ± 2.56)E+02 pCi/L.
- A total of 1,363 deer and 85 feral hogs were taken from SRS during 14 hunts as part of the site's controlled hunt program. This compares with 1,685 deer and 109 feral hogs taken in 1996. The hunts are conducted to control the site's deer and hog populations and to reduce the number of animal-vehicle collisions.

THE Savannah River Site (SRS) radiological environmental surveillance program is designed to survey and quantify any effects that routine and nonroutine operations might have on the site and on the surrounding area and population. The program represented an extensive network in 1997 that covered approximately 2,000 square miles and extended up to 25 miles from the site. In conjunction with the radiological effluent monitoring program (chapter 5, "Radiological Effluent Monitoring"), the program enables SRS to monitor ambient radiological conditions and determine site contributions of radioactive materials to the environment.

Routine radiological surveillance activities are performed by the Environmental Protection Department's Environmental Monitoring Section (EMS) and by the Savannah River Technology Center (SRTC). The Savannah River also is monitored by other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC) and the Georgia Department of Natural Resources (GDNR).

As part of the radiological surveillance program, routine surveillance of all radiation exposure pathways (ingestion, inhalation, immersion, and submersion) is performed on all environmental media that may lead to a measurable annual dose at the site boundary. This chapter summarizes surveillance results of the atmosphere (air and rainwater), surface water (seepage basins, site streams, and the Savannah River), drinking water, food products (terrestrial and aquatic), wildlife, soil, sediment, and vegetation. Also summarized are results of extensive monitoring of ambient gamma radiation levels performed on site, at the site boundary, and in population centers (surrounding communities). A description of the surveillance program and 1997 results for groundwater can be found in chapter 10, "Groundwater."

All results discussed in this chapter are based on available samples and/or analyses. Because of sampling and/or analytical difficulties, some sample analyses may be missing. Problems may have arisen with sample collection, such as loss of power to the sampling site or inaccessibility to the sampling site (locked gates, flooding, etc.) Historically, the number of samples that is unavailable or cannot be analyzed for some reason has proven to be only a small fraction of the overall number of samples. Results for collected samples can be rejected after analysis for such reasons as insufficient sample volume, low chemical yield, or equipment failure.

The ± value reported with individual results is a counting uncertainty; the ± value reported with averages (means) is a standard deviation. The lower limit of detection (LLD) often varies because of counting times and other factors. Negative analytical results may be produced by EMS analytical software. These results occur when the detection instrument background is greater than the activity in the sample. Nominal LLDs for the types of analyses being performed on the various environmental surveillance media can be found in table 2 of *SRS Environmental Data for 1997* (WSRC–TR–97–00324).

In 1997, approximately 10,000 radiological analyses were performed on approximately 5,000 samples (not including groundwater). Analytical results for 1997 appear in *SRS Environmental Data for 1997.* Information on the rationale for the radiological environmental surveillance program can be found in chapter 3, "Environmental Program Information." Data from earlier years can be found in previous SRS environmental reports and data publications. Document numbers for these can be found in appendix F, "Environmental Monitoring Reports."

A complete description of the SRS radiological environmental surveillance program can be found in section 1105 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1 (SRS EM Program).

Air

Description of Surveillance Program

EMS maintains an extensive network of 23 sampling stations in and around SRS to monitor the concentration of radioactive materials in the air. These locations are divided into four subgroups, as follows:

- onsite
- site perimeter
- a control location at 25 miles
- selected major population centers at 25 and 100 miles

Figure 6–1 shows all the sampling locations except the 25- and 100-mile stations.

The air surveillance program helps determine the impact (if any) of site operations on the environment and evaluates trends in airborne radionuclide concentrations. The program also is used to verify atmospheric transport models and to support emergency response activities in the event of an unplanned release of radioactive material to the atmosphere.

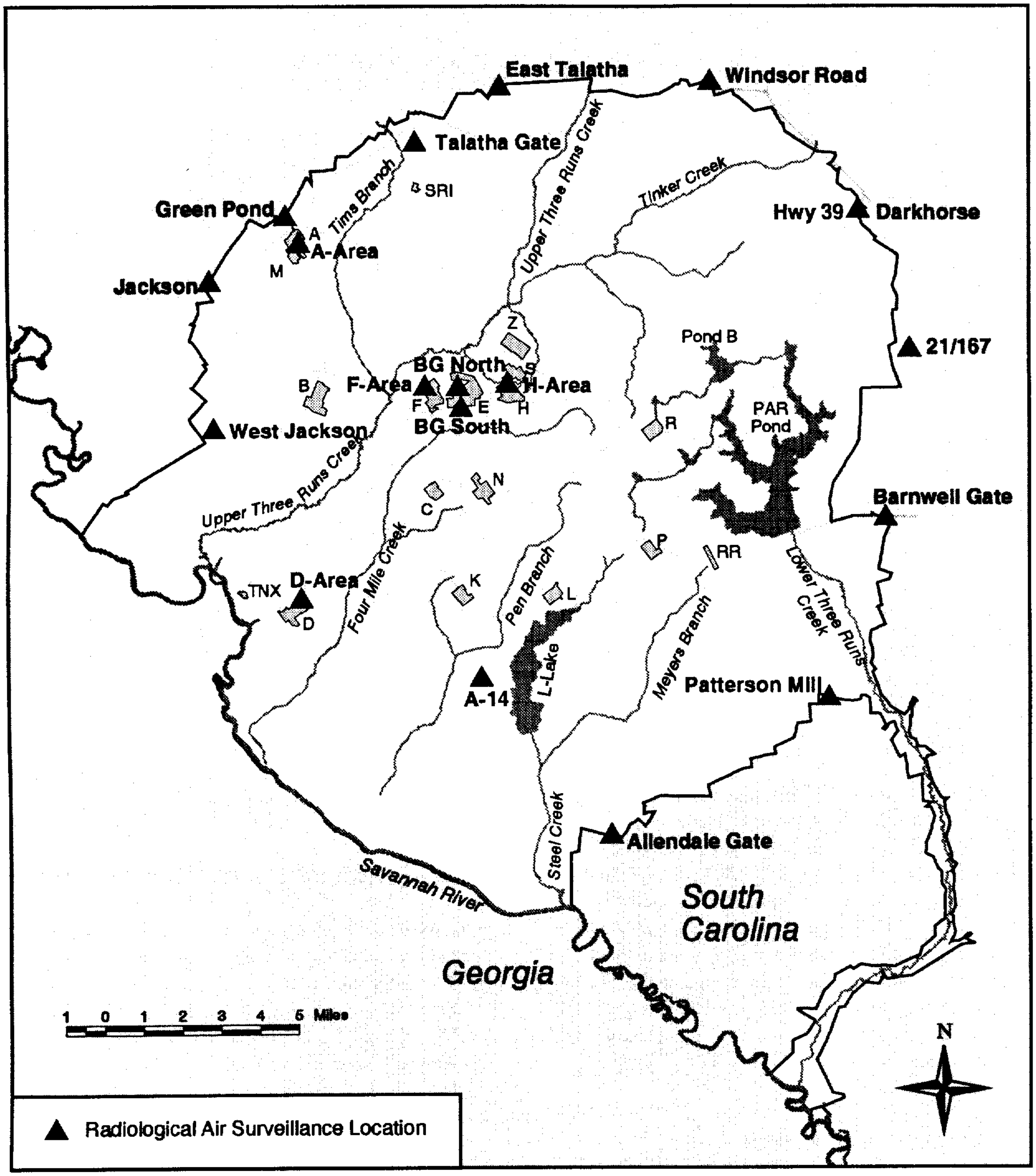
Surveillance Results

Chapter 5 details the types and quantity of radioactive material released to the environment from SRS activities in 1997. Except for tritium, specific radionuclides were not routinely detectable at the site perimeter. Both onsite and offsite activity concentrations were similar to levels observed in previous years (table 11, *SRS Environmental Data for 1997*).

Gross Alpha and Gross Beta

Gross alpha and gross beta activity analyses are performed on glass fiber filter papers. Although they cannot provide concentrations of specific radionuclides, these measurements are useful in providing information for trending of the total activity in an air sample or in screening samples.

A summary of the monitoring results from 1993–1997 is presented in table 6–1. Both the average onsite gross alpha and average onsite gross beta results are slightly higher than—but still consistent with—the 1996 results. Results from the site perimeter and 25-mile-radius stations essentially are unchanged, while the Savannah, Georgia, location showed slightly lower gross alpha activity and slightly higher gross beta activity. In summary, these results are consistent with historical trends. As



EPD/GIS Map

Figure 6–1 Radiological Air Surveillance Sampling Locations
The SRS air surveillance program consists of 19 stations located on site or along the site perimeter, as well as (not shown) three stations approximately 25 miles from the site perimeter (located near the Highway 301 Bridge over the Savannah River, the Augusta Lock and Dam, and the Aiken airport) and one approximately 100 miles from the site perimeter (at Savannah, Georgia).

observed in previous years, no significant difference was observed between the average concentration measured on site near the operating facilities and the average concentration observed at the site perimeter.

Gamma-Emitting Radionuclides

Glass fiber filters and activated charcoal canisters are collected weekly and analyzed for gamma-emitting

Table 6–1
Average Gross Alpha and Gross Beta Measured in Air (pCi/m³), 1993–1997

		Average Gross Alpha			
Locations	**1993**	**1994**	**1995**	**1996**	**1997**
On site	1.9E–3	1.4E–3	1.5E–3	1.1E–3	1.2E–3
Site perimeter	1.8E–3	1.4E–3	1.4E–3	1.0E–3	9.8E–4
25-mile radius	1.8E–3	1.4E–3	1.4E–3	1.0E–3	1.0E–3
100-mile radius	2.0E–3	1.8E–3	1.6E–3	9.4E–4	1.1E–3
		Average Gross Beta			
Locations	**1993**	**1994**	**1995**	**1996**	**1997**
On site	1.8E–2	1.7E–2	1.8E–2	1.5E–2	1.7E–2
Site perimeter	1.9E–2	1.8E–2	1.8E–2	1.5E–2	1.5E–2
25-mile radius	1.8E–2	1.8E–2	1.8E–2	1.6E–2	1.6E–2
100-mile radius	2.0E–2	1.8E–2	1.8E–2	1.4E–2	1.1E–2

radionuclides. In 1997, no manmade gamma-emitting radionuclides were observed above the nominal LLD. These results are consistent with historical results, which indicate a small number of samples with detectable activity.

Tritium

Tritium-in-air analyses are conducted on biweekly silica gel samples. Tritium is released as part of routine SRS operations and becomes part of the natural environment. Monitoring ensures that it poses no health risk to the surrounding population. Consistent with the SRS source term, tritium concentrations generally decrease with increasing distance from the tritium facilities near the center of the site. In addition, the analytical results generally agree with the predictions of the SRS transport and dose assessment model, as detailed in chapter 7, "Potential Radiation Doses."

Plutonium and Strontium

Glass fiber filters are composited either weekly or monthly and analyzed for plutonium isotopes (plutonium-238 and plutonium-239) and total strontium (strontium-89,90). These radionuclides are released in small quantities as part of routine site operations—primarily from the separations areas. The observed concentrations of the radionuclides in 1997 were similar to historical levels; all locations were near or below the nominal LLDs. Likewise, the distribution pattern of the isotopes was similar to that observed in previous years—the concentrations generally were higher near the center of the site, as expected from the source term. The concentrations then showed a decrease to background levels or detection limits at the site boundary and beyond.

Rainwater

SRS maintains a network of rainwater sampling sites as part of the air surveillance program. These stations are used to measure deposition of radioactive materials.

Description of Surveillance Program

Rainwater collection pans are located at each routine air surveillance station (figure 6–1). Ion-exchange resin columns are placed at 10 of these locations. At each of these locations, rain collected in the pan passes through the column and into a collection bottle. Both the ion-exchange resin column and the collected liquid are returned to the laboratory for analysis. The column is analyzed for gamma-emitting radionuclides, gross alpha, gross beta, plutonium-238, plutonium-239, and strontium-89,90, while the rainwater is analyzed for tritium. At all other locations, the collected rainwater is returned to the laboratory and analyzed for tritium only. Ion-exchange column sampling is performed monthly, while rainwater sampling is performed biweekly.

Surveillance Results

Detailed results of rainwater analyses can be found in tables 12 and 13 of *SRS Environmental Data for 1997.*

Gamma-Emitting Radionuclides

As in 1996, no detectable manmade gamma-emitting radionuclides were observed in rainwater samples during 1997.

Gross Alpha and Gross Beta

The gross alpha and gross beta results were consistent with those of 1996; no increasing or decreasing trend was evident. This implies that the observed values are natural background and does not indicate any contribution directly attributable to SRS.

Plutonium

Plutonium isotopes were quantified twice in 1997; the locations where activity was observed were well off site—at 25-mile and 100-mile locations. One sample from Savannah showed plutonium-238 and a sample from the Augusta Lock and Dam location showed plutonium-239. The plutonium concentrations in these two samples were slightly above the detection limit. Observed plutonium levels were consistent with those of 1996; this, along with the location of detectable activity, implies that the observed values are natural background and does not indicate any contribution directly attributable to SRS.

Strontium

As in 1996, no detectable levels of strontium-89,90 were observed in rainwater samples during 1997.

Tritium

As in previous years, tritium-in-rain values were highest at those locations near the center of the site and at D-Area. This is consistent with the D-Area and H-Area effluent release points that routinely release tritium. As with tritium in air, concentrations generally decreased as distance from the effluent release point increased (figure 6–2); this observation also is consistent with the source term and with atmospheric transport.

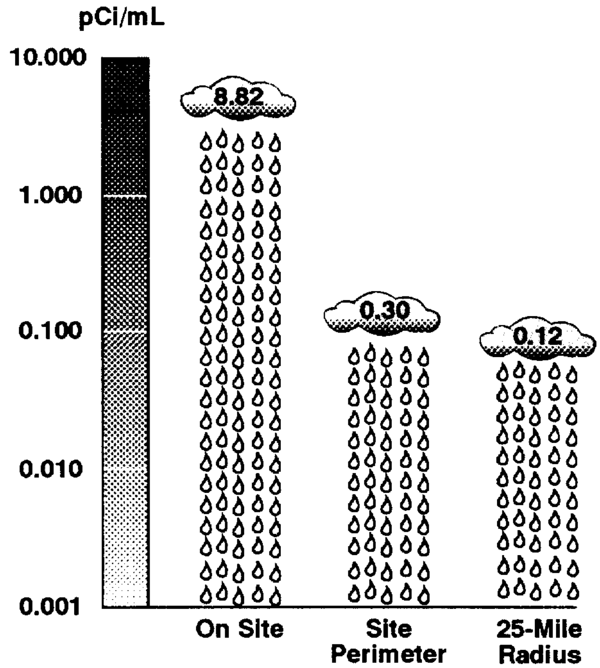


Figure 6–2 Average Concentration of Tritium in Rainwater

Tritium concentrations in rainwater (shown here in pCi/mL), generally decrease as the distance from the site increases.

Gamma Radiation

Description of Surveillance Program

Ambient gamma exposure rates in and around SRS are monitored by an extensive network of dosimeters. The site uses the thermoluminescent dosimeter (TLD) to quantify integrated gamma exposure on a quarterly basis. The TLD performs this function accurately, reliably, and relatively inexpensively.

SRS has been monitoring ambient environmental gamma exposure rates with TLDs since 1965. The information provided by this program is used primarily to determine the impact (if any) of site operations on the gamma exposure environment and to evaluate trends in environmental exposure levels. Other potential uses include

- support of routine and emergency response dose calculation models
- assistance in determining protective action recommendations in the event of an unplanned release of gamma-emitting radionuclides
- confirmatory accident assessment

The SRS ambient gamma radiation monitoring program is divided into five subprograms, as follows: onsite operating areas, site perimeter stations, population centers, air surveillance stations, and NRC/Vogtle (stations co-located with Nuclear Regulatory Commission and Georgia Power Company locations that monitor potential exposures from Georgia Power's Vogtle Electric Generating Plant). All TLDs are exchanged quarterly.

Most gamma exposure monitoring is conducted on site and at the site perimeter. Monitoring continues to be conducted in population centers within approximately 9 miles (15 km) of the site boundary, but only limited monitoring is conducted beyond this

Table 6–2
TLD Surveillance Results Summary for 1997

Monitoring Subprogram	Mean Exposure (mrem per year)	Maximum Exposure (mrem per year)	Maximum-Exposure Location
On site	97	196	N-Area #5
Site perimeter	69	81	Perimeter #65-D
Air surveillance	76	105	F-Area
Population centers	85	108	Williston, SC
NRC/Vogtle	64	110	NRC #1

distance and at the 25- and 100-mile air surveillance stations.

Surveillance Results

In general, 1997 gamma radiation surveillance program results indicated gamma exposure rates consistent with those observed in 1996. As expected, results from several onsite monitoring locations showed clearly elevated exposure rates. As in 1996, the maximum annual exposure was observed on site at Location 5 in N-Area; this location is near facilities where work is performed on steam generators. The 1997 exposure at this location was approximately 196 mrem. The remainder of the onsite location exposures generally were no greater than levels measured at the site perimeter or off site. This follows a long-term trend.

Al Mamatey Photo (98X00643–01)

An EMS technician uses a bar code reader in the field to record TLD placement information, such as badge number and location. The TLDs are packaged for protection against adverse environmental conditions.

With one exception, site perimeter and offsite locations were consistent with previously published historical results. At Nuclear Regulatory Commission (NRC) monitoring site 1, the exposure rose from 72 mrem in 1996 to 110 mrem in 1997. This change is the result of an increased exposure rate observed in the second quarter. During this time, part of a decommissioned commercial nuclear power reactor was shipped through SRS to Chem-Nuclear Systems, Inc., in Barnwell, South Carolina, for disposal. This shipment was removed from a barge and placed adjacent to NRC site 1 for several days, which resulted in the observed increased exposure.

The exposures at the remaining monitoring locations show some variation based on normal site-to-site and year-to-year differences in the components of natural ambient gamma exposure levels. This phenomena also is observed at a majority of the onsite monitoring locations because operations in many areas have been reduced or discontinued. Table 6–2 summarizes the 1997 surveillance results. Detailed analytical results from the TLD monitoring program can be found in tables 14, 15, 16, 17, and 18 of *SRS Environmental Data for 1997.*

Seepage Basins

During previous years of operation, SRS discharged liquid effluent to seepage basins to allow for the decay and natural removal of radioactivity in the water before it reached onsite streams. The practice of discharging water to the seepage basins was discontinued in 1988, but water accumulating in the basins from other sources continues to be monitored by EMS because of potential contamination from the basin soil.

Description of Surveillance Program

Seepage basin water is analyzed for gross alpha, gross beta, tritium, strontium, and gamma-emitting radionuclides. Analyses for specific radionuclides are determined by the makeup of previous releases to the basins.

In 1997, aqueous samples were scheduled to be collected annually from the TNX seepage basin, monthly from the Solid Waste Disposal Facility (SWDF), and quarterly from the A-Area, C-Area, L-Area, and P-Area seepage basins. As part of the E-Area expansion plan, EMS also monitors two basins, E-Basin North and E-Basin South, on a monthly basis. Because of dry conditions, no samples could be collected from E-Basin South, the TNX seepage basin, and the A-Area, C-Area, and L-Area basins, and not all the scheduled samples could be collected from the P-Area and SWDF basins.

Surveillance Results

Sampling results from 1997 for seepage basin water were similar to those from previous years, largely because liquid effluents no longer introduce new activity to the basins (table 19, *SRS Environmental Data for 1997*). Tritium values at all sample locations were less in 1997 than in 1996. The highest mean tritium activity, (9.34 ± 9.50)E+03 pCi/L, was found in the SWDF Basin South (E–001). The highest mean concentrations of cesium-137, (1.85 ± 0.63)E+01 pCi/L, and cobalt-60, (1.10 ± 0.34)E+01 pCi/L, were found in the P-Area seepage basin (PSB–1). The cesium-137 concentration is 9.3 percent of the 2E+02-pCi/L U.S. Environmental Protection Agency (EPA) drinking water standard for cesium-137, and the cobalt-60 concentration is 11.0 percent of the 1E+02-pCi/L EPA drinking water standard. PSB–1 also had the highest gross beta concentration, (2.47 ± 0.54)E+01 pCi/L—primarily because of the presence of cesium-137. Only one location, the L-Area Seepage Basin (LSB–1), was analyzed for the presence of strontium; the concentration was (3.16 ± 0.83)E+01 pCi/L, a significant increase from 1996. No liquid discharges to LSB–1 occurred in 1997, however, and the sample size was so small that a large variation in results could be expected from year to year; thus, the increased activity is not considered an indication of strontium buildup.

Site Streams

Continuous surveillance is used on several SRS streams (figure 6–3), including Tims Branch, Upper Three Runs Creek, Four Mile Creek (also known as Fourmile Branch), Pen Branch, Steel Creek, and Lower Three Runs Creek. Stream water sampling locations that monitor below process areas serve to detect and quantify levels of radioactivity in liquid effluents that are being transported to the Savannah River. In 1997, 23 samplers on SRS streams served as environmental surveillance points.

Description of Surveillance Program

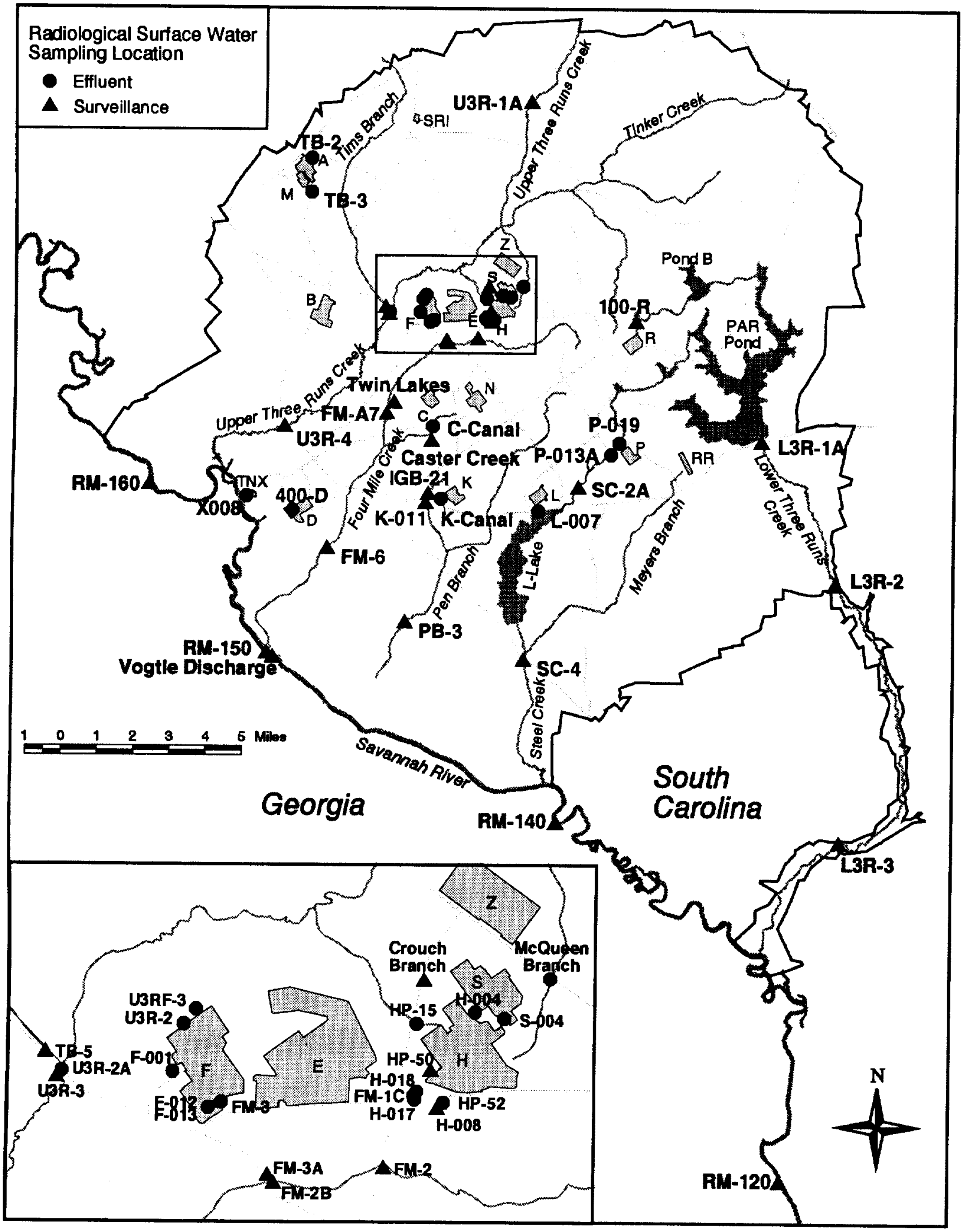
Stream samples were collected every other week during 1997 and analyzed as either biweekly or monthly composites. Frequency and types of analyses performed on each sample are based on the potential quantity and type of radionuclides likely to be present in the water at the surveillance station. Generally, tritium determinations, gamma and alpha spectroscopy, and gross alpha and gross beta screening are performed on stream water. Monthly composites also are analyzed for strontium-89,90—another likely byproduct of SRS operations. Analytical schemes for particular stream locations are documented in the SRS EM Program. The site implemented a new sample reporting regime in 1996 that requires the laboratory to report all gamma spectroscopy results for cobalt-60 and cesium-137 and all alpha spectroscopy results for uranium-234, 235, and 238 and plutonium-238 and 239, even though the results may be below the approximate detection limits listed in table 2 of *SRS Environmental Data for 1997*.

Surveillance Results

The average gross alpha, gross beta, and tritium concentrations at downstream locations near the creek mouths are presented in table 6–3. A graph showing the average tritium concentration over a 10-year period is presented in figure 6–4. The locations of these stations, well below all points at which radioactivity is introduced into the respective streams, ensure that adequate mixing has taken place and that a representative sample is being analyzed. Concentrations at surveillance station U3R-1A (above process effluents and runoff locations on Upper Three Runs Creek) are listed for comparison purposes in table 6–3. Detailed results of stream water analyses appear in table 20 of *SRS Environmental Data for 1997*. The following sections contain discussions of surveillance results from each of the major SRS streams.

Tims Branch

A tributary of Upper Three Runs Creek, Tims Branch receives effluents from M-Area and SRTC. A surveillance point on Tims Branch, TB-5, is located downstream of all release points and before entry into Upper Three Runs Creek. Tritium was below the nominal short count LLD in Tims Branch in 1997, and gross alpha and beta measurements, while above the detection limits, are comparable to levels seen above SRS at the U3R-1A sampling location.



EPD/GIS Map

Figure 6–3 Radiological Surface Water Sampling Locations

Surveillance and effluent sampling points are at SRS seepage basins and streams and on the Savannah River.

Table 6–3
Average 1997 Concentration of Radioactivity in SRS and Surveillance Station Waters (pCi/L)

Location[a]	Gross Alpha	Gross Beta	Tritium
Lower Limits of Detection	6.23E–01	1.55E+00	1.30E+03[b]
Onsite Downstream Locations			
Tims Branch (TB–5)	(3.83 ± 2.09)E+00	(2.23 ± 0.93)E+00	(7.32 ± 3.38)E+02
Upper Three Runs (U3R–4)	(2.83 ± 1.70)E+00	(1.78 ± 0.78)E+00	(3.29 ± 2.04)E+03
Four Mile Creek (FMC–6)	(1.72 ± 2.08)E+00	(1.46 ± 0.46)E+01	(2.16 ± 0.41)E+05
Pen Branch (PB–3)	(1.28 ± 1.00)E+00	(1.95 ± 1.12)E+00	(1.15 ± 0.34)E+05
Steel Creek (SC–4)	(1.64 ± 1.41)E+00	(2.93 ± 3.31)E+00	(1.81 ± 4.45)E+04
Lower Three Runs (L3R–2)	(1.33 ± 1.13)E+00	(2.54 ± 1.12)E+00	(1.32 ± 0.40)E+03
Onsite Surveillance Station (for comparison purposes)			
Upper Three Runs (U3R–1A)	(3.13 ± 1.40)E+00	(1.74 ± 0.87)E+00	(4.03 ± 2.87)E+02
Lower Limit of Detection			4.07E+02[c]

a Site surveillance locations are near mouths of streams.
b Lower limit of detection for tritium by short count
c Lower limit of detection for tritium by long count

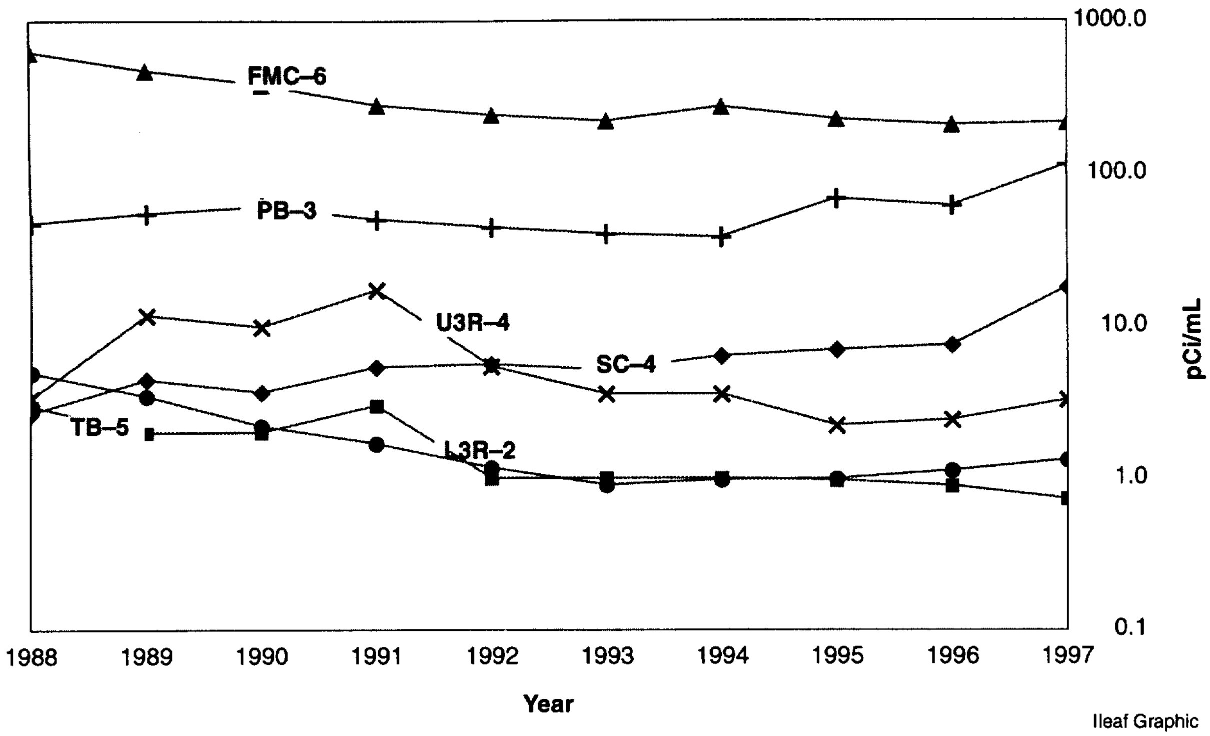
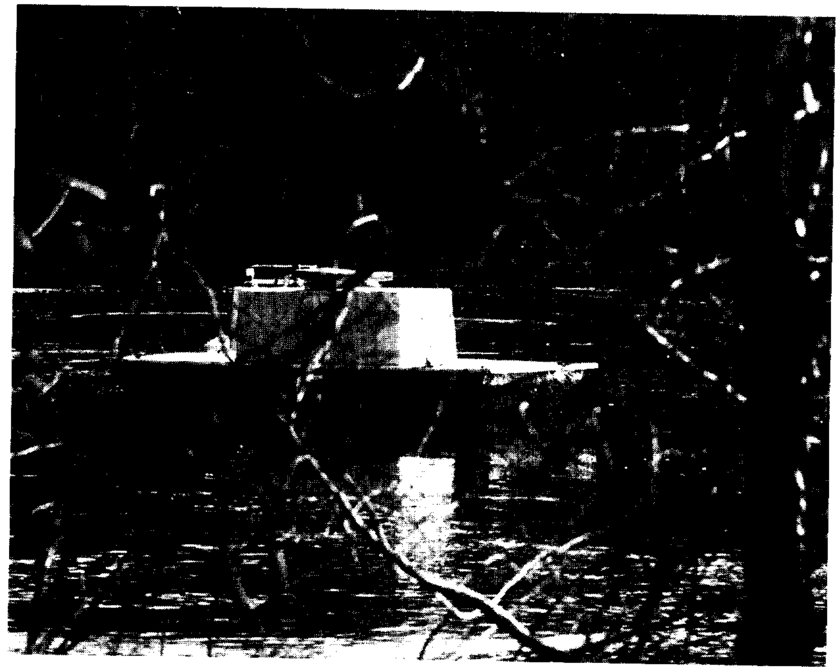


Figure 6–4 Average Tritium Concentration in SRS Streams, 1988–1997
Stream water analysis shows an increase in tritium concentration in two SRS streams.



Barges like the one shown here on the Savannah River are utilized by EMS to collect water samples for radiological analyses. The barges, which also are used on SRS streams and ponds, are equipped with automatic samplers.

Al Mamatey Photo (94X06744–06)

Upper Three Runs Creek

Upper Three Runs Creek receives discharges from the Effluent Treatment Facility (ETF), flow from Tims Branch, effluent from the Naval Fuels Facility, and stormwater runoff from F-Area and H-Area. Tritium, the predominant radionuclide detected in Upper Three Runs Creek, is discharged primarily from the ETF. The average concentration of tritium in 1997 at U3R–4, located on SRS Road A and the downstream point nearest to the Savannah River, was (3.29 ± 2.04)E+03 pCi/L, or 16.5 percent of the 2.00E+04-pCi/L EPA drinking water standard for tritium—up from 12.1 percent in 1996. The mean gross alpha concentration at U3R–4 was (2.83 ± 1.70)E+00 pCi/L, or 18.9 percent of the 15-pCi/L EPA drinking water standard for gross alpha—up from 12.3 percent in 1996. Mean cobalt-60 and cesium-137 concentrations were less than the nominal LLD. Mean concentrations for uranium-234 and 238 and plutonium-238 were slightly higher than the nominal LLD, but the total activity from all uranium and plutonium isotopes, including uranium-234, 235, and 238 and plutonium-238 and 239, was only 0.21 pCi/L, or 1.37 percent of the 15-pCi/L EPA drinking water limit for gross alpha activity.

Four Mile Creek

Four Mile Creek receives effluents from F-Area, H-Area, and C-Area, as well as from water that has migrated from seepage basins and is outcropping into the stream. Four Mile Creek transported the majority of radioactivity present in SRS streams in 1997—mostly in the form of gross beta-gamma activity and tritium. The gross beta-gamma is made up of strontium-89,90 (outcropping from retired seepage basins) and cesium-137 (from direct releases and resuspension of activity deposited in the streambed). The amount of tritium transported in Four Mile Creek was approximately 53.5 percent of the total amount reaching the Savannah River in 1997. Because the highest tritium concentrations are present at surveillance points along Four Mile Creek, and not at the stations monitoring direct releases, most of the tritium transport is due to outcropping activity from retired seepage basins and from the SWDF. This activity has decreased significantly since the F-Area and H-Area seepage basins were closed in 1988 (figure 6–4).

Pen Branch

Pen Branch receives discharges from K-Area and flow from a tributary, Indian Grave Branch. Because K-Reactor has not operated since 1992, tritium detected in Pen Branch is due to water entering from Indian Grave Branch, which carries tritium outcropping from the K-Area percolation field and seepage basins. A 1996 investigation identified a previously unmonitored groundwater tritium migration source that enters the stream above PB–3. With continued tritium migration into Pen Branch, the tritium level at PB–3 increased from (6.22 ± 1.15)E+04 pCi/L in 1996 to (1.15 ± 0.34)E+05 pCi/L in 1997. Mean cobalt-60 and cesium-137 concentrations were less than the nominal LLD. Detectable amounts of uranium-234 and 238 were found at PB–3; however, the total concentration for all alpha-emitting isotopes, including uranium-234, 235, and 238 and plutonium-238 and 239, was only 0.23 pCi/L, or 1.6 percent of the 15-pCi/L EPA drinking water limit for alpha activity. The strontium level at PB–3 was (1.68 ± 2.46)E–01 pCi/L, or 2.1 percent of the most restrictive EPA drinking water limit (8E+00 pCi/L for strontium-90) for isotopes of strontium.

Steel Creek

Steel Creek receives releases from L-Area effluents and tritium migration from P-Area seepage basins. When P-Area diverts water away from PAR Pond to Steel Creek, the area's discharges are transported to the stream. All releases enter L-Lake, water from which overflows into Steel Creek and is monitored at SC–4. The mean tritium level at SC–4 in 1997 was (1.81 ± 4.45)E+04 pCi/L—up from the 1996 level of (7.54 ± 0.86)E+03 pCi/L. The increase is attributed to one analytical result that was considerably higher than historical values at PB–3. An investigation indicated that the sample either was mislabeled or contaminated and was not a reflection of higher tritium levels at PB–3. Because the highest tritium concentration, (2.95 ± 0.03)E+05 pCi/L, was measured at the surveillance station at SC–2A—and not at the direct-release monitoring stations in L-Area and P-Area—activity being transported in Steel Creek is attributed to outcropping from the P-Area seepage basins. The mean gross alpha concentration at SC–4 was (1.64 ± 1.41)E+00 pCi/L, or 10.9 percent of the EPA drinking water limit for alpha activity. The strontium level at SC–4 was (0.71 ± 1.37)E–01 pCi/L—less than 1 percent of the most restrictive EPA drinking water limit for isotopes of strontium.

Lower Three Runs Creek

Lower Three Runs Creek receives overflow from PAR Pond, a manmade pond that receives discharges from P-Area. Gross beta concentrations in Lower Three Runs Creek are above the nominal LLD. This is attributable to low concentrations of cesium-137 from previous releases during P-Area and R-Area operations. Mean concentrations for gross alpha, tritium, cobalt-60 and cesium-137 at L3R–3 all were below the nominal LLD. The highest strontium mean concentration—from L3R–1A at SRS Road B—was (2.65 ± 3.16)E–01 pCi/L, or 3.3 percent of the most restrictive EPA drinking water limit for isotopes of strontium.

Savannah River

Continuous surveillance is performed along the Savannah River at points above and below SRS and below the point at which Plant Vogtle liquid discharges enter the river. In 1997, five locations along the river served as environmental surveillance points. River sampling locations are shown in figure 6–3.

Description of Surveillance Program

The Savannah River, which provides SRS its western boundary for a 35-mile stretch, is analyzed to determine what effects, if any, the site's effluents have on the river water. Gross screening for alpha and beta emitters, along with determinations of specific radionuclides, such as tritium and gamma emitters, is performed on biweekly composites.

Surveillance Results

Detailed results of Savannah River water analyses can be found in table 21 of *SRS Environmental Data for 1997.*

Gross Alpha, Gross Beta, and Tritium

The average concentrations of gross alpha, gross beta, and tritium at river locations are presented in table 6–4. The order of the locations begins at RM (river mile)–160, above the site, and ends at RM–120, after all site streams enter the Savannah River. Samplers situated between RM–160 and RM–120 are located at regular intervals along the SRS boundary and where Plant Vogtle's discharges feed into the river.

Tritium is the predominant radionuclide detected above background levels in the Savannah River. The highest average concentration in 1997, (8.30 ± 0.20)E+03 pCi/L, was measured at the Vogtle discharge location. The average concentration above SRS, measured at RM–160, was (1.37 ± 1.26)E+02 pCi/L. The average concentration at RM–120, located at U.S. Highway 301 below SRS, was (1.10 ± 0.45)E+03 pCi/L. The RM–120 concentration was less than 6 percent of the 2.00E+04-pCi/L drinking water standard set by EPA for tritium in drinking water. The average tritium concentrations were lower at all sampling locations than in 1996 except at the Vogtle discharge location, which showed a slight increase.

The average alpha activity at each river location was below the LLD, which demonstrated the absence of significant alpha-emitting radionuclides in the river. The average gross beta activity at each location was slightly above the LLD. Both the alpha and beta concentrations were consistent with data from

Table 6–4
Average 1997 Concentration of Radioactivity in the Savannah River (pCi/L)

Location	Gross Alpha	Gross Beta	Tritium
Lower Limits of Detection	6.23E–01	1.55E+00	4.07E+02
RM–120	(0.90 ± 2.03)E–01	(2.80 ± 0.46)E+00	(1.10 ± 0.45)E+03
RM–140	(2.51 ± 3.42)E–01	(4.05 ± 0.75)E+00	(1.34 ± 0.50)E+03
RM–150	(1.78 ± 2.61)E–01	(4.56 ± 0.84)E+00	(1.39 ± 0.70)E+03
Vogtle discharge	(2.45 ± 3.15)E–01	(3.39 ± 0.67)E+00	(1.40 ± 1.86)E+03
RM–160	(2.23 ± 2.57)E–01	(2.97 ± 0.67)E+00	(1.37 ± 1.26)E+02

previous years, which indicates that alpha and beta activity in the river is not impacted by SRS releases.

Tritium Transport in Streams and River

Tritium is introduced into SRS streams and the Savannah River from production areas on site. Because of the mobility of tritium in water and the quantity of the radionuclide released during the years of SRS operations, a tritium balance has been performed annually since 1960 (table 22, *SRS Environmental Data for 1997*). The balance is evaluated among the following alternative methods of calculation:

- tritium releases from effluent release points and calculated seepage basin and SWDF migration (direct releases)
- tritium transport in SRS streams and the last sampling point before entry into the Savannah River (stream transport)
- tritium transport in the Savannah River downriver of SRS after subtraction of any measured contribution above the site (river transport)

Figure 6–5 shows graphic and numeric summaries of the last 38 years of direct releases, stream transport, and river transport determined by EMS.

In 1997, tritium transport increased for direct releases plus migration and for stream and river transport. The increases are attributed to greater discharges at ETF and D-Area and to analytical anomalies at SC–4. Estimated tritium releases in SRS streams and the Savannah River can be found in table 10 of *SRS Environmental Data for 1997*. Detailed discussions of these occurrences can be found in chapter 5, "Radiological Effluent Monitoring."

General agreement between the three calculational methods of annual tritium transport—measurements at the source, stream transport, and river transport—serves to validate SRS sampling schemes and counting results. Differences between the various methods can be attributed to uncertainties arising in the collection and analytical processes, including determinations of water flows and varying transport times. For conservatism, the highest of the results obtained from the three methods is used in annual environmental dose calculations (chapter 7).

Drinking Water

EMS collects drinking water samples from locations at SRS and at water treatment facilities that use Savannah River water. Potable water is analyzed at offsite treatment facilities to ensure that SRS operations are not adversely affecting the water supply and to provide voluntary assurance that drinking water does not exceed EPA drinking water standards for radionuclides.

Description of Surveillance Program

Sampling on site consists of monthly grab samples at production areas and quarterly grab samples at nonproduction and perimeter stations. Collected monthly off site are composite samples from

- two water treatment plants downriver of SRS that supply treated Savannah River water to Beaufort and Jasper counties in South Carolina and to Port Wentworth, Georgia
- the North Augusta (South Carolina) Water Treatment Plant

At all the offsite facilities, raw and finished water samples are collected daily and composited for analysis by EMS. All drinking water samples are screened for alpha, beta, and gamma emitters and analyzed specifically for tritium. The onsite samples also are analyzed once a year for strontium-89,90.

Surveillance Results

Gross Alpha and Gross Beta

All drinking water samples collected by EMS are screened for gross alpha and gross beta concentrations to determine if activity levels warrant further analysis (table 23, *SRS Environmental Data for 1997*). No samples collected in 1997 exceeded EPA's 1.50E+01-pCi/L alpha activity limit or 5.00E+01-pCi/L beta activity limit. As during previous years, the highest average alpha concentration—(1.00 ± 0.24)E+01-pCi/L at the 701-5G Aiken Barricade (Talatha Gate)—has been characterized for specific alpha activity, with at least a partial source of activity due to radium-226. No sample's average exceeded 8.00E+00 pCi/L of beta activity. This concentration is the EPA limit for strontium-90, which is the most restrictive beta-emitting radionuclide.

Strontium

No drinking water samples collected and analyzed by EMS for strontium-89,90 exceeded the 1.90E+00-pCi/L detection limit of the EMS laboratories. This limit is approximately 25 percent of the EPA drinking water standard for strontium-90.

Tritium

No drinking water samples collected and analyzed by EMS exceeded the 2.00E+04-pCi/L EPA tritium limit. Detectable levels of tritium were present in the drinking water samples collected monthly from the Beaufort-Jasper and Port Wentworth water treatment facilities. These levels reflect the introduction of tritium from SRS operations into the Savannah River. The average tritium concentration in finished water at Beaufort-Jasper in 1997, (9.17 ± 2.12)E+02-pCi/L, was 5 percent of the EPA drinking water limit. The average tritium concentration at Port Wentworth, (9.66 ± 2.56)E+02 pCi/L, was 5 percent of the EPA drinking water limit. The levels of tritium at both

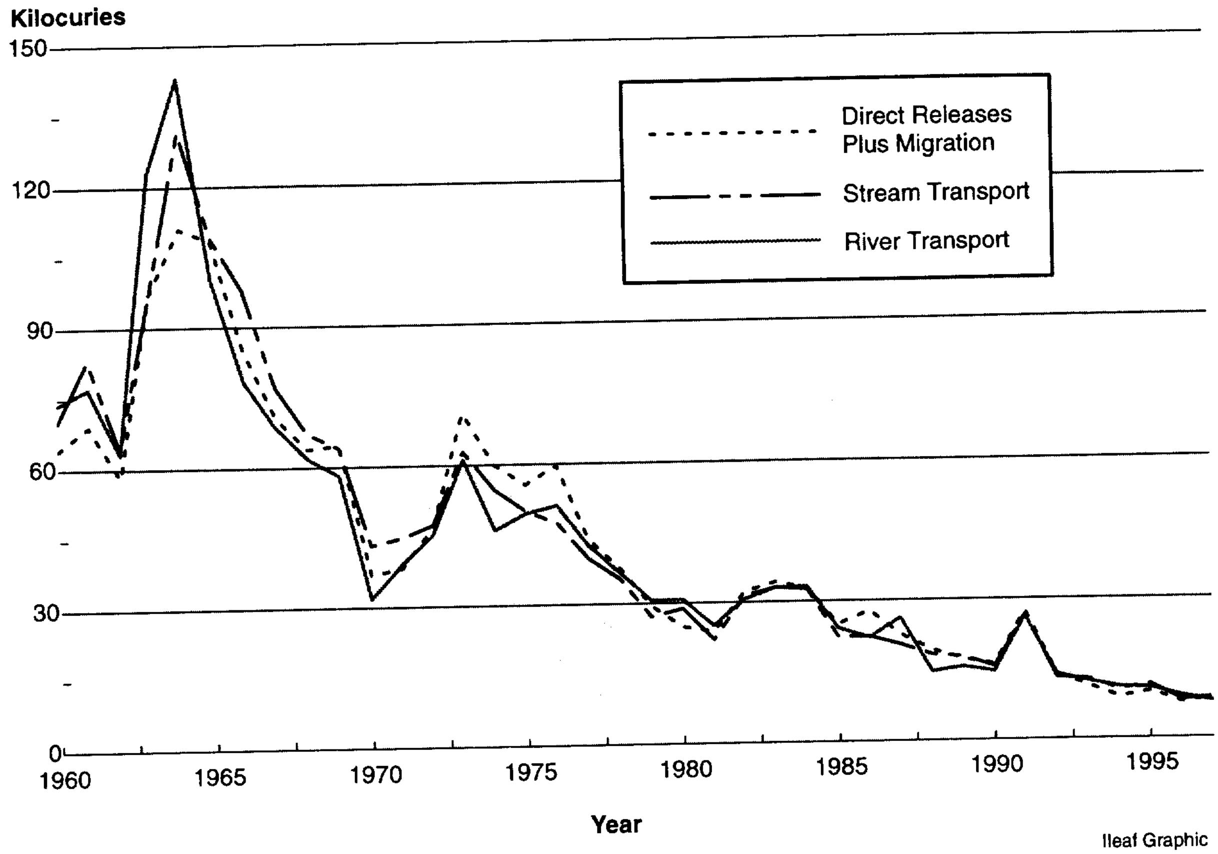


Figure 6–5 SRS Tritium Transport Summary, 1960–1997
SRS has maintained a tritium balance of direct releases plus migration, stream transport, and river transport since 1960 in an effort to account for and trend tritium releases in liquid effluents from the site. The general downward slope over time indicates that tritium transport has decreased as production has slowed and effluent controls have been developed.

treatment facilities was virtually identical to those measured in 1996.

Terrestrial Food Products

The terrestrial food products surveillance program consists of radiological analyses of food product samples typically found in the Central Savannah River Area (CSRA). Because radioactive materials can be transported to man through the consumption of milk and other food products containing radioactivity, food product samples are analyzed to determine what effects, if any, SRS operations have on them. Data from the food product surveillance program are not used to show direct compliance with any dose standard; however, the data can be used as required to verify dose models and determine environmental trends.

Description of Surveillance Program

Meat, Fruit, and Greens

The food products surveillance program divides the area that surrounds the SRS, approximately 9 miles (15 km) beyond its perimeter, into four quadrants: northeast, southeast, southwest, and northwest. Samples of food—including meat (beef or chicken), fruit (peaches or melons), green vegetables (collards), and milk—are collected from one location within each of the quadrants and from a control location within an extended (to 25 miles beyond the perimeter) southeast quadrant. All food samples are collected annually except milk, which is collected monthly for analysis of tritium and gamma-emitting radionuclides and quarterly for analysis of strontium-90.

Food samples are analyzed for gamma-emitting radionuclides, tritium, strontium-89,90, plutonium-238, and plutonium 239.

Milk

During 1997, EMS collected milk samples at five dairies within a 25-mile radius of SRS and from locally produced inventories of a major distributor. One of the monthly samples—from a dairy at Gracewood, Georgia—could not be collected because no milk was available.

Milk samples are analyzed for tritium and gamma-emitting radionuclides, primarily cesium-137 and iodine-131. Additional milk samples are collected quarterly and analyzed for strontium-90.

Surveillance Results

Detailed results of food sample analyses can be found in tables 24 and 25 in *SRS Environmental Data for 1997*.

Gamma-Emitting Radionuclides

The only manmade gamma-emitting radionuclide detected in food products, excluding milk, was cesium-137. The maximum concentration, (6.43 ± 0.63)E–02 pCi/g, was measured in beef from the 15-km northwest quadrant. Generally, concentrations of cesium-137 in indicator samples were similar to those measured at the control location. These concentrations were similar to those observed in previous years.

Cesium-137 also was the only manmade gamma-emitting radionuclide detected in milk samples during 1997. Measured average concentrations ranged from a high of (3.73 ± 1.86)E+00 pCi/L at the Denmark, South Carolina, location to a lows below the nominal LLD at several locations. The mean concentrations measured in 1997 were similar to those measured in 1996.

Iodine-131 was not detected in any 1997 milk samples. Because of its short physical half-life (8 days), iodine-131 generally is not detected, except shortly after tests of nuclear weapons or in the wake of events such as the Chernobyl incident. There were no announced nuclear weapons tests or other major nuclear incidents in 1997.

Tritium

Tritium in milk and other samples is attributed to releases from SRS. Tritium concentrations in food products, excluding milk, ranged from a high of (2.02 ± 0.54)E–01 pCi/g, measured in beef from the 15-km northeast quadrant, to lows below the nominal LLD at several samples. The concentrations were similar to those measured in 1996.

Milk from two dairies showed detectable concentrations of tritium at some point during 1997. The maximum concentration, (7.89 ± 1.13)E+02 pCi/L, was measured at the Jackson, South Carolina, location. The minimum concentration was below the nominal LLD at several locations. Tritium concentrations measured in milk in 1997 were similar to those in 1996 and generally reflected atmospheric releases from the site.

Strontium

The highest strontium-89,90 concentration detected in food products, excluding milk, during 1997 was

(7.73 ± 3.79)E–02 pCi/g—found in greens from the northeast quadrant; the lowest was below the nominal LLD at several locations. Strontium-89,90 levels generally were within the ranges observed during past years.

Strontium-90 analysis was performed on milk from all six sampling locations during 1997. None of the samples collected showed detectable concentrations.

Plutonium

Concentrations of plutonium-238 in food products, excluding milk, during 1997 were below the nominal LLD at all five sampling locations. Plutonium-239 in food products, excluding milk, was detectable only at the 25-mile southeast control location, where the concentration was (2.94 ± 2.82)E–04 pCi/g—in beef. Plutonium-238 and plutonium-239 concentrations in food products, excluding milk, during 1997 were similar to the 1996 concentrations.

Aquatic Food Products

Description of Surveillance Program

The aquatic food product surveillance program includes both fish (freshwater and marine) and shellfish. To determine the potential dose and risk to the public from consumption of these fish, both are sampled.

Nine surveillance points for the collection of fish are located on the Savannah River (figure 6–6). These points are at

- the Augusta Lock and Dam area (control location), above the site
- five areas where site streams enter the Savannah River
- the U.S. Highway 301 bridge area, below the site
- Stokes Bluff Landing, below the site
- the U.S. Highway 17A bridge area, below the site

Nine surveillance points for fish collection also are located within the SRS boundary. These points are at PAR Pond, L-Lake, Pond B, Lower Three Runs Creek, Upper Three Runs Creek, Beaver Dam Creek, Pen Branch, Steel Creek, and Four Mile Creek.

Freshwater fish are grouped into one of three categories: bass, panfish (bream or crappie), or catfish. Marine (saltwater) fish, collected from the U.S. Highway 17A bridge area, also are grouped into one of three categories: predatory fish, filter feeders, or bottom-dwelling fish. Sea trout and red drum (spottail bass) are placed in the predatory group; mullet in the filter feeder group; and catfish and flounder in the bottom-dwelling group. The fish are selected for sampling because they are the most sought-after fish in the Savannah River, according to the latest creel survey conducted by the Fisheries Management Section of GDNR's Wildlife Resources Division.

For analysis purposes, five fish from each category at each collection location are combined to create a composite. Composites are divided into edible (meat fillet only) and nonedible (scales, skin, head, fins, viscera, bone) portions. Analyses are conducted for gross alpha and gross beta on edible portions for all locations and on nonedible portions for all offsite locations except those at Stokes Bluff Landing and at the U.S. Highway 17A bridge area. Freshwater fish collected from the Augusta Lock and Dam location downstream through the U.S. Highway 301 bridge area also are analyzed for strontium-89,90; plutonium-238 and plutonium-239 and tritium (edible portions only); and gamma-emitting radionuclides. Freshwater fish (edible portions only) from river locations at Stokes Bluff Landing and the U.S. Highway 17A bridge area and from onsite streams and ponds are analyzed for gross alpha, gross beta, and gamma-emitting radionuclides.

Marine fish (edible portions only) also are analyzed for gross alpha, gross beta, and gamma-emitting radionuclides.

In the shellfish surveillance program, samples of oysters and crabs are collected on the coast near Savannah. The shellfish are analyzed for gross alpha, gross beta, strontium-89,90, and gamma-emitting radionuclides.

Calculations of risk from the consumption of fish from the Savannah River can be found in chapter 7.

Surveillance Results

In the following surveillance results discussion, uncertainty values are provided because most measurements were at or near the LLD.

Freshwater Fish

Detailed analytical results from freshwater fish composites can be found in table 26 of *SRS Environmental Data for 1997.*

Savannah River All categories of freshwater fish from all nine Savannah River locations were collected during 1997.

Gross alpha activity in Savannah River edible composites was below the LLD at all nine sampling

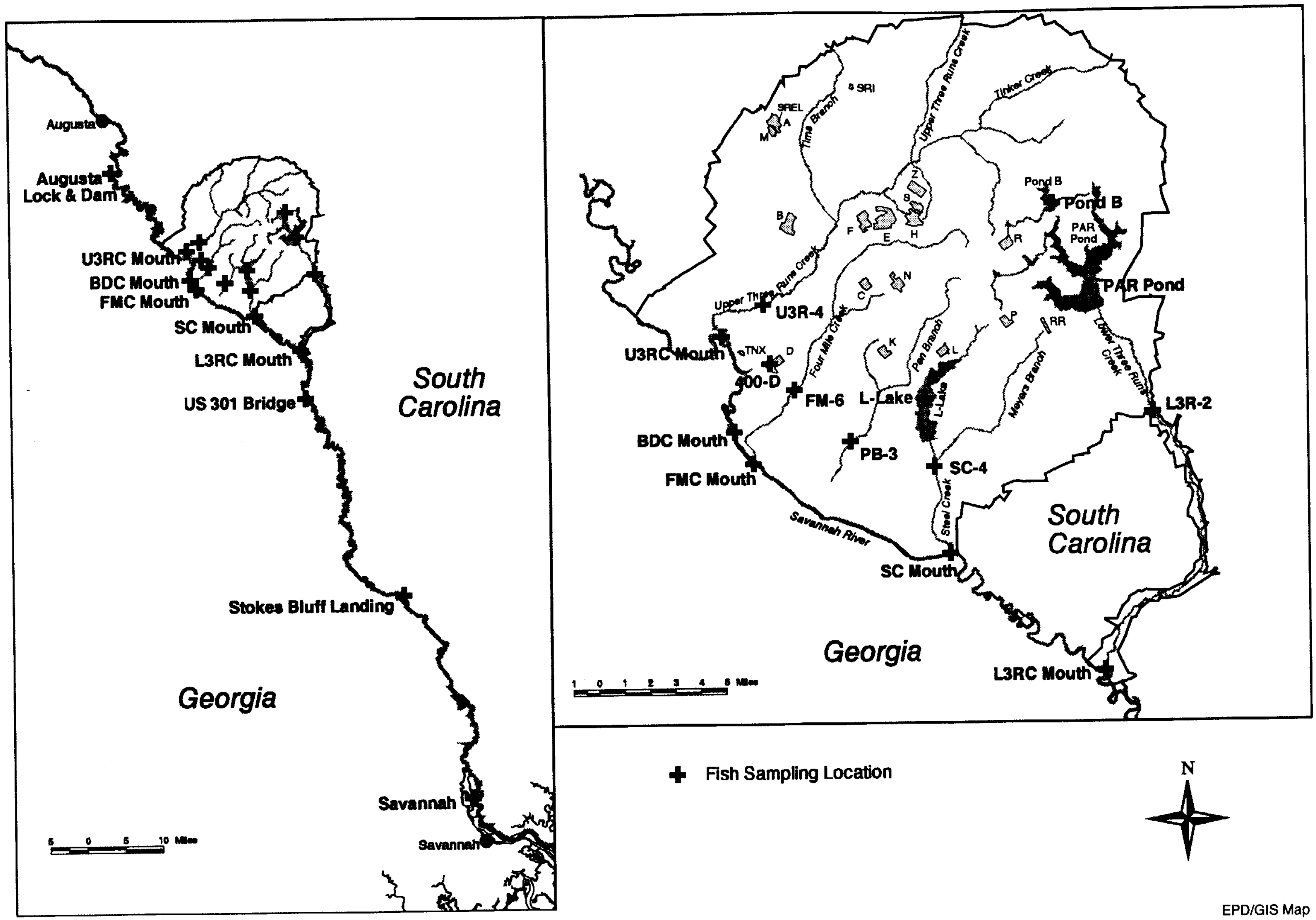


Figure 6–6 SRS Fish Sampling Locations
SRS collects fish (for both radiological and nonradiological analyses) from the Savannah River above, adjacent to, and below the site, as well as at Stokes Bluff Landing and near Savannah, Georgia.

locations, and gross alpha activity in river nonedible composites was below the LLD at all seven sampling locations.

Gross beta activity in Savannah River edible composites was detectable at all nine locations, ranging from a high of (3.99 ± 0.50)E+00 pCi/g in catfish from the mouth of Steel Creek to a low of (1.02 ± 0.28)E+00 pCi/g in bream from the U.S. Highway 17A bridge area. Gross beta activity in river nonedible composites was detectable at all seven locations, ranging from a high of (1.03 ± 0.11)E+01 pCi/g in catfish from the Augusta Lock and Dam location to lows below the LLD in several composites.

Cesium-137 was the only manmade, gamma-emitting radionuclide detected in 1997 fish composites. Cesium-137 activity in Savannah River edible composites was detectable at all nine sampling locations, ranging from a high of (9.20 ± 0.56)E–01 pCi/g in bass from the mouth of Four Mile Creek to lows below the LLD in several composites. Cesium-137 activity in river nonedible composites was detectable at all seven sampling locations, ranging from a high of (6.34 ± 0.43)E–01 pCi/g in bass from the mouth of Upper Three Runs Creek to lows below the LLD in several composites.

Strontium-89,90 activity in Savannah River edible fish in 1997 was detectable at six of seven sampling locations, ranging from a high of (5.86 ± 0.81)E–02 pCi/g in bream from the mouth of Four Mile Creek to lows below the LLD in several composites. Strontium-89,90 in river nonedible composites was detectable at all seven sampling locations, ranging from a high of (1.62 ± 0.05)E+00 pCi/g in bass from the mouth of Upper Three Runs Creek to a low of (6.07 ± 1.14)E–02 pCi/g in bream from the Augusta Lock and Dam location.

Tritium activity in Savannah River edible composites in 1997 was detectable at five of the seven sampling locations and ranged from a high of (2.67 ± 0.02)E+01 pCi/g in bream from the mouth of Four Mile Creek to lows below the LLD in several composites.

Onsite Streams and Ponds Not enough fish could be collected from onsite streams and ponds in 1997 for composite samples (five from the same category per location) from Four Mile Creek and Pen Branch.

Gross alpha activity in fish composites (edible portions only) from onsite streams and ponds was below the LLD at all seven sampled locations. Gross beta activity, on the other hand, was detectable at all seven of these locations, and ranged from a high of (5.18 ± 0.13)E+01 pCi/g in bass from Pond B to a low of (1.57 ± 0.32)E+00 pCi/g in bream from Steel Creek 4.

Cesium-137—the only manmade, gamma-emitting radionuclide found in 1997 fish composites from onsite streams and ponds—was detectable at all seven sampled locations. The activity ranged from a high of (9.21 ± 0.44)E+01 pCi/g in bass from Pond B to a low of (5.51 ± 1.81)E–02 pCi/g in catfish from Beaver Dam Creek.

Marine Fish

In the marine fish category, red drum (spottail bass) and mullet were collected in 1997 from the U.S. Highway 17A bridge area. Catfish composites and one spottail bass composite could not be collected because of mechanical problems with the fish-shocking unit. All gross alpha concentrations measured in marine fish composites during 1997 were below the LLD. Gross beta concentrations, however, were detectable in all five composites collected and ranged from a high of (2.46 ± 0.35)E+00 pCi/g in spottail bass to a low of (1.52 ± 0.28)E+00 pCi/g in mullet.

Cesium-137 was the only manmade, gamma-emitting radionuclide detected in 1997 marine fish composites. Cesium-137 activity in edible marine fish composites ranged from a high of (9.52 ± 1.87)E–02 pCi/g in mullet to lows below the LLD.

Detailed analytical results from marine fish composites can be found in table 27 of *SRS Environmental Data for 1997.*

Shellfish

A sample of oysters and a sample of crabs—both from near the mouth of the Savannah River—were collected in 1997. Analytical results showed that no manmade radionuclides above the nominal LLD were present in these samples (table 28, *SRS Environmental Data for 1997*).

Deer and Hogs

Description of Surveillance Program

Annual hunts, open to members of the general public, are conducted at SRS to control the site's deer and feral hog populations and to reduce animal-vehicle accidents. Before any animal is released to a hunter, EMS uses portable sodium iodide detectors to perform field analysis for cesium-137. The dose resulting from consumption is calculated for each animal, and each hunter's cumulative total is tracked to ensure compliance with the DOE dose limit for the general public. Media samples (muscle and/or bone) are collected periodically for laboratory analysis based on a set frequency, on cesium-137 levels, and/or on exposure limit considerations.

Surveillance Results

During 1997, 1,363 deer and 85 feral hogs were taken from the site as part of the controlled hunt program. This compares with 1,685 deer and 109 feral hogs taken during the 1996 hunts. The number of hunts remained at 14 in 1997.

Gamma-Emitting Radionuclides

In 1997, the maximum field measurement of cesium-137 in deer muscle was approximately 22 pCi/g, while the mean cesium-137 concentration was approximately 5 pCi/g. In feral hogs, the maximum field measurement of cesium-137 in muscle was approximately 8 pCi/g, while the mean concentration was approximately 2 pCi/g.

Each animal is monitored prior to release, and the field measurements are supplemented by laboratory analyses. Samples are collected from approximately 10 percent of the animals processed, including every 10th animal monitored and any animal that results in a hunter's annual dose exceeding 25 mrem (approximately 25 percent of the DOE limit)—either alone or in combination with previous animals killed by the hunter. In 1997, 147 samples from 134 animals were collected and analyzed for gamma-emitting radionuclides.

As observed during previous hunts, cesium-137 was the only manmade gamma-emitting radionuclide detected during laboratory analysis. Generally, the cesium-137 concentrations measured by the field and lab methods were comparable. Field measurements ranged from approximately 1 pCi/g to 18 pCi/g, while lab measurements ranged from approximately 1 pCi/g to 20 pCi/g.

Strontium

Strontium levels are determined in some of the animals analyzed for cesium-137. Typically, muscle and bone samples are collected for analysis from the same animals checked for cesium-137, and the samples are analyzed for strontium-89,90 (table 29, *SRS Environmental Data for 1997*).

In 1997, 31 muscle samples from 19 animals were collected for strontium-89,90 analysis. None of the samples showed detectable strontium-89,90. These results are consistent with those observed during previous hunts—most animals do not have detectable strontium-89,90 in muscle tissue, and generally only low levels are present in the remainder of the animals.

In addition, 14 bone samples were collected from 14 animals for strontium-89,90 analysis. As observed in previous hunts, the analytical results indicated a wide range of strontium-89,90 concentrations, with levels ranging from a minimum of approximately 2 pCi/g to a maximum of approximately 21 pCi/g. Generally, the strontium-89,90 concentrations in bone tissue appear to be slightly lower than those observed in 1996. As expected, the concentrations in bone tissue were significantly higher than in muscle. This is because strontium, whether stable or radioactive, is chemically similar to calcium and thus tends to accumulate in bone.

Turkeys

Description of Surveillance Program

Wild turkeys are trapped on site by the South Carolina Wildlife and Marine Resources Department and used to repopulate South Carolina game areas. All turkeys are monitored for cesium-137 with portable sodium iodide detectors before leaving SRS. No turkey with a reading above 25 pCi/g is released off site.

Surveillance Results

EMS monitored 108 turkeys in 1997. Concentrations of cesium-137 generally were similar to those measured in the past, with all results 6.0 pCi/g or less. This compares to maximum concentrations in 1996 of 5.0 pCi/g, in 1995 of 1.0 pCi/g, and in 1994 of 10 pCi/g. The LLD of the sodium iodide detectors is 1.0 pCi/g.

Beavers

Description of Surveillance Program

The U.S. Forest Service administers a contract for the trapping of beavers in selected areas within the SRS perimeter. The purpose of this trapping is to reduce the beaver population in specific areas of the site and thereby minimize dam-building activities that can result in flood damage to timber stands, to primary and secondary roads, and to railroad beds. All beavers are monitored for cesium-137 with portable sodium iodide detectors and disposed of in the SRS sanitary landfill.

Surveillance Results

EMS monitored 178 beavers in 1997. The maximum cesium-137 concentration was 12.5 pCi/g, measured in an animal trapped near Steel Creek; the minimum was 1.0 pCi/g. These results compare with maximums of 10.5 pCi/g in 1995 and 1996, 22 pCi/g in 1994, and 47 pCi/g in 1993—all with minimum concentrations of 1.0 pCi/g.

Soil

The SRS soil monitoring program provides

- data for long-term trending of radioactivity deposited from the atmosphere (both wet and dry deposition)
- information on the concentrations of radioactive materials in the environment

Routine and nonroutine SRS atmospheric releases, as well as worldwide fallout, are monitored in this program. The concentrations of radionuclides in soil vary greatly among locations because of differences in rainfall patterns and in the mechanics of retention and transport in different types of soils. Because of this program's design, a direct comparison of data from year to year is not appropriate.

Description of Surveillance Program

Soil samples were collected in 1997 from four uncultivated and undisturbed locations in E-Area (burial ground), F-Area, H-Area, and Z-Area—one sample from each area—and from one control location (off site) near the U.S. Highway 301 bridge over the Savannah River, as shown in figure 6–7. One location approximately 100 miles from SRS—at Savannah—also was sampled. Changes implemented in 1995 and 1996 as part of an overall comprehensive review of the environmental monitoring program reduced the total number of sampling locations to six for 1997—four on site, one at the U.S. Highway 301 location and one at Savannah.

Hand augers or other similar devices are used in sample collection to a depth of 3 inches. The samples are analyzed for gamma-emitting radionuclides, strontium-89,90, plutonium-238, and plutonium-239. The rationale for each sampling site is explained in the SRS EM Program.

Surveillance Results

Detailed analytical results from soil samples collected during 1997 can be found in table 30, *SRS Environmental Data for 1997*.

Gamma-Emitting Radionuclides

Cesium-137 was observed at levels above the nominal LLD in 1997 at one offsite location and two of the onsite ones. The highest concentration detected, (1.75 ± 0.24)E–01 pCi/g, was in a sample taken from H-Area, and the lowest was below the nominal LLD. The highest offsite concentration was (1.36 ± 0.30)E–01 pCi/g, at the U.S. Highway 301 bridge area.

Plutonium

Of the six soil sampling locations, only F-Area showed a concentration of plutonium-238 above the nominal LLD—at (1.60 ± 0.30)E–02 pCi/g. Two of the locations had concentrations of plutonium-239 above the nominal LLD—F-Area, at (1.21 ± 0.27)E–02 pCi/g, and H-Area, at (1.31 ± 0.28)E–02 pCi/g.

Strontium

Soil samples from all locations were analyzed for strontium-89,90, and all results were below the nominal LLD.

Sediment

Sediment sample analysis measures the movement, deposition, and accumulation of long-lived radionuclides in stream beds and in the Savannah River bed. Significant year-to-year differences may be evident because of the continuous deposition and remobilization occurring in the stream and river beds, but the data obtained can be used to observe long-term environmental trends.

Description of Surveillance Program

Sediment samples (annual) were collected at 23 locations in 1997—eight in the Savannah River and 15 in site streams (figure 6–8). Samples are obtained with a Ponar dredge or an Emery pipe dredge and analyzed for gamma-emitting fission and activation products, strontium-89,90, plutonium-238, and plutonium-239.

Surveillance Results

Concentrations of radionuclides in river sediment during 1997 were similar to those of past years. Maximum activity was observed in samples from the mouth of Lower Three Runs Creek for cesium-137 and at the mouth of Upper Three Runs Creek for plutonium-238 and plutonium-239. No river sediment samples collected in 1997 contained detectable concentrations of strontium-89,90. Detailed analytical results from all sediment samples collected during the year can be found in table 31, *SRS Environmental Data for 1997*.

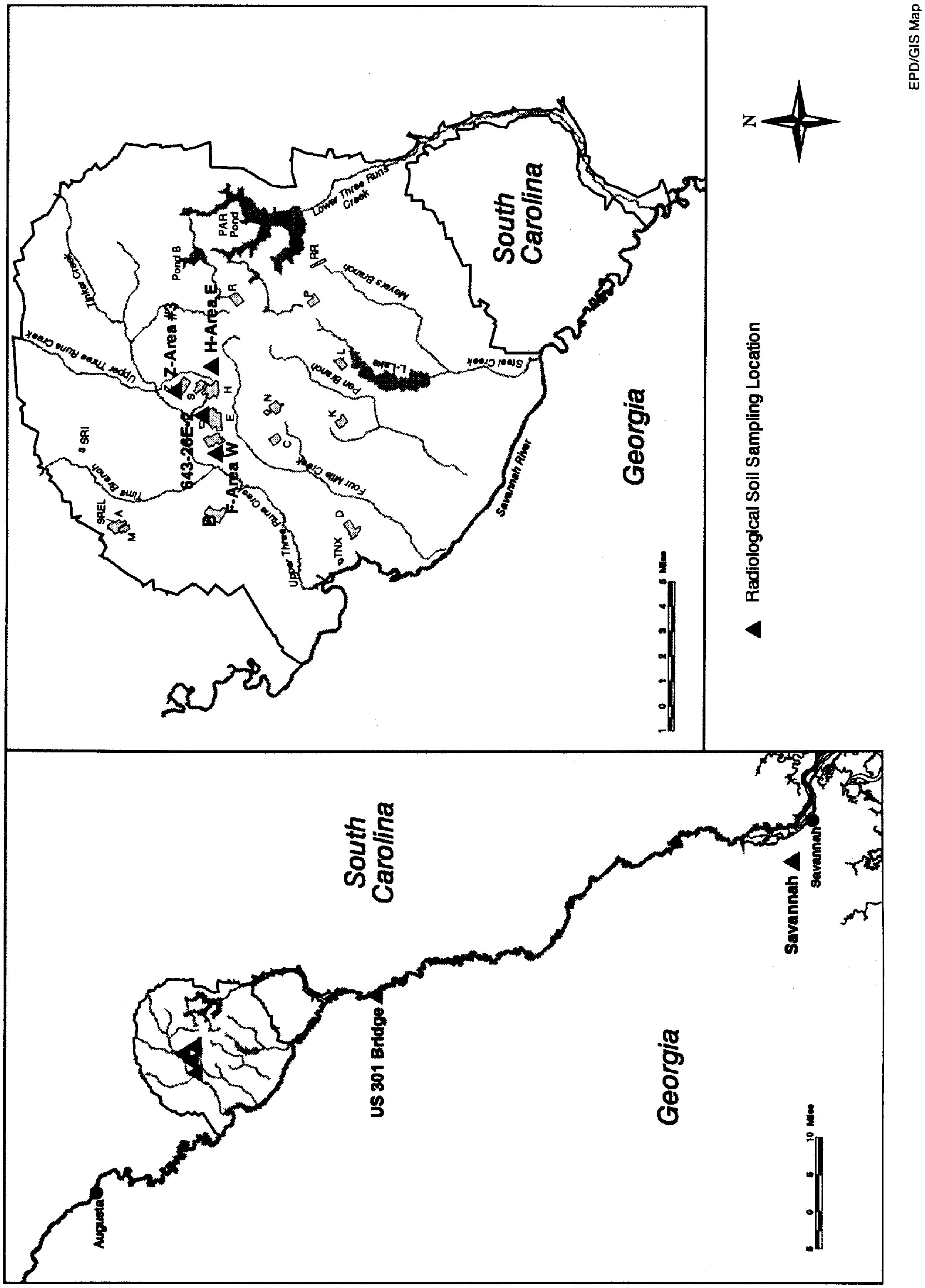
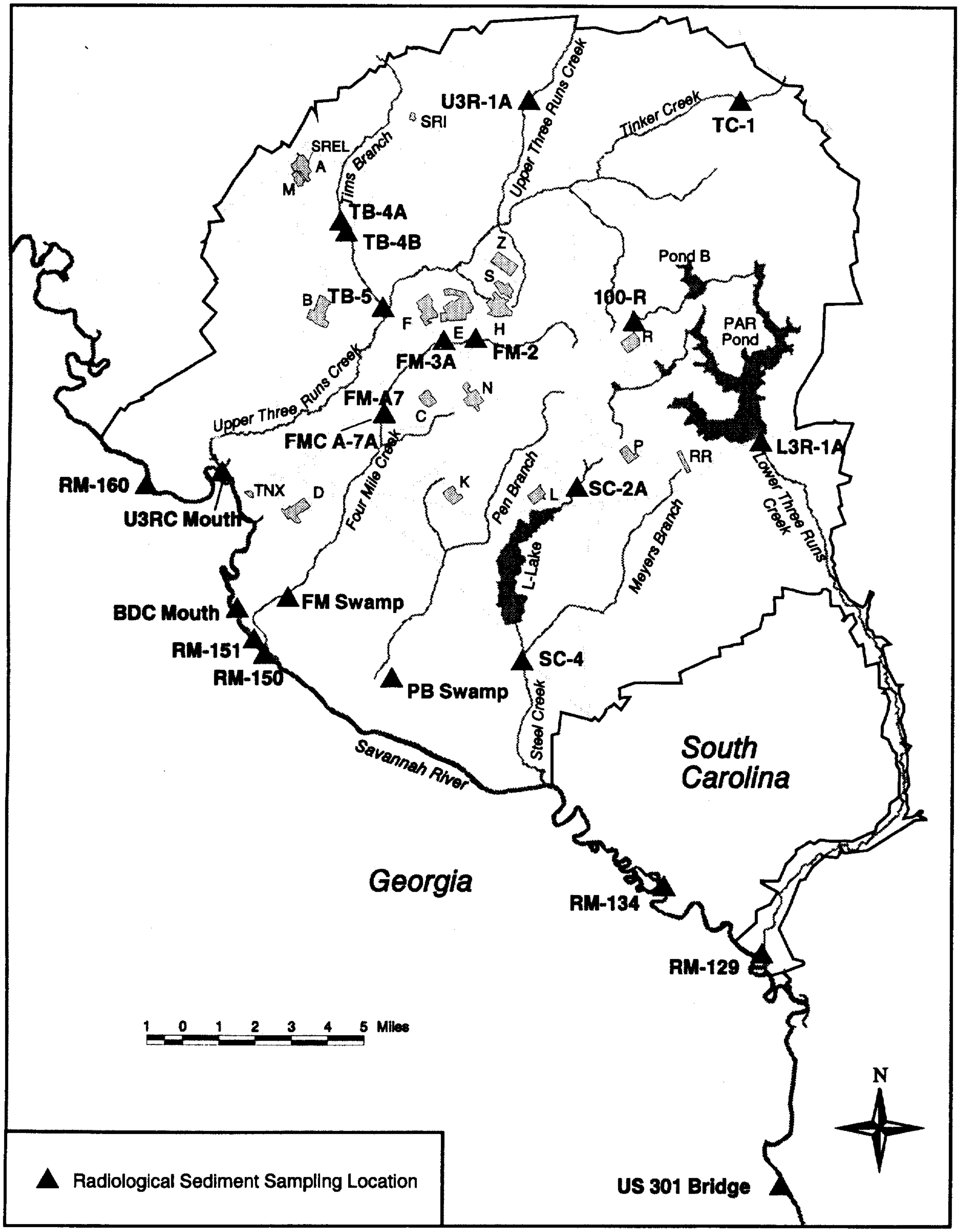


Figure 6–7 Radiological Soil Sampling Locations
SRS collected soil samples in 1997 from four onsite locations and two offsite locations—one near the U.S. Highway 301 bridge over the Savannah River and one near Savannah, Georgia.



EPD/GIS Map

Figure 6–8 Radiological Sediment Sampling Locations
Sediment samples were collected in 1997 at eight Savannah River locations—upriver of, adjacent to, and downriver of the site—and 15 site stream locations.

Gamma-Emitting Radionuclides

Cesium-137 and Cobalt-60 were the only manmade gamma-emitting radionuclides observed in river and stream sediments during 1997.

The highest cesium-137 concentration in streams, (1.89 ± 0.06)E+01 pCi/g, was detected in sediment from Four Mile Creek A7–A (Beaver Pond); the lowest concentrations were below the nominal LLD at two locations. The highest level found on the river, (1.24 ± 0.06)E+00 pCi/g, was at the mouth of Lower Three Runs Creek; the lowest levels were below the nominal LLD at several locations. Generally, cesium-137 concentrations were slightly higher in stream sediments than in river sediments. This is to be expected because the streams receive radionuclide-containing liquid effluents from the site. Most radionuclides settle out and deposit on the stream beds or at the streams' entrances to the swamp areas along the river.

Cobalt-60 was detected above the nominal LLD in sediment from the following locations:

- Four Mile A–7A
- Four Mile Creek Swamp Discharge
- Four Mile Creek at Road A–7
- Steel Creek 4 at Road A
- River Mile 118.7 (Highway 301 crossing)

The highest Cobalt-60 concentration, (1.35 ± 0.13)E–01 pCi/g, was measured at Four Mile A–7A; concentrations at the other 18 sediment sampling locations were below the nominal LLD.

Plutonium

Concentrations of plutonium-238 in sediment ranged from a high of (2.60 ± 0.27)E–01 pCi/g at the Four Mile A–7A location to lows below the nominal LLD at several locations. Concentrations of plutonium-239 ranged from a high of (1.24 ± 0.15)E–01—also at the Four Mile A–7A location—to lows below the nominal LLD at several locations. As expected, concentrations of these isotopes in streams generally were higher than concentrations in the river. Differences observed when these data are compared to those of previous years probably are attributable to the effects of resuspension and deposition, which occur constantly in sediment media.

Strontium

Strontium 89,90 was detected above the nominal LLD in 1997 at only three of the 15 site stream sediment sampling locations. The maximum strontium-89,90 concentration, (7.16 ± 0.53)E–01 pCi/g, which occurred at the Four Mile Creek A–7A location, is slightly higher than in 1996. The change probably is due to the year-to-year variations cited earlier.

Grassy Vegetation

The radiological program for grassy vegetation is designed to collect and analyze samples from onsite and offsite locations to determine radionuclide concentrations. Vegetation samples are obtained to complement the soil and sediment samples in order to determine the environmental accumulation of radionuclides and help confirm the dose models used by SRS. The program also provides information that can be used to determine the effects, if any, of various radioactive material operations on the surrounding vegetation.

Typically, grasses are collected for vegetation because of their year-round availability. Bermuda grass is preferred because of its importance as a pasture grass for dairy herds.

Description of Surveillance Program

Vegetation samples are obtained from

- locations containing soil radionuclide concentrations that are expected to be higher than normal background levels
- locations receiving water that may have been contaminated

The vegetation surveillance program in 1997 involved the collection of (annual) samples at 100 onsite locations (figure 6–9) and one offsite location. Onsite sampling locations encircle burial ground and basin areas. Site perimeter air monitoring stations provide sampling within each 30-degree sector around the site boundary. The offsite sampling location, selected as a control site, is near the environmental air monitoring station in Savannah.

Vegetation samples are analyzed for gross alpha and gross beta, gamma-emitting radionuclides, tritium, and strontium because vegetation can be contaminated externally by the deposition of airborne radioactive contaminants (i.e., from fallout) and internally by uptake, from soil or water, by the roots. While the vegetation surveillance program makes no attempt to differentiate between contributions of the external and internal contaminations, contributions can be approximated when radionuclide concentrations in local soils are known.

The sampling and analysis programs for grassy vegetation are documented in WSRC–3Q1–2,

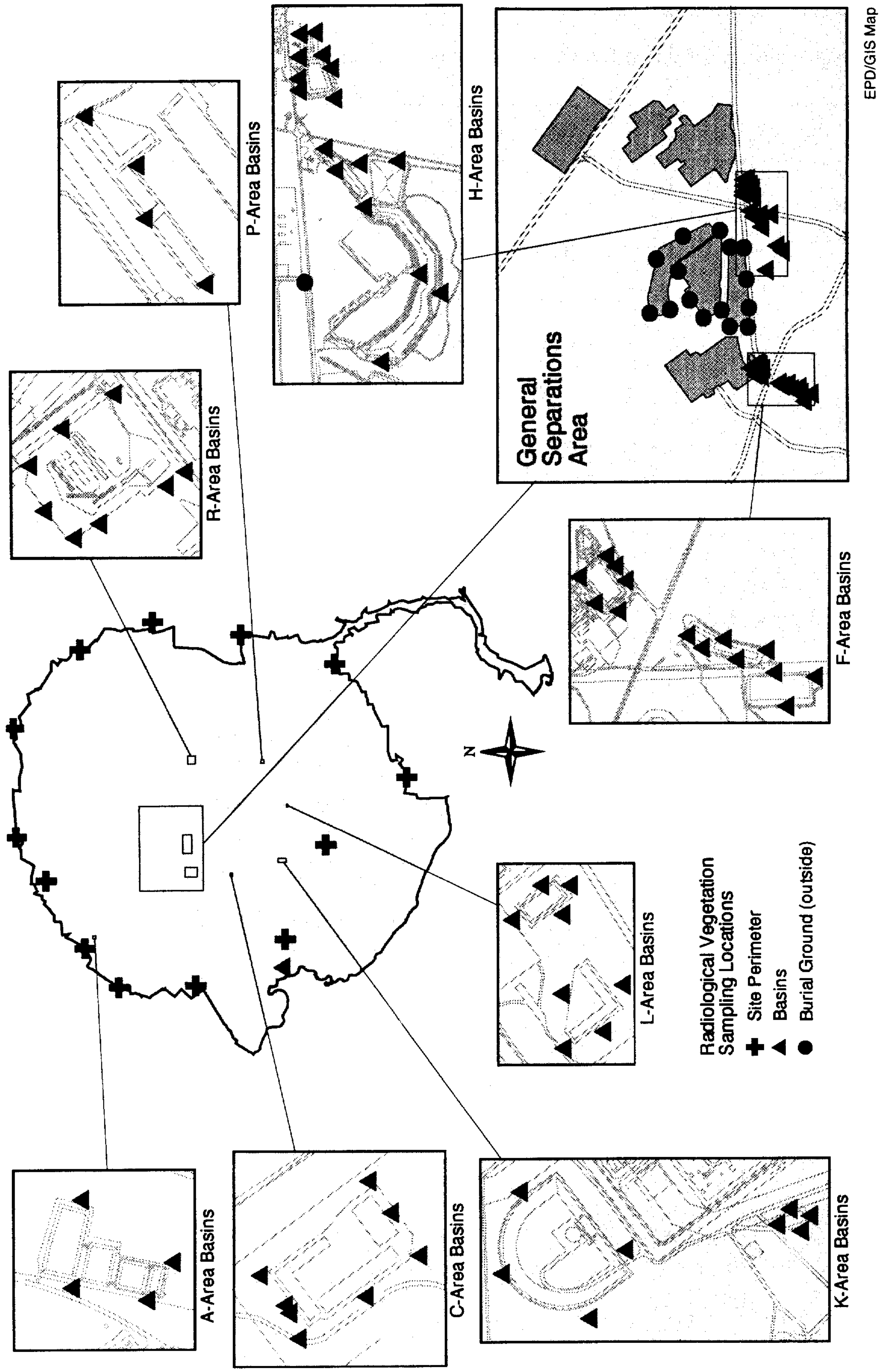


Figure 6–9 SRS Onsite Vegetation Sampling Locations
Vegetation samples were collected for radiological analysis from 100 locations on site and one off site (Savannah, Georgia) in 1997.

Table 6–5
Maximum Radionuclide Concentrations in Vegetation from Chemical, Seepage, and Retention Basins (pCi/g)

	Maximum	Location
Gross Alpha	(1.59 ± 0.65)E+00	A-Area Seepage
Gross Beta	(3.61 ± 0.22)E+01	H-Area Retention
Cobalt-60	(6.19 ± 3.24)E–02[a]	K-Area Retention
Strontium	(1.26 ± 0.04)E+01	H-Area Retention
Cesium-137	(9.63 ± 0.32)E+00	H-Area Retention

a Activity is less than the lower limit of detection.

Volume 1, Section 1105.3.10.2. Operational details of sample collection are in procedure manual WSRC–3Q1–3, while analytical procedures are in WSRC–3Q1–4 and WSRC–3Q1–6.

Surveillance Results

The 1997 vegetation surveillance program was divided into two broad areas: annual basin samples (chemical, retention, and seepage) and annual surveillance and SWDF (outside-burial ground) samples. All surveillance results are based on dry weight. Detailed analytical results from vegetation samples collected during 1997 can be found in tables 32 and 33 of *SRS Environmental Data for 1997.*

Tritium Onsite and site perimeter tritium concentrations generally were higher than the concentrations of the vegetation samples collected from the 100-mile-radius location. These higher concentrations on site and at the site perimeter are attributed to atmospheric tritium releases from SRS and, on site, to contaminated shallow groundwater.

Chemical, Retention, and Seepage Basin Samples

All samples from a specific operating area in the vicinity of the chemical, retention, and seepage basins are composited for analysis of gross alpha, gross beta, gamma-emitting radionuclides, and strontium-89,90. Maximum concentrations are presented in table 6–5.

Solid Waste Disposal Facility Samples

All samples in the vicinity of the SWDF are analyzed for gross alpha, gross beta, and gamma-emitting radionuclides; some of these samples also are analyzed for tritium and strontium-89,90. Maximum concentrations are presented in table 6–6.

Table 6–6
Maximum Radionuclide Concentrations in Vegetation from Outside the Solid Waste Disposal Facility (pCi/g)

	Maximum	Location
Gross Alpha	(1.38 ± 0.711)E+00	643–26E–1
Gross Beta	(2.30 ± 0.19)E+01	OBG–9
Tritium	(1.06 ± 0.01)E+01	643–26E–4
Cobalt-60	(4.54 ± 3.54)E–02[a]	643–26E–2
Strontium	(0.39 ± 1.25)E–01[a]	643–26E–4
Cesium-137	(1.74 ± 0.32)E–01	OBG–9

a Activity is less than the lower limit of detection.

Chapter 7

Potential Radiation Doses

Bill Carlton, Timothy Jannik, and Ali Simpkins
Savannah River Technology Center

1997 Highlights

- The potential dose to the maximally exposed individual from liquid releases in 1997 was estimated at 0.13 mrem (0.0013 mSv). This dose is 0.13 percent of DOE's 100-mrem all-pathway dose standard for annual exposure. The dose is about 7 percent lower than the 1996 dose of 0.14 mrem (0.0014 mSv)—primarily because of reductions in cesium-137 and tritium oxide releases.
- The estimated dose to the maximally exposed individual from airborne releases was 0.05 mrem (0.0005 mSv). This dose is 0.5 percent of DOE's 10-mrem air pathway dose standard for annual exposure. The dose in1997 was the same as in 1996.
- The potential maximally exposed individual all-pathway dose was 0.18 mrem (0.0018 mSv)—0.05 mrem from the airborne pathway plus 0.13 mrem from the liquid pathway. This dose is 5 percent lower than the 1996 all-pathway dose of 0.19 (0.0019 mSv).
- The maximum potential dose that could have been received by a hunter was estimated at 26 mrem (0.26 mSv), or 26 percent of DOE's 100-mrem all-pathway dose. This hunter harvested nine animals, and it was assumed that he personally consumed the entire edible portion (359 pounds) of all of them.
- The potential maximum dose for a recreational fisherman was based on the consumption of 19 kg (42 pounds) of Savannah River fish having the highest measured concentrations of radionuclides. Bass caught at the mouth of Steel Creek had the highest concentrations in 1997. Consumption of these bass could have resulted in a dose of 0.65 mrem (0.0065 mSv).

THIS chapter presents the potential doses to offsite individuals and the surrounding population from 1997 Savannah River Site (SRS) atmospheric and liquid radioactive releases. Additionally, potential doses from special-case exposure scenarios—such as deer meat, fish, and goat milk consumption and crops irrigated with Savannah River water—are documented.

Unless otherwise noted, the generic term "dose" used in this report includes both the committed effective dose equivalent (50-year committed dose) from internal deposition of radionuclides and the effective dose equivalent attributable to sources external to the body. Use of the effective dose equivalent allows doses from different types of radiation and to different parts of the body to be expressed on the same relative basis.

Many parameters—such as radioactive release quantities, population distribution, meteorological conditions, radionuclide dose factors, human consumption rates of food and water, and environmental dispersion—are considered in the dose models used to estimate offsite doses at SRS. Descriptions of the effluent monitoring and environmental surveillance programs discussed in this chapter can be found in chapter 5, "Radiological Effluent Monitoring," and chapter 6, "Radiological Environmental Surveillance." A complete description of how potential doses are calculated can be found in section 1108 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1 (SRS EM Program). Tables containing all potential dose calculation results are presented in *SRS Environmental Data for 1997* (WSRC–TR–97–00324).

Applicable dose regulations can be found in appendix A, "Applicable Guidelines, Standards, and Regulations," of this document.

Calculating Dose

Potential offsite doses from SRS effluent releases of radioactive materials (atmospheric and liquid) are calculated for the following scenarios:

- maximally exposed individual
- 80-kilometer (50-mile) population

Because the U.S. Department of Energy (DOE) has adopted dose factors only for adults, SRS calculates maximally exposed individual and collective doses as if the entire 80-kilometer population consisted of adults [DOE, 1988].

The International Commission on Radiological Protection (ICRP), in its Publications #56 and #67, has established age-specific dose factors for six age groups, ranging from 3-month-old infants to adults. However, dose factors for only a select group of radioisotopes were published, and these are applicable to only the ingestion pathway. In general, for most radioisotopes, the dose to an infant is higher than to an adult. For the radioisotopes that constitute most of SRS's radioactive releases (i.e., tritium and cesium-137), the dose to infants would be approximately two to three times higher than to adults. The dose to older children becomes progressively closer to the adult dose.

When the ICRP completes age-specific dose factors for all radioisotopes and develops an age-specific lung model for inhalation, and when DOE adopts these factors and models, doses will be calculated for the various age groups.

SRS also uses adult consumption rates for food and drinking water and adult usage parameters to estimate intakes of radionuclides (tables 38 and 40, *SRS Environmental Data for 1997*). These intake values and parameters were developed specifically for SRS based on an intensive regional survey [Hamby, 1991]. The survey includes data on agricultural production (table 36, *SRS Environmental Data for 1997*), consumption rates for food products, and use of the Savannah River for drinking water and recreational purposes.

Dose Calculation Models

To calculate annual offsite doses, SRS uses radiation transport and dose models developed for the commercial nuclear industry [NRC, 1977]. The models are implemented at SRS in the following computer programs [SRS EM Program, 1996]:

- MAXIGASP: calculates maximum and average doses to offsite individuals from atmospheric releases.
- POPGASP: calculates collective doses from atmospheric releases.
- LADTAPII: calculates maximum and average doses to offsite individuals and the population from liquid releases.
- CAP88: calculates doses to offsite individuals from atmospheric releases to demonstrate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) under the Clean Air Act.

The CAP88 computer code is required under the Clean Air Act to calculate offsite doses from atmospheric releases from existing and proposed facilities. SRS uses the CAP88 dose estimates to show NESHAP compliance, but not for routine dose calculations. Both the CAP88 and the MAXIGASP codes use modeling based on U.S. Nuclear Regulatory Commission Regulatory Guide 1.109.

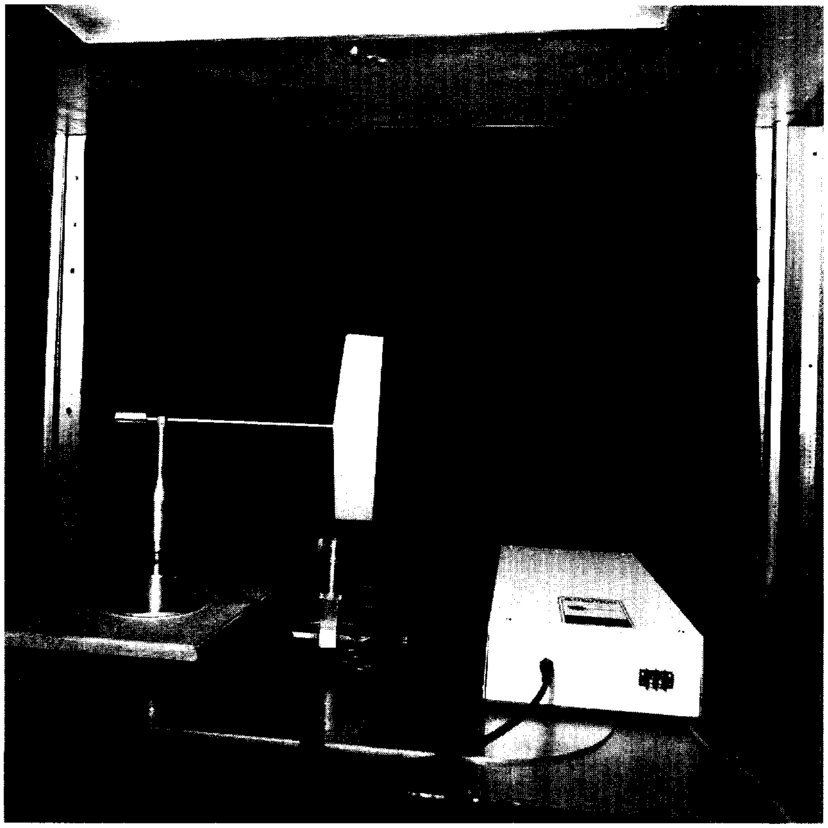
Dose to the Maximally Exposed Individual

When calculating radiation doses to the public, SRS uses the concept of the maximally exposed individual; however, because of the conservative lifestyle assumptions used in the dose models, no such person is known to exist. The parameters used for the dose calculations are

For airborne releases: Someone who lives at the SRS boundary 365 days per year and consumes large amounts of milk, meat, and vegetables produced at that location

For liquid releases: Someone who lives downriver of SRS (near River Mile 120) 365 days per year, drinks 2 liters of untreated water per day from the Savannah River, consumes a large amount of Savannah River fish, and spends the majority of time on or near the river

To demonstrate compliance with the DOE Order 5400.5 all-pathway dose standard of 100 mrem per year, SRS conservatively combines the airborne pathway and liquid pathway dose estimates, even though the two doses are calculated for hypothetical individuals residing at different geographic locations.



A fiber-optic wind vane with cabling and light source/hardware case has been developed as part of a Cooperative Research and Development Agreement between WSRC and Met One Instruments, Inc., an Oregon-based private company. Fiber-optic technology was used in this project to eliminate damaging electrical surges caused by lightning and radio-frequency interference—problems often associated with meteorological sensors installed on tall towers such as those at SRS. Complete and accurate meteorological data play a critical role in dose calculations.

Hugh Smith Photo (96–1680–3E)

Meteorological Database

Meteorological data are used as input for the atmospheric transport and dose models.

For 1997, all potential offsite doses from releases of radioactivity to the atmosphere were calculated with quality-assured meteorological data for A-Area (located near the northwest SRS boundary), D-Area (located near the west-southwest site boundary), and H-Area (located near the center of the site). Meteorological data for A-Area (used for A-Area and M-Area releases) and D-Area (used for D-Area releases) were added in 1996 to improve the accuracy of the dose estimates. During 1997, all the meteorological databases were updated to reflect 1992–1996, the most current 5-year compilation period (table 34, *SRS Environmental Data for 1997*). A 5-year average database is used instead of the actual annual data because of the difficulty of compiling, inputting, and validating all the data in time to be used for the current-year dose calculations.

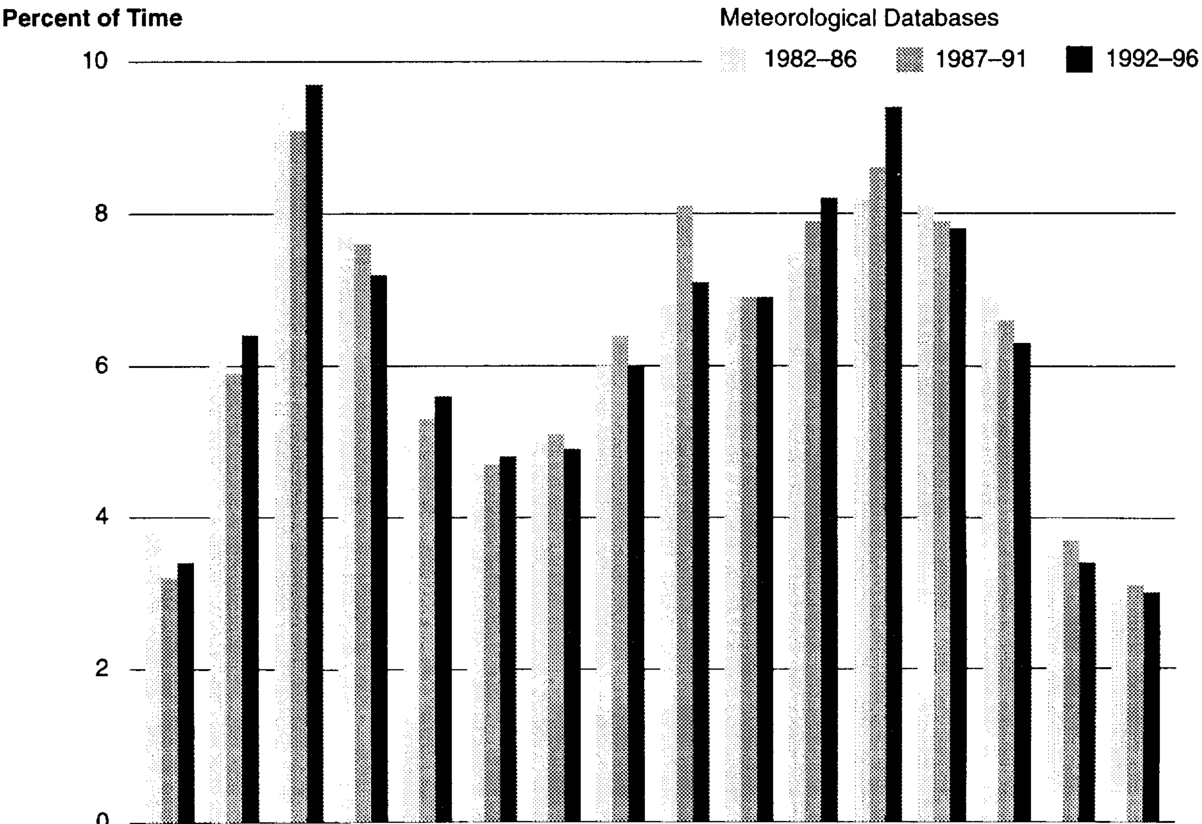
Figure 7–1 compares wind direction frequency from the new 1992–1996 database with that of the two previous databases—from 1982–1986 and 1987–1991. These databases show that there is no prevailing wind at SRS, which is typical for the lower midlands of South Carolina. The databases also indicate that there is no identifiable trend in the wind patterns over the three 5-year time periods. The wind rose developed from the 1992–1996 database is shown in figure 7–2. The maximum frequency that the wind blew in any one direction was 9.7 percent of the time, which occurred toward the southwest direction.

The meteorological measurements include all dispersion conditions observed during the 5-year period, ranging from unstable (considerable turbulence, which leads to rapid dispersion) to very stable (very little turbulence, which produces a narrow, undispersed plume). The data for 1992–1996 indicate that the SRS area experiences stable conditions (atmospheric stability classes E, F, G) about 18.4 percent of the time.

Population Database and Distribution

Collective, or population, doses from atmospheric releases are calculated for the population within a 80-kilometer (50-mile) radius of SRS.

For 1997 dose calculations, the 1990 population database prepared by the University of South Carolina was used. This database distributes the population into a grid of cells one-second latitude by



Sector	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1982–86	3.8	6.1	9.6	7.7	5.7	4.9	5.0	6.0	6.8	6.9	7.5	8.2	8.1	6.9	4.0	2.9
1987–91	3.2	5.9	9.1	7.6	5.3	4.7	5.1	6.4	8.1	6.9	7.9	8.6	7.9	6.6	3.7	3.1
1992–96	3.4	6.4	9.7	7.2	5.6	4.8	4.9	6.0	7.1	6.9	8.2	9.4	7.8	6.3	3.4	3.0

Ileaf Graphic

Figure 7–1 Comparison of H-Area Meteorological Databases for Three Time Periods Indicating Percent of Time Wind Blows Toward Sector

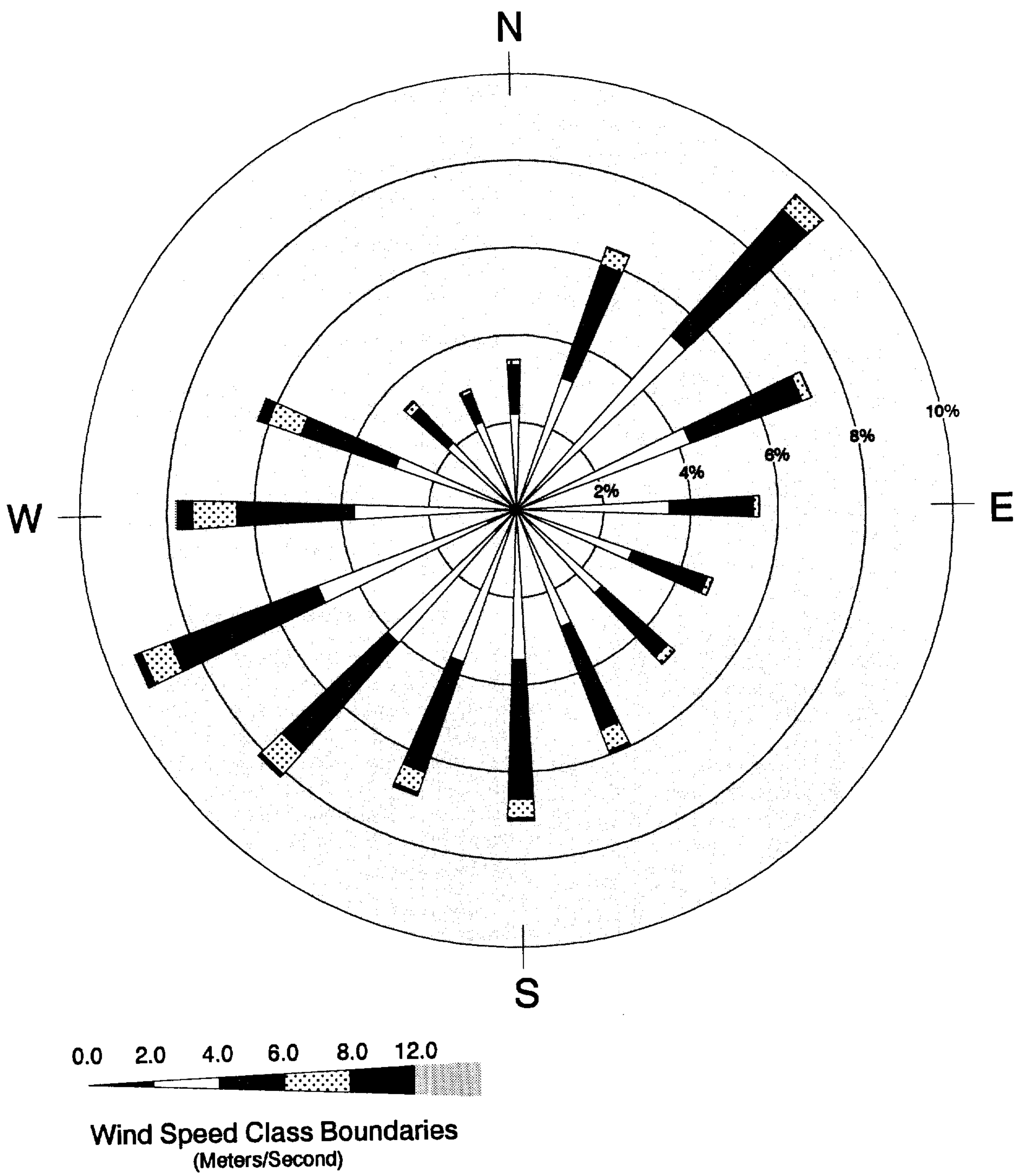
one-second longitude. This database is transformed by the POPGASP Code into polar coordinates of 16 compass sectors and varying radial distances out to 80 kilometers. The POPGASP Code can prepare a polar coordinate database for any release point put into the code in polar coordinates. A separate, fixed-polar-coordinate database was prepared for use with the CAP88 Code, which does not have the capability of transforming the grid into polar coordinates. The population database generated by the POPGASP Code is centered on the geographical center of SRS (table 35, *SRS Environmental Data for 1997*).

Within the 80-kilometer radius, the total population for 1990 was 620,100, compared to 555,200 for 1980, a 12-percent population growth in 10 years.

Some of the collective doses resulting from SRS liquid releases are calculated for the populations served by the City of Savannah Industrial and Domestic Water Supply Plant (formerly Cherokee Hill Water Treatment Plant), near Port Wentworth, Georgia, and by the Beaufort-Jasper Water Treatment Plant, near Beaufort, South Carolina. According to the treatment plant operators, the population served by the Port Wentworth facility is approximately 10,000 persons, and the population served by the Beaufort-Jasper facility is approximately 60,000 persons.

River Flow Rate Data

Offsite dose from liquid effluents varies each year with the amount of radioactivity released and the amount of dilution (flow rate) in the Savannah River. Although flow rates are recorded at U.S. Geological Survey (USGS) gauging stations at the SRS boat dock and near River Mile 120 (U.S. Highway 301 bridge), these data are not used directly in dose calculations. This is because weekly river flow rates



EPD/GIS Graphic

Figure 7–2 Wind Rose for SRS, 1992–1996
This wind rose graphically depicts the percent of occurrence frequencies of six wind speed categories by 16 cardinal wind direction sectors at SRS. The wind speed categories are defined on the plot; direction is defined as the sector *from* which the wind blows. The data used to generate the wind rose consist of hourly averages of wind speed and direction at the H-Area meteorological tower for the 5-year period 1992–1996; measurements were taken 200 feet above the ground.

fluctuate widely (i.e., short-term dilution varies from week to week). Used instead are "effective" flow rates, which are based on measured concentrations of tritium in Savannah River water and measured concentrations in water used at the downstream water treatment plants. However, the USGS-measured flow rates are used for comparison to these calculated values.

For 1997, the River Mile 120 calculated (effective) flow rate of 8,704 cubic feet per second was used in determining doses to maximally exposed individuals, population doses from recreation and fish consumption, and potential doses from crops irrigated with river water. This flow rate was slightly more than the 1996 effective flow rate of 8,640 cubic feet per second. For comparison, during 1997 the USGS-measured flow rate at River Mile 120 was 10,464 cubic feet per second, which was about 9 percent less than the 1996 measured rate of 11,467 cubic feet per second. Therefore, the calculated value is more conservative because it accounts for less dilution.

The 1997 calculated (effective) flow rate for the Beaufort-Jasper facility was 10,441 cubic feet per second, which was about 5 percent less than the 1996 rate of 10,941 cubic feet per second.

The 1997 calculated (effective) flow rate for the Port Wentworth facility was 9,911 cubic feet per second, which was about 2 percent less than the 1996 rate of 10,144 cubic feet per second.

The 1997 calculated Savannah River estuary flow rate (11,510 cubic feet per second) was used only for calculation of dose from consumption of salt water invertebrates.

Uncertainty in Dose Calculations

Radiation doses are calculated using the best available data. If adequate data are unavailable, then site-specific parameters are selected that would result in a conservative estimate of the maximum dose.

All radiation data and input parameters have an uncertainty associated with them, which causes uncertainty in the dose determinations. For example, there is uncertainty in the assumption that an individual eats 81 kg (179 pounds) of meat each year. Obviously, a few people will eat more than 81 kg, but most probably will eat less. Uncertainties can be combined mathematically to create a distribution of doses rather than a single number. While the concept is simple, the calculation is quite difficult. A detailed technical discussion of the method of estimating uncertainty at SRS was published in the July 1993 issue of *Health Physics* [Hamby, 1993].

Dose Calculation Results

Liquid and air pathway doses are calculated for the maximally exposed individual and for the surrounding population. In addition, a sportsman dose is calculated separately for consumption of fish, deer, and feral hogs, which are nontypical exposure pathways. Finally, a dose is calculated for the aquatic biota found in SRS streams.

Liquid Pathway

This section contains information on liquid release quantities used as source terms in SRS dose calculations, including a discussion about radionuclide concentrations in Savannah River fish. The calculated dose to the maximally exposed individual, the calculated collective (population) dose, and the potential dose from agricultural irrigation are presented.

Liquid Release Source Terms

The 1997 radioactive liquid release quantities used as source terms in SRS dose calculations are presented in chapter 5 and summarized by radionuclide in table 7–1. In order to maintain conservatism, the stream transport tritium release total of 8,550 Ci (3.2E+14 Bq), which was the highest value of the three alternative tritium release calculation methods employed at SRS (chapter 6), was used in the dose calculations.

As discussed in chapter 5, for dose calculations, releases of unidentified beta-gamma emitters were summed with strontium-89,90 releases, and unidentified alpha emitters were summed with releases of plutonium-239.

For use in dose determinations and model comparisons, concentrations of radionuclides in Savannah River water and fish were measured at several locations along the river. The measured concentrations of tritium oxide in the Savannah River near River Mile 120 and at the Beaufort-Jasper and Port Wentworth water treatment facilities are shown in table 7–1, as are the LADTAPII computer code-determined concentrations for the other released radionuclides.

The 12-month average tritium oxide concentrations measured in the Savannah River near River Mile 120 (1.10 pCi/mL), and at the Beaufort-Jasper (0.92 pCi/mL) and Port Wentworth (0.97 pCi/mL) water treatment plants, remained below the U.S. Environmental Protection Agency (EPA) and DOE

Table 7–1
1997 Radioactive Liquid Release Source Term and 12-Month Average Downriver Radionuclide Concentrations (Calculated Concentrations Are Based on Effective River Flow Rates)

Nuclide	Curies Released	12-Month Average Concentration (pCi/mL)		
		Below SRS[a]	Beaufort-Jasper[b]	Port Wentworth[c]
H-3[d]	8.55E+03	1.10E+00[e]	9.17E–01[e]	9.66E–01[e]
Sr-89,90[f]	2.14E–01	2.75E–05	2.29E–05	2.42E–05
I-129	7.82E–02	1.01E–05	8.39E–06	8.83E–06
Cs-137[d]	1.25E–01	1.61E–05[e]	1.34E–05	1.41E–05
U-234	2.76E–02	3.55E–06	2.96E–06	3.12E–06
U-235	7.76E–04	9.98E–08	8.32E–08	8.77E–08
U-238	2.97E–02	3.82E–06	3.19E–06	3.36E–06
Pu-238	1.00E–03	1.29E–07	1.07E–07	1.13E–07
Pu-239[g]	5.05E–02	6.50E–06	5.42E–06	5.71E–06
Am-241	9.92E–06	1.28E–09	1.06E–09	1.12E–09
Cm-244	3.34E–06	4.30E–10	3.58E–10	3.77E–10

a Near Savannah River Mile 120, downriver of SRS at the U.S. Highway 301 bridge
b Beaufort-Jasper, South Carolina, drinking water
c Port Wentworth, Georgia, drinking water
d Curies released based on measured environmental surveillance values (tritium stream transport, table 10, *SRS Environmental Data for 1997*, and cesium-137 in River Mile 120 fish, table 53, *SRS Environmental Data for 1997*).
e Measured concentrations; all other concentrations calculated using models verified with tritium measurements.
f Includes unidentified beta releases
g Includes unidentified alpha releases

concentration standards of 20 pCi/mL and 80 pCi/mL, respectively.

The 1997 River Mile 120 concentration was 5 percent less than the 1996 concentration of 1.16 pCi/mL, primarily because the amount of tritium oxide released from SRS during 1997 was about 5 percent less than the amount released during 1996 (8,950 curies in 1996 versus 8,550 curies in 1997).

Annual average tritium concentrations measured during the period 1988–1997 at River Mile 120 and at the Beaufort-Jasper and Port Wentworth facilities are compared to the EPA standard in figure 7–3. The data for Beaufort-Jasper and Port Wentworth are the tritium concentrations measured in the finished drinking water at each facility.

Radionuclide Concentrations in River Fish At SRS, an important dose pathway for the maximally exposed individual is from the consumption of fish.

Fish exhibit a high degree of bioaccumulation for certain elements. For the element cesium (including radioactive isotopes of cesium), the bioaccumulation factor for Savannah River fish is approximately 3,000. That is, the concentration of cesium found in fish flesh is about 3,000 times greater than the concentration of cesium found in the water in which the fish live.

Because of this high bioaccumulation factor, cesium-137 is more easily detected in fish flesh than in river water. Therefore, the fish pathway dose from cesium-137 is based directly on the radioanalysis of the fish collected near Savannah River Mile 120, which is the assumed location of the hypothetical maximally exposed individual (table 53, *SRS Environmental Data for 1997*). The fish pathway dose from all other radionuclides is based on the calculated concentrations determined by the LADTAPII code. A consumption rate of 19 kg (42 pounds) of fish per year is used in the maximally exposed individual dose calculation [Hamby, 1991]. Some fraction of this estimated dose is due to cesium-137 from worldwide fallout and from neighboring Vogtle Electric Generating Plant; however, that amount is difficult to determine and is not subtracted from the total.

The dose determinations are accomplished in the LADTAPII code by substituting a cesium-137 release value that would result in the measured concentration in river fish, assuming the site-specific bioaccumulation factor of 3,000. A weighted average concentration (based on the number of fish in each composite analyzed) of cesium-137 in River Mile 120 fish was used for maximally exposed individual and population dose determinations. Using the above factors, the cesium-137 release value used for LADTAPII input was 1.25E–01 Ci (4.63 E+09 Bq), which is more conservative than the measured effluent release value of 4.78E–02 Ci (1.77E+09 Bq) and was about 19 percent less than the 1996 value of 1.55E–01 Ci (5.74E+09 Bq).

Dose to the Maximally Exposed Individual

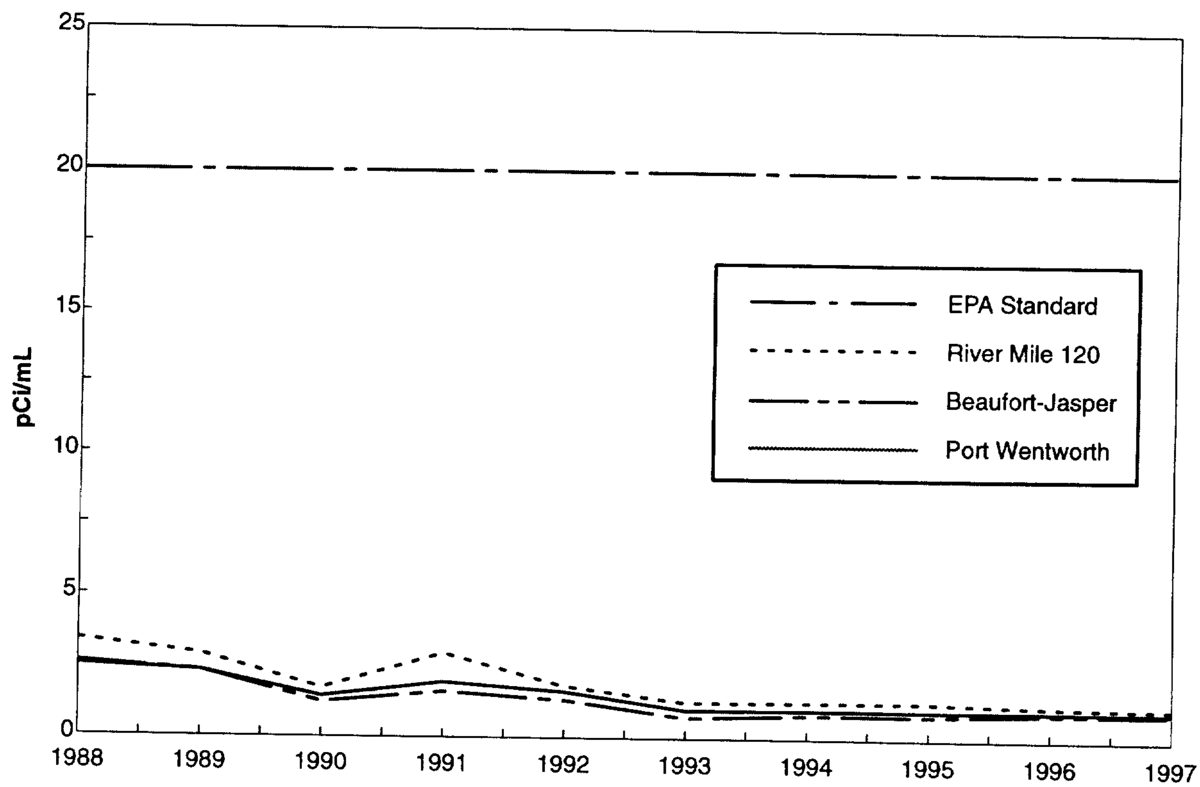
The potential liquid pathway dose to the hypothetical maximally exposed individual living downriver of SRS, near River Mile 120, was determined based on adult intake and usage parameters discussed earlier in this chapter and on other site-specific physical parameters (table 41, *SRS Environmental Data for 1997*).

As shown in table 7–2, the highest potential dose to the maximally exposed individual from liquid releases in 1997 was estimated at 0.13 mrem (0.0013 mSv). This dose is 0.13 percent of DOE's 100-mrem all-pathway dose standard for annual exposure.

The 1997 potential maximally exposed individual dose was about 7 percent less than the 1996 dose of 0.14 mrem (0.0014 mSv)—primarily because of reductions in cesium-137 and tritium oxide releases.

Approximately 36 percent of the dose to the maximally exposed individual at the site perimeter resulted from the ingestion of cesium-137, mainly from the consumption of fish, and about 40 percent resulted from the ingestion (via drinking water) of tritium oxide (table 48, *SRS Environmental Data for 1997*). In 1997, more than 17 percent of the liquid pathway maximally exposed individual dose was attributed to unidentified alpha emitters, which are conservatively accounted for as plutonium-239 releases in the dose calculations (chapter 5, "Radiological Effluent Monitoring").

Drinking Water Pathway Persons downriver of SRS may receive a radiation dose by consuming drinking water that contains radioactivity as a result of liquid releases from the site. In 1997, tritium oxide in downriver drinking water represented the majority



Ileaf Graphic

Figure 7–3 Annual Average Tritium Concentrations at River Mile 120, Beaufort-Jasper, and Port Wentworth (1988–1997) Compared to EPA Standard of 20 pCi/mL.

Table 7–2
Potential Dose to the Maximally Exposed Individual from SRS Liquid Releases in 1997

	Committed Dose	Applicable Standard	Percent of Standard
Maximally Exposed Individual			
At Site Boundary (untreated river water)	0.13 mrem	100 mrem[a]	0.13
At Port Wentworth (public water supply only)	0.07 mrem	4 mrem[b]	1.75
At Beaufort-Jasper (public water supply only)	0.07 mrem	4 mrem[b]	1.75

a All-pathway dose standard: 100 mrem per year (DOE Order 5400.5)
b Drinking water pathway standard: 4 mrem per year (DOE Order 5400.5 and EPA, 1975)

of the dose (about 65 percent) received by persons at downriver water treatment plants.

The calculated doses to maximally exposed individuals whose entire daily intake of water is supplied by the Beaufort-Jasper and Port Wentworth water treatment facilities, located downriver of SRS, were determined for maximum (2 liters per day for a year) water consumption rates.

The maximum potential dose during 1997 was less than (but rounded up to) 0.07 mrem (0.0007 mSv) at both the Beaufort-Jasper Water Treatment Plant and the City of Savannah Industrial and Domestic Water Supply Plant (Port Wentworth) (tables 49 and 50, *SRS Environmental Data for 1997*).

As shown in table 7–2, the maximum dose of 0.07 mrem (0.0007 mSv) is 1.75 percent of the DOE and EPA standard of 4 mrem per year from public water supplies. The 1997 maximum potential drinking water dose was slightly more than the 1996 maximum dose of 0.06 mrem (0.0006 mSv). This increase in dose is attributed to an increase in unidentified alpha releases during 1997, which offset the decrease in tritium oxide. More than 26 percent of the drinking water dose was attributed to unidentified alpha emitters (accounted for as plutonium-239).

Collective (Population) Dose

The collective drinking water consumption dose is calculated for the discrete population groups at Beaufort-Jasper and Port Wentworth. The collective dose from other pathways is calculated for a diffuse population that makes use of the Savannah River. However, it cannot be described as being in a specific geographical location.

Potential collective doses were calculated, by pathway and radionuclide, using the LADTAPII computer code (table 51, *SRS Environmental Data for 1997*). In 1997, the collective dose from SRS liquid releases was estimated at 2.4 person-rem (0.024 person-Sv). This was more than the 1996 collective dose of 2.2 person-rem (0.022 person-Sv). Because a majority of the collective dose is attributed to the drinking water pathway, the increase in collective dose is caused by the increase in unidentified alpha releases during 1997.

Potential Dose from Agricultural Irrigation

The 1990 update of land- and water-use parameters [Hamby, 1991] revealed that there is no known use of river water downstream of SRS for agricultural irrigation purposes. However, in response to public concerns, potential doses from this pathway are calculated for information purposes only and are not included in calculations of the official maximally exposed individual or collective doses. For 1997, a potential offsite dose of 0.13 mrem (0.0013 mSv) to the maximally exposed individual and a collective dose of 8.8 person-rem (0.088 person-Sv) were estimated for this exposure pathway. As in previous years, collective doses from agricultural irrigation were calculated for 1,000 acres of land devoted to each of four major food types—vegetation, leafy vegetation, milk, and meat (table 52, *SRS Environmental Data for 1997*).

Air Pathway

This section describes the atmospheric source term and concentrations used for dose determinations and presents the calculated dose to the maximally exposed individual, as well as the calculated collective (population) dose. Also included is a discussion about how SRS demonstrates NESHAP compliance.

Atmospheric Source Terms

The 1997 radioactive atmospheric release quantities used as the source term in SRS dose calculations are presented in chapter 5. For dose calculation purposes, releases of unidentified beta emitters were summed with strontium-89,90 releases and releases of unidentified alpha emitters were summed with plutonium-239 releases (table 4, *SRS Environmental Data for 1997*).

Estimates of unmonitored diffuse and fugitive sources were considered, as required for demonstrating compliance with NESHAP regulations. Most of the estimated diffuse and fugitive releases occurred at the separations areas, the reactor areas, and the Solid Waste Disposal Facility.

Airborne effluents are grouped by major release points for dose calculations. For the MAXIGASP code, five release locations with specific release heights were used (table 37, *SRS Environmental Data for 1997*).

The CAP88 code can calculate doses from collocated release heights but cannot combine calculations for releases at different geographical locations. Therefore, for CAP88 calculations, airborne effluents were grouped for elevated releases (61 meters) and ground-level releases (0 meters), and the geographical center of the site was used as the release location for both (table 39, *SRS Environmental Data for 1997*).

Atmospheric Concentrations

The MAXIGASP and CAP88 codes calculate average and maximum concentrations of all released radionuclides at the site perimeter. These calculated concentrations are used for dose determinations instead of measured concentrations. This is because most radionuclides released from SRS cannot be measured, using standard methods, in the air samples collected at the site perimeter and offsite locations. However, the concentrations of tritium oxide at the site perimeter locations usually can be measured and are compared with calculated concentrations as a verification of the dose models.

In table 7–3, the average 1988–1997 tritium oxide concentrations in air—measured at four locations near the center of the site (F-Area, H-Area, SWDF North, and SWDF South) and at 14 locations along the site perimeter—are compared to the average concentrations calculated for the site perimeter, using the MAXIGASP code. These data show that the calculated site-perimeter tritium oxide concentrations consistently and reasonably approximate the measured values and therefore are appropriate for use in dose determinations.

The average tritium oxide concentration in air measured at the 14 site perimeter locations during 1997 was 12 pCi/m^3 (0.44 Bq/m^3), which is a 9-percent increase from the 1996 measured value of 11 pCi/m^3 (0.41 Bq/m^3). The 1997 measured value is more than, but compares favorably with, the MAXIGASP and CAP88 computer code values of 10 pCi/m^3 (0.37 Bq/m^3) and 9 pCi/m^3 (0.33 Bq/m^3), respectively.

The increase in measured tritium oxide concentrations was not expected because the amount of tritium oxide released from the site in 1997 (39,100 curies) was about 2.5 percent less that the amount released in 1996 (40,100 curies).

The reason for the increase in tritium oxide concentrations—both at the site perimeter and, as shown in table 7–3, at the four center-of-site locations—is not known for certain. However, it may be attributed to (1) uncertainty in concentration measurements at lower release levels or (2) uncertainty in determining the form (i.e., elemental versus oxide) of the total amount of tritium released from the site. Because of sampling difficulties, the elemental form of tritium (i.e., the hydrogen gas T_2 form) is not measured at the site perimeter or at the center-of-site locations.

The maximum tritium oxide concentration measured in air at the site perimeter was 20 pCi/m^3 (0.74 Bq/m^3), which occurred at the D-Area location. This value is less than, but compares favorably with, the MAXIGASP calculated value of 21 pCi/m^3 (0.78 Bq/m^3).

The CAP88 code calculated a maximum site perimeter concentration of 14 pCi/m^3 (0.52 Bq/m^3). This value is lower than the MAXIGASP code value because the CAP88 code assumes that all releases occurred from only one point, which is located at the center of the site.

Table 7–3
Ten-Year History of SRS Atmospheric Tritium and Tritium Oxide Releases and Average Measured Tritium Oxide Concentrations in Air Compared to Calculated Concentrations in Air

			Average Tritium Oxide Concentrations in Air		
Year	Total Tritium Released (Ci)	Tritium Oxide Released[a] (Ci)	Center of Site (measured at 4 locations) (pCi/m^3)	Site Perimeter (measured at 14 locations) (pCi/m^3)	Site Perimeter (calculated by dose model) (pCi/m^3)
1988	462,000	288,000	1,030	54	87
1989	309,000	218,000	790	37	65
1990	253,000	175,000	530	32	53
1991	200,000	137,000	310	21	42
1992[b]	156,000	100,000	420	27	30
1993	191,000	133,000	450	30	37
1994[c]	160,000	107,000	350	23	30
1995	97,000	55,000	300	16	16
1996	55,300	40,100	123	11	11
1997	58,000	39,100	162	12	10

a Tritium oxide releases are included with elemental tritium releases in the "Total Tritium Released" column.
b During May 1992, the method for determining tritium oxide concentrations in air was changed to the use of measured humidity values instead of a single generic value. The listed concentrations are for May to December 1992.
c During 1994, because of problems with measuring location-specific humidity values, a single generic value of 11.4 g/m^3 was used for absolute humidity.

Dose to the Maximally Exposed Individual

The potential air pathway dose to a hypothetical maximally exposed individual located at the site perimeter was determined using the MAXIGASP computer code. The adult consumption and usage parameters used for the calculations were discussed earlier in this chapter.

In 1997, the estimated dose to the maximally exposed individual was 0.05 mrem (0.0005 mSv), which is about 0.5 percent of the DOE Order 5400.5 ("Radiation Protection of the Public and the Environment") standard of 10 mrem per year. This dose was the same as the 1996 dose. Tritium oxide releases accounted for about 71 percent of the dose to the maximally exposed individual. Table 7–4 compares the maximally exposed individual's dose with the DOE standard.

For 1997, the MAXIGASP code determined that the west-southwest sector of the site was the location of the maximally exposed individual. Figure 7–4 shows the potential dose to the maximally exposed

Table 7–4
Potential Dose to the Maximally Exposed Individual from SRS Atmospheric Releases in 1997

	MAXIGASP	CAP88 (NESHAP)
Calculated dose	0.05 mrem	0.05 mrem
Applicable standard	10 mrem[a]	10 mrem[b]
Percent of standard	0.5%	0.5%

a DOE: DOE Order 5400.5, February 8, 1990
b EPA: (NESHAP) 40 CFR 61 Subpart H, December 15, 1989

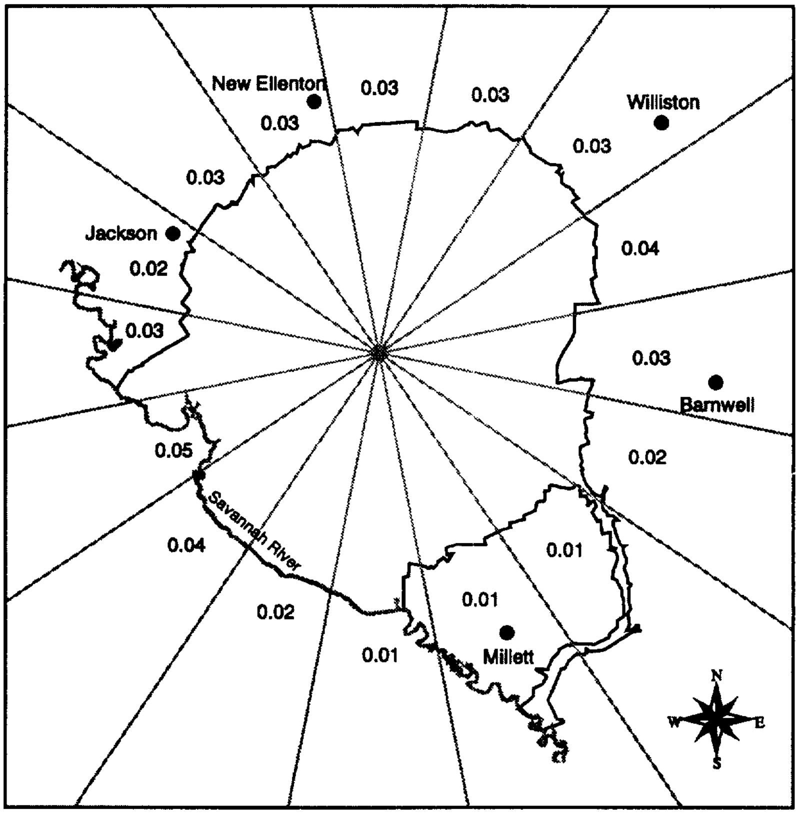


Figure 7–4 Sector-Specific Adult Maximally Exposed Individual Air Pathway Doses (in mrem) for 1997

Maximally exposed individual site boundary doses from airborne releases are shown for each of the 16 compass point directions surrounding SRS. As indicated by the dose totals for 1997, the west-southwest sector was the location of the highest maximally exposed individual dose.

EPD/GIS Map

individual residing at the site boundary for each of the 16 major compass point directions around SRS.

The major pathways contributing to the dose to the maximally exposed individual from atmospheric releases were from inhalation (42 percent) and from consumption of vegetation (38 percent), cow milk (11 percent), and meat (8 percent) (table 42, *SRS Environmental Data for 1997*).

Additional calculations of the dose to the maximally exposed individual were performed substituting goat milk for the customary cow milk pathway. The potential dose using the goat milk pathway also was estimated at 0.05 mrem (0.0005 mSv) (table 43, *SRS Environmental Data for 1997*).

Collective (Population) Dose

Potential doses also were calculated, by pathway and radionuclide, using the POPGASP computer code for the population (620,100 people) residing within 80 kilometers of the center of SRS (table 35, *SRS Environmental Data for 1997*).

In 1997, the collective dose was estimated at 2.2 person-rem (0.022 person-Sv)—less than 0.01 percent of the collective dose received from natural sources of radiation (about 186,000 person-rem) (table 44, *SRS Environmental Data for 1997*).

Tritium oxide releases, which decreased about 2.5 percent during 1997, accounted for 81 percent of the collective dose. However, the 1997 collective dose was approximately 21 percent lower than the 1996 collective dose of 2.8 person-rem (0.028 person-Sv)—primarily because the new 5-year meteorological database (1992–1996) documents the increase in wind instability over the previous 5-year database (table 34, *SRS Environmental Data for 1997*). Increased wind instability generates greater dispersion of contaminants, which in turn results in a lower dose.

The disparity between the decrease in tritium oxide releases and the decrease in collective dose indicates that the use of a historical 5-year average database in lieu of the applicable-year meteorological data may introduce an uncertainty of ± 20 percent or more into the collective-dose calculations.

NESHAP Compliance

To demonstrate compliance with NESHAP (Clean Air Act, 40 CFR 61, Subpart H) regulations, maximally exposed individual and collective doses were calculated, and a percentage of dose contribution from each radionuclide was determined using the CAP88 computer code.

The dose to the maximally exposed individual, calculated with CAP88, was estimated at 0.05 mrem (0.0005 mSv), which is 0.5 percent of the 10-mrem-per-year EPA standard, as shown in table 7–4. Tritium oxide releases accounted for almost 94 percent of this dose (tables 45 and 46, *SRS Environmental Data for 1997*).

The CAP88 collective dose was estimated at 5.5 person-rem (0.055 person-Sv). Tritium oxide releases accounted for about 94 percent of this dose (table 47, *SRS Environmental Data for 1997*).

As the data in tables 46 and 47 show, the CAP88 code estimates a higher dose than do the MAXIGASP and POPGASP codes. The CAP88 maximally exposed individual dose is slightly higher than the MAXIGASP calculated dose, but both doses are rounded to the second decimal point (i.e., 0.05 mrem) for consistency within the environmental report.

Most of the differences occur in the tritium dose estimated from food consumption. The major cause of this difference is the CAP88 code's use of 100-percent equilibrium between tritium in air moisture and tritium in food moisture, whereas the MAXIGASP and POPGASP codes use 50-percent equilibrium values, as recommended by the Nuclear Regulatory Commission [NRC, 1977]. A recent publication indicates that the 50-percent value is correct for the atmospheric conditions at SRS [Hamby and Bauer, 1994].

Because tritium oxide dominates the doses determined using the CAP88 code, and because the CAP88 code is limited to a single, center-of-site release location, other radionuclides (such as iodine-129, plutonium-239, and ruthenium-106) are less important—on a percentage-of-dose basis—for the CAP88 doses than for the MAXIGASP and POPGASP doses.

All-Pathway Dose

To demonstrate compliance with the DOE Order 5400.5 all-pathway dose standard of 100 mrem per year (1.0 mSv per year), SRS conservatively combines the maximally exposed individual airborne pathway and liquid pathway dose estimates, even though the two doses are calculated for hypothetical individuals residing at different geographic locations.

Figure 7–5 shows a 10-year history of SRS's all-pathway doses (airborne pathway plus liquid pathway doses to the maximally exposed individual).

For 1997, the potential maximally exposed individual all-pathway dose was 0.18 mrem (0.0018 mSv)—0.05 mrem from airborne pathway plus 0.13 mrem from liquid pathway. This dose is 5 percent lower than the 1996 all-pathway dose of 0.19 mrem (0.0019 mSv).

Figure 7–6 shows a comparison of the 1997 maximum potential all-pathway dose attributable to SRS operations (0.18 mrem) with the average annual radiation dose received by a typical Central Savannah

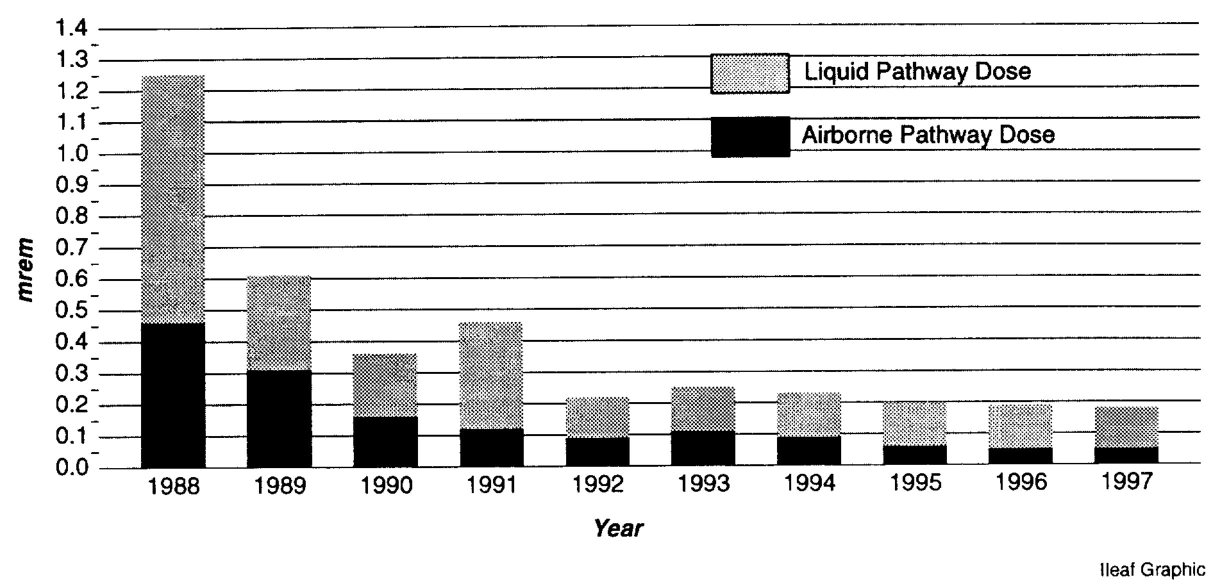


Figure 7–5 Ten-Year History of SRS Maximum Potential All-Pathway Doses to the Maximally Exposed Individual (Airborne plus Liquid Pathways)

River Area (CSRA) resident from natural and manmade sources of radiation (360 mrem).

As shown in table 7–5, the 1997 potential all-pathway dose of 0.18 mrem (0.0018 mSv) is 0.18 percent of the 100-mrem-per-year DOE dose standard.

Sportsman Dose

DOE Order 5400.5 specifies radiation dose standards for individual members of the public. The dose standard of 100 mrem per year includes doses a person receives from routine DOE operations through all exposure pathways. Nontypical exposure pathways, not included in the standard calculations of the doses to the maximally exposed individual, are considered and quantified separately. This is because they apply to low-probability scenarios, such as consumption of fish caught exclusively from the mouths of SRS streams, or to unique scenarios, such as volunteer deer hunters.

Deer and Hog Consumption Pathway

For approximately 6 weeks each year, controlled hunts of deer and feral hogs are conducted at SRS. Hunt participants are volunteers. Before any harvested animal is released to a hunter, SRS personnel perform a field analysis for cesium-137 on the deer and hogs at the hunt site, using portable sodium iodide detectors. Like fish, deer and hogs have a high bioaccumulation factor for cesium.

The estimated dose from consumption of the harvested deer or hog meat is determined for each hunter. During 1997, the maximum potential dose that could have been received by a hunter was estimated at 26 mrem (0.26 mSv), or 26 percent of DOE's 100-mrem all-pathway dose standard (table 7–5). This dose was determined for a prolific hunter who had harvested nine animals during the 1997 hunts. The hunter-dose calculation is based on the conservative assumption that the hunter individually consumed the entire edible portion—approximately 163 kg (359 pounds)—of the animals he harvested from SRS.

An additional deer meat consumption pathway considered was for a hypothetical offsite individual whose entire intake of meat during the year was deer meat. It was assumed that this individual harvested deer that had resided on SRS, but then moved off site. The estimated dose was based on the maximum annual meat consumption rate for an adult of 81 kg per year [Hamby, 1991].

Based on these low-probability assumptions and on the gross average concentration of cesium-137 (4.42 pCi/g) in deer harvested from SRS during 1997, the potential maximum dose from this pathway was estimated at 14 mrem (0.14 mSv). An average 80-km background cesium-137 concentration of 1 pCi/g is subtracted from the onsite gross average concentration before calculating the dose. The 80-km background concentration is based on previous studies performed at SRS (table 33, *SRS Environmental Data for 1994,* WSRC–TR–95–077).

As shown in table 7–5, the 1997 offsite hunter potential dose is 14 percent of DOE's 100-mrem all-pathway dose standard. This dose was the same as the 1996 dose.

Table 7–5
1997 All-Pathway and Sportsman Doses Compared to the DOE All-Pathway Dose Standard

	Committed Dose (mrem)	Applicable Standard[a] (mrem)	Percent of Standard
Maximally Exposed Individual Dose			
All-Pathway (Liquid Plus Airborne Pathway)	0.18	100	0.18
Sportsman Doses			
Creek Mouth Fisherman	0.65	100	0.65
Onsite Hunter	26	100	26
Offsite Hunter	14	100	14

a All-pathway dose standard: 100 mrem per year (DOE Order 5400.5)

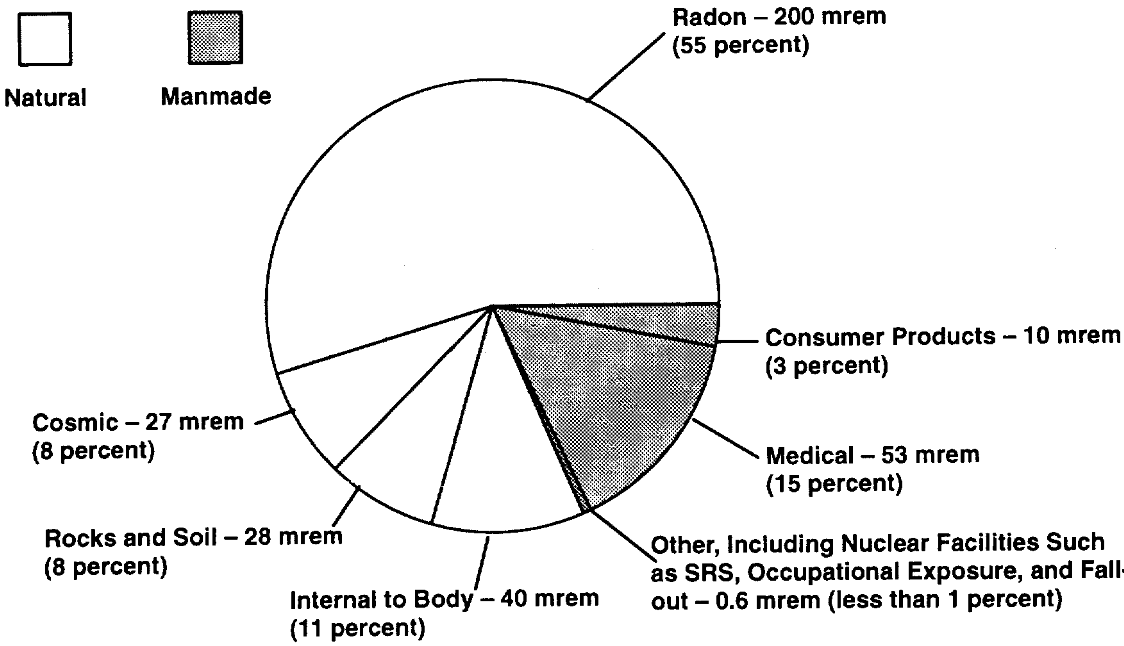


Figure 7–6 Contributions to the U.S. Average Individual Dose
The major contributor to the annual average individual dose in the United States, including residents of the CSRA, is naturally occurring radiation (about 300 mrem) [NCRP, 1987]. During 1996, SRS operations potentially contributed a maximum individual dose of 0.18 mrem, which is less than 0.05 percent of the 360-mrem total annual average dose (natural plus manmade sources of radiation).

Fish Consumption Pathway

For 1997, analyses were conducted of fish taken from the mouths of five SRS streams, and the subsequent estimated doses from the maximum consumption of 19 kg (42 pounds) per year [Hamby, 1991] of these fish were determined (table 53, *SRS Environmental Data for 1997*). Fish flesh was composited by species for each location and analyzed for tritium, strontium-90, cesium-137, plutonium-238, and plutonium-239.

As shown in table 7–5, the maximum potential dose from this pathway was estimated at 0.65 mrem (0.0065 mSv) from the consumption of bass collected at the mouth of Steel Creek. This hypothetical dose is based on the low-probability scenario that, during 1997, a fisherman consumed 19 kg of bass caught exclusively from the mouth of Steel Creek. More than 97 percent of this potential dose was from cesium-137. Again, some fraction of this cesium-137 is from worldwide fallout and from neighboring Vogtle Electric Generating Plant; however, that amount is difficult to determine and is not subtracted from the total.

Potential Risk from Consumption of SRS Creek Mouth Fish

During 1991 and 1992, in response to a U.S. House of Representative Appropriations Committee request for a plan to evaluate risk to the public from fish collected from the Savannah River, SRS developed—in conjunction with EPA, the Georgia Department of Natural Resources (GDNR), and the South Carolina Department of Health and Environmental Control (SCDHEC)—and implemented the *Westinghouse Savannah River Company/Environmental Monitoring Section Fish Monitoring Plan* [SRS EM Program, 1996]. Part of the reporting requirements of this plan are to perform an assessment of radiological risk from the consumption of Savannah River fish, and to summarize the results in the annual *SRS Environmental Report*. The following sections discuss the potential radiological risks from the consumption of Savannah River fish, using SRS-published data from 1993 through 1997. Potential radiological risks are determined using both the ICRP–60 [ICRP, 1990] and the EPA [EPA, 1991] methods.

Exposure Scenario In EPA's risk assessment guidance document [EPA, 1991], two fish consumption pathways are considered—the recreational fisherman scenario and the subsistence fisherman scenario. Because of SRS's relatively remote location, the recreational fisherman scenario—as opposed to the subsistence fisherman scenario—is considered the more reasonable exposure scenario and is used in this assessment.

It is assumed that a recreational fisherman fishes for a single species of fish—either panfish, such as bream; predators, such as bass; or bottom dwellers, such as catfish—from the mouth of the worst-case SRS stream. Access to upstream portions of SRS streams is prohibited by postings, fencing (where possible), and periodic patrols.

Per EPA guidance [EPA, 1991], the maximum consumption rate that should be used for determining risk to the recreational fisherman is 19 kilograms (42 pounds) per year. This is the same as the consumption rate used by SRS for demonstrating maximally exposed individual dose compliance [Hamby, 1991].

The EPA guidance document requires that critical subpopulations and fish species be considered in risk assessments. Currently, there are no known sensitive subpopulations (e.g., Native Americans) in the immediate SRS region who are known to regularly consume whole fish (edible and nonedible portions) as part of their typical diet. Also, there are no known species of fish, such as smelt, in the SRS region of the Savannah River that are commonly eaten whole. Therefore, it is reasonably assumed that the recreational fisherman consumes only the edible (fillet only) portion of the fish caught.

Risk Factors For the EPA method, estimates of potential risk are calculated directly by multiplying the amount of each radionuclide ingested by the appropriate risk (slope) factors provided in EPA's *Health Effects Assessment Summary Tables* (HEAST) [EPA, 1996]. The HEAST ingestion slope factors are best estimates of potential, age-averaged, lifetime excess cancer incidence (fatal and nonfatal) risk per unit of activity ingested.

For the ICRP–60 method, estimates of potential risk are determined first by calculating a radiation dose attributable to the amount of radionuclides ingested and then multiplying that dose by the ICRP–60 coefficient of risk of severe detriment of 7.3E–07 per mrem [ICRP, 1990]. Stated another way, if a group of 10,000,000 people each received a radiation dose of 1 mrem, during their collective lifetimes there would theoretically be 7.3 additional severe detrimental incidences (fatal/nonfatal cancer or severe hereditary effects), which is small compared to the 2,000,000 or more expected fatal cancer incidences from other causes during their lifetimes [BEIR V, 1990].

The ICRP–60 risk coefficient includes factors for

- fatal cancers (5.0E–07 per mrem)
- nonfatal cancers (1.0E–07 per mrem)
- hereditary effects (1.3E–07 per mrem)

It should be noted that all radiological risk factors are based on observed and documented health effects to actual people who have received high doses (greater than 100,000 mrem) of radiation, such as the Japanese atomic bomb survivors. Radiological risks at low doses (less than 10,000 mrem) are theoretical and are estimated by extrapolating the observed health effects at high doses to the low-dose region by using a linear, no-threshold model. However, cancer and other health effects have not been observed consistently at low radiation doses because the health risks either do not exist or are so low that they are undetectable by current scientific methods.

Exposure Duration According to EPA guidance, the upper bound value of 30 years can be used for exposure duration when calculating reasonable maximum residential exposures. This assessment compares the potential risks of exposure durations of 1 year, 30 years, and 50 years. The 30-year and 50-year exposure duration risks are simply 30 times and 50 times the 1-year exposure duration risk, respectively.

Risk Comparisons The maximum potential radiation doses and lifetime risks from the consumption of SRS creek mouth fish for 1-year, 30-year, and 50-year exposure durations are shown in table 7–6 and are compared to the radiation risks associated with the DOE Order 5400.5 all-pathway dose standard of 100 mrem (1.0 mSv) per year.

For each year, the maximum recreational fisherman dose was caused by the consumption of bass collected at the mouth of Steel Creek. More than 97 percent of the doses are attributable to cesium-137.

Figure 7–7 shows a 5-year history of the annual potential radiation doses from consumption of Savannah River fish. As yet, no apparent trends can be discerned from the data. This is because there is large variability in the annual cesium-137 concentrations measured in fish from the same location due to differences in (1) the size of the fish collected each year, (2) their mobility and location within the stream mouth from which they are collected, and (3) the time of year they are collected.

Also, it should be noted that most of the cesium-137 that exists in SRS stream watersheds is legacy

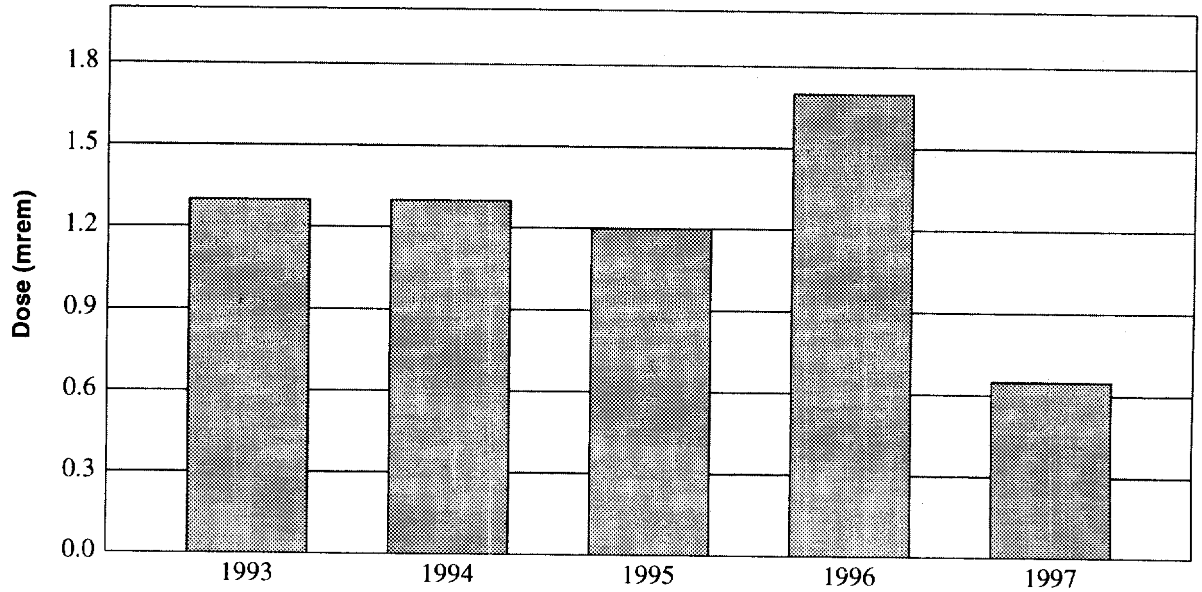
Table 7–6
Potential Lifetime Risks from the Consumption of Savannah River Fish Compared to Dose Standards (1993–1997)

	Committed Dose (mrem)	ICRP–60 Risk Method	EPA/CERCLA Risk Method
1997 Savannah River Fish			
1-Year Exposure	0.65	4.8E–07	4.1E–07
30-Year Exposure	20	1.4E–05	1.2E–05
50-Year Exposure	33	2.4E–05	2.1E–05
1996 Savannah River Fish			
1-Year Exposure	1.7	1.2E–06	1.1E–06
30-Year Exposure	51	3.7E–05	3.3E–05
50-Year Exposure	85	6.2E–05	5.5E–05
1995 Savannah River Fish			
1-Year Exposure	1.2	8.8E–07	7.4E–07
30-Year Exposure	36	2.6E–05	2.2E–05
50-Year Exposure	60	4.4E–05	3.7E–05
1994 Savannah River Fish			
1-Year Exposure	1.3	9.5E–07	8.2E–07
30-Year Exposure	39	2.8E–05	2.5E–05
50-Year Exposure	65	4.7E–05	4.1E–05
1993 Savannah River Fish			
1-Year Exposure	1.3	9.5E–07	7.9E–07
30-Year Exposure	39	2.8E–05	2.4E–05
50-Year Exposure	65	4.7E–05	4.0E–05
Dose Standard			
100-mrem/year All Pathway			
1-Year Exposure	100	7.3E–05	6.3E–05
30-Year Exposure	3,000	2.2E–03	1.9E–03
50-Year Exposure	5,000	3.7E–03	3.2E–03

contamination left from relatively large liquid releases that occurred during the early years of operations at SRS (1954–1963) and is not from current direct operational releases [Carlton et al., 1994]. Therefore, there is large annual variability in the amount of cesium-137 available in the water and sediments at the site stream mouths; this is caused by annual changes in stream flow rates (turbulence) and water chemistry.

As indicated in table 7–6, the 50-year maximum potential lifetime risks from consumption of SRS creek mouth fish range between 2.4E–05 and 6.2E–05, which are below the 50-year risk associated with the dose standard.

According to EPA practice, if a potential risk is calculated to be less than 1.0E–06 (i.e., one additional case of cancer over what would be expected in a group of 1,000,000 people), then the risk is considered minimal and the corresponding contaminant concentrations are considered negligible. If a calculated risk is greater than 1.0E–04 (one additional case of cancer in a population of 10,000), then some form of corrective action or remediation usually is required. However, if a calculated risk falls between 1.0E–04 and 1.0E–06, which is the case with the maximum potential lifetime risks from the consumption of Savannah River fish, then the risks are considered acceptable if they are kept as low as reasonably achievable (ALARA).



Ileaf Graphic

Figure 7–7 Annual Potential Radiation Doses from Consumption of Savannah River Fish (1993–1997)

At SRS, the following programs are in place to ensure that the potential risk from site radioactive liquid effluents (and, therefore, from consumption of Savannah River fish) are kept ALARA:

- radiological liquid effluent monitoring program (chapter 5)
- radiological environmental surveillance program (chapter 6)
- environmental ALARA program [SRS EM Program, 1996]

Dose to Aquatic Animal Organisms

DOE Order 5400.5 establishes an interim dose standard for protection of native aquatic animal organisms. The absorbed dose limit to these organisms is 1 rad per day (0.01 Gy per day) from exposure to radioactive material in liquid effluents released to natural waterways.

Hypothetical doses to aquatic biota in SRS streams are calculated annually to demonstrate compliance with this 1-rad-per-day (0.01-Gy-per-day) dose standard. Upper-limit doses are calculated with measured radioactivity transport and minimum flow rates for each surface stream. Flow rates are chosen to maximize the biota dose. Source terms (stream transport) are provided by the site's Environmental Monitoring Section (table 54, *SRS Environmental Data for 1997*).

The CRITR computer code [Soldat et al., 1974], incorporated as part of the LADTAPII code, calculates internal and external doses to aquatic biota and to higher trophic levels that depend on aquatic biota for food. The CRITR Code is one of the three aquatic biota dose codes recommended by DOE [DOE, 1991]. External doses are calculated with the same external dose factors used for man [DOE, 1988]. Internal doses are based on the physical size of the biota (effective radius) and on effective energies provided for each radionuclide for each radius. The maximum dose to biota was estimated at 0.015 rad per day (0.00015 Gy per day), which occurred in ducks in Four Mile Creek. This is 1.5 percent of the 1-rad-per-day (0.01-mGy-per-day) DOE dose limit.

Radiological Assessment Program

The preparation of documents describing the effects of SRS operations on the environment began in 1988. The format chosen was a separate document for each major radionuclide or group of similar radionuclides. The documents describe the operating history of the site with respect to the production, storage, and release of each radionuclide. The transport of the radionuclide in air, surface water, and groundwater is explained, and a calculation of the dose estimate to individuals and the population surrounding SRS is presented. As of December 31, 1997, the following documents had been published[a]:

- *Assessment of Tritium in the Savannah River Site Environment*, WSRC–TR–93–214
- *Cesium in the Savannah River Site Environment*, WSRC–RP–92–250
- *Uranium in the Savannah River Site Environment*, WSRC–RP–92–315
- *Radioiodine in the Savannah River Site Environment*, WSRC–RP–90–424–2
- *Assessment of Radiocarbon in the Savannah River Site Environment*, WSRC–TR–93–215
- *Assessment of Technetium in the Savannah River Site Environment*, WSRC–TR–93–217
- *Assessment of Strontium in the Savannah River Site Environment*, WSRC–RP–92–984
- *Plutonium in the Savannah River Site Environment*, WSRC–RP–92–879, Rev. 1
- *Assessment of Mercury in the Savannah River Site Environment*, WSRC–TR–94–0218ET
- *Assessment of Noble Gases in the Savannah River Site Environment*, WSRC–TR–95–0219
- *Assessment of Activation Products in the Savannah River Site Environment*, WSRC–TR–95–0422
- *Assessment of Selected Fission Products in the SRS Environment*, WSRC–TR–96–0220

A document for neptunium, americium, and curium is scheduled for publication in 1998.

a Copies of these documents can be obtained from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

Chapter 8

Nonradiological Effluent Monitoring

Carl Cook, Larry Eldridge, and Stuart Stinson
Environmental Protection Department

To Read About . . . See Page . . .

1997 Highlights

- At SRS, there are 194 permitted/exempted nonradiological air emission sources, 153 of which were in operation to some capacity in 1997. Thirty-five of the SRS permitted sources are permitted for toxic air pollutants; 29 of these were operated during the year.
- SRS conducts no onsite monitoring for ambient air quality; however, the site is required to show compliance with various air quality standards. This is accomplished by using air dispersion modeling techniques. These models showed that SRS was in compliance with all applicable ambient air quality standards in 1997.
- SRS monitors nonradioactive releases to surface water through NPDES. The site discharged water into site streams and the Savannah River under five NPDES permits in 1997.
- Thirty-three of the site's 37 permitted outfalls discharged; three did not discharge and one was not in service. Results from seven of the 5,758 discharge-sample analyses exceeded limits because of process upsets, but the site still achieved a 99.9-percent compliance rate—higher than the 98-percent rate mandated by DOE.

NONRADIOACTIVE air emissions originating at Savannah River Site (SRS) facilities are monitored at their points of discharge by direct measurement, sample extraction and measurement, or process knowledge. Air monitoring is used to determine whether all emissions and ambient concentrations are within applicable regulatory standards.

Nonradiological liquid effluent monitoring encompasses sampling and analysis and is performed by the Environmental Protection Department's Environmental Monitoring Section (EMS) and the Savannah River Technology Center.

A complete description of EMS sampling and analytical procedures used for nonradiological monitoring can be found in sections 1101–1111 (SRS EM Program) of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1. A summary of data results is presented in this chapter; more complete data can be found in *SRS Environmental Data for 1997* (WSRC–TR–97–00324).

Airborne Emissions

The South Carolina Department of Health and Environmental Control (SCDHEC) regulates nonradioactive air emissions—both criteria pollutants and toxic air pollutants—from SRS sources. Each source of air emissions is permitted or exempted by SCDHEC, with specific limitations identified. The bases for the limitations are outlined in various South Carolina and federal air pollution control regulations and standards. Many of the applicable standards are source dependent, i.e., applicable to certain types of industry, processes, or equipment. However, some standards govern all sources for criteria and toxic air pollutants and ambient air quality. Air pollution control regulations and standards applicable to SRS sources are discussed briefly in appendix A, "Applicable Guidelines, Standards, and Regulations." Other air standards are listed in appendix C, "Standard No. 8 Toxic Air Pollutants."

At SRS, there are 194 permitted/exempted nonradiological air emission sources, 153 of which were in operation in some capacity during 1997. The remaining 41 sources either were being maintained in a "cold standby" status or were under construction.

Specific permits for operating facilities are listed in appendix D, "SRS Environmental Permits."

Description of Monitoring Program

Major nonradiological emissions of concern from stacks at SRS facilities include sulfur dioxide, carbon monoxide, oxides of nitrogen, particulate matter smaller than 10 microns, volatile organic compounds, and toxic air pollutants. Stacks that have such emissions at SRS include those associated with diesel engine-powered equipment, package No. 2 fuel oil steam generators, powerhouse coal-fired boilers, the Defense Waste Processing Facility, the in-tank precipitation process, groundwater air strippers, and various other process facilities. Emissions from SRS sources are determined during an annual emissions inventory from calculations using source operating parameters such as fuel oil consumption rates, total hours of operation, and the emission factors provided in the U.S. Environmental Protection Agency (EPA) "Compilation of Air Pollution Emission Factors," AP–42. The calculation for boiler sulfur dioxide emissions also uses the average sulfur content of the coal and assumes 100 percent liberation of sulfur and 100 percent conversion to sulfur dioxide. Most of the processes at SRS are unique sources requiring nonstandard, complex calculations that use process chemical or material throughputs, hours of operation, chemical properties, etc., to determine actual emissions. In addition to the annual emissions inventory, compliance with various standards is determined in several ways, as follows:

At the SRS powerhouses, stack compliance tests are performed every 2 years for each boiler by airborne emission specialists under contract to SRS. The tests include

- sampling of the boiler exhaust gases to determine particulate emission rates and carbon dioxide and oxygen concentrations
- laboratory analysis of coal for sulfur content, ash content, moisture content, and BTU output

Sulfur content and BTU output are used to calculate sulfur dioxide emissions. SCDHEC also conducts visible-emissions observations during the tests to verify compliance with opacity standards. The day-to-day control of particulate matter smaller than 10 microns is demonstrated by opacity meters in all SRS powerhouse stacks.

For the package steam generating boilers in K-Area and P-Area, compliance with sulfur dioxide standards is determined by analysis of the fuel oil purchased from the offsite vendor. The percent of sulfur in the fuel oil must be below 0.5 and is reported to SCDHEC each quarter. Compliance with particulate emission standards is demonstrated by mass-balance calculations rather than stack emission tests.

Table 8–1
SRS Power Plant Boiler Capacities

Location	Number of Boilers	Capacity (BTU/hr)
A-Area	2	71.7E+06
H-Area	3	71.1E+06

Compliance by SRS diesel engines and other process stacks is determined during annual compliance inspections by the local SCDHEC district air manager. These inspections include a review of operating parameters, an examination of continuous-emission monitors (where required for process or boiler stacks), and a visible-emissions observation for opacity.

Compliance by all toxic air pollutant and criteria pollutant sources also is determined by using EPA-approved air dispersion models. Air dispersion modeling is extremely conservative unless refined models are used. The Industrial Source Complex Version No. 3 model was used to predict maximum ground-level concentrations occurring at or beyond the site boundary for new sources permitted during 1997. Some site sources of toxic air pollutants also are required to be stack tested every 2 years.

Monitoring Results

As noted earlier, emissions are calculated each year as part of an annual emissions inventory. In 1997, operating data were compiled and emissions were calculated for 1996 operations for all site air emission sources (table 55, *SRS Environmental Data for 1997*). Because this process, which begins in January, requires up to 6 months to complete, this report will provide a more comprehensive examination of total 1996 emissions, with only limited discussion of available 1997 monitoring results. Actual emissions for 1997 will be compiled and reported in depth in the *SRS Environmental Report for 1998*.

Two power plants with five coal-fired boilers are operated by Westinghouse Savannah River Company (WSRC) at SRS. These boilers are used to generate steam, which is used for facility heating systems and, where required, as process steam. The location, number of boilers, and capacity of each boiler for these plants are listed in table 8–1. The A-Area and H-Area boilers are overfeed stoker fed and use coal as their only fuel. Only the A-Area No. 1 boiler was due for stack-testing in 1997, but because it was down for overhaul for an extended period time, the testing will be conducted in 1998.

SRS also has four package steam generating boilers fired by No. 2 fuel oil. The steam from these boilers is used primarily to heat buildings during cold weather, but also for process steam. The location, number of boilers, and capacity of each boiler are shown in table 8–2. During 1997, only the 76.8- and 38.0-mmBTU/hr boilers were operated. The percent of sulfur in the fuel oil burned during the year was certified by the vendor to meet the requirements of the permit.

At SRS, 110 permitted and exempted sources, both portable and stationary, are powered by internal combustion diesel engines. These sources include portable air compressors, diesel generators, emergency cooling water pumps, and fire water pumps ranging in size from 150 to 2050 kilowatts for generators and 200 to 520 horsepower for air compressor and pump engines. Fuel oil consumption for the diesel engines operated in 1996 was 596,116 gallons. Total fuel consumption for 1997 will be included in the report for calendar year 1998.

Another significant source of criteria pollutant emissions at SRS is the burning of forestry areas across the site. The Savannah River Forest Station (SRFS), a unit of the U.S. Department of Agriculture Forest Service, periodically conducts controlled burning of vegetation and undergrowth as a means of preventing uncontrolled forest fires. During 1996, SRFS personnel burned a total of 12,309 acres across the site.

Other sources of criteria pollutants at SRS are too numerous to discuss here by type. Table 8–3 provides the 1996 atmospheric emissions results for all SRS sources, as determined by the air emissions inventory conducted in 1997. All calculated emissions were within applicable SCDHEC standards and permit limitations during 1996.

Thirty-five of the SRS permitted sources are permitted for toxic air pollutants; 29 of these were operated during 1997. Ten of the toxic air pollutant sources are required to be stack tested following startup to verify initial compliance with their respective permitted emission rates. Subsequent test requirements will be specified in their respective operating permits when the permits are issued. During 1997, one soil vapor extraction/catalytic oxidation unit and the Consolidated Incineration Facility were stack tested. Table 8–4 shows the test results and the permitted emission rates for the soil vapor extraction/catalytic oxidation unit. The results indicate that all permit limits have been met. The results of the Consolidated Incineration Facility stack test are too numerous to list here and still are being evaluated by SCDHEC for compliance.

Table 8–2
SRS Package Steam Boiler Capacities

Location	Number of Boilers	Capacity (BTU/hr)
K-Area	1	76.8E+06
K-Area	1	38.0E+06
Portable	2	17.0E+06

Table 8–3
1996 Criteria Pollutant Air Emissions[a]

Pollutant Name	Actual Tons/Year
Sulfur dioxide (SOX)	5.42E+02
Total suspended particulates	5.18E+02
PM10 (particulate matter 10 microns)	2.19E+02
Carbon monoxide	3.35E+03
Ozone (volatile organic compounds)	3.20E+02
Gaseous fluorides (as hydrogen fluoride)	8.24E–02
Nitrogen dioxide (NOX)	4.42E+02
Lead	1.77E–02

a From all SRS sources (permitted and nonpermitted)

Total toxic air pollutant emissions at SRS are determined annually in tons per year for each pollutant (table 55, *SRS Environmental Data for 1997*). It should be noted that some toxic air pollutants (e.g., benzene) regulated by SCDHEC also are, by nature, volatile organic compounds (VOCs). As such, the total for VOCs in table 8–3 includes toxic air pollutant emissions.

Ambient Air Quality

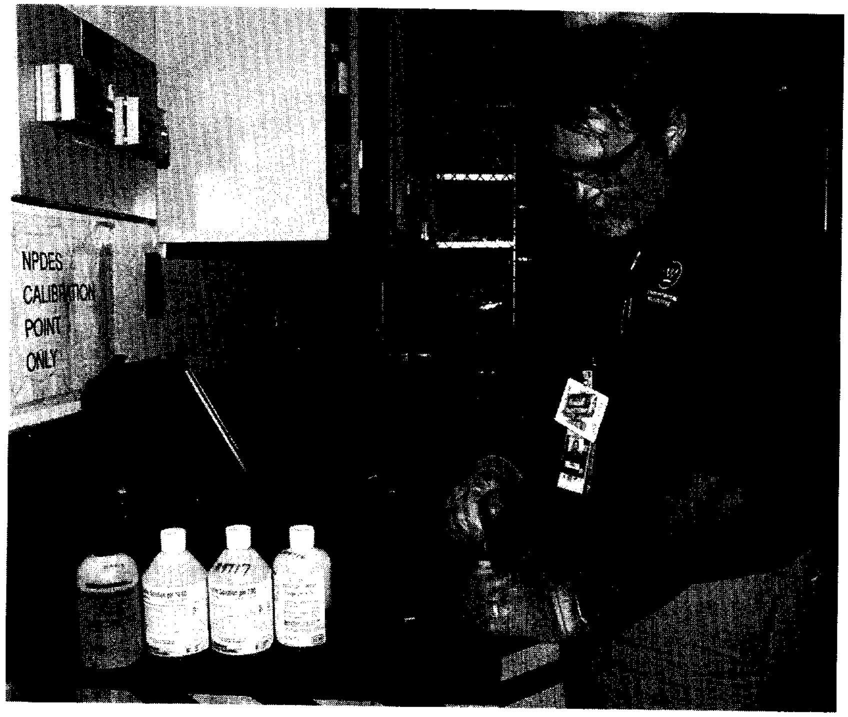
Under existing regulations, SRS is not required to conduct onsite monitoring for ambient air quality;

Table 8–4
Soil Vapor Extraction Unit/Catalytic Oxidation Stack Test Results

SVEU	Pollutant	Result lb/hr	Permitted Emission lb/hr
782–8M	HCL	0.091	3.950
	PCE	0.023	0.260
	TCE	0.007	0.200

An EMS sampling technician calibrates a NPDES field instrument in the laboratory. NPDES protocol requires daily calibration of all field instruments.

Al Mamatey Photo (98X00643–02)



however, the site is required to show compliance with various air quality standards. To accomplish this, air dispersion modeling was conducted during 1997 for new emission sources as part of the sources' construction permitting process. The modeling analysis showed that SRS air emission sources were in compliance with applicable regulations. Also in 1997, SRS conducted a complete modeling analysis using 1996 emissions data and new source information to

- show compliance with SCDHEC Air Pollution Control Regulation 61–62.5, Standard No. 2 (for criteria pollutants) and Standard No. 8 (for toxic air pollutants)
- establish emission rates for the SRS Title V (Part 70) operating permit

South Carolina and Georgia continue to monitor ambient air quality near SRS as part of the network associated with the Clean Air Act. Resulting data are available to the public through (1) the South Carolina Bureau of Air Quality and (2) the Georgia Department of Natural Resources, Environmental Protection Division, Air Protection Branch.

Liquid Discharges

Description of Monitoring Program

SRS monitors nonradioactive releases to surface waters through the National Pollutant Discharge Elimination System (NPDES). As required by EPA and SCDHEC, SRS has NPDES permits for discharges to the waters of the United States and South Carolina. These permits require that SRS test water discharged from the site for pollutants. Also mandated are specific sites to be monitored, parameters to be tested, and monitoring frequency—as well as analytical, reporting, and collection methods. Detailed requirements for each permitted discharge point—including parameters sampled for, permit limits for each parameter, sampling frequency, and method for collecting each sample—can be found in the individual permits, which are available to the public through SCDHEC's Freedom of Information office at (803) 734–5376.

In 1997, SRS discharged water into site streams and the Savannah River under four NPDES permits: one for industrial wastewater (SC0000175), one for general utility water discharges (SCG250162), and two for stormwater runoff—SCR000000 (industrial discharge) and SCR100000 (construction discharge). A fifth NPDES permit, ND0072125, is a "No Discharge" permit that regulates sludge sampling at outfall ND–1, at the Central Sanitary Wastewater Treatment Facility.

Permit SC0000175 regulated 37 industrial wastewater outfalls until June 1997, when outfall C–04 was removed from the permit. Permit SCG250162 requires sampling at only one utility water discharge location, and that location did not discharge during 1997. Permits SCR000000 and SCR100000 expired in September 1997, but a notice of intent was filed in August 1997 with SCDHEC to enable SRS to continue coverage of stormwater runoff under the expired permits. The new permits were still in the approval process at the end of 1997. Permit SCR000000 regulates 52 stormwater outfalls that are sorted into 11 groups. Samples were obtained from 13 locations in 1997 to provide representative sampling of all the groups. Permit SCR100000 does not require sampling unless requested by SCDHEC to address specific discharge issues at a given construction site; SCDHEC did not request such sampling in 1997.

NPDES samples are preserved in the field according to 40 CFR 136, the federal document that lists specific sample collection, preservation, and analytical methods acceptable for the type of pollutant to be analyzed. Chain-of-custody procedures are followed after collection and during transport to the analytical laboratory. The samples then are accepted by the laboratory and analyzed according to procedures listed in 40 CFR 136 for the parameters required by the permit.

The effectiveness of the NPDES monitoring program is documented by a surveillance program involving chemical and biological evaluation of the waters to which effluents have been discharged. More monitoring information can be found in chapters 9, "Nonradiological Environmental Surveillance," and 12, "Special Surveys and Projects."

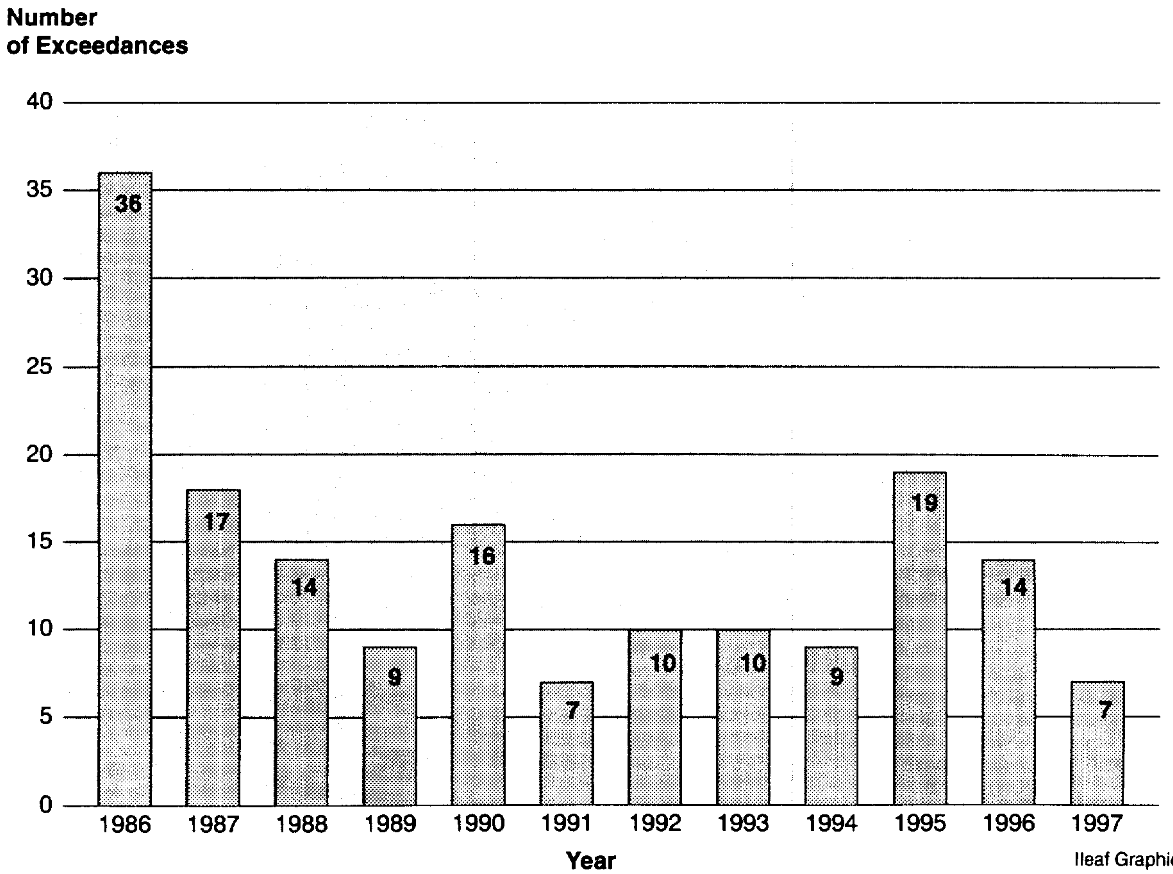
Monitoring Results

SRS reports analytical results to SCDHEC through a monthly discharge monitoring report, which includes an explanation concerning any analytical measurements outside permit limits and a summary of all analyses performed at each permitted outfall. Complete results from 1997 NPDES industrial discharges (permit SC0000175) can be found in tables 56 and 57, *SRS Environmental Data for 1997.*

During 1997, 33 of 37 permitted outfalls discharged; three did not discharge; and one was not in service. Results from seven of the 5,758 discharge-sample analyses performed during 1997 exceeded permit limits because of process upsets, such as the Bryozoan infestation at outfall G–10, but the site still achieved a 99.9-percent compliance rate—higher than the 98-percent rate mandated by DOE. A list of the 1997 exceedances appears in table 8–5. Figure 8–1 shows the NPDES exceedances at SRS from 1986 through 1997, along with the site's compliance rate for each of those years.

A total of 533 analyses were performed during 1997 on stormwater discharge samples. SCDHEC has not mandated permit limits for stormwater outfalls except for outfall A–008, where all 1997 analyses were within permit limits. Complete results of 1997 NPDES stormwater sample analyses can be found in table 58, *SRS Environmental Data for 1997.*

Fifty-nine analyses were performed during 1997 on sanitary sludge samples. Results from one of the analyses—for zinc—exceeded permit limits. Results from all the land application analyses can be found in table 59, *SRS Environmental Data for 1997.*



Year	*Number of Analyses*	*Compliance Rate*
1986	6,240	99.4%
1987	6,560	99.7%
1988	6,250	99.8%
1989	6,859	99.9%
1990	6,810	99.8%
1991	8,329	99.9%
1992	7,729	99.9%
1993	8,000	99.9%
1994	7,568	99.9%
1995	7,515	99.8%
1996	5,737	99.8%
1997	5,758	99.9%

Figure 8–1 History of NPDES Exceedances at SRS, and Site's Compliance Rate, 1986–1997
To determine the compliance rate, the number of analyses not exceeding limits for a given year is divided by the total number of analyses. For example, 5,758 analyses were performed in 1997, with seven exceedances. To calculate the compliance rate for that year, divide 5,751 (5,758 minus 7) by 5,758 for a quotient of .9987—or 99.9 percent.

Table 8–5
1997 NPDES Exceedances at SRS

Page 1 of 1

Department	Outfall	Date	Analysis	Result	Possible Cause	Corrective Action
FDD	C–04	April 17	pH	5.7 SU (min)	Unknown	None; outfall removed from service prior to discovery of source
SUD	X–8A	May 7	Fecal coliform	9,100 col/100 mg/L (avg and max)	UV system out of service	UV system repaired
SUD	X–8A	May 9	Flow	20,048 gallons (max)	Water hose left on	Water valve shut off
FDD	C–04	May 20	pH	5.2 SU (min)	Unknown	None; outfall removed from service prior to discovery of source
HLWO	H–16	June 17	O&G	27 mg/L (avg and max)	Unknown	None; O&G level returned to within specifications prior to discovery of source
SUD	G–10	Aug. 6	Fecal coliform	472 col/100 mL (avg and max)	Bryozoan infestation	Under investigation
HLWO	H–16	Dec. 29	BOD	65.2 mg/L (avg and max)	Unknown	None; BOD level returned to within specifications prior to discovery of source

Key: *BOD – Biological Oxygen Demand*
O&G – Oil and Grease
SU – Standard Units
UV – Ultraviolet

Chapter 9

Nonradiological Environmental Surveillance

Bill Littrell and Stuart Stinson
Environmental Protection Department

Robert Turner
Engineering Services Department

To Read About . . . **See Page . . .**

1997 Highlights

- Approximately 6,300 nonradiological analyses for specific chemicals and metals were performed on about 1,200 samples, not including groundwater.
- A project to consolidate and upgrade site drinking water systems was completed in July. The site's 12 largest drinking water systems were consolidated to three. Drinking water supplies were tested routinely to ensure compliance with state and federal drinking water standards.
- All samples collected from SRS drinking water systems were in compliance with SCDHEC and EPA water quality limits, with the following exceptions—samples collected on June 23 and June 25 from the ATTA well water supply and on August 26 and September 4 from the Central Sanitary Wastewater Treatment Facility well water supply tested positive for total coliform bacteria. Resamples collected after disinfection and flushing were total-coliform-negative.
- Two hundred and eight fish caught from SRS streams and ponds and the Savannah River were analyzed for mercury. The mercury concentration in fish from onsite waters ranged from 2.82 µg/g in a bass from Lower Three Runs Creek to less than the reporting limit of 0.033 µg/g at several locations.

NONRADIOACTIVE environmental surveillance at the Savannah River Site (SRS) involves the sampling and analysis of surface water (six onsite streams and the Savannah River), drinking water, sediment, groundwater, and fish. Surface water, drinking water, sediment, and fish surveillance programs are discussed in this chapter. However, a description of the surveillance program and 1997 results for groundwater can be found in chapter 10, "Groundwater."

The Environmental Protection Department's Environmental Monitoring Section (EMS) and the Savannah River Technology Center (SRTC) perform nonradiological surveillance activities. The Savannah River also is monitored by other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC) and the Georgia Department of Natural Resources (GDNR). In addition, the Academy of Natural Sciences of Philadelphia conducts special environmental surveys on the Savannah River through a program that began in 1951. The academy's studies are discussed in chapter 12, "Special Surveys and Projects."

A complete description of the EMS sample collection and analytical procedures used for nonradiological surveillance can be found in section 1105 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC-3Q1-2, Volume 1 (SRS EM Program). A summary of analytical results is presented in this chapter; however, more complete data can be found in *SRS Environmental Data for 1997* (WSRC-TR-97-00324). Information on the rationale for the nonradiological environmental surveillance program can be found in chapter 3, "Environmental Program Information."

In 1997, approximately 6,300 nonradiological analyses for specific chemicals and metals were performed on about 1,200 samples, not including groundwater.

SRS currently does not conduct onsite surveillance for ambient air quality. However, to ensure compliance with SCDHEC air quality regulations and standards, SRTC conducted air dispersion modeling for all site sources of criteria and toxic air pollutants in 1993. This modeling indicated that all

SRS sources were in compliance with air quality regulations and standards. Since that time, additional modeling conducted for new sources of criteria and toxic air pollutants has demonstrated continued compliance by the site with these regulations and standards. The states of South Carolina and Georgia continue to monitor ambient air quality near the site as part of a network associated with the federal Clean Air Act.

Surface Water

SRS streams and the Savannah River are classified as "Freshwaters" by SCDHEC. Freshwaters are defined as surface water suitable for

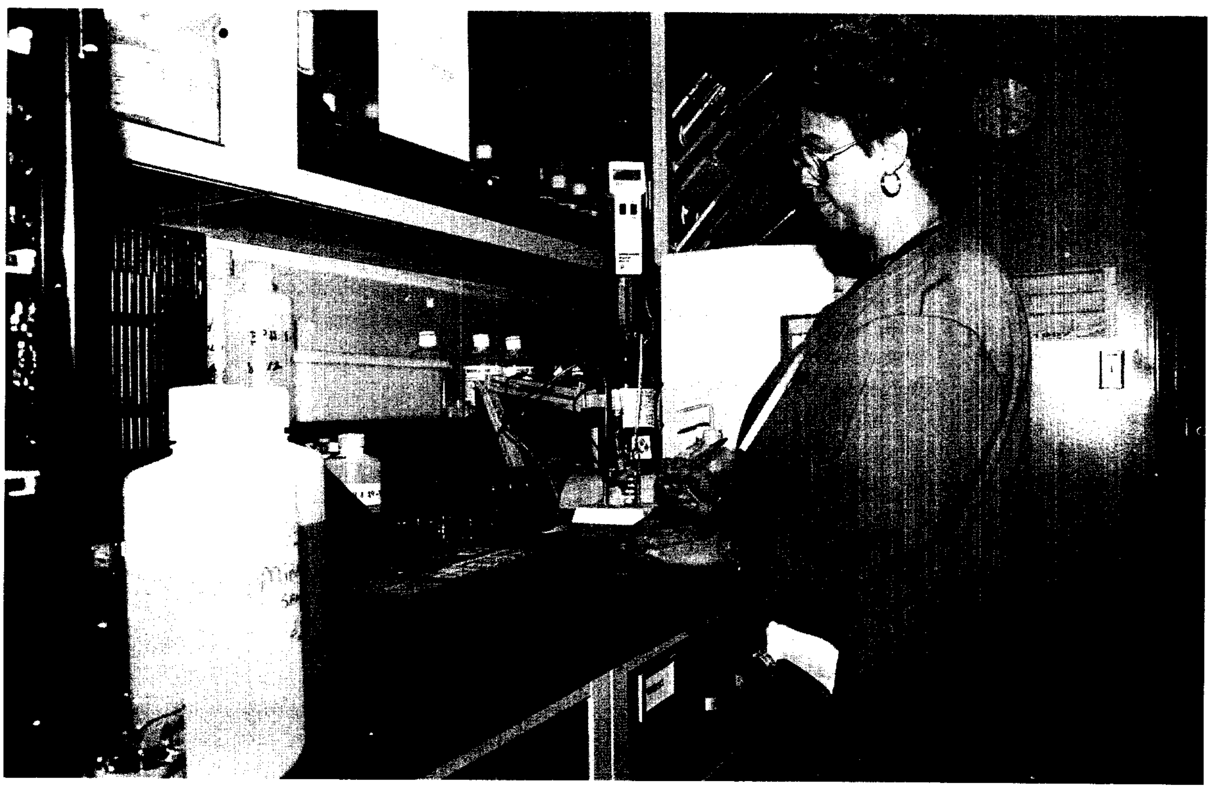
- primary—and secondary—contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- fishing and survival and propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Appendix A, "Applicable Guidelines, Standards, and Regulations," provides some of the specific guides used in water quality surveillance, but because some of these guides are not quantifiable, they are not tracked (i.e., amount of garbage found).

Description of Surveillance Program

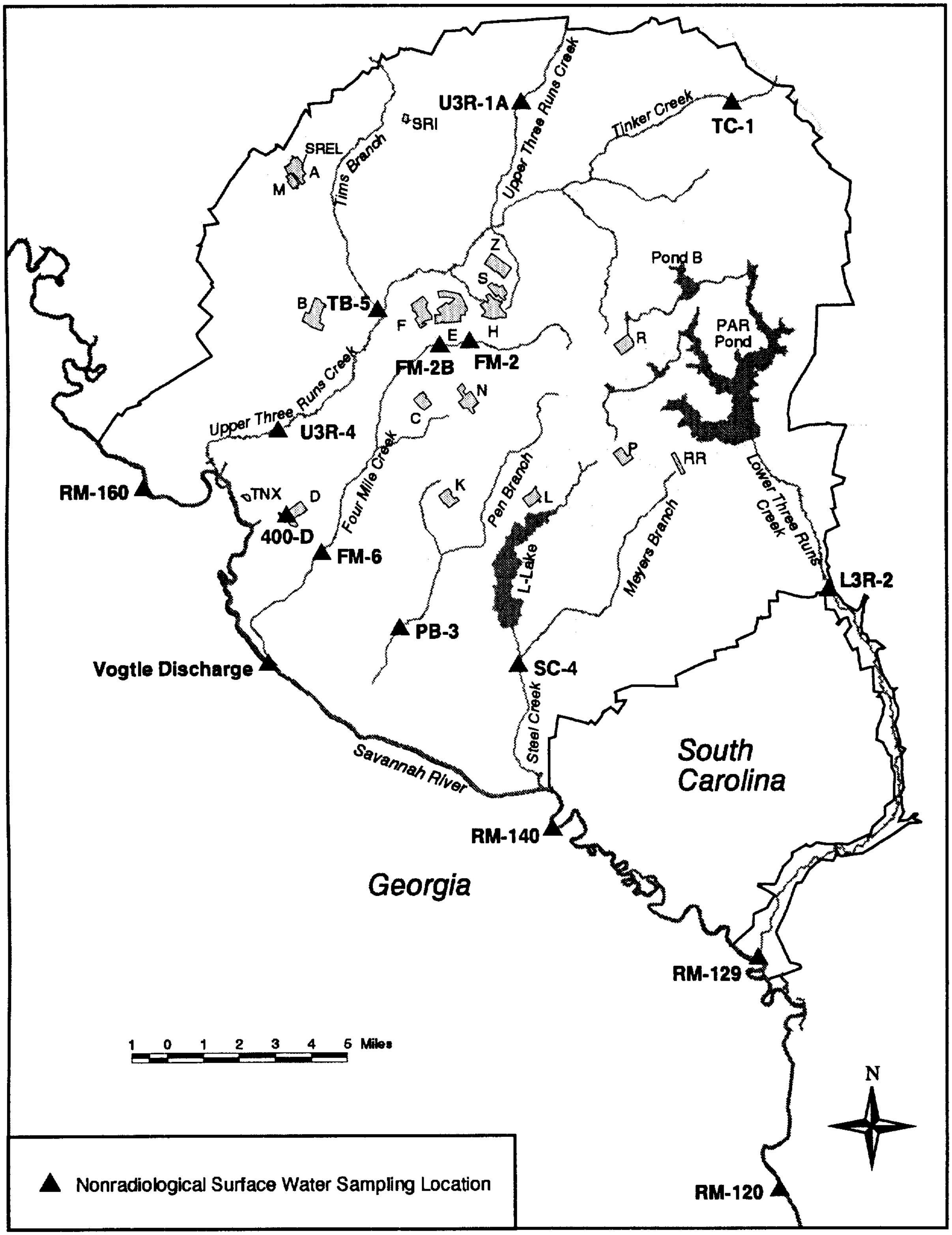
SRS stream and Savannah River nonradiological surveillance is conducted for any evident degradation that could be attributed to the water discharges regulated by the site National Pollutant Discharge Elimination System (NPDES) permits and materials that may be released inadvertently from sources other than routine release points. In the surveillance program, site streams and the Savannah River are sampled monthly for various physical and chemical properties. Surface water sampling locations are shown in figure 9–1.

Each SRS stream receives varying amounts of treated wastewater and rainwater runoff from site facilities. Stream locations are sampled for water quality at monthly and quarterly frequencies by the conventional grab-collection technique. Each grab



Al Mamatey Photo (98x005991–01)

Using a pH meter (that provides a measure of acidity), an EMS laboratory technician verifies field data of surface water samples as part of good laboratory practices. Technicians also verify conductivity measurements taken in the field.



EPD/GIS Map

Figure 9–1 Nonradiological Surface Water Sampling Locations

Surface water samples are collected from five Savannah River and eleven SRS stream locations and are analyzed for various chemical and physical properties.

sample shows the water quality at the time of sampling only.

River sampling sites are located upriver of, adjacent to, and downriver of the site to compare the SRS contribution of pollutants with background levels of chemicals from natural sources and from contaminants produced by municipal sewage plants, medical facilities, and other upriver industrial facilities. Nonradiological surveillance of the river also checks for any degradation that could be attributed to the water discharges regulated by site NPDES permits.

To monitor the quality of water coming onto and leaving the site, field measurements for conductivity, dissolved oxygen, pH, and temperature are taken monthly and laboratory analyses are conducted for other water quality parameters, such as nutrients, metals, pesticides/herbicides, and other physical properties. Comparison of the results from upstream and downstream locations (locations that are below process areas or at points where the water leaves the site) indicates any impact the site may have had on the water.

The natural chemical and physical parameters measured monthly on each stream and in the river vary to some extent throughout the year. This natural variation can be trended on a month-to-month basis. When results diverge greatly from the historical norm, an abnormal discharge event or occurrence in the environment may be indicated. An investigation is held to determine if a release has occurred.

Surveillance Results

During 1997, because of computer error, personnel collecting water quality samples for the nonradiological surveillance program failed to collect the following: Four Mile Creek–2B sample (February) and pesticide/herbicide samples (first quarter) at all locations. The problem was corrected, and all samples were collected in a timely fashion for the rest of the year. Results can be found in table 60, *SRS Environmental Data for 1997*.

The data trend for 1997 at location Four Mile Creek–2 indicated an anomaly for the month of July. The pH level dropped from the expected 5-to-7 range to 4.2; conductivity approximately tripled from the 40s range to 114 µmho/cm; and TSS (total suspended solids) almost tripled from the spring high of 13 mg/L to 37 mg/L. In addition, aluminum, magnesium, iron, and zinc showed increases. While pH excursions do occur down into the lower-5-range and perhaps the upper-4-range due to the acid nature of the surrounding pine forest, they usually are not accompanied by increases in conductivity, TSS, and metals. When the low pH was noted, collection personnel returned to the location for another sample. Because the follow-up sample showed nothing abnormal, no NPDES outfall showed any excursion from typical levels, no rain event had happened within the 10 days prior to the anomaly, no known discharge had occurred from onsite facilities, and nothing out of the ordinary was seen at the next downstream station, the one-time anomaly observed in July was not believed to represent a significant deterioration in the overall water quality in the creek.

Comparison of the upstream to downstream locations where available (Upper Three Runs Creek) and month-to-month trends for each of these stations indicated normal trends for a southern pine forest stream except for the previously mentioned excursion. The pH varied within the 5-to-7 range, while the conductivity ranged from 20 farther upstream to slightly above 100 farther downstream. Nitrate levels for most streams and the river locations usually ranged below 0.50 mg/L. Four Mile–6 had the highest nitrate concentration of all the streams (between 1 and 2 mg/L). This was due to discharges into Four Mile Creek from the waste treatment facility above the sampling location. Phosphate levels were higher in the Savannah River than on site. The November and December phosphate numbers in the river at River Mile–160 (RM–160, a control location upstream from SRS) were about 0.5 mg/L, dropping off as the water flowed downstream. The phosphate concentration on site ranged from a high of about 0.2 mg/L to approximately 0.01 mg/L. Metals across the site generally reflected values found in site soils.

Generally, pesticides and herbicides were below detection except for the herbicide 2,4–D. This herbicide was found at four locations—RM–160, Tinker Creek (TC–1, one of two controls for Upper Three Runs Creek), Upper Three Runs–4 (U3R–4), and Beaver Dam Creek (400–D)—during the May quarterly collection only. This is a commonly used herbicide, both on site and off site, for control of vegetative growth. The maximum level found (0.694 mg/L) was at River Mile–160.

No excursions other than the aforementioned took place. Analysis of the data indicates that SRS discharges are not significantly affecting the water quality of the site streams or the river.

Drinking Water

A project to consolidate and upgrade site drinking water systems was completed in July. The site's 12 largest drinking water systems were consolidated to three systems. The site also has 15 small drinking water facilities at remote security barricades, field laboratories, and field offices that serve populations of fewer than 25 persons (figure 9–2).

Well water from the McBean, Congaree, Black Creek, and Middendorf aquifers is utilized for the 18 drinking water systems. Most of these well water supplies require treatment to ensure that SCDHEC and U.S. Environmental Protection Agency (EPA) drinking water quality standards are maintained. Treatment processes include aeration to remove dissolved gases; filtration to remove iron; and addition of potable water treatment chemicals to adjust pH, prevent piping corrosion, and prevent bacterial growth.

Description of Surveillance Program

SRS drinking water supplies are tested routinely to ensure compliance with SCDHEC and EPA drinking water standards (appendix B) and monitoring requirements. This testing includes

- daily testing to monitor concentration of any potable water treatment chemicals added
- monthly or quarterly testing to confirm that bacteria are not present
- periodic testing for metals, organic and inorganic chemicals, and radionuclides

Surveillance Results

All samples collected from SRS drinking water systems during 1997 were in compliance with SCDHEC and EPA water quality limits, with the following exceptions—samples collected on June 23 and June 25 from the Advanced Tactical Training Area (ATTA) well water supply and on August 26 and September 4 from the Central Sanitary Wastewater Treatment Facility well water supply tested positive for total coliform bacteria. Resamples collected after disinfection and flushing tested negative for total coliform.

Bottled water, not well water, is used for drinking water at these facilities, However, regulations require that well water supplies meet drinking water quality standards because well water is used for hand washing at these locations.

Analytical results from volatile organic samples (collected from all onsite drinking water systems and three offsite water treatment facilities by EMS personnel) were less than the method detection limit of 2 μg/L.

Sediment

EMS's nonradiological sediment surveillance program provides a method of determining the deposition, movement, and accumulation of nonradiological contaminants in stream systems.

Description of Surveillance Program

The nonradiological sediment program consists of the collection of sediment samples at eight onsite stream locations and three Savannah River locations (figure 9–3). Collection is made by either a Ponar sediment sampler or an Emery pipe dredge sampler. The samples are analyzed for various inorganic contaminants (metals) and pesticides/herbicides. The program is designed to check for the existence and possible buildup of the inorganic contaminants as well as for pesticides/herbicides.

Surveillance Results

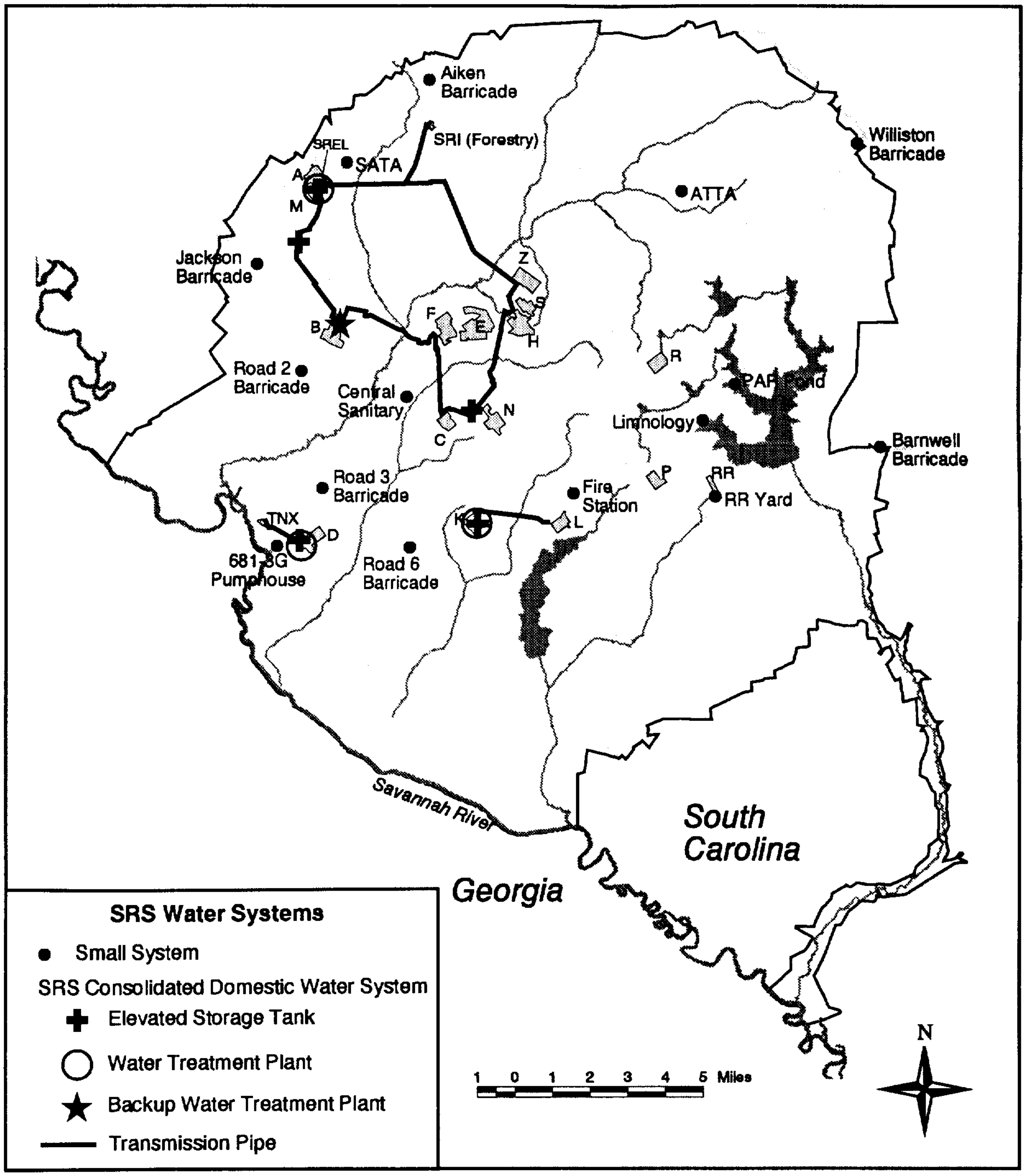
As in the previous year, no pesticides or herbicides were found in sediment samples to be above the practical quantitation limits in 1997. All pesticide/herbicide results were below the detection limits of EPA analytical procedures used. All inorganic contaminants results were within the normal range expected (table 61, *SRS Environmental Data for 1997*).

Fish

Mercury is a naturally occurring metal that cycles between land, water, and air. The major sources of atmospheric mercury are as follows:

- Natural—Degassing of the earth's crust generates 2,700 to 6,000 tons of mercury per year [WHO, 1990].
- Manmade—Burning of fossil fuels releases an estimated 5,000 tons of mercury per year [Klaassen et al., 1986]; industrial and other discharges account for an undetermined amount.

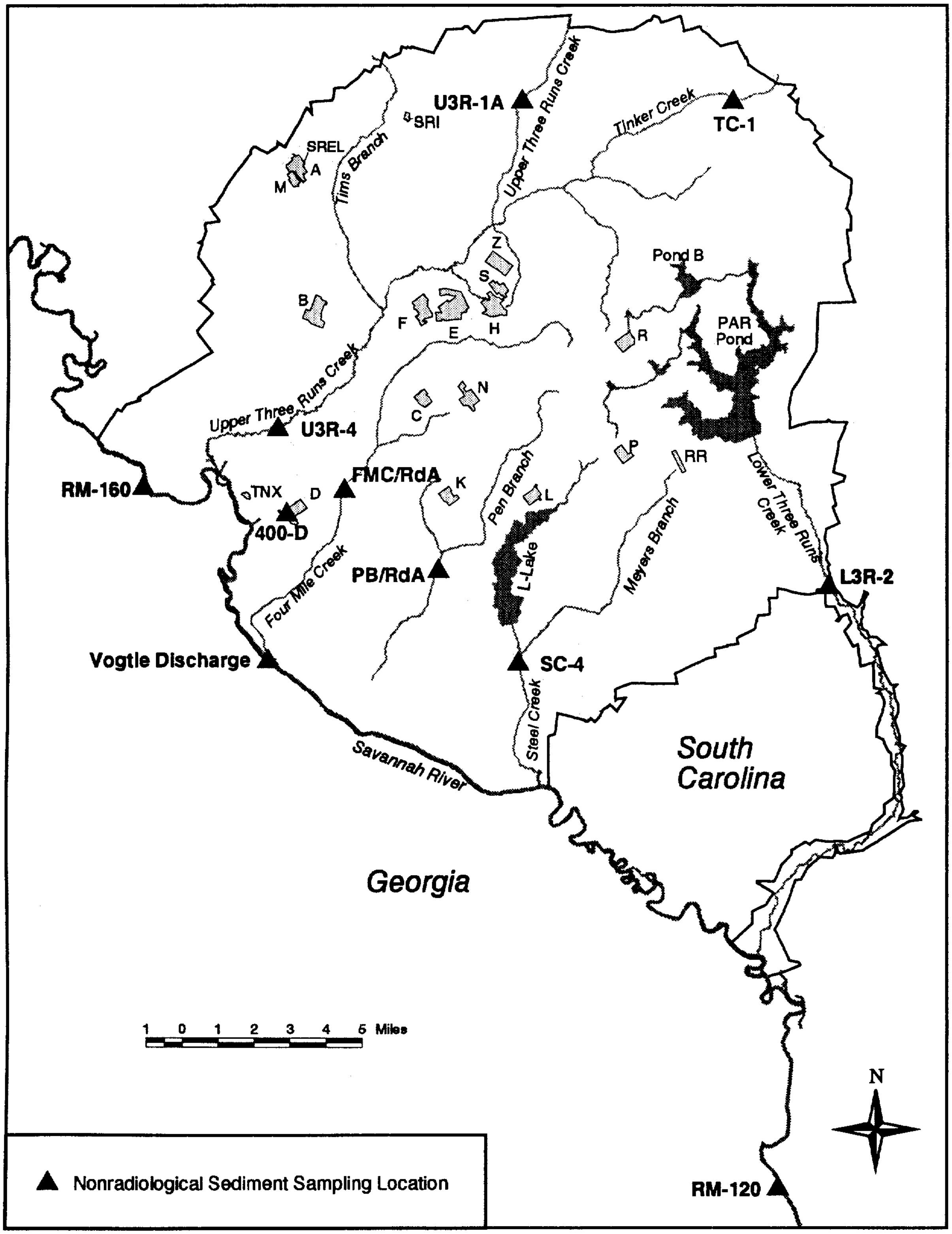
As mercury enters streams and rivers through rainfall, runoff, and discharges, it is converted to the chemical compound methylmercury by bacterial and other processes. As part of the natural cycling, some mercury is absorbed by plants and animals into their tissues. Fish absorb methylmercury from food they ingest and from water as it passes over their gills; the methylmercury then is bound in their tissues. Consumption by people of fish containing methylmercury then completes the mercury pathway



EPD/GIS Map

Figure 9–2 Nonradiological Drinking Water Sampling Locations
In 1997, the site's 12 largest drinking water systems were consolidated into three systems. The site also has 15 small drinking water facilities that serve populations of fewer than 25 persons. The three larger systems are depicted by transmission pipes, elevated storage tanks, water treatment plants, and a backup water treatment plant.

to humans. The amount of fish that can be eaten safely varies with (1) the concentration of methylmercury, (2) the amount consumed, and (3) the frequency of consumption. These factors are the basis of calculations performed during "risk analysis," a method to determine how much fish can be consumed safely.



EPD/GIS Map

Figure 9–3 Nonradiological Sediment Sampling Locations

Sediment samples are collected at eight onsite stream locations and three Savannah River locations. The samples are analyzed for various inorganic contaminants (metals) and pesticides/herbicides.

State and federal regulatory agencies calculate the health risk associated with the consumption of fish, then recommend consumption guidelines based on that risk. Adherence to these guidelines can effectively control one's exposure to methylmercury. A list of fish advisories and/or recommended consumption limits can be obtained from state environmental agencies. (The EPA source for monthly consumption limits can be found on page 144 under "Surveillance Results.")

Description of Surveillance Program

EMS analyzes the flesh of fish caught from onsite streams and ponds and from the Savannah River to determine concentrations of mercury in the fish [SRS EM Program, 1996]. The fish analyzed represent the most common edible species of fish in the Central Savannah River Area (CSRA), an 18-county area in Georgia and South Carolina that surrounds Augusta, Georgia, and includes SRS. (Sampling locations for fish are depicted in a map in chapter 6, "Radiological Environmental Surveillance," page 98.)

Perspective on Mercury

Mercury in the environment can come from natural sources, such as volcanoes and venting of the earth's crust, and from manmade sources and processes, such as fungicides and fossil fuel combustion byproducts and the manufacture of chlorine, sodium hydroxide, plastics, and electrical apparatus.

An important source in the SRS region may be in releases upriver of the site. Much of the mercury detected in SRS fish has been attributed to offsite sources, such as Savannah River water [Davis et al., 1989]. Savannah River water is pumped onto the site to support fire protection efforts and the sanitary waste treatment plant and to maintain L-Lake's water level. The water subsequently is released into site streams and lakes.

Surveillance Results

In 1997, 208 fish from SRS streams and ponds and the Savannah River were caught and analyzed for mercury. No fish were caught from the Beaver Dam Creek (400–D), Pen Branch–3, and Four Mile Creek–6 locations.

The mercury concentrations in fish analyzed from onsite waters ranged from a high of 2.82 μg/g in a bass from Lower Three Runs Creek to values less than the reporting limit (0.33 μg/g) at several locations. Mercury concentrations in offsite fish ranged from a high of 1.30 μg/g in a bass from the Steel Creek River Mouth to values less than the reporting limit (0.33 μg/g) at several locations. In all instances except one—at Lower Three Runs Creek River Mouth—bass contained higher levels of mercury than panfish and catfish collected at the same location (table 62, *SRS Environmental Data for 1997*).

EPA criteria taken from "Guidance For Assessing Chemical Contaminant Data For Use In Fish Advisories, Volume II Risk Assessment And Fish Consumption Limits" (EPA 823–B–94–004, June 1994), gives the monthly consumption limits for chronic systemic health endpoint for the general population. Table 3–57 in the EPA publication indicates that the recommended monthly consumption limit for fish collected at the highest offsite location for 1997 (Steel Creek River Mouth) would be between one and two 8-ounce servings per month.

Chapter 10

Groundwater

Kathleen Dapkus and Jen Williams
Exploration Resources, Inc.

To Read About . . . **See Page . . .**

1997 Highlights

- Most analytical results from groundwater monitoring were similar to those of recent years. However, the results show that ongoing remediation efforts at A-Area and M-Area have slowed the spread of contamination (primarily organics and metals) and reduced the impact of operations in those areas on the groundwater.
- In most of the reactor areas (K-Area, L-Area, and P-Area), tritium is the most widespread contaminant. Trichloroethylene is the most widespread contaminant in C-Area, and tritium is significantly elevated there as well. Organics are present in groundwater near the burning/rubble pits in these areas and near the chemicals, metals, and pesticides pit in L-Area. Metals are present near the reactor seepage basins in C-Area and P-Area and near the chemicals, metals, and pesticides pits in L-Area. No metals are present in K-Area, and no evidence of tritium exists in R-Area, but other radionuclides and metals are present in the groundwater.
- D-Area shows continued contamination associated with activities at the coal-fired power plant and related facilities and with organics and metals near the oil disposal basin. The contaminant plume in the TNX area indicated the presence of organics, metals, radionuclides, and other constituents near disposal sites.
- In the general separations and waste management areas (E-Area, F-Area, and H-Area), the groundwater contamination plumes include tritium, radionuclides, metals, organics, and other constituents. Metals and organics are present in N-Area. Stabilization and closure programs are ongoing in these areas. S-Area and Z-Area do not show evidence of any groundwater contamination.
- Organics, metals, tritium, and other radionuclides are present in the groundwater near the sanitary landfill, while tritium was identified in two wells and gross alpha in a single well in B-Area.

Groundwater beneath an estimated five to 10 percent of the Savannah River Site (SRS) has been contaminated by industrial solvents, tritium, metals, or other constituents used or generated by operations at SRS. Groundwater in areas indicated on figure 10–1 contains one or more of these constituents at or above the levels of the Safe Drinking Water Act primary drinking water standards (DWS) of the U.S. Environmental Protection Agency (EPA).

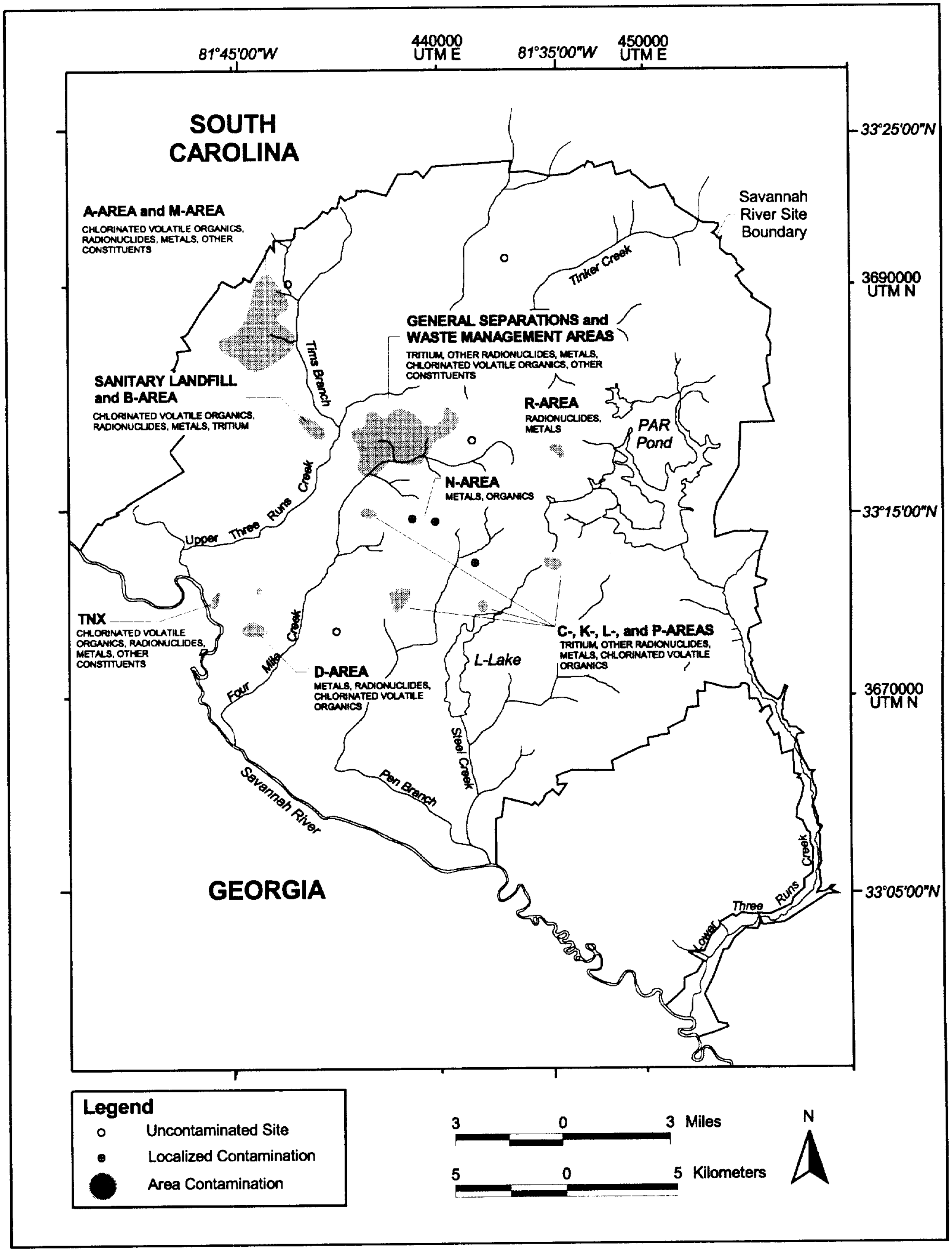
This chapter summarizes the groundwater monitoring results for approximately 1,350 wells in 92 locations (figure 10–1) within designated areas at SRS. Only results exceeding the DWS are presented in figures and tables in this report. Most constituents are compared to the final federal primary DWS. In some cases, comparison is to the proposed primary DWS or the interim final primary DWS. (See appendix A, "Applicable Guidelines, Standards, and Regulations," for additional information about applicable monitoring standards, and appendix B, "Drinking Water Standards," for the DWS.) Some information about additional constituents is discussed in the text of this chapter.

Detailed groundwater monitoring results are presented in the following public documents: *The Savannah River Site's Groundwater Monitoring Program, First Quarter 1997* (ESH/EMS/970488); *The Savannah River Site's Groundwater Monitoring Program, Second Quarter 1997* (ESH/EMS/970489); *The Savannah River Site's Groundwater Monitoring Program, Third Quarter 1997* (ESH/EMS/970490); and *The Savannah River Site's Groundwater Monitoring Program, Fourth Quarter 1997* (ESH/EMS/970491). Full results for each well sampled during a quarter are presented alphabetically in the quarterly reports.

Another public document, the *Environmental Protection Department's Well Inventory* (ESH/EMS/970617), contains detailed maps of the wells at each monitored location.

Groundwater at SRS

When rain falls, part of the rainwater runs off of the surface of the earth into streams, and part of it soaks into the soil (figure 10–2). The water that runs off is called direct runoff, and the water that soaks in and infiltrates the soil is called groundwater. Groundwater moves through the soil and eventually reappears at



Exploration Resources, Inc.

Figure 10–1 Facilities Monitored by the SRS Monitoring Well Network, Including Areas Having Constituents Exceeding Drinking Water Standards in 1997

Key for Figure 10–1

A-Area and M-Area

- A-Area and M-Area Plume Monitoring
- A-Area and M-Area Recovery Well Network
- A-Area Background Well Near Firing Range
- A-Area Burning/Rubble Pits and A-Area Ash Pile
- A-Area Coal Pile Runoff Containment Basin
- A-Area Metals Burning Pits
- M-Area Hazardous Waste Management Facility
- Metallurgical Laboratory Seepage Basin
- Miscellaneous Chemical Basin
- Motor Shop Oil Basin
- Savannah River Laboratory Seepage Basins
- Silverton Road Waste Site

General Separations and Waste Management Areas (E-Area, F-Area, H-Area, S-Area, and Z-Area)

- Burial Ground Expansion (E-Area Vaults)
- Burma Road Rubble Pit
- E-Area Vaults
- E-Areas Hazardous Waste/Mixed Waste Disposal Facility
- F-Area Ash Basin
- F-Area Burning/Rubble Pits
- F-Area Canyon Building and A-Line Uranium Recovery Facility
- F-Area Coal Pile Runoff Containment Basin
- F-Area Effluent Treatment Cooling Water Basin
- F-Area Retention Basins
- F-Area Sanitary Sludge Land Application Site
- F-Area Seepage Basins and Inactive Process Sewer Line
- F-Area Seepage Basins Remediation Extraction Wells
- F-Area Seepage Basins Remediation Injection Tank
- F-Area Tank Farm
- H-Area Auxiliary Pump Pit
- H-Area Canyon Building
- H-Area Coal Pile Runoff Containment Basin
- H-Area Effluent Treatment Cooling Water Basin
- H-Area Retention Basins
- H-Area Sanitary Sludge Land Application Site
- H-Area Seepage Basins and Inactive Process Sewer Line
- H-Area Seepage Basins Remediation Extraction Wells
- H-Area Seepage Basins Remediation Injection Tank
- H-Area Tank Farm
- HP-52 Outfall Area
- Old Burial Ground
- Old F-Area Seepage Basin
- S-Area Defense Waste Processing Facility Vitrification Building
- S-Area Facilities
- Waste Solidification and Disposal Facility
- Wells Between the F-Area Canyon Building and the Naval Fuel Material Facility
- Z-Area Low-Point Drain Tank
- Z-Area Saltstone Facility Background Wells

C-Area

- Bioremediation Facility
- C-Area Burning/Rubble Pit
- C-Area Coal Pile Runoff Containment Basin
- C-Area Disassembly Basin
- C-Area Reactor Seepage Basins

K-Area

- K-Area Ash Basin
- K-Area Burning/Rubble Pit
- K-Area Coal Pile Runoff Containment Basin
- K-Area Disassembly Basin
- K-Area Reactor Seepage Basin
- K-Area Retention Basin
- K-Area Tritium Sump

L-Area

- L-Area Acid/Caustic Basin and L-Area Oil and Chemical Basin
- L-Area Bingham Pump Outage Pit
- L-Area Burning/Rubble Pit
- L-Area Disassembly Basin
- L-Area Reactor Seepage Basin
- L-Area Research Wells

P-Area

- P-Area Bingham Pump Outage Pit
- P-Area Burning/Rubble Pit
- P-Area Coal Pile Runoff Containment Basin
- P-Area Disassembly Basin
- P-Area Reactor Seepage Basins

R-Area

- R-Area Bingham Pump Outage Pit
- R-Area Burning/Rubble Pits
- R-Area Coal Pile
- R-Area Disassembly Basin
- R-Area Reactor Seepage Basins

Sanitary Landfill and B-Area

- B-Area Microbiology Wells
- Sanitary Landfill and Interim Sanitary Landfill

Central Shops (N-Area)

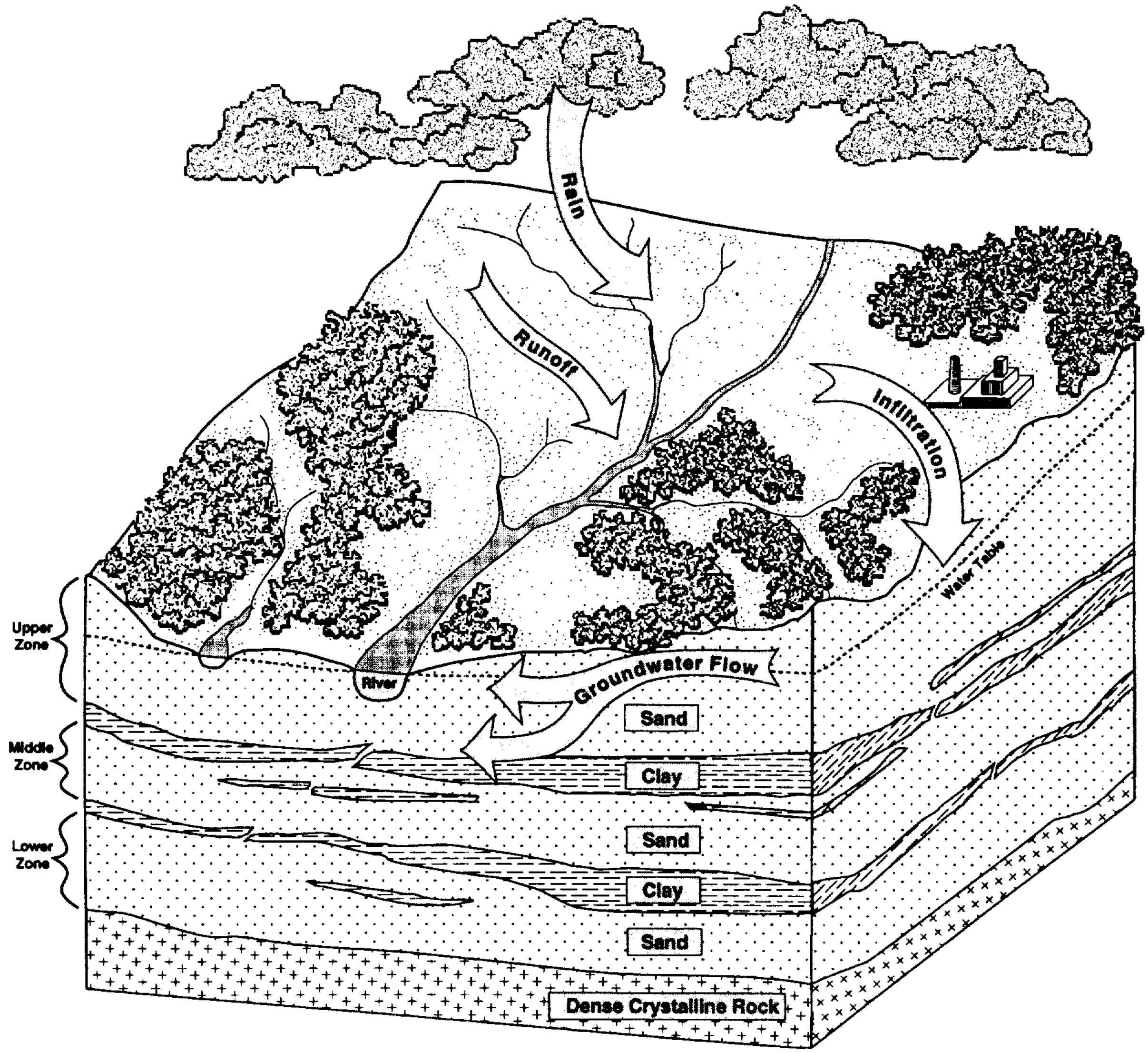
- Ford Building Seepage Basin
- Hazardous Waste Storage Facility
- N-Area Diesel Spill
- N-Area Fire Department Training Facility

D-Area and TNX

- D-Area Coal Pile, Coal Pile Runoff Containment Basin, and Ash Basins
- New TNX Seepage Basin
- Old TNX Seepage Basin
- Road A Chemical Basin (Baxley Road)
- TNX-Area Assessment Wells
- TNX-Area Background Wells
- TNX-Area Operable Unit Wells
- TNX-Area Recovery Wells
- TNX Burying Ground
- TNX Intrinsic Remediation Piezometers

Other Sites

- Background Well near Hawthorne Fire Tower
- Chemicals, Metals, and Pesticides Pits



Exploration Resources, Inc.

Figure 10–2 Groundwater at SRS

the surface in springs, swamps, or rivers. Potentially hazardous substances in the soil may dissolve as the groundwater infiltrates and moves down through the soil to the water table. In this way, contaminants in the soil can move with the groundwater and may become a health risk.

SRS is built on a 700–1,200-foot stack of sediments composed of sand, clayey sand, and clay, with a small amount of limestone. Dense crystalline rock lies under the sediments. The groundwater in the vicinity moves through the sediments, mostly in the sand layers. The clay layers allow very little groundwater to flow through them; therefore, their presence between sand layers helps direct the flow of groundwater and contaminants.

At SRS, groundwater moves in several sandy zones that are separated by less permeable clay layers. The upper zone comprises the rainwater that moves down from the surface. Water in this zone moves either laterally to discharge or downward into lower zones. Beneath the upper zone is a clay layer that retards the water moving downward into the lower zones. In some areas of SRS, this clay layer is thick and undisturbed and is effective in preventing the upper zone of groundwater from moving downward. In other areas, this clay layer is thin, broken, or missing, and the groundwater from the top zone can move readily into lower zones.

Below the upper zone is another zone of sand where the water moves relatively freely. Water in this middle zone is used for domestic water supplies. Below the middle zone is another clay layer and then a lower zone of groundwater. The lowest zone is the most important aquifer in the region and supplies water to domestic and industrial users.

Groundwater beneath SRS flows slowly—at rates ranging from inches to several hundred feet per year—toward streams and swamps on site and into the Savannah River. Figures 10–3 and 10–4 illustrate the potentiometric contours and horizontal-flow directions of the middle and lower zones beneath SRS. Similar to contour lines on a weather map that connect points of equal barometric pressure, the figures' potentiometric surface contour lines connect below-ground regions of equal hydraulic head (elevation of the water in a well or piezometer). Horizontal-flow directions of groundwater within these zones are indicated on figures 10–3 and 10–4 by bold arrows perpendicular to the contour lines. In both zones, the direction of flow beneath monitored waste sites generally is toward the Savannah River, the Savannah River Swamp, Upper Three Runs Creek, or Lower Three Runs Creek. Surface water in the swamp and creeks eventually flows into the Savannah River.

The upper zone is the most affected in general by activity at SRS. The middle zone is known to be contaminated in several areas. Contamination in the lowest zone has been identified only in A-Area and M-Area.

Monitoring wells are used extensively at SRS to assess the effect of site activities on groundwater quality. Most of the wells monitor the highest groundwater zone, although wells in lower zones are present at the sites with the larger groundwater contamination plumes.

Description of the Groundwater Monitoring Program

The groundwater monitoring program at SRS gathers information to determine the effect of site operations on groundwater quality. The program is designed to

- assist SRS in complying with environmental regulations and U.S. Department of Energy (DOE) directives
- provide data to identify and monitor constituents in the groundwater
- permit characterization of new facility locations to ensure that they are suitable for the intended facilities
- support basic and applied research projects

The groundwater monitoring program at SRS is conducted by the Environmental Geochemistry Group (EGG) of the Environmental Protection Department/Environmental Monitoring Section (EPD/EMS) of Westinghouse Savannah River Company (WSRC). To assist other departments in meeting their responsibilities, EGG provides the services for installing monitoring wells, collecting and analyzing samples, and reporting results.

The *Savannah River Site Environmental Monitoring Plan* (WSRC–3Q1–2, Section 2000) provides details about the following aspects of the groundwater monitoring program:

- well siting, construction, maintenance, and abandonment
- sample planning
- sample collection and field measurements
- analysis
- data management
- related publications, files, and databases

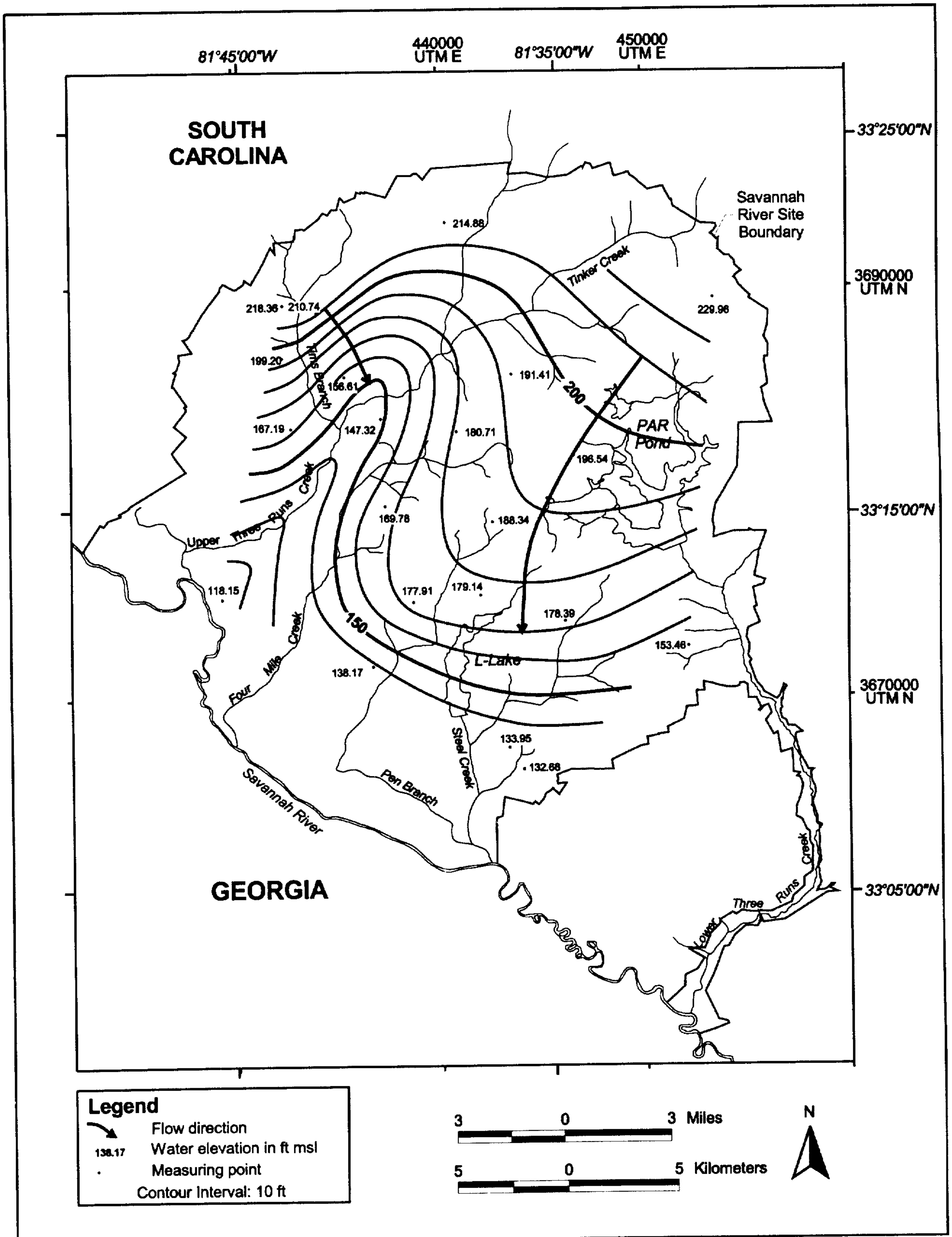
The next four sections of this chapter present overviews of several of these topics, along with information specific to 1997.

Sample Scheduling and Collection

EMS schedules groundwater sampling either in response to specific requests from SRS personnel or as part of its ongoing groundwater monitoring program. These groundwater samples provide data for reports required by federal and state regulations and for internal reports and research projects. The groundwater monitoring program schedules wells to be sampled at intervals ranging from quarterly to triennially.

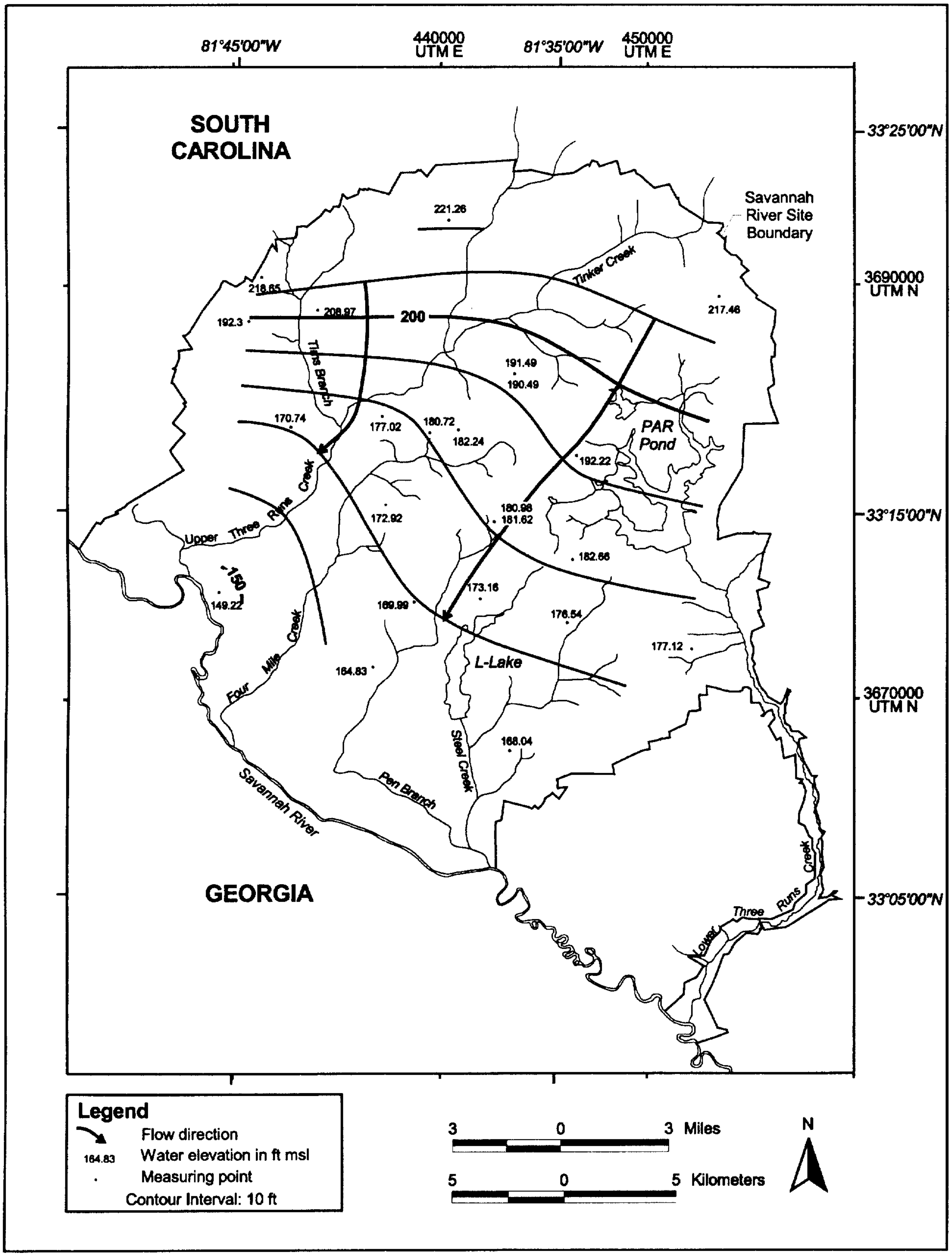
- Groundwater from new wells added to the program is analyzed for environmental-screening constituents (table 10–1) for 4 consecutive quarters for only the wells identified in the *Savannah River Site Screening Program Wells* (ESH-EMS–960084).
- Environmental-screening analyses are conducted once every 3 years for only the wells identified in the *Savannah River Site Screening Program Wells* (ESH-EMS–960084).
- If their environmental-screening constituent concentrations are above certain limits, wells identified in the *Savannah River Site Screening Program Wells* (ESH-EMS–960084) are sampled annually.

Personnel outside EMS may request sample collection as often as weekly. In addition to



Exploration Resources, Inc.

Figure 10–3 Potentiometric Surface and Horizontal Groundwater Flow Directions of the Middle Zone at SRS During the First Quarter of 1997



Exploration Resources, Inc.

Figure 10–4 Potentiometric Surface and Horizontal Groundwater Flow Directions of the Lower Zone at SRS During the First Quarter of 1997

Table 10–1 Environmental-Screening Constituents

Aluminum
Arsenic
Barium
Boron
Cadmium
Calcium
Chloride
Chromium
Fluoride
Gross alpha
Iron
Lead
Lithium
Magnesium
Manganese
Mercury
Nitrate-nitrite as nitrogen
Nonvolatile beta
Potassium
Selenium
Silica
Silver
Sodium
Sulfate
Total dissolved solids
Total organic carbon
Total organic halogens
Total phosphates (as P)
Tritium

environmental-screening constituents, constituents that may be analyzed by request include suites of herbicides, pesticides, additional metals, volatile organics, and others. Radioactive constituents that may be analyzed by request include gamma emitters, iodine-129, strontium-90, radium-228, uranium isotopes, and other alpha and beta emitters.

Groundwater samples are collected from monitoring wells, generally with either pumps or bailers dedicated to the well to prevent cross-contamination among wells. Occasionally, portable sampling equipment is used; this equipment is decontaminated between wells.

Sampling and shipping equipment and procedures are consistent with EPA, South Carolina Department of Health and Environmental Control (SCDHEC), and U.S. Department of Transportation guidelines. EPA-recommended preservatives and sample-handling techniques are used during sample storage and transportation to both onsite and offsite analytical laboratories. Potentially radioactive samples are screened for total activity (alpha and beta emitters) prior to shipment to determine appropriate packaging and labeling requirements.

Deviations (caused by dry wells, inoperative pumps, etc.) from scheduled sampling and analysis for 1997 are enumerated in the SRS quarterly groundwater monitoring reports cited on the first page of this chapter.

In 1997, approximately 50,500 radiological analyses and 344,100 nonradiological analyses were performed on groundwater samples collected from approximately 1,350 monitoring wells.

Analytical Procedures

In 1997, General Engineering Laboratories of Charleston, South Carolina, performed most of the groundwater analyses. Recra LabNet Philadelphia of Lionville, Pennsylvania; QST Environmental, Inc., of Gainesville, Florida; and EMAX Laboratories, Inc., of Torrance, California, also performed groundwater analyses. The contracted laboratories are certified by SCDHEC to perform specified analyses.

The EMS radiological laboratory at SRS screened potentially radioactive samples for total activity prior to shipment. Environmental Physics, Inc., of Charleston subcontracted radiological analyses from General Engineering Laboratories; Thermo NUtech of Oak Ridge, Tennessee, and Quanterra Incorporated of Richland, Washington, subcontracted radiological analyses from Recra LabNet Philadelphia.

Full lists of constituents analyzed, analytical methods used, and the laboratories' estimated quantitation limits are given in the SRS quarterly groundwater reports referenced earlier.

Evaluation of Groundwater Data

EMS receives analytical results and field measurements as reports and as ASCII files that are loaded into databases at SRS. Logbooks track receipt and transfer of data to the Geochemical Information Management System (GIMS) database, and computer programs present the data in a format that can be validated.

Quality control practices include the following:

- verification of well names and sample dates for field and analytical data
- verification that all analyses requested on the chain-of-custody forms were completed by each laboratory
- identification of data entry problems (e.g., duplicate records, incorrect units)

- comparison of analytical data to historical data and review of the data for transcription, instrument, or calculation errors
- comparison of blind replicates and laboratory in-house duplicates for inconsistencies
- identification of laboratory blanks and blind blanks with elevated concentrations

Possible transcription errors and suspect results are documented and submitted to the appropriate laboratory for verification or correction. No changes are made to the database until the laboratory documents the problem and solution. Changes to the database are recorded in a logbook.

The quarterly groundwater monitoring reports identify queried results verified by the laboratory and list groundwater samples associated with blanks having elevated results. These reports also present the results of intralaboratory and interlaboratory quality assurance comparisons (chapter 11, "Quality Assurance").

Changes to the Groundwater Monitoring Program during 1997

Well Abandonments and Additions; Changes to the Sampling Schedule

During 1997, 16 wells were abandoned for the following reasons:

- Two wells from the chemicals, metals, and pesticides pits were abandoned because they were dry.
- Fourteen wells in the R-Area reactor seepage basins were abandoned because some of them were substandard and the remainder were not needed as part of the R-Area monitoring program.

The following 114 wells and piezometers were monitored for the first time in 1997:

- Two new wells were installed in the C-Area burning/rubble pit for Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) characterization.
- Four new wells were installed in the chemicals, metals, and pesticides pits for RFI/RI characterization.
- Four new wells were installed in the F-Area retention basin for sampling in conjunction with the RFI/RI project.
- Three new wells were installed at Ford Building seepage basin to comply with RFI/RI requirements.
- Eight new wells and four new piezometers were installed in the H-Area retention basin in support of RFI/RI characterization.
- Four new wells were installed in the Warner's Pond and HP-52 outfall area to support RFI/RI characterization.
- Two new wells were installed in the K-Area Bingham pump outage pit to be sampled in compliance with requests from EPA and SCDHEC.
- Two new wells were installed in the L-Area burning/rubble pit to comply with RFI/RI characterization requirements.
- Nine wells were sampled at L-Lake to provide information for an RFI/RI/Baseline Risk Assessment report.
- Three new wells were installed in the L-Area Bingham pump outage pit to be sampled in compliance with RFI/RI requirements.
- Three new wells were installed in the P-Area Bingham pump outage pit to be sampled in compliance with RFI/RI requirements.
- Three new wells were installed in the R-Area Bingham pump outage pit to be sampled in compliance with RFI/RI requirements.
- One new well was installed to replace an existing well in D-Area coal pile runoff containment basin, and 26 additional wells were sampled for the first time to support RFI/RI precharacterization.
- Eight new wells were installed in the miscellaneous chemical basin for sampling in conjunction with the RFI/RI project in the miscellaneous chemical basin/metals burning pit.
- Twenty-eight new wells were installed at the R-Area reactor seepage basins as part of an RFI/RI project.
- One new well was installed at the TNX Operative Unit to support TNX effectiveness monitoring for the TNX Air Stripper.
- Three new wells were installed at the TNX Operative Unit to support a GeoSiphon cell demonstration and USGS intrinsic bioremediation investigation.

The following 49 wells received only water level measurements for the first time in 1997:

- Twenty-four wells in the F-Area seepage basins
- Four piezometers in the H-Area retention basin

- Twenty-one wells in the H-Area seepage basins

Two water treatment unit injection tanks, one in F-Area and one in H-Area, were monitored in 1997, as required for the first time by SCDHEC.

The following changes were implemented in the groundwater monitoring quality control program during 1997:

- EGG eliminated the split field blank and split blind replicate for RCRA-regulated quality assurance (QA) sites.
- Volatile organic constituents no longer are requested for analysis from field blanks (Because a trip blank analyzed for volatile organic constituents accompanies every cooler containing samples to be analyzed for volatiles, it was determined that those field blank analyses were redundant.)
- Sampling costs for trip blank visits were eliminated by having the subcontracted laboratories, rather than the samplers, prepare the trip blanks.
- The frequency of QA sampling at RCRA-regulated sites was reduced from 10 percent to 5 percent.

Groundwater Monitoring Results at SRS

This section summarizes groundwater monitoring results during the first three quarters of 1997 for each of the following areas at SRS:

- A-Area and M-Area
- C-Area
- D-Area and TNX
- General separations and waste management areas (E-Area, F-Area, H-Area, S-Area, and Z-Area)
- K-Area
- L-Area and chemicals, metals, and pesticides pits
- N-Area
- P-Area
- R-Area
- Sanitary Landfill and B-Area

Groundwater monitoring results for each area in the above list are (1) illustrated with a figure showing the extent of contamination, (2) described in the text, and (3) summarized with a table.

A figure (from each area) shows facilities of interest at or near the site and illustrates areas of notable contamination above DWS. The figures do not specify every contaminant identified through groundwater monitoring, but they illustrate contamination above DWS.

Each figure is accompanied by a brief description of the sites and facilities of interest in the area, an explanation of groundwater flow, and the nature of contamination in the area.

The description of contamination at each area concludes with a table that summarizes the following information:

- major groups of constituents
- percent of wells sampled that contained constituents above drinking water standards
- number of wells sampled for each constituent group
- sources of contamination

Substantial areas of contamination identified in the tables are illustrated in more detail, in some cases, in the accompanying figures. For example, a table may identify metals contamination, and the figure may show that most of that contamination is lead.

Groundwater Contamination at A-Area and M-Area

Location and Facilities

The administration and manufacturing areas, A-Area and M-Area, are located in the northwest portion of SRS. A-Area houses administrative and research facilities, including the Savannah River Technology Center. M-Area was used for production of nuclear fuels, targets, and other reactor components.

A-Area and M-Area include the following facilities and sites associated with the groundwater monitoring program:

- A-Area ash pile
- A-Area burning/rubble pits
- A-Area coal pile runoff containment basin
- A-Area metals burning pit
- M-Area Hazardous Waste Management Facility
- M-Area settling basin
- Metallurgical Laboratory seepage basin
- Miscellaneous chemical basin
- Motor Shop oil basin
- Savannah River Laboratory seepage basins
- Silverton Road waste site

Nature of Contamination

Surface drainage in A-Area and M-Area is toward Tims Branch, approximately to the east, and toward valleys to the northwest and southwest that lead to the Savannah River.

The water table in this vicinity slopes to the southeast, south, and southwest toward Tims Branch and other discharge points. Most of the water of the upper saturated zone migrates downward into lower water-bearing zones.

Figure 10–5 shows the extent of contamination and the location of the various contaminant groups at A-Area and M-Area. There is a large groundwater contamination plume under and downgradient of A-Area and M-Area. Organic constituents—the primary contaminants—are found throughout the area and account for the largest percentage of contaminated wells. Trichloroethylene, tetrachloroethylene, and other organic compounds were used as degreasers during manufacturing and research. After use, organic wastes, metals, and other contaminants were placed into unlined basins, from which they slowly seeped into the groundwater. Contaminants also entered the groundwater as the result of spills or leaking pipes.

The highest concentrations of organics and metals generally are found beneath seepage and settling basins in central and southern portions of the area. The entire contaminant plume covers approximately 3 square miles and is approximately one-third mile from the SRS boundary.

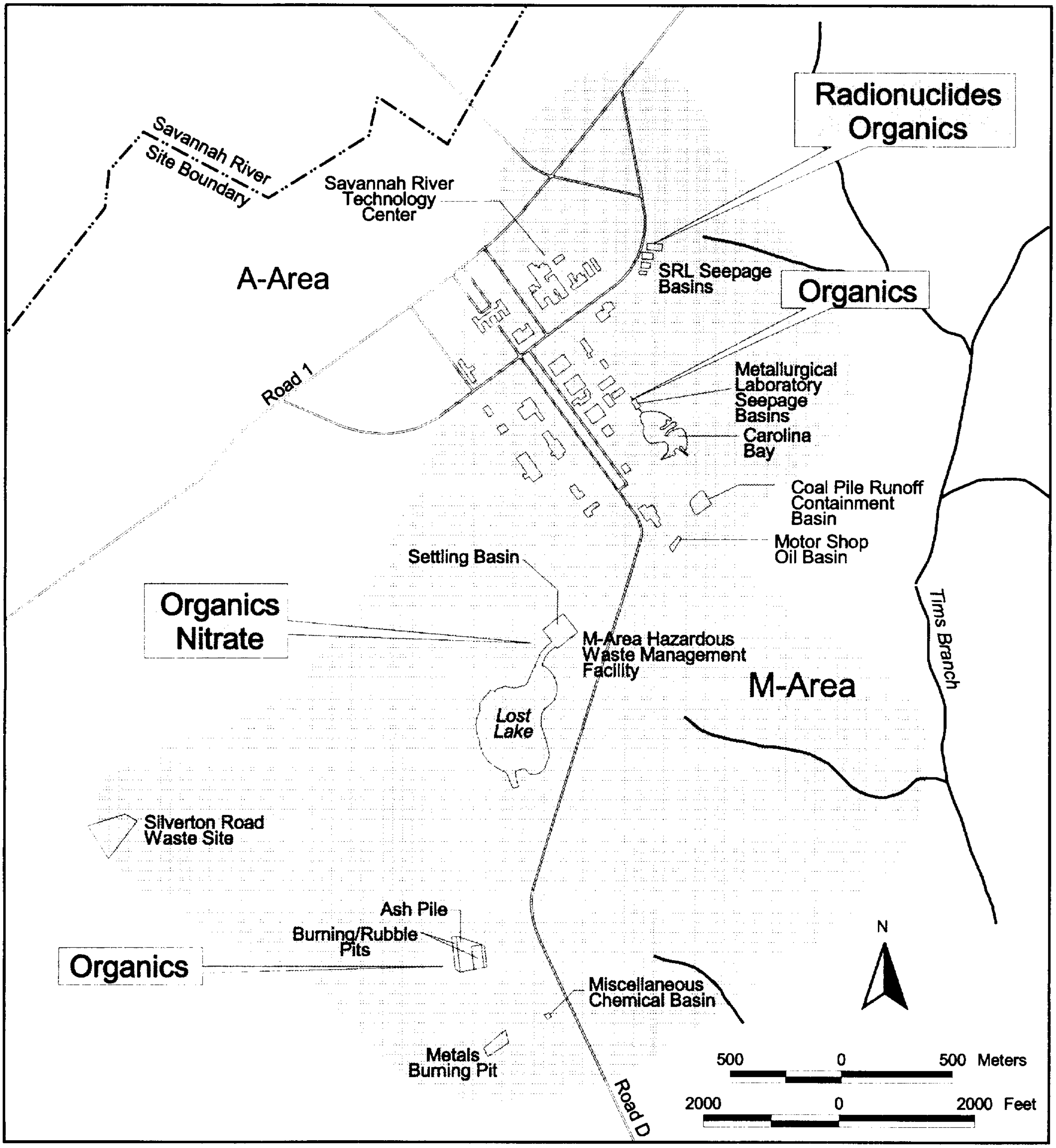
Because of the chemical nature of trichloroethylene and tetrachloroethylene and the groundwater conditions in the upper aquifer zone, the contaminant movement generally is downward into deeper aquifers. Once in the deeper aquifers, these contaminants may be moved horizontally by faster groundwater flow rates.

The ASB 6 well cluster monitors the contaminant plume just west of the Savannah River Laboratory seepage basins. Figure 10–6 illustrates the concentration of trichloroethylene in these wells since January 1991. The trichloroethylene concentration is highest in well ASB 6AA, which monitors an aquifer zone below those monitored by ASB 6A and ASB 6C. Trichloroethylene concentrations also are notable in well ASB 6TA, which monitors the Crouch Branch Aquifer Zone, the deepest aquifer zone monitored in A-Area and M-Area.

Table 10–2 summarizes 1997 groundwater monitoring results for A-Area and M-Area.

Remediation

Ongoing remediation efforts have substantially altered the groundwater and contaminant flow patterns in the upper, middle, and lower aquifer zones beneath A-Area and M-Area. Remediation efforts include capping the basins and extracting and processing volatile organics from the groundwater. At the end of 1997, approximately 363,000 pounds of volatile organics had been removed from the groundwater since 1985. Remediation efforts also included pumping contaminated air to six units, one of which was new in 1997, where the volatile organic compounds were destroyed. At the end of 1997, these units had destroyed approximately 255,000 pounds of degreaser solvent since August 1994. While ongoing remediation never will clean up contaminated groundwater zones completely, it can slow the spread of contamination and minimize the impact to the environment.



Exploration Resources, Inc.

Figure 10–5 Extent of Groundwater Contamination Beneath A-Area and M-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

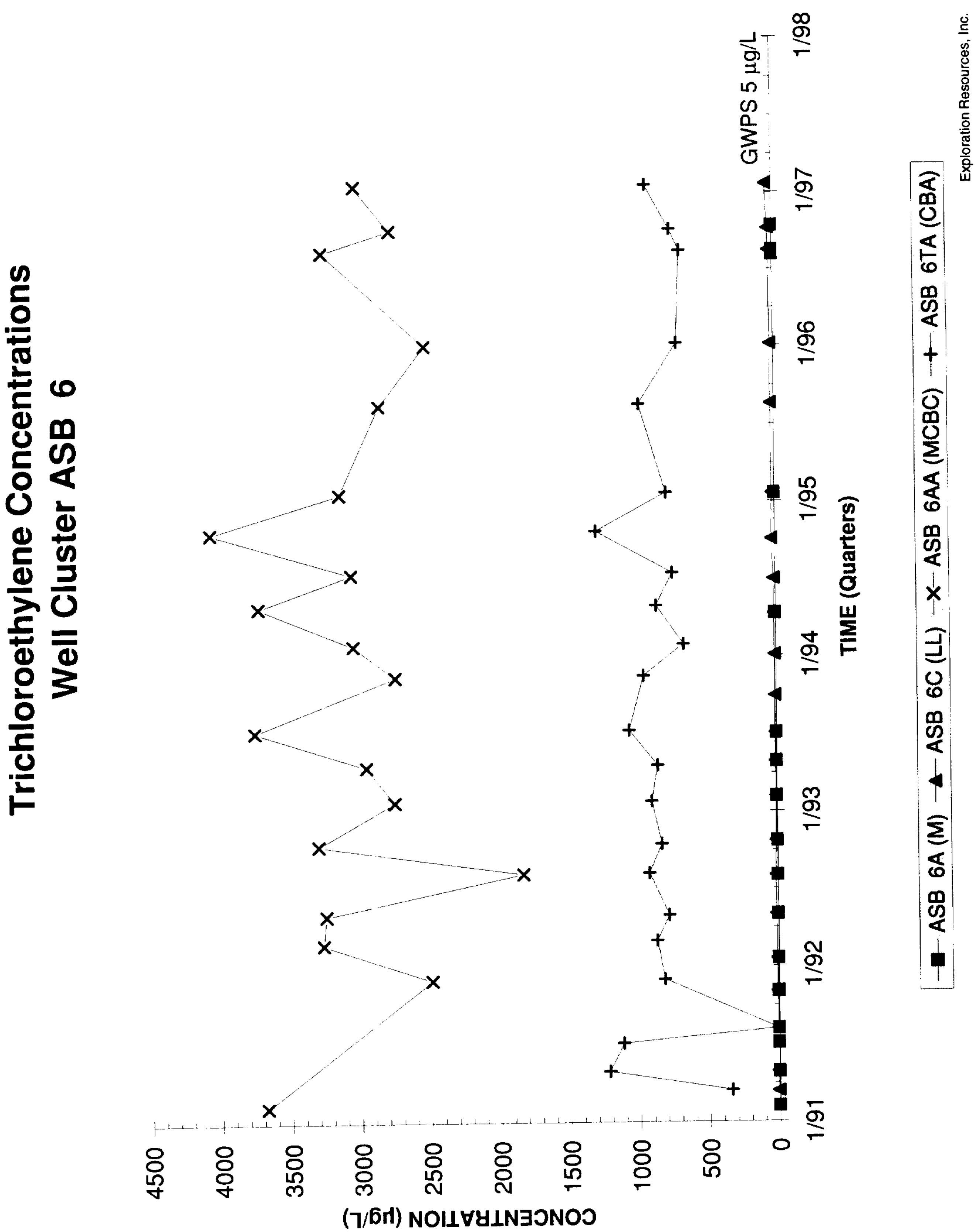
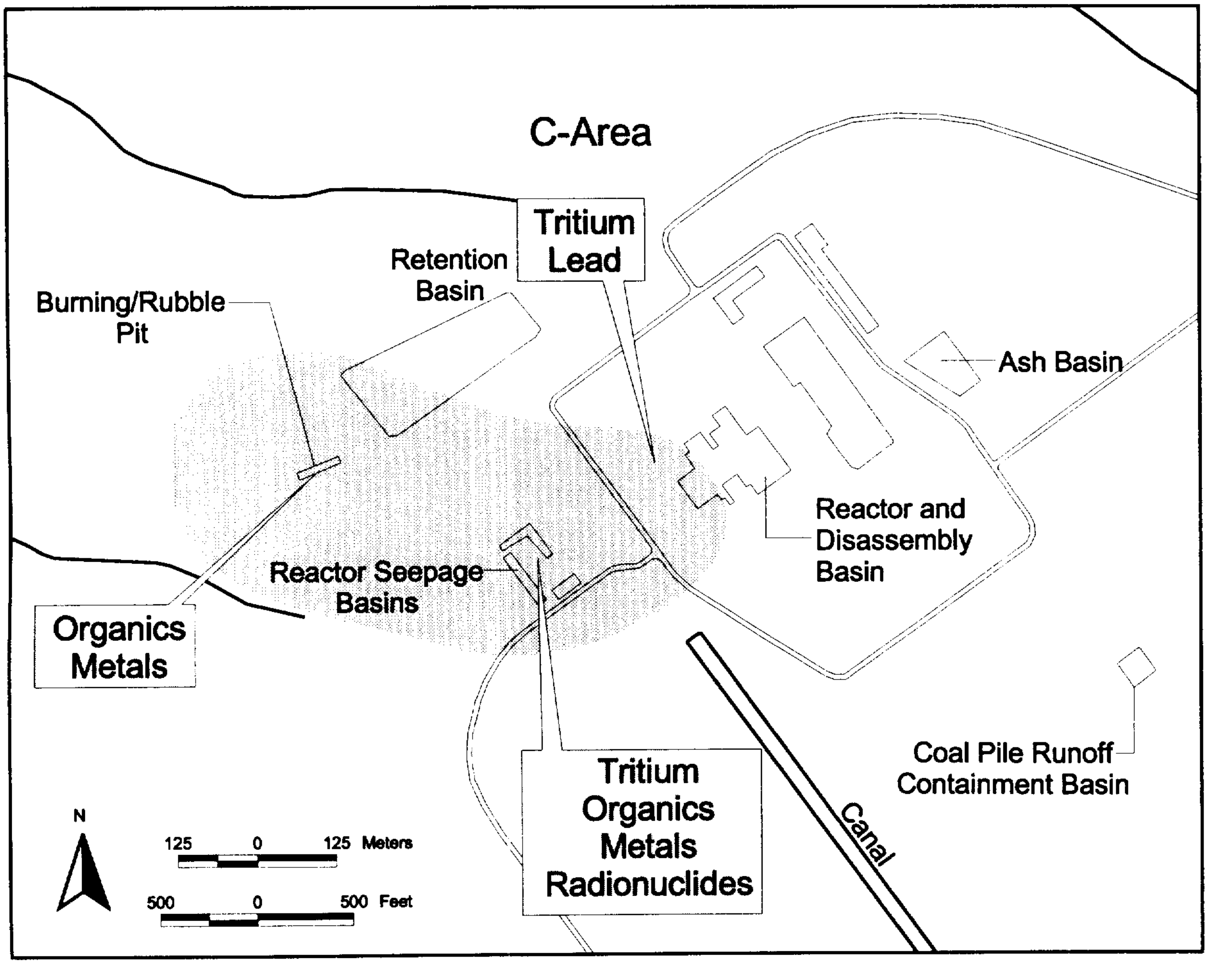


Figure 10–6 Trichloroethylene Concentrations in Well Cluster ASB 6

Table 10–2 Constituent Groups Above Drinking Water Standards at A-Area and M-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	0	13	None
Metals	2%	288	HWMF, Motor Shop oil basin, settling basin, Silverton Road waste site
Organics	52%	280	HWMF, metals burning pit, Met Lab seepage basin, miscellaneous chemical basin, SRL seepage basins
Pesticides/PCBs	5%	43	HWMF
Tritium	0%	41	None
Other radionuclides	24%	271	SRL seepage basins
Other constituents	7%	276	HWMF

Note: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.



Exploration Resources, Inc.

Figure 10–7 Extent of Groundwater Contamination Beneath C-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at C-Area

Location and Facilities

C-Area, which is in the west-central part of SRS, contains the C-Area reactor. The C-Area reactor achieved criticality in March 1955 and was shut down in 1985 for maintenance. It was placed on cold standby in 1987, followed by cold shutdown.

C-Area includes the following facilities associated with the groundwater monitoring program:

- C-Area ash basin
- C-Area burning/rubble pit
- C-Area coal pile runoff containment basin
- C-Area disassembly basin
- C-Area reactor
- C-Area reactor seepage basins
- C-Area retention basin

Nature of Contamination

Groundwater flow beneath C-Area tends to be toward incised creeks near the area. Horizontal flow generally is west toward Four Mile Creek (also known as Fourmile Branch), and surface drainage is predominantly west toward a tributary of Four Mile Creek.

During routine reactor operations, the radioactivity level from tritium built up in the disassembly basins that held activated target rods. Periodically, the water from these basins was purged to limit worker exposure. During different time periods, the water was discharged to the reactor seepage basins or to surface streams. Tritium also escaped from the disassembly basins.

The C-Area burning/rubble pit and basins also received materials that could cause groundwater contamination.

Figure 10–7 shows the extent of contamination and the location of the various contaminant groups at C-Area. Trichloroethylene is the most widespread contaminant; the highest activities are in wells near the burning/rubble pits.

Table 10–3 shows the tritium concentrations in selected C-Area wells from 1993 to 1997. Lead and tritium also are present in many wells. Thallium is present in wells near the burning/rubble pits and reactor seepage basins, and other constituents are elevated in a few wells. Monitoring results are consistent with those of previous years.

Table 10–4 summarizes 1997 groundwater monitoring results for C-Area.

Table 10–3 Tritium Concentrations (in µCi/mL) in Selected C-Area Wells, 1993–1997

Well	1993	1994	1995	1996	1997
CDB 1	2.3E–05	9.6E–05	2.8E–05	1.6E–05	2.6E–05
CDB 2	1.4E–03	1.9E–03	2.4E–04	1.8E–04	4.3E–04
CSB 1A	5.6E–05	4.1E–05	7.8E–05	2.3E–05	2.9E–05
CSB 3A	3.1E–02	3.0E–02	2.1E–03	2.3E–02	1.1E–02
CSB 4A	1.7E–02	1.9E–02	2.4E–02	1.4E–02	7.6E–03
CSB 5A	1.5E–03	3.1E–03	3.4E–03	3.5E–03	4.0E–03
CSB 6A	5.0E–03	6.6E–03	3.8E–03	2.7E–03	4.4E–03

Notes: Data for CDB 1 and CDB 2 are from third quarter of the respective year. Data for the CSB wells are from third quarter for 1993 and 1994, first quarter for 1995 and 1997, and second quarter for 1996.

The federal final primary DWS for tritium is 2.0E–05 µCi/mL.

Table 10–4 Constituent Groups Above Drinking Water Standards at C-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	60%	15	Burning/rubble pit, disassembly basin, reactor seepage basins
Organics	67%	18	Burning/rubble pit, reactor seepage basins
Pesticides/PCBs	0%	6	None
Tritium	58%	12	Disassembly basin, reactor seepage basins
Other radionuclides	36%	11	Reactor seepage basins
Other constituents	0	17	None

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans were not sampled at C-Area during 1997.

Groundwater Contamination at D-Area and TNX

Location and Facilities

D-Area, located in the southwest part of SRS, includes a large coal-fired power plant and the inactive heavy-water facilities.

D-Area includes the following facilities associated with the groundwater monitoring program:

- D-Area burning/rubble pits
- D-Area coal pile, coal pile runoff containment basin, and ash basins
- D-Area oil disposal basin
- Road A chemical basin (Baxley Road)

TNX, also located in the southwest part of SRS—and operated by the Savannah River Technology Center—tests equipment prior to installation and develops new designs. The nearest SRS boundary is the Savannah River, approximately one-quarter mile to the west.

Facilities in TNX include the following:

- New TNX seepage basin
- Old TNX seepage basin
- TNX burying ground

Nature of Contamination

The water table in D-Area discharges to the Savannah River and to a nearby swamp along Beaver Dam Creek. The water table surface in the vicinity of the coal pile runoff containment basin in D-Area is very close to the ground surface and drains to Beaver Dam Creek, which flows into the Savannah River Swamp.

Figure 10–8 shows the extent of contamination and the location of the various contaminant groups at D-Area and TNX. There is substantial contamination of the groundwater near the coal pile runoff containment basin. The water is characterized by high conductivity and total dissolved solids. Elevated levels of metals, alpha-emitting radionuclides, and volatile organics are present. The contamination is consistent with the leaching of coal and coal ash. Table 10–5 shows nickel concentrations in selected D-Area wells from 1993 to 1997.

A separate plume of contaminated groundwater is present near the D-Area oil disposal basin. Volatile organics and lead have been detected above DWS.

The water table in TNX discharges to the Savannah River and the nearby Savannah River Swamp.

There is a plume of contaminated groundwater underneath much of TNX and downgradient into the Savannah River Swamp. Volatile organic compounds and nitrate are the most widely distributed contaminants. Lead and thallium also are present near the known disposal sites.

Table 10–6 summarizes 1997 groundwater monitoring results for D-Area and TNX.

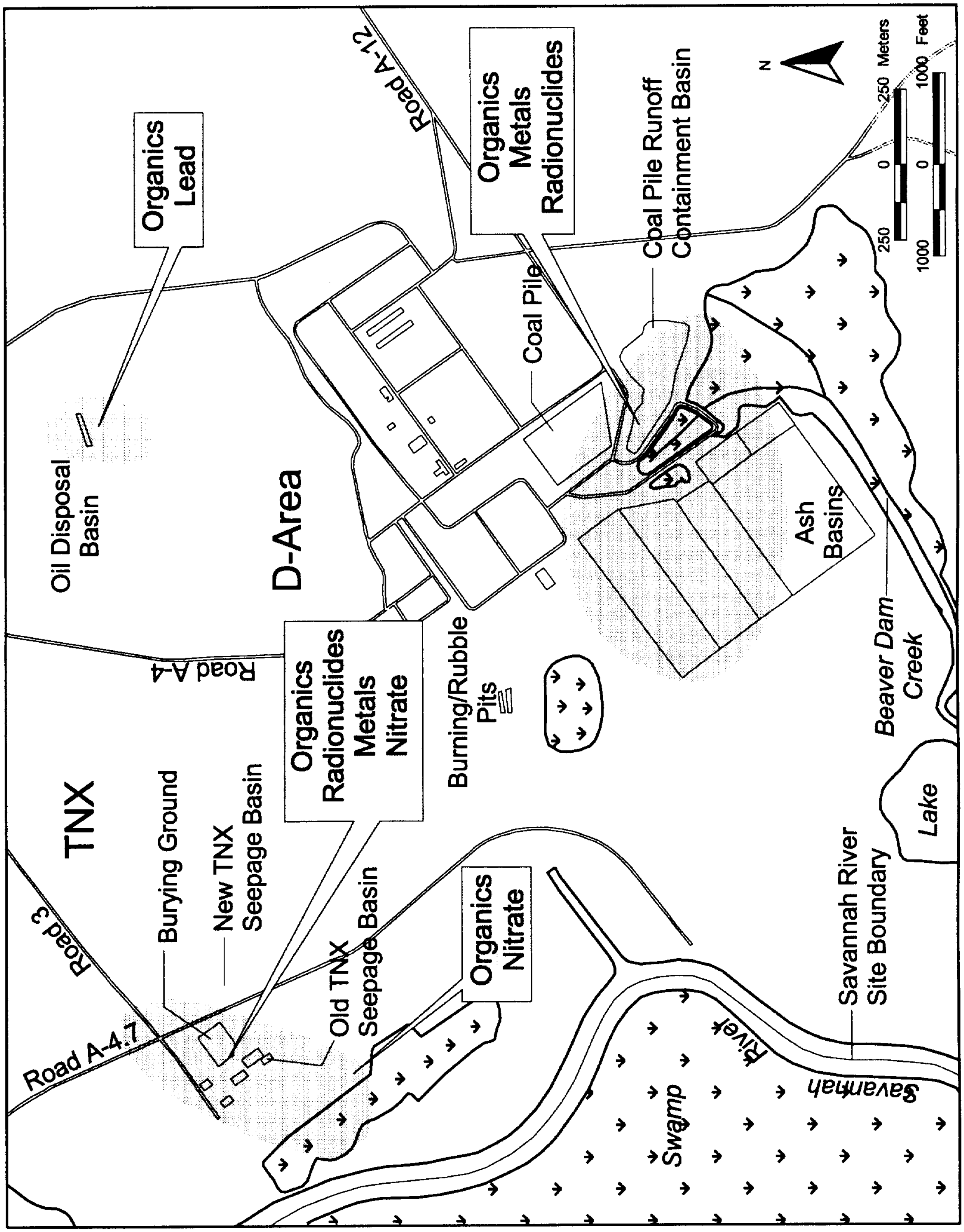
Table 10–5 Nickel Concentrations (in µg/L) in Selected D-Area Wells, 1993–1997

Well	1993	1994	1995	1996	1997
DCB 1A	5,900	3,590	5,010	NA	1,090
DCB 4A	289	363	221	369	429
DCB 5A	189	207	197	NA	372
DCB 6	1,920	2,050	NA	NA	1,740
DCB 10	1,570	5,230	460	1,390	1,090
DCB 15	468	530	676	NA	628

Notes: NA = not analyzed. Nickel was not analyzed in these wells during 1996. DCB 6 was not sampled during 1995 because of mechanical problems.

Data for 1993 and 1994 are from third quarter. Data for 1995 and 1997 are from first quarter. Data for 1996 are from second quarter.

The federal final primary DWS for nickel is 100 µg/L.



Exploration Resources, Inc.

Figure 10–8 Extent of Groundwater Contamination Beneath D-Area and TNX in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Table 10–6 Constituent Groups Above Drinking Water Standards at D-Area and TNX in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	0%	31	None
Metals	36%	107	Coal facilities, oil disposal basin, old TNX seepage basin, TNX burying ground
Organics	41%	108	Coal facilities, oil disposal basin, old TNX seepage basin, TNX burying ground
Pesticides/PCBs	0%	80	None
Tritium	2%	99	Coal facilities, north of new TNX seepage basin
Other radionuclides	29%	99	Coal facilities, old TNX seepage basin, TNX burying ground
Other constituents	16%	104	Old TNX seepage basin, TNX burying ground

Note: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Groundwater Contamination at the General Separations and Waste Management Areas

Location and Facilities

The separations and waste management areas, which include E-Area, F-Area, H-Area, S-Area, and Z-Area, are located in the central part of SRS. Reactor-produced materials are processed in the chemical separations plants in F-Area and H-Area, where uranium, plutonium-238, and plutonium-239 are separated from each other and from fission products. These areas also have facilities for purification and packaging of tritium and for storage of fission wastes.

The separations and waste management areas include the following facilities associated with the groundwater monitoring program:

E-Area

- Burial Ground expansion (E-Area Vaults)
- E-Area Hazardous Waste/Mixed Waste Disposal Facility
- Old Burial Ground
- Radioactive Waste Burial Ground (also known as Solid Waste Disposal Facility)

F-Area

- F-Area acid/caustic basin
- F-Area Burma Road rubble pit
- F-Area burning/rubble pits
- F-Area canyon building and A-Line Uranium Recovery Facility
- F-Area coal pile runoff containment basin and ash basins
- F-Area effluent treatment cooling water basin
- F-Area sanitary sludge land application site
- F-Area seepage basins and inactive process sewer line
- F-Area tank farm
- New F-Area retention basin
- Old F-Area retention basin
- Old F-Area seepage basin

H-Area

- H-Area acid/caustic basin
- H-Area auxiliary pump pit
- H-Area canyon building
- H-Area coal pile runoff containment basin and ash basin
- H-Area effluent treatment cooling water basin
- H-Area sanitary sludge land application site
- H-Area retention basin
- H-Area seepage basins and inactive process sewer line
- H-Area tank farm
- New H-Area retention basin
- Old H-Area retention basin

S-Area

- Defense Waste Processing Facility Vitrification Building
- S-Area auxiliary pump pit
- S-Area low-point pump pit

Z-Area

- Z-Area low-point drain tank
- Z-Area Saltstone Disposal Facility
- Waste Solidification and Disposal Facility

Nature of Contamination

Surface drainage in these areas of SRS is to Four Mile Creek to the south and Upper Three Runs Creek and its tributaries to the north and west.

E-Area, F-Area, and H-Area are located on the groundwater divide between Four Mile Creek and Upper Three Runs Creek. Near-surface groundwater in the southern portions of these areas discharges to Four Mile Creek and its tributaries. Near-surface groundwater in the northern portions of these areas discharges to Upper Three Runs Creek and its tributaries to the north.

S-Area and Z-Area are located on the groundwater divide between Upper Three Runs Creek and its tributaries to the west.

Figure 10–9 shows the extent of contamination and the location of the various contaminant groups at the general separations areas. The facilities at E-Area, F-Area, and H-Area have been sources of substantial groundwater pollution. In the past, the seepage and retention basins in F-Area and H-Area have been used to dispose of liquids containing radionuclides, metals, organics, and nitrates. Radioactive liquids have leaked into the groundwater below the tank farms. Tritium and metals have leached from materials buried in E-Area. Several stabilization and closure programs have been implemented to reduce the impact of the sources of groundwater contamination. The newer facilities in S-Area and Z-Area are not known to produce any groundwater pollution.

Many groundwater contamination plumes overlap in the area. Plumes from the Old Burial Ground and the F-Area and H-Area seepage basins discharge radionuclides, metals, nitrates, and tritium into Four Mile Creek. An extensive tritium plume is migrating north from the Solid Waste Disposal Facility. Other plumes are under the buildings, tank farms, and other waste disposal areas.

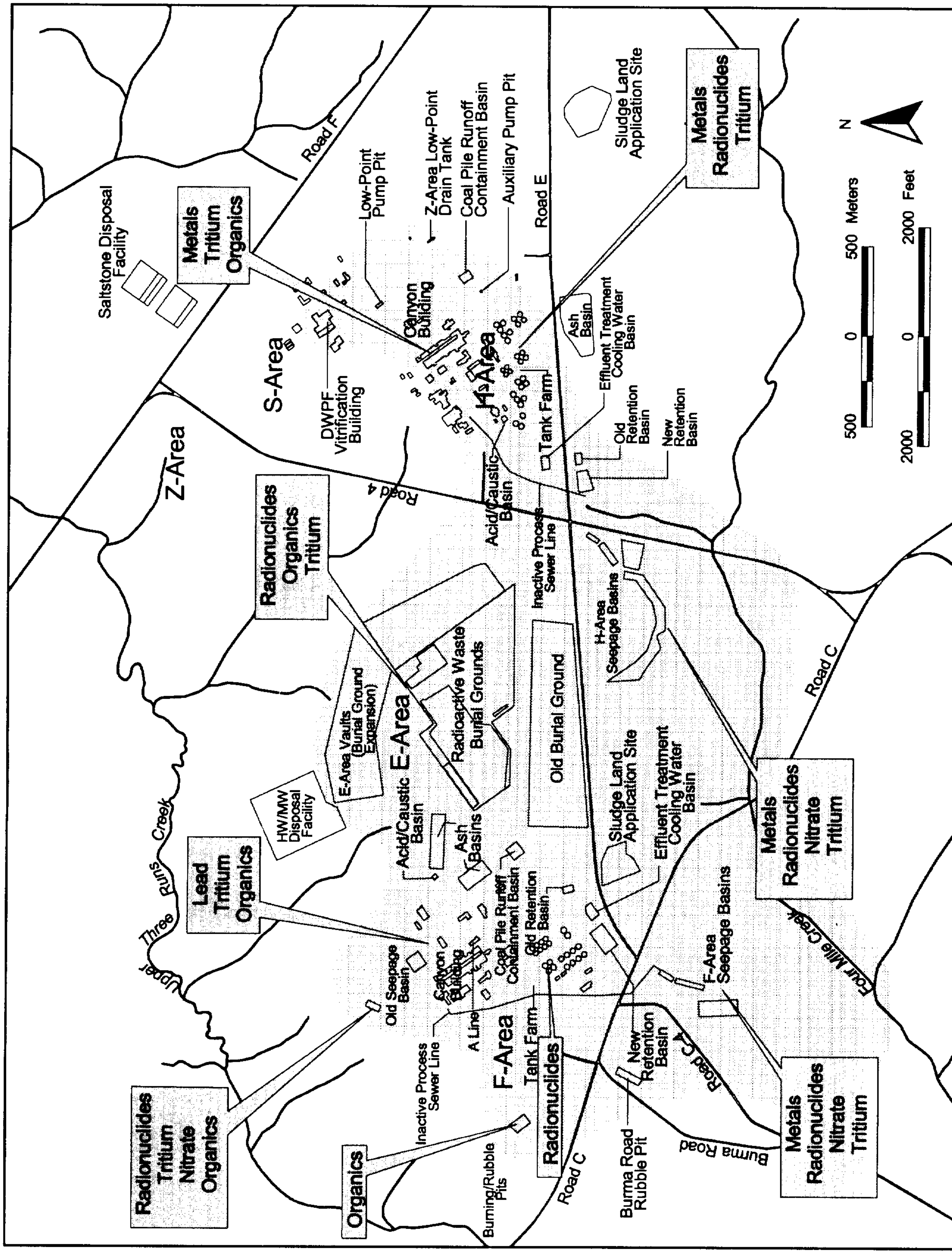
The F-Area HWMF well network monitors three distinct hydrostratigraphic units in the uppermost aquifer beneath the facility. Figure 10–10 illustrates the concentration of gross alpha in well cluster FSB 95 since January 1991. The gross alpha concentration is higher in well FSB 95DR but is also notable in FSB 95CR. Groundwater flow in Water Table and Barnwell/McBean aquifer zones generally are south or southwest toward Four Mile Creek.

Table 10–7 summarizes 1997 groundwater monitoring results for the general separations and waste management areas.

Table 10–7 Constituent Groups Above Drinking Water Standards at the General Separations and Waste Management Areas in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	0%	14	None
Metals	16%	520	Canyon buildings, H-Area tank farm, seepage basins
Organics	8%	384	Burial Grounds, burning/rubble pit, canyon buildings, old F-Area seepage basin
Pesticides/PCBs	0%	38	None
Tritium	48%	432	Burial Grounds, canyon buildings, H-Area tank farm, seepage basins
Other radionuclides	37%	441	Burial Grounds, seepage basins, tank farms
Other constituents	25%	365	Seepage basins

Note: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.



Exploration Resources, Inc.

Figure 10–9 Extent of Groundwater Contamination Beneath the General Separations and Waste Management Areas in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

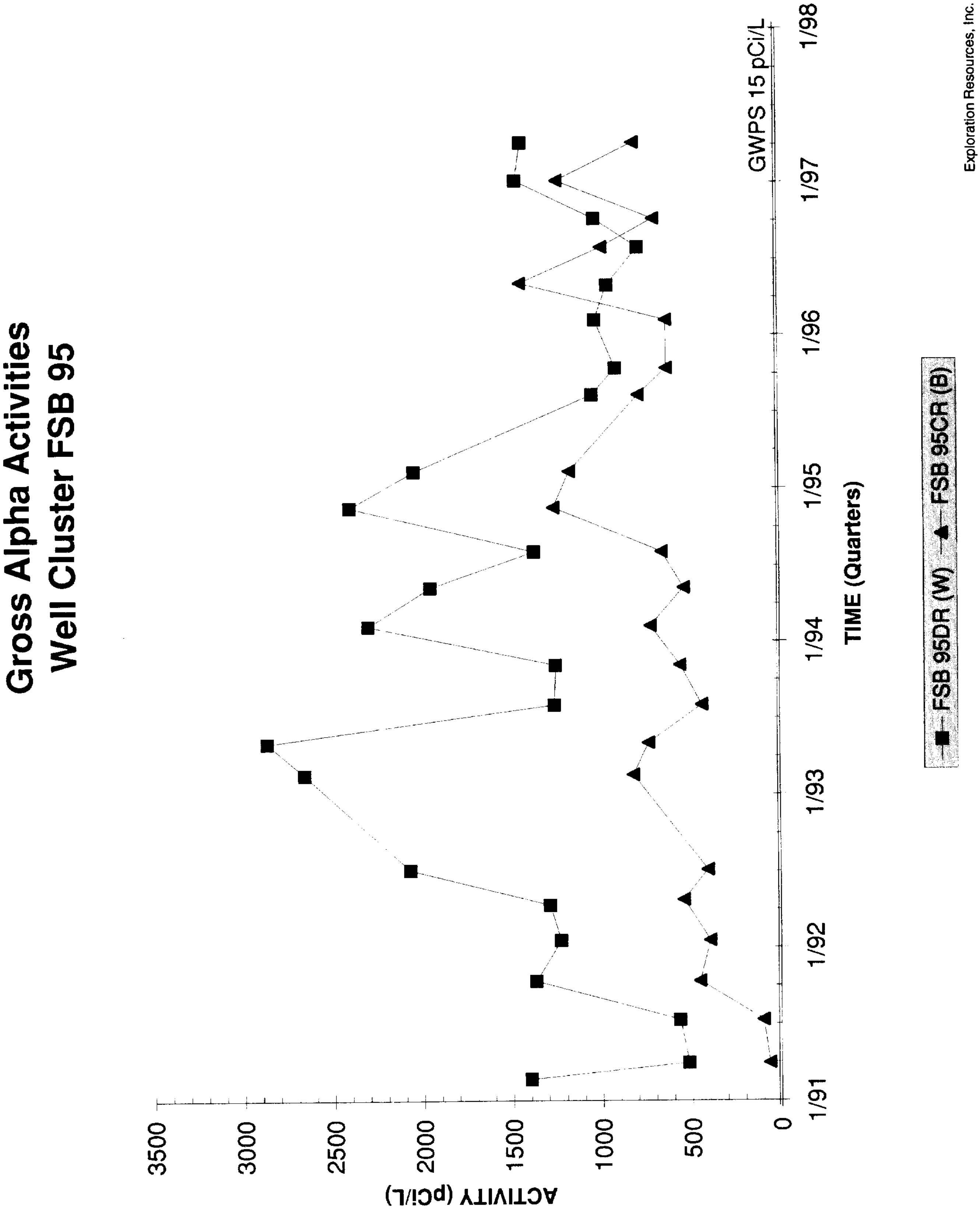
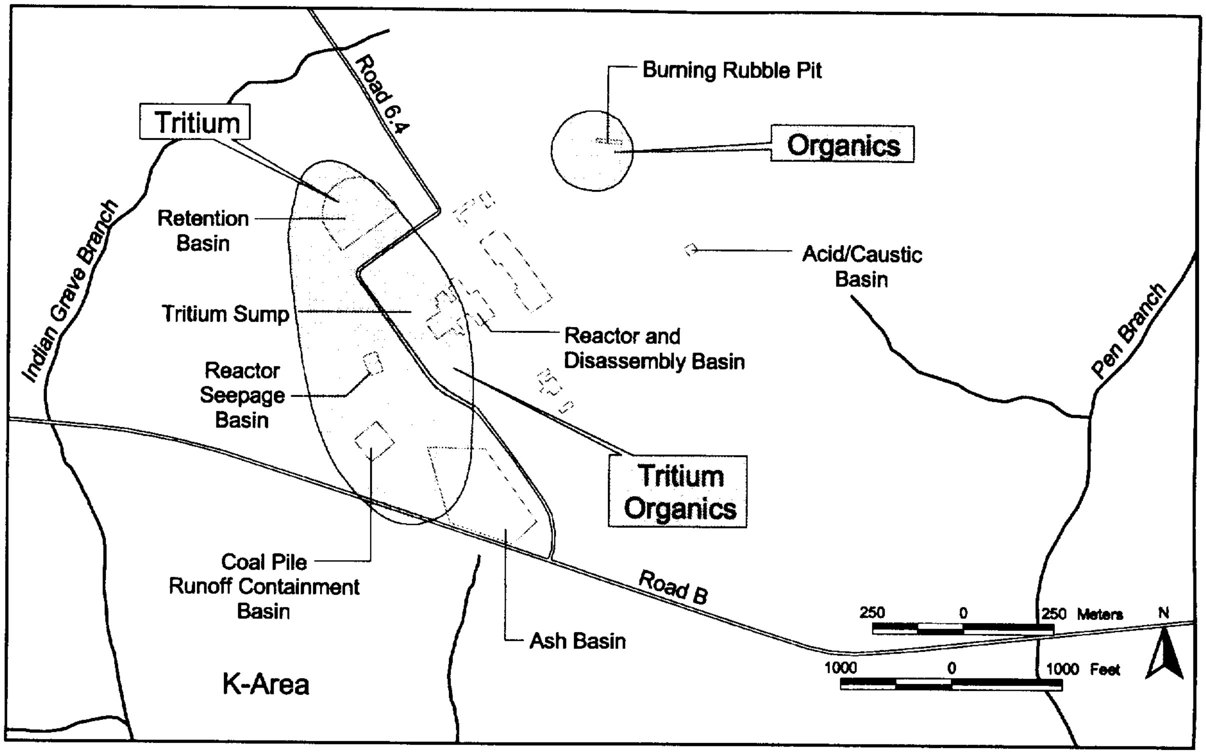


Figure 10–10 Gross Alpha Activities in Well Cluster FSB 95



Exploration Resources, Inc.

Figure 10–11 Extent of Groundwater Contamination Beneath K-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at K-Area

Location and Facilities

K-Area is in the south-central part of SRS and contains the K-Area reactor, which achieved criticality in 1954 and was shut down in 1988 for maintenance. The reactor was placed in cold shutdown in February 1996.

K-Area includes the following facilities associated with the groundwater monitoring program:

- K-Area acid/caustic basin
- K-Area ash basin
- K-Area Bingham pump outage pit
- K-Area burning/rubble pit
- K-Area coal pile runoff containment basin
- K-Area diesel tank spill
- K-Area disassembly basin
- K-Area reactor
- K-Area reactor seepage basin
- K-Area retention basin
- K-Area sludge land application site
- K-Area tritium sump

Nature of Contamination

The bisection of Pen Branch and Indian Grave Branch isolates the near-surface groundwater. Deeper groundwater flows toward the Savannah River.

Figure 10–11 shows the extent of contamination and the location of the various contaminant groups in K-Area. Several plumes of contaminated groundwater are at K-Area. The largest plume consists of tritium-contaminated water around the disassembly basin, the reactor seepage basin, and the retention basin. As described in the C-Area discussion, these sites are known sources of tritium. Low levels of volatile organics are detected in some wells that monitor this plume.

Some groundwater under and near the ash basin and the coal pile runoff containment basin has gross-alpha contamination. This is a typical contaminant leached from coal and coal ash.

The groundwater underneath the burning/rubble pit is contaminated with tetrachloroethylene.

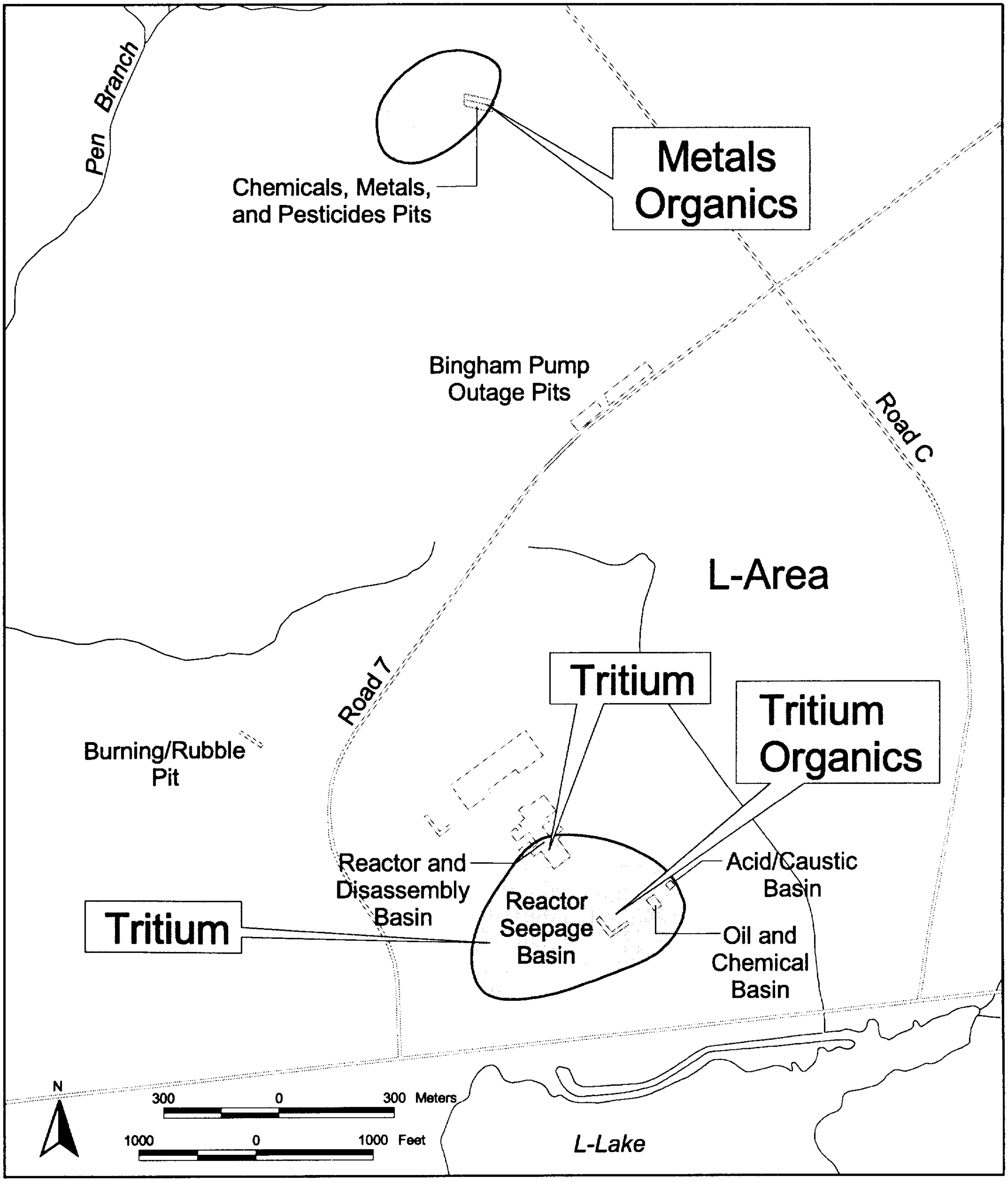
Table 10–8 summarizes 1997 groundwater monitoring results for K-Area.

Table 10–8 Constituent Groups Above Drinking Water Standards at K-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	0%	15	None
Organics	57%	7	Burning/rubble pit, disassembly basin, reactor seepage basin
Pesticides/PCBs	—	—	
Tritium	87%	15	Disassembly basin, reactor seepage basin, retention basin
Other radionuclides	18%	17	Ash basin, coal pile runoff containment basin
Other constituents	0%	11	None

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans and pesticides/PCBs were not sampled at K-Area during 1997.



Exploration Resources, Inc.

Figure 10–12 Extent of Groundwater Contamination Beneath L-Area and the Chemicals, Metals, and Pesticides Pits in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at L-Area and the Chemicals, Metals, and Pesticides Pits

Location and Facilities

L-Area is in the south-central part of SRS and contains the L-Area reactor, which achieved criticality in 1954 and continued production until 1968, when it was placed in warm standby. It subsequently operated from 1985 until 1988, when it was shut down for maintenance. It was placed in warm standby in December 1991 to be put into operation as a backup to K-Reactor, if necessary, but since has been placed in cold shutdown.

L-Area includes the following facilities associated with the groundwater monitoring program:

- L-Area acid/caustic basin
- L-Area Bingham pump outage pit
- L-Area burning/rubble pit
- L-Area disassembly basin
- L-Area oil and chemical basin
- L-Area reactor
- L-Area reactor seepage basin

The chemicals, metals, and pesticides (CMP) pits are near the head of Pen Branch. The pits were used from 1971 to 1979 to dispose of waste consisting of drummed oil, organic solvents, and small amounts of pesticides and metals. In 1984, the pits were excavated to form two trenches, backfilled, and capped. During excavation, most of the contaminated material was removed to the Hazardous Waste Storage Facility.

Nature of Contamination

Figure 10–12 shows the extent of contamination and the location of the various contaminant groups at L-Area and the CMP pits. There is a plume of contaminated groundwater downgradient between the L-Area reactor buildings and L-Lake. Tritium is the most extensive contaminant, and lead, nitrate, and tetrachloroethylene are present in low concentrations. Tritium activity in a monitoring well about 1,000 feet southwest of the reactor building has increased substantially since 1994. Tetrachloroethylene and nitrate are present near the disassembly basin and the oil and chemical basin.

Several small tributaries of Steel Creek receive surface drainage from L-Area. The near-surface groundwater discharges to Steel Creek and Pen Branch.

A plume of groundwater underneath the CMP pits is contaminated with volatile organics and metals. Monitoring results from 1997 were similar to those of previous years.

Surface drainage at the CMP pits is to the north toward Pen Branch and to the south toward a tributary of Pen Branch. Groundwater flows downward and horizontally away from the pits.

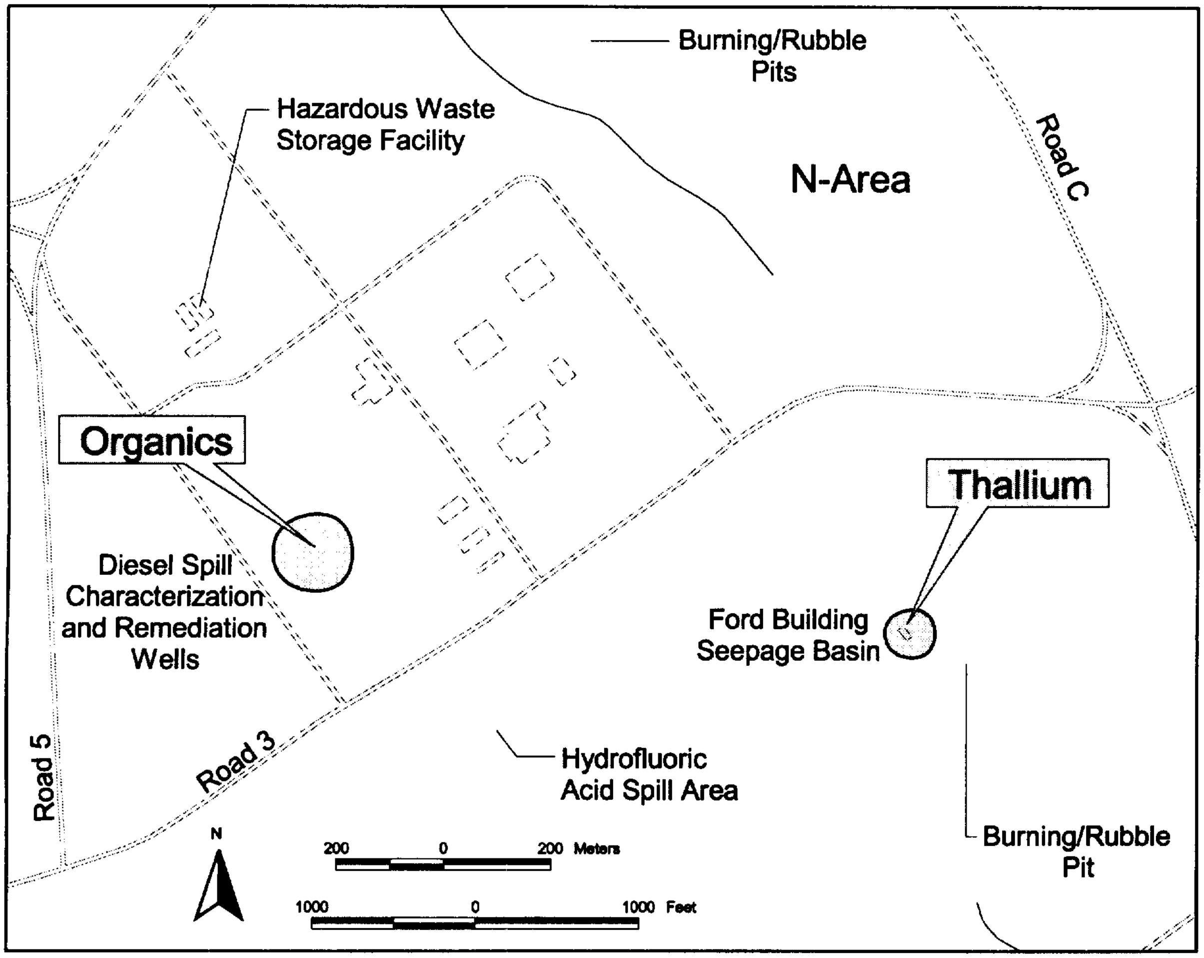
Table 10–9 summarizes 1997 groundwater monitoring results for L-Area and the CMP pits.

Table 10–9 Constituent Groups Above Drinking Water Standards at L-Area and the Chemicals, Metals, and Pesticides Pits in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	9%	22	CMP pits
Organics	27%	15	CMP pits
Pesticides/PCBs	0%	7	None
Tritium	30%	20	Disassembly basin, oil and chemical basin, reactor seepage basin
Other radionuclides	5%	19	Bingham pump outage pit
Other constituents	6%	18	Oil and chemical basin

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans were not sampled at L-Area or the CMP pits during 1997.



Exploration Resources, Inc.

Figure 10–13 Extent of Groundwater Contamination Beneath N-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at N-Area

Location and Facilities

N-Area, also called the Central Shops area, is located in the central part of SRS and provides supply, maintenance, and other support services for SRS.

N-Area includes the following facilities associated with the groundwater monitoring program:

- Ford Building seepage basin
- Hazardous Waste Storage Facility
- Hydrofluoric acid spill
- N-Area burning/rubble pits
- N-Area diesel spill
- N-Area Fire Department Training Facility

Figure 10–13 shows the extent of contamination and the location of the various contaminant groups in N-Area. Surface drainage in N-Area is to tributaries of Four Mile Creek to the north, west, and south and to tributaries of Pen Branch to the east. Four Mile Creek, Upper Three Runs Creek, and several other incised creeks are located between N-Area and the SRS boundary and are areas of groundwater discharge. Figure 10–1 shows the locations of these streams.

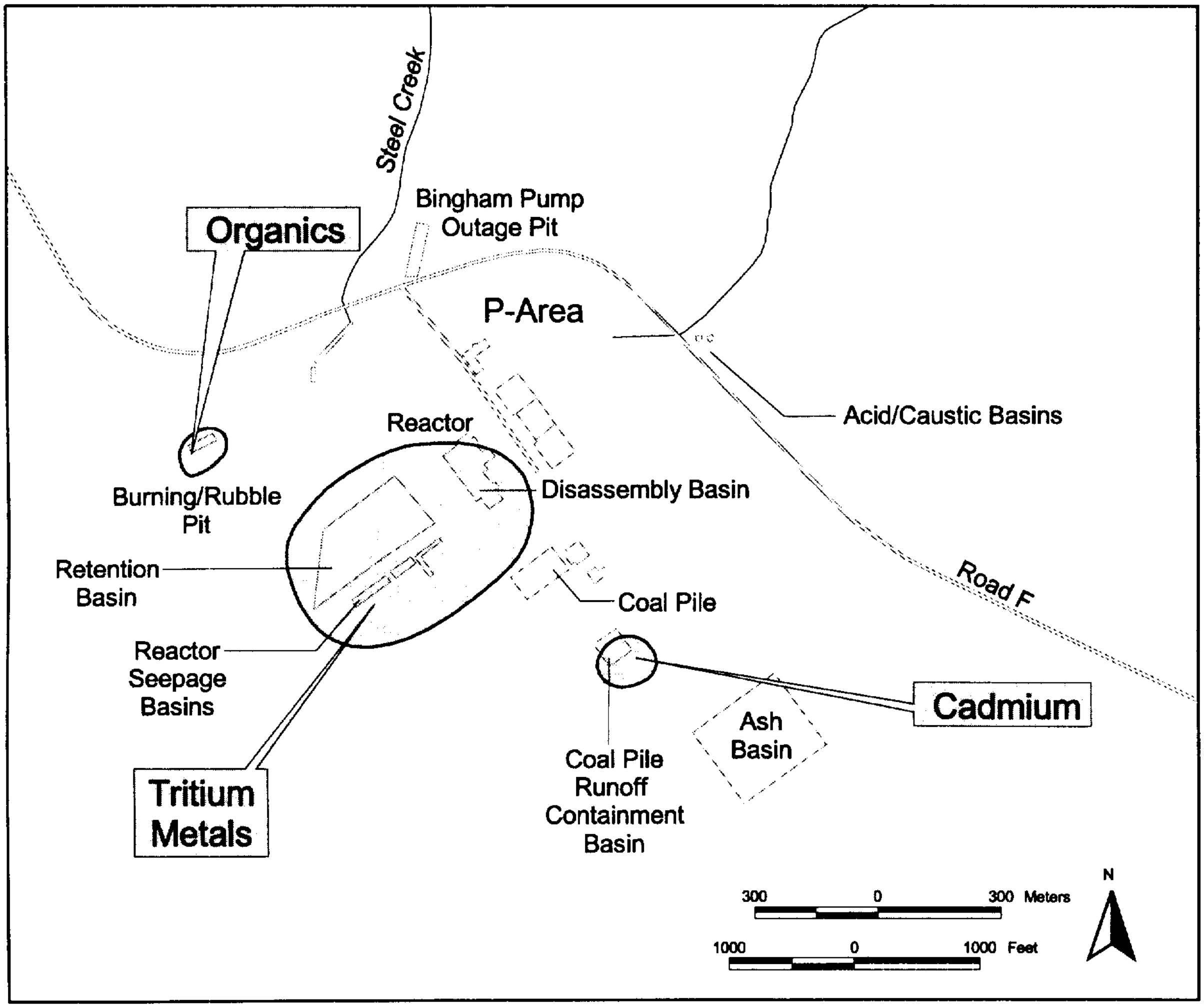
Table 10–10 summarizes 1997 groundwater monitoring results for N-Area.

Table 10–10 Constituent Groups Above Drinking Water Standards at N-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	9%	11	Ford Building seepage basin
Organics	33%	3	Diesel spill
Pesticides/PCBs	0%	1	None
Tritium	0%	8	None
Other radionuclides	0%	8	None
Other constituents	0%	10	None

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans and pesticides/PCBs were not sampled at N-Area during 1997.



Exploration Resources, Inc.

Figure 10–14 Extent of Groundwater Contamination Beneath P-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at P-Area

Location and Facilities

P-Area, located in the south-central part of SRS, houses the P-Area reactor, which achieved criticality in 1954, was shut down for maintenance in 1987 and has since been placed in cold shutdown.

P-Area includes the following facilities associated with the groundwater monitoring program:

- P-Area acid/caustic basins
- P-Area ash basin
- P-Area Bingham pump outage pit
- P-Area burning/rubble pit
- P-Area coal pile and coal pile runoff containment basin
- P-Area disassembly basin
- P-Area reactor
- P-Area reactor seepage basins
- P-Area retention basin

Nature of Contamination

Lower Three Runs Creek to the east, Steel Creek to the southwest, and Meyers Branch to the south and east isolate the near-surface groundwater in P-Area. Figure 10–1 shows the locations of these streams. The horizontal hydraulic gradients vary across P-Area and increase near a tributary to PAR Pond. The horizontal gradients also increase near a tributary to Steel Creek to the southeast.

Figure 10–14 shows the extent of contamination and the location of various contaminant groups at P-Area. The largest plume of contaminated groundwater in P-Area consists of tritium contamination near the disassembly basin and the reactor seepage basins. Lead was elevated in a few wells near the seepage basins. These results are consistent with those of past years and are expected, based on the tritium disposal at these sites.

Table 10–11 shows tritium concentrations in selected P-Area wells from 1993 to 1997.

As in the past, low levels of trichloroethylene were detected in the groundwater near the burning/rubble pits. Also, cadmium was elevated near the coal pile runoff containment basin.

Table 10–12 summarizes 1997 groundwater monitoring results for P-Area.

Table 10–11 Tritium Concentrations (in µCi/mL) in Selected P-Area Wells, 1993–1997

Well	1993	1994	1995	1996	1997
PDB 2	2.3E–04	2.6E–04	2.4E–04	8.0E–05	5.2E–05
PDB 3	5.5E–05	2.0E–04	5.4E–05	4.4E–05	1.6E–04
PDB 4	NA	NA	6.0E–05	4.2E–05	4.0E–05
PDB 5	NA	NA	7.1E–05	4.5E–05	3.8E–05
PSB 1A	8.1E–02	8.1E–02	7.7E–02	3.6E–02	2.1E–02
PSB 2A	6.0E–02	8.3E–02	1.9E–03	5.0E–02	2.5E–02
PSB 3A	1.8E–02	1.3E–02	3.9E–02	6.5E–03	3.1E–03
PSB 4A	3.6E–04	8.1E–04	5.2E–04	2.3E–04	1.1E–04
PSB 5A	4.2E–05	3.0E–05	2.0E–05	1.4E–05	1.5E–05
PSB 6A	4.9E–02	3.2E–02	1.5E–02	3.8E–02	2.6E–02
PSB 7A	5.1E–03	2.8E–03	1.4E–03	9.3E–04	3.0E–04

Notes: NA = not analyzed. PDB 4 and 5 were not installed until January 1995.

All data are from third quarter of the respective year, except for the data for the PSB wells during 1995 and 1996. These data are from first quarter because these wells were not sampled for tritium during third quarters 1995 and 1996.

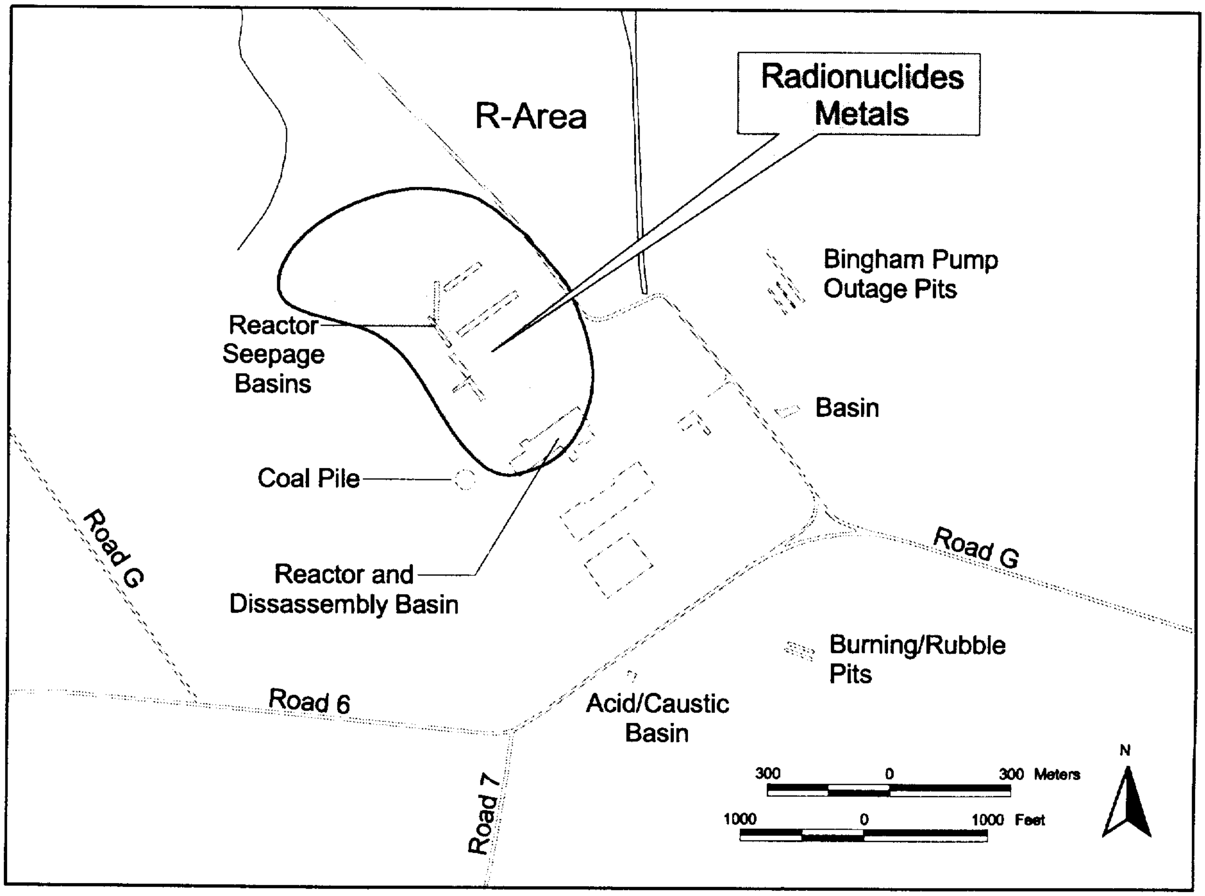
The federal final primary DWS for tritium is 2.0E–05 µCi/mL.

Table 10–12 Constituent Groups Above Drinking Water Standards at P-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	23%	22	Coal pile runoff containment basin, reactor seepage basins
Organics	13%	15	Burning/rubble pit
Pesticides/PCBs	0%	13	None
Tritium	67%	15	Reactor seepage basins
Other radionuclides	5%	20	Burning/rubble pit
Other constituents	0%	19	None

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans were not sampled at P-Area during 1997.



Exploration Resources, Inc.

Figure 10–15 Extent of Groundwater Contamination Beneath R-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at R-Area

Location and Facilities

R-Area, located in the east-central part of SRS, houses the R-Reactor, which achieved criticality in 1953 and was shut down permanently in 1964.

R-Area includes the following facilities associated with the groundwater monitoring program:

- R-Area acid/caustic basin
- R-Area Bingham pump outage pit
- R-Area burning/rubble pits
- R-Area coal pile
- R-Area disassembly basin
- R-Area reactor
- R-Area reactor seepage basins

Nature of Contamination

Surface drainage in R-Area is to the northwest and northeast toward Mill Creek and Pond A and to the southeast and southwest toward tributaries of Pond 2 and Pond 4. Figure 10–1 shows the locations of these streams.

Incised tributaries and streams and PAR Pond separate near-surface groundwater at R-Area from the site boundary to the east. R-Area is near a groundwater divide between Mill Creek and PAR Pond. The groundwater just north of R-Area naturally discharges to Mill Creek to the northwest and to the R-Area Canal of Pond A to the northeast. The groundwater from the southern part of R-Area naturally discharges to a tributary of Pond 4 south of R-Area.

Figure 10–15 shows the extent of contamination and the location of various contaminant groups at R-Area. The only substantial groundwater contamination at R-Area consists of radionuclides, lead, and other metal contamination surrounding the reactor disassembly basin and the seepage basins. This contamination is consistent with that of previous years and with the history of the site.

On November 8, 1957, an experimental fuel element failed during a calorimeter test in the emergency section of the R-Area disassembly basin. Following this incident, the original seepage basin received approximately 2,700 Ci of gross beta activity, including strontium-90 and cesium-137, each of which has a half-life of about 30 years. Much of the released radioactivity was contained in that basin, which was backfilled in December 1957. Five more basins were placed in operation in 1957 and 1958 to assist in containing the radioactivity.

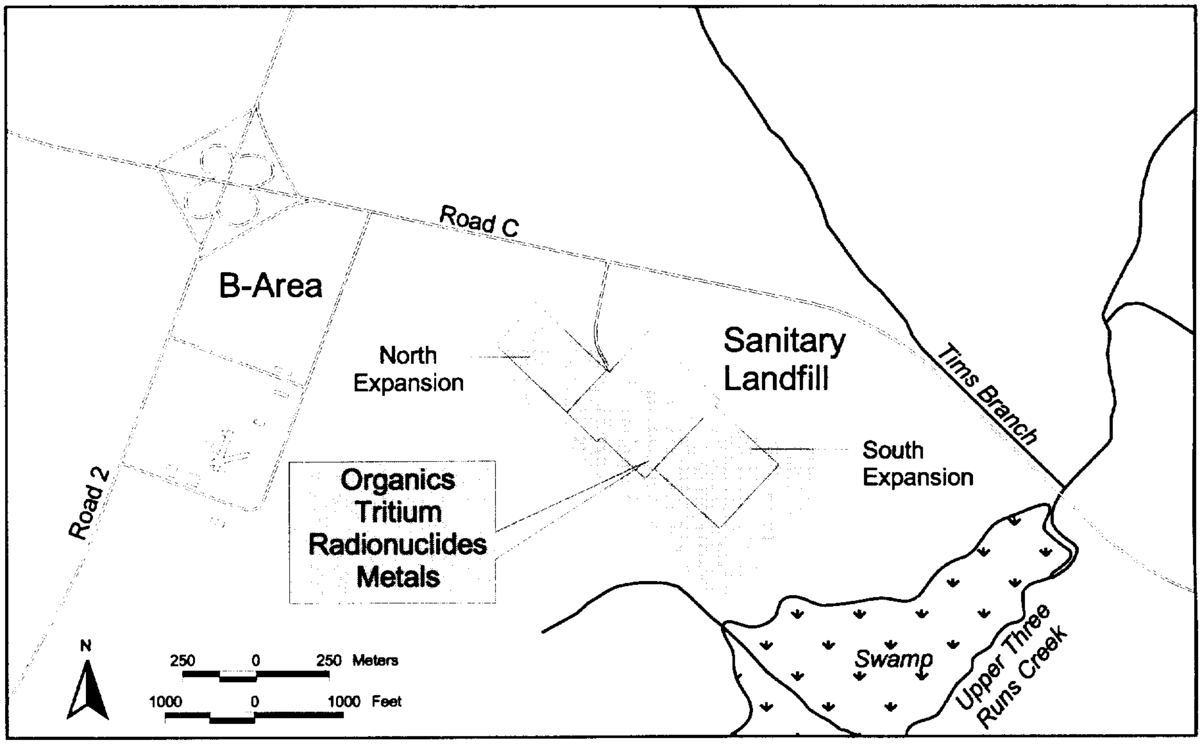
Table 10–13 summarizes 1997 groundwater monitoring results for R-Area.

Table 10–13 Constituent Groups Above Drinking Water Standards at R-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	30%	27	Reactor seepage basins
Organics	0%	3	None
Pesticides/PCBs	0%	3	None
Tritium	0%	12	None
Other radionuclides	25%	24	Reactor seepage basins
Other constituents	0%	18	None

Notes: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans were not sampled at R-Area during 1997.



Exploration Resources, Inc.

Figure 10–16 Extent of Groundwater Contamination Beneath the Sanitary Landfill and B-Area in 1997 and Location of Noteworthy Sources of Contamination Exceeding Drinking Water Standards

Groundwater Contamination at the Sanitary Landfill and B-Area

Location and Facilities

The Sanitary Landfill is south of Road C, about midway down the slope from the Aiken Plateau to Upper Three Runs Creek.

The Sanitary Landfill began receiving waste from office, cafeteria, and industrial activities during 1974. Materials such as paper, plastics, rubber, wood, cardboard, rags, metal debris, pesticide bags, empty cans, carcasses, asbestos in bags, and sludge from SRS's wastewater treatment plant were placed in unlined trenches and covered daily with soil or a fabric substitute. The original section of the landfill and its southern expansion, with a total area of approximately 54 acres, have been filled. The portion of approximately 16 acres known as the northern expansion, or the interim sanitary landfill, ceased operations in November 1994.

Nature of Contamination

Surface drainage at the Sanitary Landfill is to the south-southeast, toward Upper Three Runs Creek. Horizontal groundwater flow is to the southeast, toward Upper Three Runs Creek.

Sanitary landfills are intended to receive only nonradioactive, nonhazardous waste. However, until October 1992, some hazardous wastes (specifically, solvent-laden rags and wipes used for cleaning, decontamination, and instrument calibration) were buried in portions of the original 32-acre landfill and its southern expansion.

Figure 10–16 shows the extent of contamination and the location of various contaminant groups at the Sanitary Landfill and near B-Area. There is a substantial plume of contaminated groundwater under and downgradient of the Sanitary Landfill. Organic compounds are the most widespread contaminants, but metals, tritium, and other radionuclides also are present.

Tritium was detected in one well above DWS near the Sanitary Landfill in 1997. Gross alpha was elevated in one well near the landfill.

Table 10–14 summarizes the 1997 groundwater monitoring results for the Sanitary Landfill and B-Area.

Table 10–14 Constituent Groups Above Drinking Water Standards at the Sanitary Landfill and B-Area in 1997

Constituent Groups	Percent of Wells with Results above Standards	Number of Wells Sampled	Sources of Contamination
Dioxins/furans	—	—	
Metals	13%	48	Sanitary Landfill
Organics	37%	51	Sanitary Landfill
Pesticides/PCBs	0%	8	None
Tritium	4%	49	Sanitary Landfill
Other radionuclides	2%	42	Sanitary Landfill
Other constituents	0%	4	None

Note: Drinking Water Standards refer to federal final primary DWS, proposed primary DWS, and interim final primary DWS.

Dioxins/furans were not sampled in the Sanitary Landfill or B-Area in 1997.

Chapter 11

Quality Assurance

Bob Henderson, Moheb Khalil,
Walt Kubilius, and Stuart Stinson
Environmental Protection Department

To Read About . . . See Page . . .

1997 Highlights

- In the blind sample program routinely conducted by EMS to assess the quality and reliability of pH field data, pH measurements were taken on 26 samples. All field pH measurements except one was within EPA's suggested acceptable control limit.
- Twelve blind samples were analyzed for tritium by the EMS laboratory. All tritium data were within the control limits except one, whose low-activity level was near the EMS minimum detectable activity. The results of these blind samples were used to validate analytical work in the chemistry and counting laboratory.
- The EMS laboratory participated in three interlaboratory comparison programs to track performance accuracy. These program are run by DOE, EPA, and NIST. In general, EMS's performance in these interlaboratory comparison program was excellent.

THE Environmental Monitoring Section (EMS) of the Savannah River Site's (SRS) Environmental Protection Department (EPD) maintains a quality assurance (QA) program to continuously verify the integrity of data generated by its own environmental monitoring program and by its subcontracted laboratories.

Various definitions have been suggested for QA and quality control (QC). Frequently, the terms are used interchangeably. In the EMS program, QA consists of the system whereby the laboratory can assure clients and other outside entities, such as government agencies and accrediting bodies, that the laboratory is generating data of proven and known quality. QC refers to those operations undertaken in the laboratory to ensure that the data produced are generated within known probability limits of accuracy and precision.

Although QC represents the core activity in a QA program, the latter encompasses much more than the technical operations of controlling quality. Another QA component is quality assessment, which refers to the evaluation activities that provide assurance that the QC job is being done effectively.

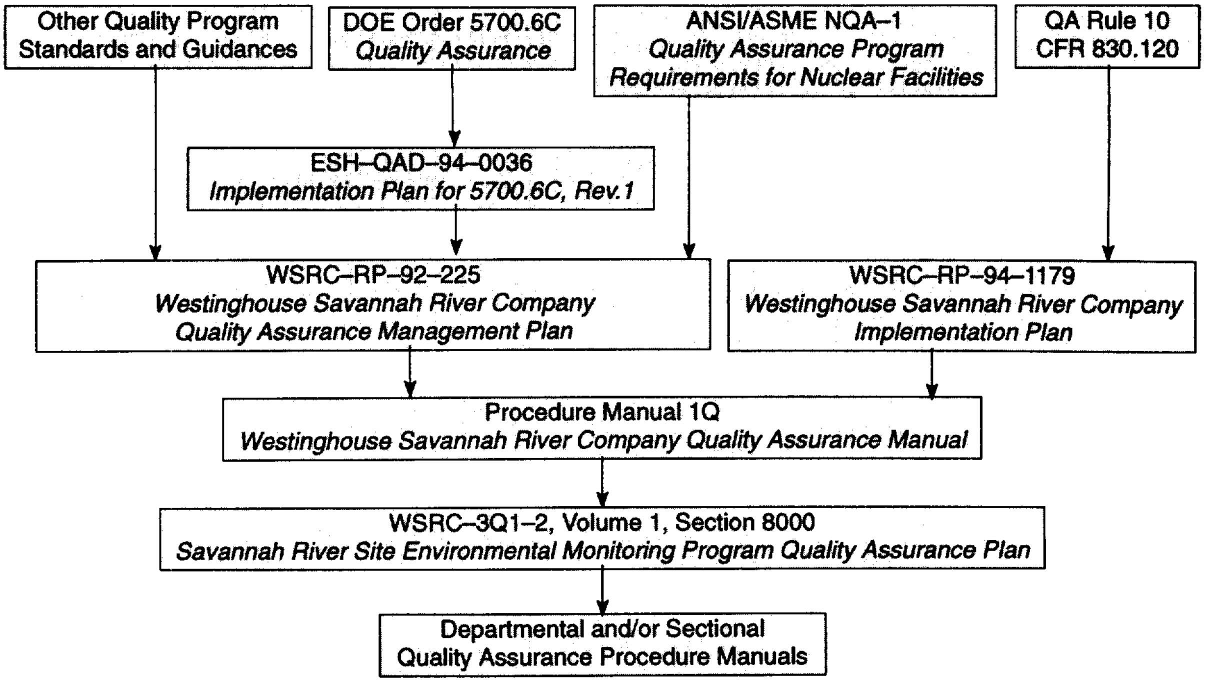
Each aspect of the environmental monitoring program, from sample collection to data reporting, must address QC and quality assessment standards defined in the *Savannah River Site Environmental Monitoring Program Quality Assurance Plan*, section 8000, WSRC–3Q1–2.

This chapter summarizes the QA program. Tables containing the 1997 QA/QC data can be found in *SRS Environmental Data for 1997*, WSRC–TR–97–00324. A more complete description of the EMS QA program can be found in section 1110 of the *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1 (SRS EM Program).

Guidelines and applicable standards for the QA environmental monitoring program can be found in appendix A, "Applicable Guidelines, Standards, and Regulations," of this document. Detailed information about federal, state, and local QA regulations and standards can be found in the SRS EM Program. Figure 11–1 illustrates the hierarchy of relevant guidance documents that support the EMS QA/QC program.

Quality Assurance/Quality Control for Environmental Monitoring Section Laboratories

General objectives of the QA/QC program include validity, traceability, and reproducibility of reported results; comparability of results within data bases; representativeness of each sample to the population



Guidance Documents that Support Programs

- International Organization for Standardization (ISO) 9000 Series of Standards, including ISO 14001, Environmental Management System
- *Specifications and Guidelines for Environmental Data Collection and Environmental Technology Programs,* ANSI/ASQC E–4
- General Requirements for the Competence of Calibration and Testing Laboratories ISO/IEC Guide 25–1990

Figure 11–1 SRS EM Program QA/QC Document Hierarchy/Relevant Guidance Documents

or condition being measured; and accuracy and precision.

Training for Personnel

EMS personnel are responsible for understanding and complying with all requirements applicable to the activities with which they are involved. Consequently, appropriate training courses are provided to assist them in fulfilling their responsibilities. Courses include training on applicable QA procedures, Occupational Safety and Health Administration-mandated training, and General Employee Training. Regulations and procedures that govern the environmental monitoring program are emphasized.

EMS technicians begin with specific training determined by job assignment. The section's technical work is based on procedures in the WSRC–3Q1 series of manuals:

- "Environmental Sampling Procedures," WSRC–3Q1–3
- "Environmental Radiochemistry Procedures," WSRC–3Q1–4
- "Environmental Water Quality Procedures," WSRC–3Q1–5
- "Environmental Counting Room Procedures," WSRC–3Q1–6
- "Environmental Data Management and Computer Support Procedures," WSRC–3Q1–10

In 1997, the EMS training plan was completed. The plan includes a mission statement and a description of the section's three functional groups (Environmental Sampling and Reporting, Environmental Chemistry and Analysis, and Environmental Geochemistry); general and specific job descriptions; specific assignments and qualifications; the requirements of job-specific training; and lists of annual required training and developmental training. A copy of each professional's training history from the Training

Statistical Terms

coefficient of variation measure of precision calculated as the standard deviation divided by the average of a set of values; usually multiplied by 100 to be expressed as a percentage

mean measurement of central tendency, commonly called the average

mean relative difference measure of reproducibility of identical chemical analyses

median middle value of a set of data when the data are ranked in increasing or decreasing order

percent difference measure of accuracy used to compare "known" values with laboratory measurements; represents the absolute difference between the known and measured value divided by the true value; usually multiplied by 100 to be expressed as a percentage

standard deviation indication of the dispersion of a set of results around the average of samples collected

Records and Information System (TRAIN) is attached to the plan.

Internal Quality Assurance Program

Specific QA checks and accepted practices are conducted by each EMS group, as described in the following paragraphs.

Field Sampling Group

Blind Sample Program EMS routinely conducts a blind sample program for field measurements of pH to assess the quality and reliability of field data measurements. Measurements of pH are taken in the field using the same equipment as is used for routine measurements.

During 1997, blind pH field measurements were taken for 26 samples (table 63, *SRS Environmental Data for 1997*). All field pH measurements except one were within the U.S. Environmental Protection Agency's (EPA) suggested acceptable control limit of ± 0.4 pH units of the true (known) value. Investigation of the out-of-control measurement indicated that the instrument used for this analysis was calibrated correctly. The cause of this discrepancy is unknown.

Instrumentation Calibration EMS personnel also measure chlorine, dissolved oxygen, and temperature in water samples; but because of the difficulties in providing field standards, these measurements are not suitable for a blind sample program. Therefore, quality control of these analyses relies instead on instrumentation calibration, per the WSRC–3Q1 procedure series.

Chemistry and Counting Laboratories

Laboratory performance is evaluated through instrument checks, control charts, and data analyses. In the chemistry group, graphical and numerical trending is conducted on technician and method performance, with reports generated for sample results that exceed warning limits. The Counting Laboratory runs source checks and instrument backgrounds and performs calibrations regularly to monitor and characterize instrumentation.

Routine samples prepared and counted in EMS laboratories are subject to a variety of QC checks to assess and ensure validity. These checks make up 30 percent of the analytical workload. The Environmental Chemistry and Analysis group prepares spikes, blanks, duplicates, and blind samples to check the performance of routine analyses. Spikes and blanks are used to calculate a recovery efficiency of an analytical method, to adjust for background radiation, and to evaluate counting equipment performance.

Blind samples, the radionuclide composition of which is unknown to the technicians preparing or counting the samples, provide a constant check on the proficiency of the chemistry and counting laboratories. Based on matrix availability, blind and spiked samples are prepared from National Institute of Standards and Technology (NIST)-traceable material or standardized against NIST material. Upon completion of analyses, ratios between the measured and true values are calculated, and the results are added to control charts to identify trends. To address the high relative error of radioactive measurements at low levels, the difference between measured and true values is evaluated against standard deviation units of the true value. During 1997, 12 blind samples were analyzed for tritium (table 64, *SRS Environmental Data for 1997*). All tritium data were within the control limits except one, whose low-activity level was near the EMS minimum detectable activity. The results of these blind samples were used to validate analytical work in the chemistry and counting laboratories.

The EMS laboratory is certified by the South Carolina Department of Health and Environmental Control (SCDHEC) for its alkalinity, chemical oxygen demand, total suspended solids, specific conductance, nitrate-nitrogen, orthophosphate phosphorus, chloride, sulfate, total dissolved solids, and field pH analyses. In the continuing recertification program by SCDHEC through EPA, the laboratory passed all test parameters to receive recertification in 1997 in a performance evaluation report from a water pollution study (WP037).

Data Verification and Validation

Results received from the Counting Laboratory are electronically evaluated by the Environmental Monitoring Computer Automation Program (EMCAP). Sample parameters—such as air flows, counting aliquots, and decay times—are flagged if values exceed preset limits or vary significantly from previous entries. An acceptance range for each analysis, based on historical results, is calculated for all routine environmental samples. Sample results outside the acceptance range are submitted for individual review, which may result in repeating the analyses, recounts, recalculations, or resampling for verification.

Before data are reported, they must be reviewed and validated by qualified personnel. Electronic verification is performed on 100 percent of the data stored in EMS data bases. Through this verification, data anomalies are removed or data are rejected if there is disagreement with EMS QA/QC policies. The validation methods and criteria are documented in QAP 21–1 of WSRC–1Q and in "Environmental Geology Procedures," WSRC–3Q1–7. Quality control requirements for managing, evaluating, and publishing environmental monitoring data are defined in WSRC–3Q1–2, section 8250.

External Quality Assurance Program

The EMS laboratory participates in three interlaboratory comparison programs to track performance accuracy. Under two of these programs, the U.S. Department of Energy (DOE) and EPA send samples to participating laboratories throughout the year and compare the laboratories' results to true values. Under the third program, NIST likewise sends samples to participating laboratories and compares the results. These comparisons test the accuracy of procedures within the EMS laboratories.

Quality Assurance Program

The DOE Quality Assurance Program (QAP) tests the quality of environmental data reported to DOE by its contractors. Reference samples for this program—including soil/sediment, water, vegetation, and air filter samples—are prepared by the DOE/EML (Environmental Measurements Laboratory) and sent to participating laboratories. Analytical results are reported to the DOE/EML and are compared with the test results of other laboratories. The DOE/EML evaluates the results and distributes them to the participating laboratories. Results are rated as acceptable (A), acceptable with warning (W), and not acceptable (N). Most EMS preparation methods and analytical instruments are tested during this study. Control charts are maintained according to DOE/EML control limits.

Work was completed in June on the 46th set of QAP samples from a DOE/EML radiological intercomparison study. EMS analyzed 15 isotopes in air, 7 in soil, 7 in vegetation, and 12 in water for a total of 41 results. Forty of the results were rated "A," one was rated "W," and none were rated "N." A performance rating of 98 percent acceptable was achieved for this study.

In QAP set 47, which was completed in December, EMS analyzed 15 isotopes in air, 7 in soil, 7 in vegetation, and 13 in water for a total of 42 results. Thirty-nine of the results were rated "A," two were rated "W," and one was rated "N." The nonacceptable result was for strontium-90 on air filters. This result was reviewed, and the QC supporting result was within limits. The analysis was repeated by an alternative method, and the same "within limits" result was obtained. No further corrective action is planned. A performance rating of 93 percent acceptable was achieved for this study.

The QAP results for the two sets can be found in table 65, *SRS Environmental Data for 1997*. The table includes the DOE/EML control limits for nonacceptable results.

Quality Assurance Division Program

The second program is administered by the Quality Assurance Division (QAD) of the EPA Environmental Monitoring System Laboratory in Las Vegas, Nevada. This division is responsible for QC of environmental radiological measurements. EPA provides participating laboratories with water, air filter, and milk samples that contain a variety of radionuclides with activity concentrations near environmental background levels. The samples are distributed according to schedule throughout the year. Control charts are maintained for the QAD results according to EPA control limits. Historical trends alert EMS to a method bias that may be occurring in its laboratories. The QAD program enables EMS to document the accuracy of radiological analysis data, to identify instrument and procedural problems, and to compare analysis performance with other participating laboratories.

For the 1997 program, EMS analyzed 11 isotopes in 17 samples for a total of 37 results. Thirty-two of the results were acceptable, and a performance rating of 86 percent acceptable was achieved for the year. The QAD results can be found in table 66, *SRS Environmental Data for 1997*.

National Institute of Standards and Technology Radiochemistry Intercomparison Program

In the third intercomparison program, EMS represented Westinghouse Savannah River Company (WSRC) in the NIST Radiochemistry Intercomparison Program (NISTRIP), which is designed to identify a group of facilities that can qualify as reference laboratories as defined by American National Standards Institute document N42.2, "Measurement Quality Assurance for Radioassay Laboratories." NIST traceability was achieved by EMS for the analysis of water for actinides by alpha spectroscopy. NIST traceability is being sought for actinides on air filters.

A comparison of EMS results and the NIST values is given in table 67, *SRS Environmental Data for 1997*. A comparison of EMS results with those from other participating laboratories is given in figure 11–2. The other laboratories are Environmental Evaluation Group, Westinghouse Waste Isolation Pilot Project, and Carlsbad Environmental Monitoring and Research Center, all in Carlsbad, New Mexico; Sandia National Laboratories, Albuquerque, New Mexico; and National Air and Radiation Environmental Laboratory, Montgomery, Alabama.

Quality Assurance/Quality Control for Subcontracted Laboratories

Subcontracted laboratories providing analytical services must have a documented QA/QC program and meet the quality requirements defined in WSRC–1Q. The subcontracted laboratories used during 1997 and the types of analyses performed are listed in table 11–1, page 189.

EMS personnel perform an annual evaluation of each subcontracted laboratory to ensure that the laboratories maintain technical competence and follow the required QA programs. Each evaluation includes an examination of laboratory performance with regard to sample receipt, instrument calibration, analytical procedures, data verification, data reports, records management, nonconformance and corrective actions, and preventive maintenance. EMS provides reports of the findings and recommendations to each laboratory and conducts followup evaluations as necessary.

Nonradiological Liquid Effluents

Nonradiological liquid effluent samples are collected at each permitted SRS outfall according to requirements in the National Pollutant Discharge Elimination System (NPDES) permit issued by SCDHEC (discussed in appendix A, page 208). Effluent samples are analyzed by three laboratories—two onsite laboratories and one subcontract laboratory. The EMS laboratory performs analyses for temperature, pH, dissolved oxygen, total suspended solids, and total residual chlorine. The WSRC Site Utilities Division (SUD) Wastewater Laboratory performs analyses for pH, dissolved oxygen, biological oxygen demand, and total suspended solids on sanitary facility wastewater samples. Shealy Environmental Services was the primary subcontractor for the NPDES program throughout 1997.

Interlaboratory Comparison Program

Interlaboratory comparison studies are used to compare the quality of results between laboratories performing the same analyses. During 1997, Shealy and EMS participated in interlaboratory comparison studies conducted by EPA.

All subcontracted laboratories analyzing NPDES samples must participate in the EPA Discharge Monitoring Report Laboratory Performance Evaluation program. Under this program, EPA sends to participating laboratories performance samples containing constituents normally found in industrial and municipal wastewaters.

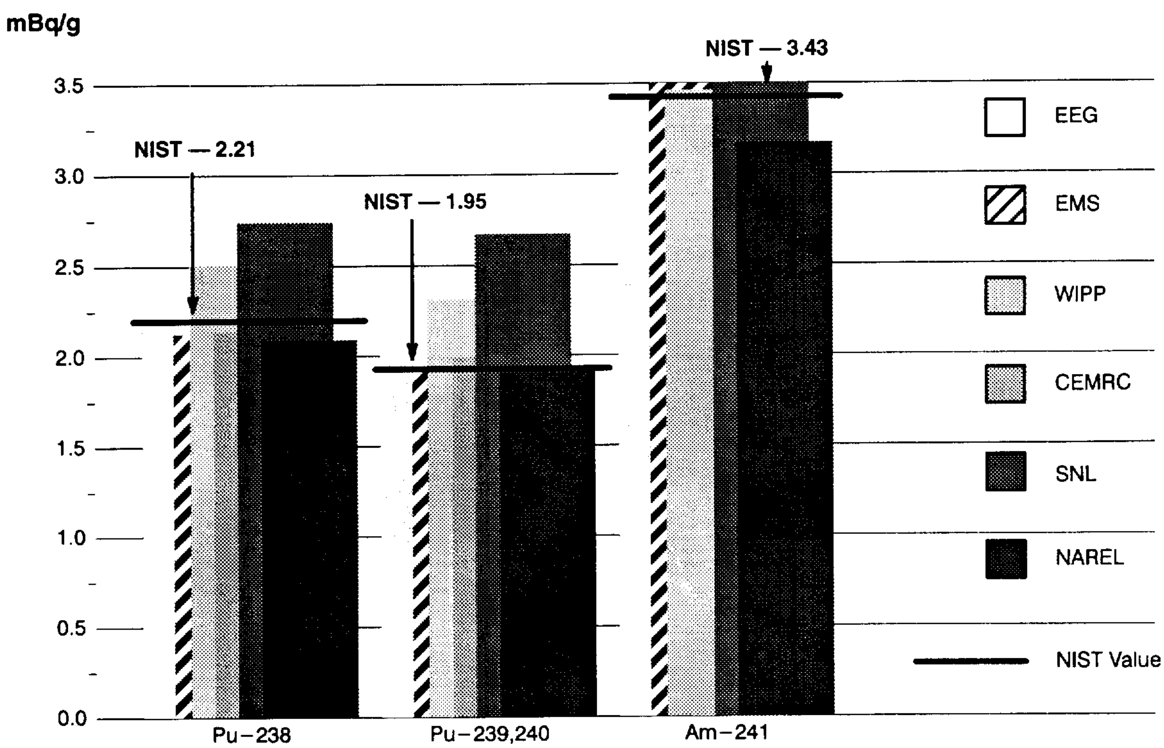
These water samples have known chemical parameters, such as chemical oxygen demand, and contain known concentrations of constituents, such as total suspended solids, oil and grease, and certain trace metals. EPA provides a final comprehensive report to the program participants. The report contains a statistical analysis of all data, as well as documentation of the known sample value, with stated acceptance limits and warning limits. Accepted variations from the known sample value depend on a variety of factors, including the precision of the analysis and the extent to which the results can be reproduced.

In 1997, Shealy ran analyses for 33 NPDES parameters under the EPA program. The EMS laboratory performed analyses for 11 parameters. The SUD laboratory performed analyses only for pH because it was not certified for biological oxygen demand, total suspended solids, and dissolved oxygen when the EPA samples were received. The EMS laboratory and the SUD laboratory were within acceptable limits for all parameters. Shealy Environmental Services was within acceptable limits for 27 of 33 parameters, an 82-percent success rate. The NPDES subcontract is required to have a minimum 80-percent success rate on EPA samples.

The parameters that were outside acceptance limits were total suspended solids, chemical oxygen demand, total organic carbon, mercury, silver, and sulfate. Shealy will perform additional EPA analyses on these parameters.

Intralaboratory Comparison Program

The intralaboratory program compares performance within a laboratory by analyzing duplicate and blind samples throughout the year. One hundred duplicate samples were analyzed during 1997 by Shealy and the EMS laboratory (table 68, *SRS Environmental Data for 1997*). Shealy analyzed 71 duplicate samples for various parameters, and the EMS laboratory analyzed 29 duplicate samples for total suspended solids. Percent difference calculations showed that 78 of these samples were within the



Ileaf Graphic

Figure 11–2 Comparison of NISTRIP Laboratory Results

EMS represented WSRC in an intercomparison program conducted by the National Institute of Standards and Technology (NIST). A look at results from participating laboratories, along with the NIST values (represented by the horizontal black bars), shows how EMS performed in comparison. (Note: CEMRC reported no results for Am-241.)

Legend Abbreviations:

EEG	Environmental Evaluation Group, Carlsbad, New Mexico
EMS	Environmental Monitoring Section, Westinghouse Savannah River Company
WIPP	Westinghouse Waste Isolation Pilot Project, Carlsbad, New Mexico
CEMRC	Carlsbad Environmental Monitoring and Research Center, Carlsbad, New Mexico
SNL	Sandia National Laboratories, Albuquerque, New Mexico
NAREL	National Air and Radiation Environmental Laboratory, Montgomery, Alabama
NIST	National Institute of Standards and Technology

Table 11–1
Subcontracted Laboratories for 1997

General Engineering Laboratories	
	groundwater nonradiological analyses
	soil/sediment
	waste characterization
Recra LabNet Philadelphia	
	groundwater nonradiological analyses
	soil/sediment
	waste characterization
Environmental Physics, Inc.	
	groundwater radiological analyses
	soil/sediment radiological analyses
	waste characterization radiological analyses
ThermoNUtech	
	groundwater radiological analyses
	soil/sediment radiological analyses
	waste characterization radiological analyses
QST Environmental, Inc.	
	groundwater radiological analyses
	groundwater nonradiological analyses
EMAX Laboratories, Inc.	
	groundwater nonradiological analyses
Microseeps	
	soil gas
	site evaluation
Shealy Environmental Services	
	NPDES analyses
	metals analyses for SRS streams and the Savannah River
	soil/sediment
	domestic water analysis
Quanterra Incorporated	
	groundwater radiological analyses

EMS internal QA/QC requirement of 20 percent. Thirteen of the samples outside acceptance limits involved either total suspended solids, oil and grease, or biological oxygen demand, the analyses of which typically produce highly variable results. In addition, the results were at or near the analytical detection limit, which produces large percent variations for small differences in actual data. Six other samples outside acceptance limits—for chromium, lead, total organic carbon, and copper—were also near the detection limit for the analyses. The remaining three analyses outside acceptance limits—for ammonia, copper, and cyanide—appeared to be related to analytical error at the subcontract laboratory, sample contamination, or improper sampling technique.

Sixty blind samples were submitted—45 to Shealy and 15 to EMS—for analysis (table 69, *SRS Environmental Data for 1997)*. Percent difference calculations showed that 43 of these samples were within the acceptable range of 20 percent. Of the 17 samples outside the acceptable range, 14 were the result of data at or near the analytical detection limit. The remaining three samples outside the acceptable range—for nickel, copper and lead—were all analyzed by Shealy and appeared to be related to analytical error at the subcontract laboratory, sample contamination, or improper sampling technique.

Stream and River Water Quality

Metals analyses of samples from SRS streams and the Savannah River also are performed by a subcontracted laboratory. The water quality program requires quality checks of 10 percent of the samples to verify the analytical results. Split composite samples normally are sent to the subcontract laboratory and a certified verifying laboratory. Because of program changes, the composite samples were not obtained in 1997. Duplicate grab samples were obtained throughout 1997 and analyzed for metals by Shealy Environmental Services. In 1998, a new QA/QC program for water quality will be implemented under the NPDES sampling program.

Shealy performed 289 duplicate analyses in 1997 (table 70, *SRS Environmental Data for 1997*). A percent relative difference calculation was performed on each data pair and compared to the acceptance limit of 20 percent. Twenty-seven samples were outside the acceptance limit. Twelve of these results were at or near the detection limit of the analyses, where small variations in results can yield large variations in percent difference calculations. The remaining 15 analyses appeared to be related to analytical error at the subcontracted laboratory, sample contamination, or improper sampling technique. Thirteen of these analyses were for phosphorous, aluminum, iron, and zinc. An investigation is in progress to determine the cause of the variations in data for these parameters.

Investigation results will be reported in *SRS Environmental Report for 1998*.

Groundwater

Groundwater analyses at SRS are performed by subcontracted laboratories. During 1997, EMAX Laboratories, Inc., General Engineering Laboratories, QST Environmental, Inc., and Recra LabNet Philadelphia (formerly Weston) were the primary subcontractors for nonradiological analyses. Environmental Physics, Inc., QST Environmental, Inc., Quanterra Incorporated, and Thermo NUtech were the primary subcontractors for radiological analyses.

Changes to the groundwater monitoring quality control program implemented during 1997 are described in chapter 10, "Groundwater."

During 1997, approximately 5 percent of the samples collected (radiological and nonradiological) for the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs were submitted to the primary laboratory for analysis as blind duplicates and to a different laboratory as a QA check.

For CERCLA projects, blind blanks were submitted to the primary and QA laboratories during the first and second quarters of 1997. Starting third quarter 1997, blind blanks were submitted to only the primary laboratory for CERCLA projects. For RCRA projects, blind blanks were submitted to only the primary laboratory all quarters of 1997. The laboratories' results were evaluated on the basis of the percentage within an acceptable concentration range.

A statistical measure, the mean relative difference (MRD), is calculated to assess result reproducibility and laboratory performance. The laboratories also analyze approximately 10 percent of samples as intralaboratory QA checks. Interlaboratory comparisons were conducted between the following:

- EMAX/Recra LabNet
- Environmental Physics/Quanterra
- Environmental Physics/Thermo NUtech
- General Engineering/Recra LabNet
- QST Environmental/EMAX
- QST Environmental/Environmental Physics
- QST Environmental/General Engineering
- QST Environmental/Quanterra
- QST Environmental/Recra LabNet
- QST Environmental/Thermo NUtech

All comparisons were within the 80-percent acceptance range utilized by the EMS QA/QC program.

EPA conducts water pollution (WP) and water supply (WS) performance evaluation studies to certify laboratories for specific analyses. During 1997, EMAX, General Engineering, QST Environmental, and Recra LabNet reported results for water pollution study WP036, and EMAX, QST, and Recra reported results for water pollution study WP037.

For study WP036, the results from EMAX were outside the acceptance limits for chloride, potassium, and sodium. The results for dibromochloromethane and nonfilterable residue were acceptable but near the acceptance limits. The results from General Engineering were outside the acceptance limits for fluoride, magnesium, potassium, and total phosphorus. In addition, the results for benzene and methylene chloride were acceptable but near the acceptance limits. The results from QST were outside the acceptance limits for chloroform and methylene chloride. In addition, the results for 5-day biochemical oxygen demand, bromodichloromethane, 1,3–dichlorobenzene, and tetrachloroethylene were acceptable but near the acceptance limits. The results from Recra for all analytes were within acceptance limits.

For study WP037, the results for EMAX were outside the acceptance limits for fluoride, total phosphorus, and total phenolics. The results for QST were outside the acceptance limits for total beryllium and total phenolics. The result for carbonaceous biochemical oxygen demand was acceptable but near the acceptance limits. The results for Recra were outside the acceptance limits for calcium, total organic carbon, and nonfilterable residue. The results for magnesium and sodium were acceptable but near the acceptance limits.

EMAX and QST reported results for water supply study WS037, and EMAX, General Engineering, and QST reported results for water supply study WS038.

For study WS037, the results for EMAX were outside the acceptance limits for dieldrin, endrin, nitrite, orthophosphate, propachlor, total organic carbon, toxaphene, and trifluralin. The results for QST were outside the acceptance limits for 2,4–D, hardness, nitrate, pentachlorophenol, total organic carbon, and 2,4,5–TP (Silvex).

For study WS038, the results for EMAX were outside the acceptance limits for 2,4–D, propachlor, tetrachloroethylene, and total organic carbon. The results for General Engineering were outside the acceptance limits for dicamba (an herbicide) and zinc. The results for QST were outside the acceptance limits for 2,4–D, cis–1,2–dichloroethylene, and orthophosphate.

Full results for all these QA/QC evaluations, including MRD calculations where appropriate, may be found in the following groundwater reports:

- *The Savannah River Site's Groundwater Monitoring Program, First Quarter 1997* (ESH-EMS-970488)
- *The Savannah River Site's Groundwater Monitoring Program, Second Quarter 1997* (ESH-EMS-970489)
- *The Savannah River Site's Groundwater Monitoring Program, Third Quarter 1997* (ESH-EMS-970490)
- *The Savannah River Site's Groundwater Monitoring Program, Fourth Quarter 1997* (ESH-EMS-970491)

Soil/Sediment

Environmental investigations of soils, sediments, and surface waters, primarily for RCRA/CERCLA units, are performed by subcontracted laboratories (table 11–1, page 189).

EMS personnel validated and managed approximately 350,000 analytical records during soil/sediment investigations in 1997. Data are validated according to EPA standards for analytical data quality unless specified otherwise by site customers. EMS delivered 29 project summary reports in 1997; each included

- a project QA/QC summary
- a discussion of validation findings
- tables of validated and qualified data

Although *Data Quality Objectives Process for Superfund* (EPA–540–R–93–071) identifies QA issues to be addressed, it does not formulate a procedure for how to evaluate these inputs, nor does it propose pass/fail criteria to apply to data and documents. Hence, the validation program necessarily contains elements from—and is influenced by—several other sources, including

- *QA/QC Guidance for Removal Activities*, interim final guidance, EPA–540–G–90–004
- *National Functional Guidelines for Organic Data Review*, Multi-Media, Multi-Concentration (OLM 01.0), and Low Concentration Water (OLC 01.0), draft, June 1991
- *Test Methods for Evaluating Solid Waste*, EPA, November 1986, SW–846, Third Edition
- *Data Validation Procedures for Radiochemical Analysis*, WHC–SD–EN–SPP–001

Data management personnel in the soil/sediment program perform additional functions to ensure the quality of the data released by EMS. Two people enter the data for each entry to help eliminate errors, and all field, shipping, invoice, and analytical data are 100 percent verified.

Relative percent difference for the soil/sediment program is calculated for field duplicates and laboratory duplicates. A summary of this information can be found in each project report prepared by the Environmental Geochemistry Group of EMS, through which the reports are available upon request. A detailed description of the activities performed during validation of soil/sediment data can be found in the Environmental Geochemistry Group Operating Handbook, ESH–EMS–950061.

Laboratory Data Record Reviews

In addition to an annual evaluation, laboratory data record reviews are performed once per quarter for groundwater and once per project for soil/sediment. A predetermined percentage of the analyses for the indicated time frame is selected for inspection by a team of validators. The samples selected for review usually have been flagged by the electronic verification of the data. At the review, analyses with QA deficiencies are identified and flagged appropriately. Results for record reviews are included as a section in the project reports delivered to the customer. A description of the activities performed during a record review, an example check list, and a report description can be found in the Environmental Geochemistry Group Operating Handbook, mentioned above.

Chapter 12

Special Surveys and Projects

Pete Fledderman
Environmental Protection Department

Eric Nelson
Environmental Sciences Section

Robin Davis
Academy of Natural Sciences of Philadelphia

1997 Highlights

- Stocking tallies taken in 1997 quantified the high densities and vigorous natural regeneration reflected in a 1995 survey indicating that approximately 100 acres of the Pen Branch delta region had sufficient bald cypress seedlings and saplings to consider the area reforested.
- A regeneration survey was conducted to establish the current stocking levels of desirable species of seedlings in the Pen Branch corridor and delta. Survey results indicated that sufficient numbers of seedlings were present in all planted areas, so it is anticipated that there are a sufficient number of trees to ensure reforestation success.
- A number of research and baselining activities have been conducted to document the recovery of the faunal component of the Pen Branch wetland system. Many of these studies were concluded in 1997 and were beginning to be reported at professional meetings, in peer-reviewed publications, and in graduate theses. Studies of aquatic macroinvertebrates and fish, concluded in the corridor reaches of the stream in September, have shown that species composition and productivity are very high in Pen Branch.
- The study design employed by ANSP in its annual survey of the Savannah River included two to five sampling stations: one to three exposed to SRS influence and an unexposed reference station upriver of the site. Multiple exposed stations are preferred because of the complex pattern of SRS inputs along the river.
- Based on the results available, most of the study elements in the 1996–1997 ANSP river quality surveys found no significant difference between biological communities upstream and downstream of the SRS, or upstream and downstream of Plant Vogtle. In summary, there is no evidence that SRS or Plant Vogtle have detrimental impacts on water quality in the Savannah River.

IN addition to routine sampling and special sampling during nonroutine environmental releases, special sampling for radiological and nonradiological surveys is conducted on and off site by personnel from the Savannah River Site (SRS) Environmental Protection Department's Environmental Monitoring Section (EMS) and from other groups, such as the Savannah River Technology Center (SRTC), and the Academy of Natural Sciences of Philadelphia (ANSP).

Both short- and long-term radiological and nonradiological surveys are used to monitor the effects of SRS effluents on the site's environment and in its immediate vicinity.

All conclusions discussed in this chapter are based on samples and analyses that have been completed. Because of sampling and/or analytical difficulties, some sample analyses may be missing, but these analyses typically represent only a very small number of samples overall.

Mitigation Action Plan for Pen Branch Reforestation

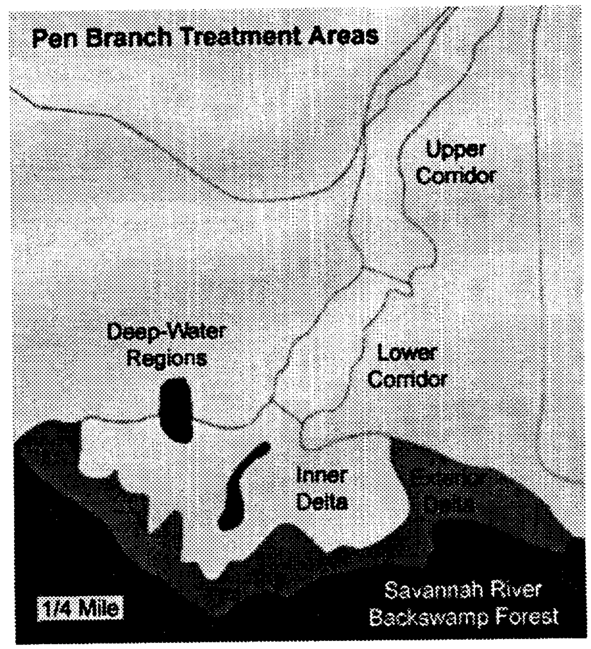
The final Environmental Impact Statement for the continued operation of K-Reactor, L-Reactor, and P-Reactor at SRS predicted several unavoidable impacts to the site's wetlands. This resulted in the development of a Mitigation Action Plan (MAP) that documented the U.S. Department of Energy (DOE) approach to mitigating these impacts [DOE, 1990]. These reactors have been closed down permanently, which has resulted in the reevaluation of the mitigation strategies identified in the 1991 MAP and its 1992 update. The section on "Mitigation for Wetlands Adversely Impacted by Operations" in the original MAP remains as the only active program element. All parties involved with the reporting process have agreed that the *SRS Environmental Report* will be used as the document to report annual progress on the reforestation portion of the commitment.

A complete history of the regulatory commitment for the reforestation can be found in the MAP 1992 update [DOE, 1992]. Since that time, the change in mission relating to K-Reactor and the increased technical information on the extent of damage and natural recovery in the Pen Branch corridor and delta have altered details of the reforestation effort. The following paragraphs describe 1997 reforestation mitigation actions.

Reforestation of the Pen Branch Corridor and Delta by Natural Succession

Natural revegetation has been occurring in the Pen Branch delta since K-Reactor last operated for an extended period of time (1988). K-Reactor thermal discharges were determined by a 1992 survey to have caused canopy loss or vegetation damage to 583 acres in the corridor, swamp, and marsh areas. The survey, which used aerial photography and aircraft-acquired multispectral data, showed less damage than anticipated [Blohm, 1995]. The final Environmental Impact Statement had estimated that 670 acres would be impacted [DOE, 1990].

During 1995, an extensive survey of natural regeneration of forest species was conducted around the outer perimeter of the delta region of Pen Branch. Results of that survey indicated that approximately 100 acres of the delta had sufficient bald cypress seedlings and saplings to consider the area reforested. Stocking tallies taken in 1997 quantified these high densities and the vigor of this natural regeneration. Naturally regenerating areas closer to the terrace areas were heavily stocked with maple, sweetgum, water tupelo, green ash, and bald cypress—and averaged more than 319 seedlings per acre. Areas of natural regeneration in the deeper swamp, stocked primarily with water tupelo and bald cypress, averaged more than 1,087 seedlings per acre. These areas are included in a Geographic Information System layer for mapping of the Pen Branch area. All areas of the Pen Branch corridor above Risher Pond Road (A–13.2) also are considered to have been reforested by natural regeneration to a bottomland hardwood forest type.



SRI/SRTC Graphic (modified)

Figure 12–1 Pen Branch Reforestation Areas
Each of five areas in the Pen Branch corridor and delta requires a specific regeneration strategy to ensure successful reforestation.

Reforestation of the Pen Branch Corridor and Delta by Planting

The Pen Branch corridor and delta are being reforested by planting with indigenous wetlands species. Seeds were collected from individual trees at SRS and in the Upper Coastal Plain during 1992–1993 to ensure appropriate genetic material for use in the project. The seeds were planted and grown at a State of Georgia nursery during 1993–1995 for use in the Pen Branch seedling planting program. These seedlings—of species appropriate to the area being reforested—subsequently were transplanted to the Pen Branch wetland areas. The reforested areas will be managed until successful reforestation has been achieved. This is the preferred method of mitigation for the Pen Branch corridor and delta because of the brief restoration time allowed by DOE.

The initial and secondary seedling plantings of the entire corridor and delta areas (figure 12–1), which it was determined would require intervention for successful mitigation, have been completed. This intervention consisted of planting approximately 31 acres of the lower corridor with a mixture of flood-tolerant hardwood species and cypress seedlings in 1993. Forty–seven acres of the upper corridor was replanted with a mixture of bottomland hardwood seedlings in 1994. Species planted have included water and pignut hickory, sycamore, green ash, swamp and water tupelo, black gum, persimmon, cherrybark and water oak, bald cypress, and swamp chestnut oak. In 1995, the upper corridor section was replanted with seedlings because of the mortality that resulted from feral hog predation on the original planted seedlings. Also in 1995, the delta area was planted for the first time with bald cypress, water tupelo, and—on drier ridges—green ash seedlings. Approximately 90 acres were planted at densities of 425 seedlings per acre. Approximately 85,000 seedlings were planted during the 3 years of planting (1993–1995) in the corridor and delta areas. An establishment report detailing all activities associated with the reforestation was issued in 1996 and serves as the operational guidebook of what silvicultural activities have occurred to accomplish the mitigation to this point [Dulohery et al., 1996].

A regeneration survey was conducted in 1997 to establish the current stocking levels of desirable species in the different areas of the Pen Branch corridor and delta regions. A series of 591 circular plots was assessed along transect lines throughout the Pen Branch system. All living woody individuals within the plots were identified by species and recorded. Results of the survey, shown in figure 12–2, indicate that sufficient numbers of seedlings are present in all the planted areas. Some mortality will continue to occur over time, but the number of seedlings available in planted areas is considerably above what would be present in a normal undisturbed bottomland hardwood or swamp forest. It is anticipated, therefore, that these stocking levels will provide sufficient numbers of trees to ensure reforestation success. A new survey to confirm this is planned for the spring of 1999.

Within each of the areas that have been planted are areas that will serve as untreated controls to assess the effectiveness of the reforestation effort ("Control" in figure 12–2). Twenty-eight acres in the delta and 20 in the corridor were left in these control sections. One control section in the upper corridor was planted inadvertently, which is why the upper corridor control area is higher than the other control areas. In all the control areas, some seedlings are establishing themselves naturally, although the numbers and diversity of species are small and below those required by regulatory compliance with respect to reforestation. This inclusion of control areas has allowed research to compare the treated and untreated areas for the purpose of measuring differences in ecological responses to the treatments. This control acreage is part of that committed to in the MAP. It will be assessed to determine if it will reforest naturally because of its proximity to the mitigated acreage; if it will not, it may receive plantings at a later date.

Because of the control/restoration comparison areas, a number of research and baselining activities have been conducted to document the recovery of the faunal component of the wetland system. Many of these studies were concluded in 1997 and were beginning to be reported at professional meetings, in peer-reviewed publications, and in graduate theses. Studies of aquatic macroinvertebrates and fish were concluded in the corridor reaches of the stream in September 1997 and have shown that species

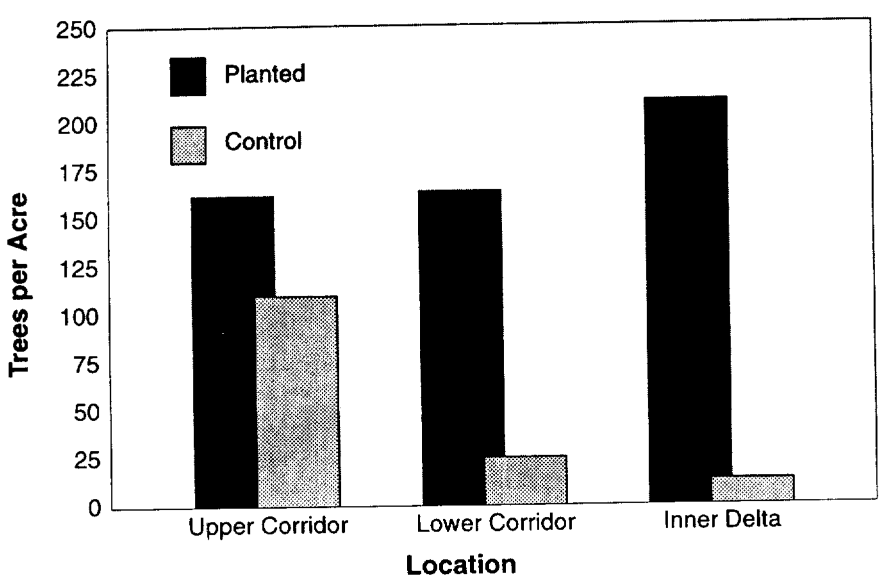


Figure 12–2 Pen Branch Seedling Stocking
A regeneration survey was conducted in 1997 to establish current stocking levels of desirable species of seedlings in different areas of the Pen Branch corridor and delta regions. Survey results indicate that sufficient numbers of seedlings are present in all the planted areas.

Ileaf Graphic

composition and productivity are very high in Pen Branch.

Observations of neotropical bird utilization of the habitats were concluded during the spring of 1996. These also showed good utilization of the Pen Branch habitat, although species diversity was lower than in mature systems [Buffington et al., 1997].

Studies to identify species composition and the relative abundance of small mammals, amphibians, and reptiles were concluded in the fall of 1996 to quantify recolonization of the bottomland hardwood forest. The herpetological baseline characterization indicated that nearly 50 species already were present in the Pen Branch corridor and that the wetland was being used for reproduction [Bowers, 1997].

These studies have been conducted by cooperators at Clemson University, the University of South Carolina, the University of Georgia, the Savannah River Ecology Laboratory, and the University of South Carolina at Aiken. Monitoring of the wetland hydrology and vegetation development is required to show successful restoration and will continue through the project life.

Several presentations to professional meetings were given during 1997 to highlight the interdisciplinary assessment methodology being developed at SRS. Also, the proceedings of a symposium held in 1996 continued to be a regularly cited document relating to the broad effort that has taken place in the Pen Branch ecosystem [Nelson, 1996]. The symposium—organized by the Environmental Sciences Section of SRTC—provided all parties involved in the restoration, monitoring, and research efforts the opportunity to share their preliminary findings. With many of these programs completed in 1997, preliminary planning of a new workshop and symposium to document the final results got under way.

Compensatory Mitigation

The option exists to compensate—by enhancing degraded wetlands or creating new wetlands—for an inability to restore Pen Branch. The option will be considered following evaluation of the success of reforesting the Pen Branch corridor and delta in the year 2000. However, it is the least desired option and will be implemented only should the existing efforts in Pen Branch prove unsuccessful.

Academy of Natural Sciences of Philadelphia River Quality Surveys

Overview

The Patrick Center for Environmental Research of ANSP has been conducting biological and water quality surveys of the Savannah River since 1951. These surveys are designed to assess potential effects of SRS contaminants and warm water discharges on the general health of the river and its tributaries. This is accomplished by seeking

- patterns of biological disturbance that are geographically associated with the site
- patterns of change over seasons or years that indicate improving or deteriorating conditions

The ANSP surveys examine algae, rooted aquatic plants, protozoa, insects and other macroinvertebrates, and fish. Detailed studies of all components (comprehensive surveys) have been conducted roughly every 4 years, and studies of selected components (cursory surveys)—including a type of algae called diatoms—have been conducted each year. Multiple levels of the aquatic food web are studied because no single group of organisms is the best indicator of all aspects of ecosystem health and because there is a broad consensus that maintaining the integrity of the entire system is important.

The study design employed in the ANSP Savannah River surveys during 1996 and 1997 included two to five sampling stations (figure 12–3): one to three exposed to SRS influence and an unexposed reference station upriver. Multiple exposed stations are preferred because of the complex pattern of SRS inputs along the river. Potential impacts are assessed by determining whether differences exist between the exposed and reference stations that either are greater or of a different character than would be expected if they were due merely to natural differences among sampling sites.

For example, the character of differences among stations is judged in part by comparing the individual species collected. Evidence of impact exists if a station shows elevated abundances of species known to tolerate pollution and depressed abundances of species known to be sensitive to pollution. If this pattern is detected at the exposed stations, but not at the reference station, SRS is implicated. If, however, the pattern is seen at the reference station, the impact must be due to sources upstream from the study area.

Other types of evidence for impact include

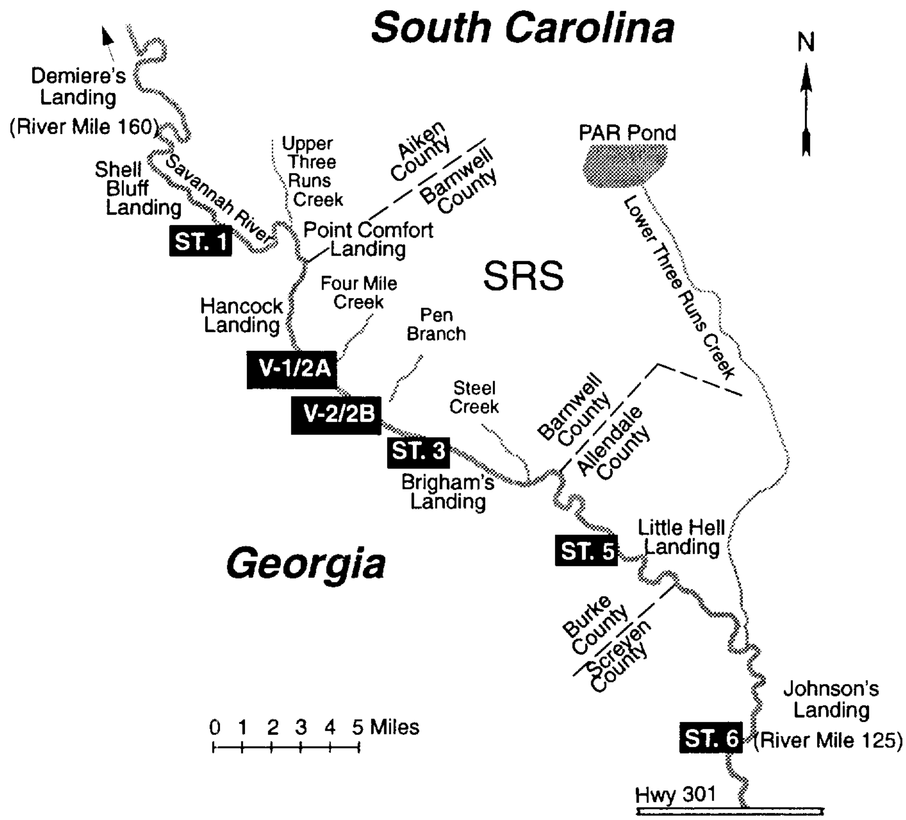


Figure 12–3 Academy Survey Sampling Sites
The Academy of Natural Sciences of Philadelphia has established specific sampling locations for surveys of the Savannah River—five exposed to SRS and other influences (stations 2A to 6) and one unexposed reference station (station 1).

96X00236.03.AIL (modified)

- decreased numbers of species
- decreased cumulative numbers of individuals
- numerical dominance by a small proportion of the species present
- decreased individual growth rates (e.g., in fish)
- decreased body weights of individuals relative to their lengths.

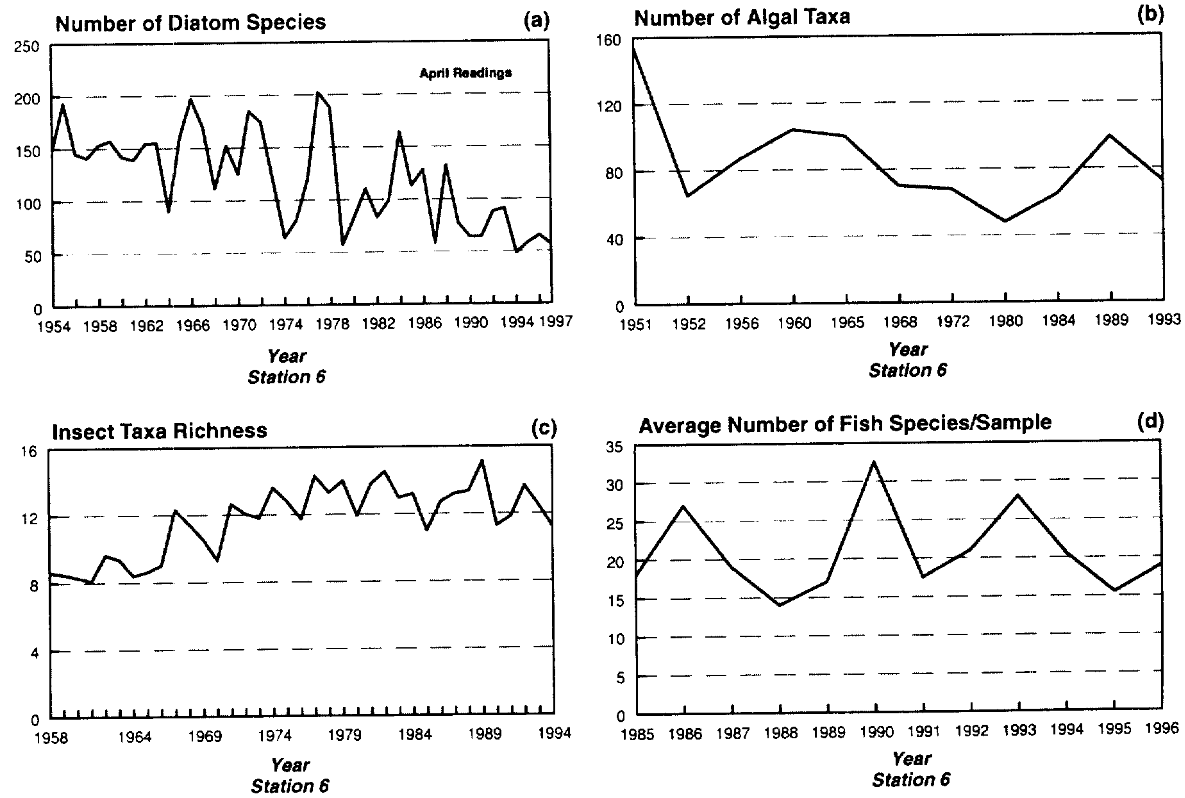
These patterns arise because pollution tends to reduce individual and population growth rates in a majority of species, while a few are able to thrive under such conditions.

Determining whether exposed and reference stations differ is complicated by the fact that considerable variation exists even among samples collected at the same time from the same location. Apparent differences therefore may be misleading if each station is characterized by only a single sample. For this reason, the ANSP surveys typically collect multiple samples from each station, making it possible to quantify both of the important components of variation: within and among stations. Compelling evidence for station differences exists if variation among samples from different stations is significantly greater than (average) variation among samples from the same station, as judged by appropriate statistical techniques. Otherwise, apparent station differences can be explained simply by natural variability.

The ANSP surveys also address variation over time (temporal variation). Important components of temporal variation include seasonal trends, multiyear trends, and trendless variability. All these components can be assessed using the unique data set generated by ANSP's long-term monitoring program in the Savannah River (figure 12–4). Regular sampling with standardized collection techniques has continued largely unmodified since the early 1950s, making this one of the most comprehensive ecological data sets available for any of the world's rivers.

Such long-term records of biological change are valuable for several reasons. Because they allow the normal degree of year-to-year variability at a site to be quantified, changes observed from one survey to the next can be assessed to determine whether they fall within the normal range, much as one would use a control chart (figure 12–5). On average, two-thirds of the data should fall between the standard deviation lines. Changes outside this range provide evidence of altered conditions at the study site.

These data sets also are useful in distinguishing between potential impacts of SRS and variation caused by other factors. In particular, part of the



ANSP Graphic (modified)

Figure 12–4 Long-term Biological Data

Examples from the ANSP's long-term biological data set for the Savannah River include (a) number of diatom species in diatometers; (b) number of algal taxa per trap; (c) number of insect taxa; and (d) average number of fish species per sample—all at station 6.

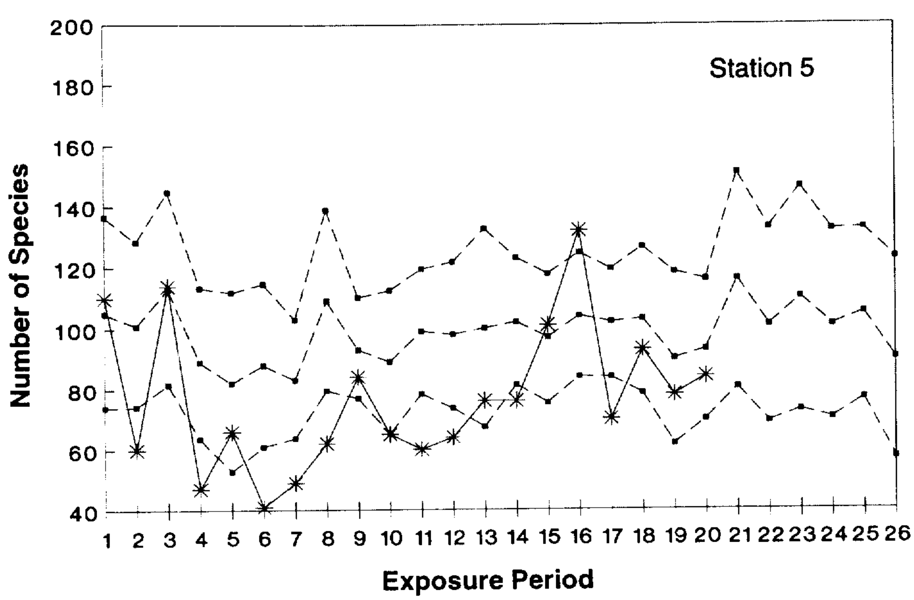


Figure 12–5 Station 5 Diatom Species

Shown are the number of diatom species in diatometers at station 5, with the 1996 values (solid line) superimposed on the mean plus or minus 1 standard deviation (dashed lines) during the period 1978–1996. Exposure periods represent 26 2-week intervals during which diatometers were deployed in the Savannah River.

ANSP Graphic (modified)

A senior scientist with ANSP's Patrick Center for Environmental Research identifies freshwater mussels collected from the Savannah River in September 1997 as part of the academy's annual biological and water quality survey of the river.

R.L. Thomas/ANSP Photo

biological variation observed over time is caused by documented changes in river flow, wastewater treatment methods, dredging activities, and so on. Correlations between the known history of such changes on the one hand, and components of variation in long-term data sets on the other, provide evidence that these components were not caused by SRS activities.

Finally, long-term data sets can provide compelling evidence for multiyear trends of improvement or deterioration in ecosystem health. For example, analyses of some of ANSP's long-term data suggest a relatively steady increase in the number of different kinds of aquatic insects living in the river during the past 35 years, as shown in figure 12–4(c). Because aquatic insect diversity is believed to be a sensitive measure of environmental quality, this pattern may indicate a long-term trend of improving water quality in the river.

Both above and below SRS, there has been a general decline in the number of diatom species growing on artificial substrates (figure 12–4a). In the earlier studies (1950s and 1960s), the number of diatom species in the detailed readings vacillated from high (150–200) during a few years to lower numbers (80–115). Studies in the 1970s and 1980s showed similar vacillation; however, the numbers were lower overall (peaks of 140 to 180 species, with lows near 60). Beginning in the late 1980s and continuing through present studies, the numbers of diatom species has been comparatively low (ranging from 60 to 130 species). The lower number of species is related to a proportion increase of more than 90 percent of one species, *Gomphonema parvulum*. This great dominance by one species, while not totally unrelated to the operation of SRS, has been observed at various times throughout the Savannah River area (above and below SRS) and in other southeastern U.S. coastal rivers (e.g., Congaree and Wateree rivers). The highly uneven communities indicate increased organic pollution.

Results

The 1996 and 1997 ANSP studies on the Savannah River included biweekly (1996) to monthly (1997) diatometer monitoring throughout the year, cursory surveys (1996) in the vicinity of SRS (algae, aquatic macrophytes, insects, and fish), and comprehensive sampling near Georgia Power Company's Vogtle Electric Generating Plant and SRS (1997 – algae, aquatic macrophytes, noninsect macroinvertebrates, insects, and fish). Plant Vogtle stations lie within the area potentially impacted by SRS and are examined to note measurable influences to river health from Vogtle that potentially could be separated from those contributed by SRS. Analyses of samples from the 1997 comprehensive and diatometer studies are not yet complete.

Results of the 1996 ANSP studies were not reported by the academy in the *SRS Environmental Report for 1996* because a new contract based on recommendations of the 1996 "Rock Hill Initiative #2" review had not been finalized [WSRC, 1996]. It was expected that data analysis results from both 1996 and 1997 would be published in the *SRS Environmental Report for 1997*. Because 1997 analyses were not completed in time, however, only the 1996 results appear in this document. Beginning with the *SRS Environmental Report for 1998*, complete results of the previous year's studies and a description of the present year's program will be presented.

Rock Hill-generated programmatic changes also resulted in elimination of the ANSP water chemistry and bacteriology studies of the river, beginning in 1996.

Progress for each component of the 1996 and 1997 studies is reported in the following paragraphs.

Diatometer Monitoring

Periphyton is an assemblage of simple plants (e.g., algae) that attach to rocks and other submerged surfaces in the river. Diatoms, a type of periphyton, are a group of algae that can be used as reliable indicators of water quality conditions. Diatoms are collected using devices called Catherwood Diatometers that float glass slides near the water's surface. The diatoms that attach and grow on these slides can be scraped off and examined in the laboratory.

In 1996, diatoms were collected continuously at locations above SRS (reference station 1), below Steel Creek (exposed station 5), and below Lower Three Runs Creek (exposed station 6). Sampling continued every 2 weeks from January through September. Samples were analyzed for each 2-week period to determine the number and relative abundances of diatom species. A more detailed analysis was performed on slides from an exposure period in April (slides removed from the river April 23–25, 1996).

In 1997, sampling and analyses were conducted monthly (12 2-week exposures for the study year); more detailed analyses were performed on slides for two exposure periods (slides removed from the river April 29 and November 4, 1997). Additionally, samples were collected in 1997 at two stations—one above (exposed station 2A) and one below (exposed station 2B) Plant Vogtle. Water quality was assessed by comparing stations and sampling periods based on the relative abundances and richness of species, and on the species' ecological requirements and tolerances.

Results of the 1996 study indicate that, as in the previous 8 years of study, the number of diatom species (species richness) was consistently lower at station 6 (below Lower Three Runs Creek) than at the upstream reference station (station 1), indicating an influence from sources in the Lower Three Runs Creek drainage. A similar trend was observed for percent dominance, an index measuring the degree of numerical dominance by a small proportion of the species. Diatom communities at the station below Steel Creek (station 5) were similar to the reference station (station 1) in species richness and community dominance.

During 1996 studies, the number of species was less than the established average. This difference usually was notable (by one standard deviation), especially during the earlier portion of the study year. The lower number of species occurred throughout the study area (i.e., at stations 1, 5, and 6) and represents a less balanced biota. Again, this is related to large populations of one species, *Gomphonema parvulum*.

The compilation of analysis results from the 1997 study is incomplete.

Algae and Aquatic Macrophyte Studies

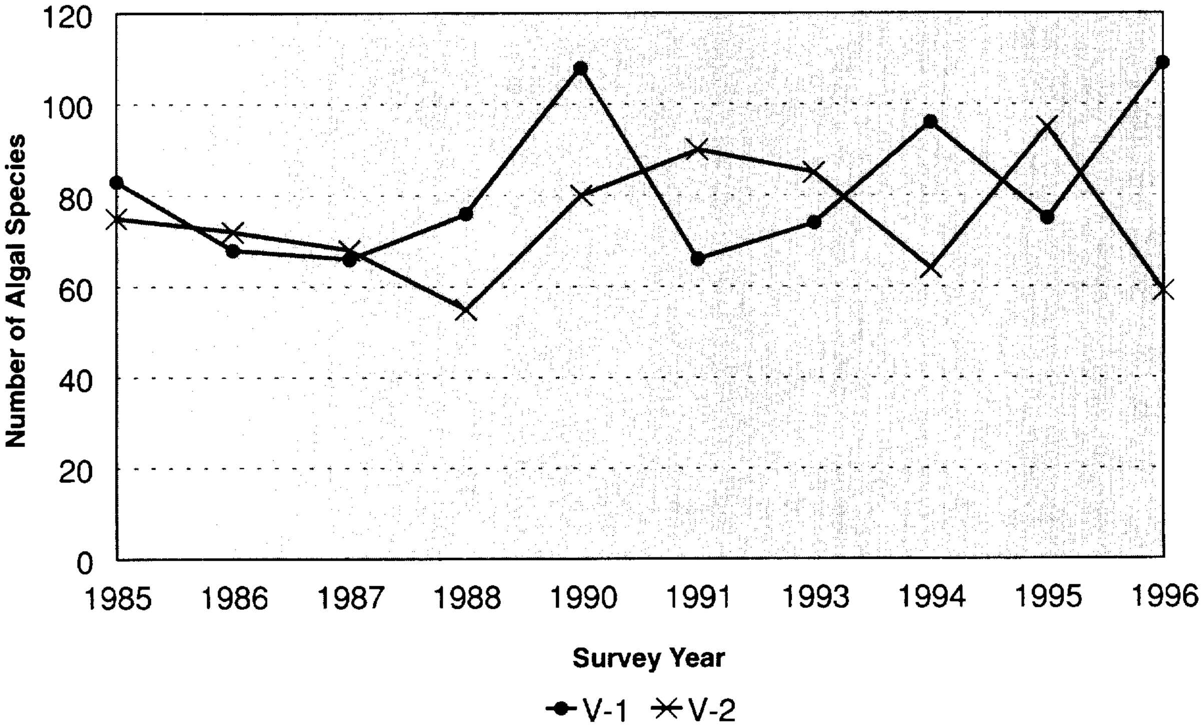
The 1996 cursory algal and aquatic macrophyte studies were carried out on the Savannah River at the reference station above SRS and at two exposed stations (5 and 6). Results from the April 1996 cursory survey show algal and aquatic macrophyte communities that were fundamentally similar to those present during previous Savannah River surveys.

The 1996 comprehensive algal and aquatic macrophyte studies were carried out on the Savannah River at two stations—one upstream and one downstream of Plant Vogtle. Results of the September 1996 comprehensive survey revealed 109 algal species at the upstream station and 59 algal species at the downstream station. Both of these are within the recorded range of species numbers for previous Vogtle studies (figure 12–6), though the difference is unusually large. The species composition of the algal flora provides no evidence of any major effect on Savannah River water quality.

The 1997 comprehensive algal and aquatic macrophyte studies were carried out on the river at the reference station above SRS and at three exposed stations downstream. The compilation of sample analysis results has not been completed.

Protozoan Studies

The 1996 comprehensive protozoan study of the Savannah River near Plant Vogtle found 59 species at station V–1 and 75 at station V–2. This species diversity lies in the range of variability (54 to 80 species for station V–1 and 54 to 75 species for station V–2) observed during past studies. Variations in diversity between the two Plant Vogtle stations in 1996 reflect differences in



ANSP Graphic (modified)

Figure 12–6 Algal Taxa
The graph's data points show the number of algal taxa at stations above (V–1) and below (V–2) Vogtle Electric Generating Plant, on the Savannah River adjacent to SRS, during the period 1985–1996.

- station V–1 river hydrodynamics, including rising water levels, increased velocity of current, and decreased water clarity
- station V–2 habitat, especially with respect to increased quality and quantity of exposed habitat attributable to low-water access and to a period of stable flows that permitted colonization prior to sampling

Generally, the highest values for both stations were found before 1990, when conspicuous beds of aquatic plants provided a stable sheltered substrate for the protozoan community.

Because of programmatic changes implemented following the 1996 "Rock Hill Initiative #2" review, examinations of the protozoan community were eliminated during the 1997 study of the Savannah River near Plant Vogtle but will be resumed in 1998 under the new Savannah River biological monitoring program.

Noninsect Macroinvertebrate Studies

The 1996 Savannah River Plant Vogtle comprehensive noninsect macroinvertebrate survey found 12 species at station V–1 and 15 species at station V–2. Although there were differences in the results from the two stations, the long-term database reveals these dissimilarities to be within the expected number of one to three species typical of past surveys. The database also shows that 1996 survey results are similar to those from 1990, 1991, and 1993. All four of these studies share reduced submerged aquatic vascular plant beds and low water levels. Since 1990, similarities in river hydrodynamics (high vs. low water) and habitat composition appear to have exerted a greater influence on noninsect macroinvertebrate species diversity than any impact from Plant Vogtle.

An examination of field notes from the September 1997 Savannah River comprehensive study of the noninsect macroinvertebrate fauna indicates a species richness that lies approximately between 26 and 30 species. Analyses of these samples and final species determinations were not complete by the end of 1997.

Insect Studies

The scope of the cursory aquatic insect survey was reduced in 1996 so that samples from only two seasons, rather than four, were analyzed. As in previous years, the 1996 cursory survey suggests that components of water quality to which insects

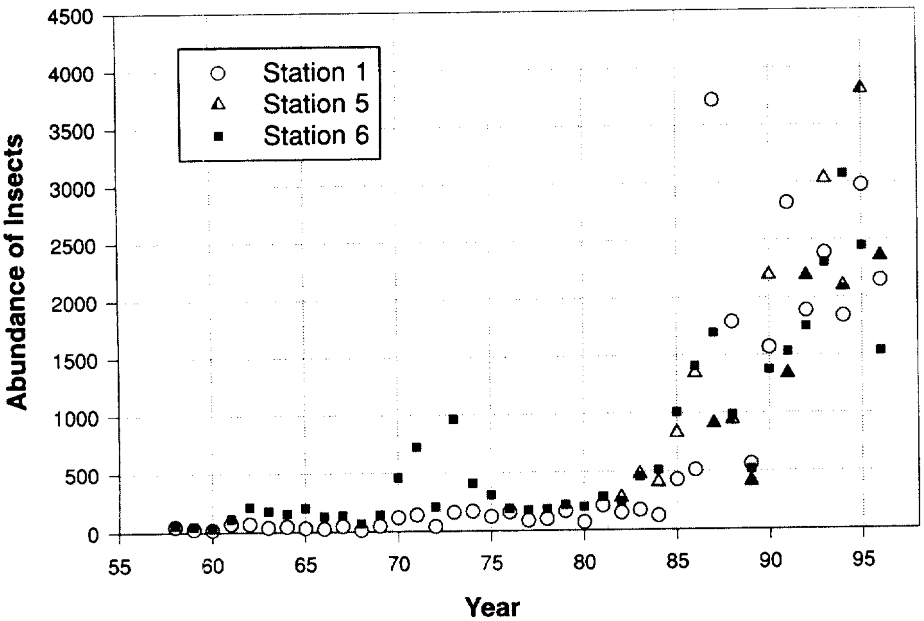


Figure 12–7 Total Abundance

The graph's data points show the the annual mean total abundance (individuals per trap) of insect taxa collected from the Savannah River at stations 1, 5, and 6 near SRS.

ANSP Graphic (modified)

generally are sensitive may be better downstream of SRS at station 6 than upstream at station 1.

There was a reduction in the annual mean abundance of insects at all stations in 1996, relative to 1995. Although the mean abundances at stations 1 and 5 in 1996 were very similar to the abundances observed in 1994, station 6 had fewer insects than had been recorded since 1991 (figure 12–7). However, station 6 continued the long-term trend of having more taxa than station 1 (figure 12–8).

For 1996, no statistically significant differences between Plant Vogtle stations V–1 and V–2 were found in any of the assessment variables (total abundance, taxa richness, Shannon-Wiener diversity, etc.). The insect faunas at these stations were similar; thus, no evidence of a Plant Vogtle impact was found.

Analysis of the 1997 data is incomplete.

Fish Studies

Two sets of fish studies were conducted in 1996. The first set compared communities in backwater habitats

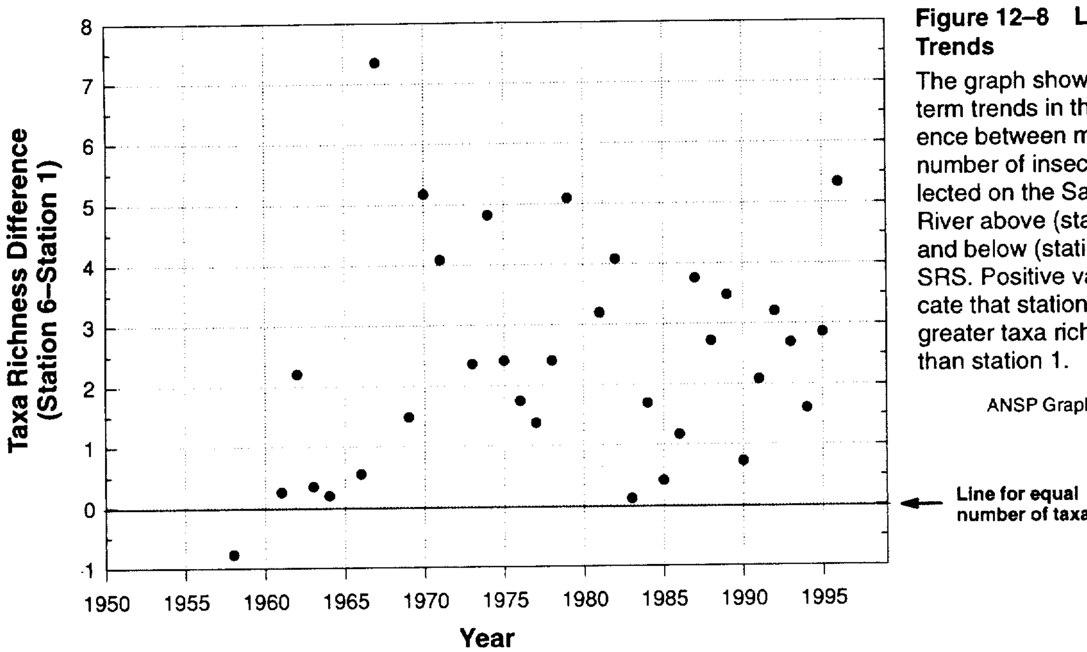


Figure 12–8 Long-term Trends

The graph shows long-term trends in the difference between mean number of insect taxa collected on the Savannah River above (station 1) and below (station 6) SRS. Positive values indicate that station 6 has greater taxa richness than station 1.

ANSP Graphic (modified)

of three main survey stations (stations 1, 5, and 6). The second involved a comprehensive comparison of communities and individual fish attributes at two stations (V–1 and V–2) located above and below Plant Vogtle. All analyses of the 1996 studies are complete.

In 1997, backwater sampling was done at stations 1, 2b, 5, and 6. Analyses of the 1997 studies are not yet complete.

The 1996 sampling involved electroshocking with multiple passes; this allowed depletion (removal) estimates of

- total populations
- individual taxa and total densities
- sampling efficiency

The sampling efficiency of most common taxa was moderate (e.g., sunfishes) to high (e.g., minnows) on each pass, allowing good density estimates. Efficiency was variable (e.g., mosquitofish and silversides) or low (e.g., topminnows and small catfishes) for some other species.

Thirty-five species were collected in the backwater samples in 1996, with a range of seven to 28 species in individual samples and 18 to 28 species at each station. Centrarchids (sunfishes, basses, and crappies) were the most common group in all samples. Six to nine species were collected in each sample. Minnows, mosquitofish, and silversides were variable in abundance. Together, these groups composed 89 to 98 percent of the individuals caught in each sample. Despite differences in densities of individual taxa, estimated total densities were relatively similar at most sites (49–93 fish/100 m^2). Species richness varied with the size of each site and the number of individual fish caught. There was large variation among sites within stations, and there were no clear differences among the three stations. Species richness in 1995 and 1996 appears somewhat lower than that of the most recent previous surveys. This may partly reflect the change in sampling technique to electrofishing.

Sampling at the Plant Vogtle stations in 1996 produced a total of 36 species. The numbers of species caught at each station and in total were lower than in most of the previous Vogtle surveys. This reflects rarity or absence of a number of species commonly found in vegetation (beds absent from the river since 1990) or snag habitat (typically spotty in distribution).

Although most species exhibited unique patterns of abundance over the 1985–1996 survey period, there were three general patterns, as follows:

- Several species (Eastern silvery minnow, redbreast sunfish, red-ear sunfish, bluegill, spottail shiner, and tesselated darter) generally were more abundant in the later surveys (1991–1995) than in the early surveys (1985–1990).
- Eastern mosquitofish and spotted sunfish showed the opposite pattern.
- The third pattern (seen in coastal shiner and rosyface chub) consisted of high abundance in the 1988–1991 and the 1994 surveys compared to the surveys from the other years.

Conditions (length-weight relationships) were compared for four common species. There were small but significant differences in the conditions of whitefin shiner and tesselated darter (higher at station V–1) and of spottail shiner (higher at station V–2). Comparisons of conditions among stations and years showed large station-year interactions; i.e., differences in conditions have not been consistent among stations or years.

Comparisons of growth rates of young-of-year whitefin shiners were conducted using otolith banding to estimate ages (in days) of fish. Growth in length was nearly linear, although there was some indication of decreasing growth rates in older young-of-year fish. The average growth rate was 0.028 cm/day; there was no significant difference in growth rate between the two stations. Growth rates were very similar during the years 1993–1996.

Conclusions

Based on the results available for this progress report, most of the study elements in the 1996–1997 ANSP river quality surveys found no significant difference between biological communities upstream and downstream of the SRS, or upstream and downstream of Plant Vogtle. Thus, there is no evidence of systemwide impacts attributable to these facilities.

Differences between biological communities were, however, found in three study elements. The 1996 diatometer monitoring program found that species diversity was consistently lower at station 6 (but not at station 5) than at the upstream reference station, suggesting a detrimental impact of conditions on Lower Three Runs Creek. This pattern was not seen in 1997. The 1996 cursory insect survey also detected station differences, but the nature of these differences suggests that components of water quality to which insects are sensitive actually improve rather than deteriorate as the river flows past SRS. This pattern may reflect recovery from impacts originating upstream of the study area. The algae, protozoa, and noninsect macroinvertebrate fish surveys detected station differences as well, but these are related to differences in hydrodynamics and available habitat and do not indicate water quality impacts.

There was an indication of disturbance in the diatom flora in 1996, possibly reflecting conditions on Lower Three Runs Creek, but no such indication was found in 1997.

In summary, the available results provide no evidence that SRS or Plant Vogtle have detrimental impacts on water quality in the Savannah River.

Appendix A

Applicable Guidelines, Standards, and Regulations

THE Savannah River Site (SRS) environmental monitoring program is designed to meet state and federal regulatory requirements for radiological and nonradiological programs. These requirements are stated in U.S. Department of Energy (DOE) orders 5400.1, "General Environmental Protection Program," and 5400.5, "Radiation Protection of the Public and the Environment"; in the Standards of Performance for New Stationary Sources, also referred to as New Standards of Performance for Stationary Sources (NSPS); in the National Emission Standards for Hazardous Air Pollutants (NESHAP); in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA—also known as the Superfund); in the Resource Conservation and Recovery Act (RCRA); in the Clean Water Act (i.e., National Pollutant Discharge Elimination System—NPDES); and in the National Environmental Policy Act (NEPA). Compliance with environmental requirements is assessed by the South Carolina Department of Health and Environmental Control (SCDHEC) and the U.S. Environmental Protection Agency (EPA).

The SRS environmental monitoring program's objectives incorporate recommendations of the International Commission on Radiological Protection (*"Principles of Monitoring for the Radiation Protection of the Public,"* ICRP Publication 43), of DOE Order 5400.1, and of DOE/EH–0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance." In addition, SRS has implemented and adheres to the SRS Environmental Management System Policy. As a result, the site has obtained International Organization for Standardization (ISO) 14001 certification. The full text of the policy in included in this appendix and begins on page 212.

Listings of permits, drinking water standards, and maximum allowable concentrations of toxic air pollutants can be found in appendix D, "SRS Environmental Permits," appendix B, "Drinking Water Standards," and appendix C, "Standard No. 8 Toxic Air Pollutants." More information about certain media is presented in this appendix.

Air Effluent Discharges

DOE Order 5400.5 establishes Derived Concentration Guides (DCGs) for radionuclides in air. DCGs, calculated by DOE using methodologies consistent with recommendations found in International Commission on Radiological Protection (ICRP) publications 26 and 30, are used as reference concentrations for conducting environmental protection programs at DOE sites and for making dose comparisons. DCGs are not considered release limits. DCGs for radionuclides in air are discussed in more detail on page 210.

In addition, radiological airborne releases are subject to EPA regulations cited in 40 CFR 61, Subpart H, NESHAP.

Regulation of nonradioactive air emissions—both criteria pollutants and toxic air pollutants—has been delegated to SCDHEC. SCDHEC, therefore, must ensure that its air pollution regulations are at least as stringent as federal regulations required by the Clean Air Act. This is accomplished by SCDHEC Regulation 61–62, "Air Pollution Control Regulations and Standards." As with many regulations found in the Code of Federal Regulations (CFR), many of SCDHEC's regulations and standards are source specific. Each source of air pollution at SRS is permitted or exempted by SCDHEC, with specific emission rate limitations or special conditions identified. The bases for the limitations and conditions are the applicable South Carolina air pollution control regulations and standards. In some cases, specific CFRs are sited in the permits issued by SCDHEC.

Three SCDHEC standards are applicable to all SRS sources—except for boilers, which govern criteria and toxic air pollutants and ambient air quality. SCDHEC Air Pollution Control Regulation 61–62.5, Standard No. 2, "Ambient Air Quality Standards," identifies eight criteria air pollutants commonly used as indices of air quality (e.g., sulfur dioxide, nitrogen dioxide, and lead) and provides allowable site boundary concentrations for each pollutant as well as the measuring intervals. Compliance with the various pollutant standards is determined by conducting air dispersion modeling for all sources of each pollutant using EPA-approved dispersion models and then comparing the results to the standard. The pollutants, measuring intervals, and allowable concentrations are given in table A–1. The standards are in micrograms per cubic meter unless noted otherwise.

Regulation 61–62.5, Standard No. 4, "Emissions from Process Industries," is applicable to all SRS sources except those regulated by a different source specific standard. For process and diesel engine stacks in existence on or before December 31, 1985, emissions shall not exhibit an opacity greater than 40 percent. For new sources, where construction was started after December 31, 1985, the opacity standard is 20 percent.

Table A–1
Criteria Air Pollutants

Pollutant	Interval	µg/m3[a,b]
Sulfur Dioxide	3 hours	1300[d]
	24 hours	365[d]
	annual	80
Total Suspended Particulates	Annual Geometric Mean	75
PM10	24 hours	150[c]
	annual	50[c]
Carbon Monoxide	1 hour	40 mg/m3
	8 hours	10 mg/m3
Ozone	1 hour	0.12 ppm[c]
Gaseous Fluorides (as HF)	12-hour avg.	3.7
	24-hour avg.	2.9
	1-week avg.	1.6
Nitrogen Dioxide	annual	100
Lead	Calendar Quarterly Mean	1.5

a Arithmetic average except in case of total suspended particulate matter (TSP)
b At 25 °C and 760 mm Hg
c Attainment determinations will be made based on the criteria contained in appendices H and K, 40 CFR 50, July 1, 1987
d Not to be exceeded more than once a year

Table A–2
Airborne Emission Standards for SRS Coal-Fired Boilers

Sulfur Dioxide	3.6 lb/10^6 BTU[a]
Total Suspended Particulates	0.6 b/10^6 BTU
Opacity	40%

a British Thermal Unit

The SCDHEC standard for toxic air pollutants are identified in Regulation 61–62.5, Standard No. 8, "Toxic Air Pollutants." This standard identifies 257 toxic air pollutants and their respective allowable site boundary concentrations. Again, as with Standard No. 2, compliance with this standard is determined by air dispersion modeling. The pollutants, chemical abstract numbers (CAS), and maximum allowable concentrations are shown in appendix C.

SCDHEC airborne emission standards for each SRS permitted source may differ, based on size and type of facility, type and amount of expected emissions, and the year the facility was placed into operation. For example, SRS powerhouse coal-fired boilers are regulated by SCDHEC Regulation 61–62.5, Standard No. 1, "Emissions From Fuel Burning Operations." This standard specifies that for powerhouse stacks built before February 11, 1971, the opacity standard is 40 percent. For new sources constructed after this date, the opacity standard typically is 20 percent. The standards for particulate and sulfur dioxide emissions are shown in table A–2.

For the package steam generating boilers in K-Area and two portable package boilers, both SCDHEC and federal regulations are applicable. The standard for sulfur dioxide emissions is specified in 40 CFR 60, Subpart Dc, "Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units," while the standard for particulate matter is found in SCDHEC Standard No. 1, "Emissions From Fuel Burning Operations." Because these units were constructed after applicability dates found in both regulations, the opacity limit for these units is the same in both regulations. The emissions standards for these boilers are presented in table A–3.

SCDHEC regulation 61–62.5, Standard No. 3, "Waste Combustion and Reduction," is applicable to

Table A–3
Airborne Emission Standards for SRS Fuel Oil-Fired Package Boilers

Sulfur Dioxide	0.5 lb/10^6 BTU
Total Suspended Particulates	0.6 b/10^6 BTU
Opacity	20%

several sources at SRS. Under this standard the Consolidated Incinerator Facility (CIF) in H-Area is considered a hazardous waste incinerator. Several of the standards for the CIF, given in table A–4, are adjusted for British Thermal Unit (BTU) content of the waste being burned.

Table A–4
Airborne Emission Standards for SRS Consolidated Incinerator Facility

Opacity	10%
Hydrochloric acid (HCl)	4 lb/hr
Particulate Matter	0.08 gr/DSCF[a]
Nickel	0.11 lb/hr[b]
Cadmium	0.0018 lb/hr[b]
Chromium	0.0090 lb/hr[b]
Arsenic	0.0046 lb/hr[b]
Lead	0.090 lb/hr [b]
Organic Compounds	Various[c]
Dioxin	99.9999% DRE

a Corrected to 7% oxygen
b Adjusted for BTU content of waste
c Must be destroyed with an efficiency of at least 99.99%

The catalytic oxidation units (COU) for SRS soil vapor extraction and ground water air stripper systems in A-Area and M-Area are classified as industrial incinerators under this standard. As such, the COUs have an opacity limit of 20 percent.

Some regulations, such as 40 CFR 60, "Standards of Performance for Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) for which Construction, Reconstruction, or Modification Commenced after July 23, 1984," specify types of emission controls that must be incorporated into the construction of a source. In this regulation, the type of control device required is dependent on the size of the tank and the vapor pressures of the material being stored. This regulation is applicable to several sources at SRS, such as the two 30,000-gallon No. 2 fuel oil storage tanks in K-Area or the four mixed solvent storage tanks in H-Area. However, because of the size of these tanks and vapor pressures of the materials being stored, these tanks are not required to have control devices installed. The only requirements applicable to SRS storage tanks are those for record keeping.

(Process) Liquid Effluent Discharges

DOE Order 5400.5 establishes DCGs for radionuclides in process effluents. (DCGs for radionuclides in water are discussed in more detail on page 211.) DCGs were calculated by DOE using methodologies consistent with recommendations found in ICRP Publications 26 and 30 and are used

- as reference concentrations for conducting environmental protection programs at DOE sites
- as screening values for considering best available technology for treatment of liquid effluents
- for making dose comparisons

DOE Order 5400.5 exempts aqueous tritium releases from best available technology requirements but not from ALARA (as low as reasonably achievable) considerations.

SRS discharges water into site streams and the Savannah River under three NPDES permits: one industrial wastewater permit (SC0000175), one general utility water discharge permit (SCG250162), and two stormwater runoff permits (SCR000000 for industrial discharges and SCR100000 for construction discharges). A fourth NPDES permit—a no-discharge permit (ND0072125)—covers land application of sludge generated at onsite sanitary waste treatment plants.

Detailed requirements for each permitted discharge point—including parameters sampled for, permit limits for each parameter, sampling frequency, and method for collecting each sample—can be found in the individual permits, which are available to the public through SCDHEC's Freedom of Information office at (803) 734–5376.

Site Streams

SRS streams are classified as "Freshwaters" by the South Carolina Pollution Control Act. Freshwaters are defined as surface water suitable for

- primary- and secondary-contact recreation and as a drinking water source after conventional treatment in accordance with SCDHEC requirements
- fishing and survival and propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Table A–5 provides some of the specific guides used in water quality surveillance, but because some of these guides are not quantifiable, they are not tracked in response form (i.e., amount of garbage found).

Savannah River

Because the Savannah River is defined under the South Carolina Pollution Control Act as a Freshwater system, the river is regulated in the same manner as are site streams (table A–5).

Drinking Water

EPA drinking water standards (40 CFR 141) for radionuclides apply at the water treatment plants operated by Beaufort and Jasper counties in South Carolina and Port Wentworth in Georgia. Drinking water standards for specific radionuclides are listed in appendix B, "Drinking Water Standards."

SRS drinking water systems must meet the water quality criteria mandated by SCDHEC State Primary Drinking Water Regulations, R.61–58. Drinking water standards for specific contaminants are provided in appendix B, "Drinking Water Standards."

SRS collects samples from all 18 systems to determine compliance with SCDHEC bacteriological water quality limits. Samples are collected monthly or quarterly, depending on the population served. SRS collects samples from the three largest systems to determine compliance with SCDHEC lead and copper water quality limits. Site systems are monitored semiannually by SRS for chlorocarbon concentrations. SCDHEC periodically collects samples from the ten largest systems to determine compliance with bacteriological, chemical, synthetic organic, volatile organic, and radiological water quality limits.

Groundwater

The analytical results of samples taken from SRS monitoring wells that exceed various standards are discussed in this report. Constituents discussed are compared to final federal primary drinking water standards (DWS), or other standards if DWS do not exist, because groundwater aquifers are defined as potential drinking water sources by the South Carolina Pollution Control Act. [SCDHEC, 1985]. The DWS can be found in appendix B, "Drinking Water Standards." DWS are not always the standards applied by regulatory agencies to the SRS waste units under their jurisdiction. For instance, standards under RCRA are DWS, groundwater protection standards, background levels, and alternate concentration limits.

Two constituents having DWS—dichloromethane and bis(2-ethylhexyl) phthalate—are not discussed in this report. Both are common laboratory contaminants and are reported in groundwater samples with little or no reproducibility. Both are reported, with appropriate flags and qualifiers, in the

Table A–5
South Carolina Water Quality Standards for Freshwaters

Note: This is a partial list only of water quality standards for freshwaters.

Parameters	Standards
a. Fecal coliform	Not to exceed a geometric mean of 200/100 mL, based on five consecutive samples during any 30-day period; nor shall more than 10 percent of the total samples during any 30-day period exceed 400/100 mL.
b. pH	Range between 6.0 and 8.5.
c. Temperature	Generally, shall not be increased more than 5 °F (2.8 °C) above natural temperature conditions or be permitted to exceed a maximum of 90 °F (32.2 °C) as a result of the discharge of heated liquids. For exceptions, see E–6, Regulation 61–68, State of South Carolina Water Classifications and Standards (May 28, 1993).
d. Dissolved oxygen	Daily average not less than 5.0 mg/L, with a low of 4.0 mg/L.
e. Garbage, cinders, ashes, sludge, or other refuse	None allowed.
f. Treated wastes, toxic wastes, deleterious substances, colored or other wastes, except those in (e) above.	None alone or in combination with other substances or wastes in sufficient amounts to make the waters unsafe or unsuitable for primary-contact recreation or to impair the waters for any other best usage as determined for the specific waters assigned to this class.
g. Ammonia, chlorine, and toxic pollutants listed in the federal Clean Water Act (307) and for which EPA has developed national criteria (to protect aquatic life).	See E–7 (list of water quality standards based on organoleptic data) and E–8 (water quality criteria for protection of human health), Regulation 61–68, State of South Carolina Water Classifications and Standards (May 28, 1993).

SOURCE: [SCDHEC, 1993]

data tables of the quarterly reports cited in chapter 10, “Groundwater.”

The standard used for lead is the SCDHEC DWS. The federal standard of 15 µg/L is a treatment standard for drinking water at the consumer’s tap; thus, it is inappropriate for use as a groundwater standard.

Of the radionuclides discussed, only gross alpha, strontium-90, and tritium are compared to true primary DWS. The regulatory standards for radionuclide discharges from industrial and governmental facilities are set under the Clean Water Act, RCRA, and Nuclear Regulatory Commission and DOE regulations. The proposed drinking water maximum contaminant levels discussed in this report are only an adjunct to these release restrictions and are not used to regulate SRS groundwater.

The standard used for gross beta is a screening standard; when public drinking water exceeds this standard, the supplier is expected to analyze for individual beta and gamma emitters. A gross beta result above the standard is an indication that one or more radioisotopes are present in quantities that would exceed the EPA annual dose equivalent for persons consuming 2 liters daily. Thus, for the individual beta and gamma radioisotopes (other than strontium-90 and tritium), the standard discussed in this report is the activity per liter that would, if only that isotope were present, exceed the dose equivalent. Similarly, the standards for alpha emitters discussed in this report are calculated to present the same risk at the same rate of ingestion.

Although radium has a DWS of 5 pCi/L for the sum of radium-226 and radium-228, the standards discussed in this report are the proposed standards of 20 pCi/L for each isotope separately. Radium-226, an alpha emitter, and radium-228, a beta emitter, cannot be analyzed by a single method. Analyses for total alpha-emitting radium, which consists of radium-223, radium-224, and radium-226, are compared to the standard for radium-226. During 1997, EPA-proposed standards of 20 pCi/L for radium-226 and 20 pCi/L for radium-228 are expected to replace the 5 pCi/L interim standard.

Four other constituents without DWS are discussed in this report when their values exceed specified levels. These constituents are specific conductance at values equal to or greater than 100 µS/cm, alkalinity (as $CaCO_3$) at values equal to or greater than 100 mg/L, total dissolved solids (TDS) at values equal to or greater than 200 mg/L, and pH at values equal to or less than 4.0 or equal to or greater than 8.5. The selection of these values as standards for comparison is somewhat arbitrary; however, these values exceed levels usually found in background wells at SRS. The occurrence of elevated alkalinity (as $CaCO_3$), specific conductance, pH, and TDS within a single well may indicate leaching of the grouting material used in well construction, rather than degradation of the groundwater.

Potential Dose

The radiation protection standards followed by SRS are outlined in DOE Order 5400.5 and include EPA regulations on the potential doses from airborne releases and treated drinking water.

The following radiation dose standards for protection of the public in the SRS vicinity are specified in DOE Order 5400.5.

Drinking Water Pathway .... 4 mrem per year
Airborne Pathway .... 10 mrem per year
All Pathways .... 100 mrem per year

The EPA annual dose standard of 10 mrem (0.1 mSv) for the atmospheric pathway, which is contained in "National Emission Standards for Hazardous Air Pollutants–Radionuclides (NESHAP)," 40 CFR Part 61, Subpart H, is adopted in DOE Order 5400.5.

These dose standards are based on recommendations of the ICRP and the National Council on Radiation Protection and Measurements (NCRP).

The DOE dose standard enforced at SRS for drinking water consumed from site drinking water systems, community drinking water systems, and downriver water treatment plants is consistent with the criteria contained in "National Interim Primary Drinking Water Regulations, 40 CFR Part 141." Under these regulations, persons consuming drinking water shall not receive an annual whole body dose—DOE Order 5400.5 interprets this dose as committed effective dose equivalent —of more than 4 mrem (0.04 mSv). Both these dose standards are based on a consumption of 2 liters of water per day. However, some radionuclide dose conversion factors (including tritium) differ between EPA and DOE. Because SRS must use DOE-provided, ICRP-based dose conversion factors, a direct comparison of the estimated drinking water doses in chapter 7, "Potential Radiation Doses," to the EPA drinking water dose standard cannot be made. However, radionuclide concentrations found in drinking water are directly compared to the EPA drinking water concentration standards in chapter 6, "Radiological Environmental Surveillance."

Comparison of Average Concentrations in Airborne Emissions to DOE Derived Concentration Guides

Average concentrations of radionuclides in airborne emissions are calculated by dividing the yearly release total of each radionuclide from each stack by the yearly stack flow quantities. These average concentrations then can be compared to the DOE DCGs, which are found in DOE Order 5400.5 for each radionuclide.

DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. DCGs, which are based on a 100-mrem exposure, are applicable at the point of discharge (prior to dilution or dispersion) under conditions of continuous exposure (assumed to be an average inhalation rate of 8,400 cubic meters per year). This means that the DOE DCGs are based on the highly conservative assumption that a member of the public has direct access to and continuously breathes (or is immersed in) the actual air effluent 24 hours a day, 365 days a year. However, because of the large distance between most SRS operating facilities and the site boundary, and because the wind rose at SRS shows no strong prevalence (chapter 7, "Potential Radiation Doses"), this scenario is improbable.

Average annual radionuclide concentrations in SRS air effluent can be referenced to DOE DCGs as a screening method to determine if existing effluent treatment systems are proper and effective.

Comparison of Average Concentrations in Liquid Releases to DOE Derived Concentration Guides

In addition to dose standards, DOE Order 5400.5 imposes other control considerations on liquid releases. These considerations are applicable to direct discharges but not to seepage basin and Solid Waste Disposal Facility (SWDF) migration discharges. The DOE order lists DCG values for most radionuclides. DCGs are used as reference concentrations for conducting environmental protection programs at all DOE sites. These DCG values are not release limits but screening values for best available technology investigations and for determining whether existing effluent treatment systems are proper and effective.

Per DOE Order 5400.5, exceedance of the DCGs at any discharge point may require an investigation of best available technology waste treatment for the liquid effluents. Tritium in liquid effluents is specifically excluded from best available technology requirements; however, it is not excluded from other ALARA considerations. DOE DCG compliance is demonstrated when the sum of the fractional DCG values for all radionuclides detectable in the effluent is less than 1.00, based on consecutive 12-month average concentrations.

DCGs, based on a 100-mrem exposure, are applicable at the point of discharge from the effluent conduit to the environment (prior to dilution or dispersion). They are based on the highly conservative assumption that a member of the public has continuous direct access to the actual liquid effluents and consumes 2 liters of the effluents every day, 365 days a year. However, because of security controls and the large distance between most SRS operating facilities and the site boundary, this scenario is highly improbable, if not impossible.

For each site facility that releases radioactivity, the site's Environmental Monitoring Section (EMS) compares the monthly liquid effluent concentrations and 12-month average concentrations against the DOE DCGs.

Environmental Restoration and Waste Management

SRS began its cleanup program in 1981. Two major federal statutes provide guidance for the site's environmental restoration and waste management activities—RCRA and CERCLA. RCRA addresses the management of regulated hazardous waste and requires that permits be obtained for facilities that treat, store, or dispose of hazardous or mixed waste. It also requires that DOE facilities perform appropriate corrective action to address contaminants in the environment. CERCLA (also known as Superfund) addresses the uncontrolled release of hazardous substances and the cleanup of inactive waste sites. This act establishes a National Priority List of sites targeted for assessment and, if necessary, corrective/remedial action. SRS was placed on this list December 21, 1989 [Fact Sheet, 1995]. In August 1993, SRS entered the Federal Facility Agreement (FFA) with EPA Region IV. This agreement governs the corrective/remedial action process from site investigation through site remediation. It also describes procedures for setting annual work priorities, including schedules and deadlines, for that process [FFA under section 120 of CERCLA and sections 3008(h) and 6001 of RCRA].

Quality Assurance/Quality Control

DOE Order 5700.6C, "Quality Assurance," sets requirements and guidelines for departmental quality assurance (QA) practices. WSRC developed an implementation plan to address the order, entitled "Revised Implementation Plan: DOE Order 5700.6C." To ensure compliance with regulations and to provide overall quality requirements for site programs, WSRC developed the *Westinghouse Savannah River Company Quality Assurance Management Plan* (WSRC–RP–92–225). The requirements of WSRC-RP-92-225 are implemented by the *Westinghouse Savannah River Company Quality Assurance Manual* (WSRC 1Q).

The *Environmental Monitoring Section Quality Assurance Plan*, Volume III (WSRC–3Q1–2), part of the EMS WSRC–3Q1 procedure series, was written to apply the QA requirements of WSRC 1Q to the environmental monitoring and surveillance program. The EMS WSRC–3Q1 procedure series includes procedures on sampling, radiochemistry, and water quality that emphasize the quality control requirements for EMS.

NESHAP defines specific QA requirements for monitoring radiological air emissions [EPA, 1989]. The EMS QA program's plan to comply with these requirements is found in WSRC–3Q1–2, Volume I, Attachment 3–1, "NESHAP QA Plan" (WSRC–IM–91–60).

To ensure valid and defensible monitoring data, the records and data generated by the monitoring program are maintained according to the requirements of DOE Order 1324.2A, "Records Disposition," and of WSRC 1Q. QA records include sampling and analytical procedure manuals, logbooks, chain-of-custody forms, calibration and training records, analytical notebooks, control charts, validated laboratory data, and environmental reports. These records are maintained and stored per the requirements of WSRC–1M–93–0060, *WSRC Sitewide Records Inventory and Disposition Schedule*.

EMS assessments are implemented according to the following documents:

- WSRC–12Q
- WSRC–1Q
- DOE Order 5700.6c, "Quality Assurance"
- DOE/EM–0159P, "Analytical Laboratory Quality Assurance Guidance"
- DOE/EM–0157P, "Laboratory Assessment Plates"
- DOE/EH–0173T, "Program Guidance"

The EMS Self Assessment Plan (ESH–EMS–97–0697) defines the requirements for self assessment and provides for verification of the compliance and effectiveness of the EMS QA/QC program. The plan's purpose is to assist management in evaluating the performance of EMS activities and the effectiveness of management controls and procedures.

Reporting

DOE Order 231.1, "Environment, Safety and Health Reporting," requires that SRS submit an environmental report.

This report, the *Savannah River Site Environmental Report for 1997*, is an overview of effluent monitoring and environmental surveillance activities conducted on and in the vicinity of SRS from January 1 through December 31, 1997.

ISO 14001 Environmental Management System

International Organization for Standardization (ISO) 14001 is the Environmental Management System Standard within the ISO 14000 series of standards, a family of voluntary environmental management standards and guidelines. SRS achieved ISO 14001 certification in 1997 by demonstrating adherence to and programmatic implementation of the SRS Environmental Management System Policy. The full text of the policy (without the names of the signatories) follows.

Savannah River Site (SRS) Environmental Management System Policy Effective February 26, 1997

OBJECTIVE:

The objective of this policy is to ensure every employee of the DOE Savannah River Operations Office (SR), all contractors, subcontractors, and other agencies performing work at the Savannah River Site (SRS) does so in accordance with DOE Order 5400.1 and the mission, the vision, the core values, and the environmental goals and objectives of the Savannah River Strategic Plan.

DIRECTIVE:

Recognizing that all aspects of operations carried out at the SRS may impact the environment, it is the policy of the DOE–SR that all employees, contractors, subcontractors, and other agencies performing work at the SRS shall abide by the policy directives in this document. In order to ensure implementation of and commitment to this Policy, Westinghouse Savannah River Company (WSRC), Wackenhut Services, Incorporated-Savannah River Site (WSI–SRS), Savannah River Ecology Laboratory (SREL), and the SR Forest Station shall sign this Policy.

This document is the SRS Environmental Management System Policy and it shall serve as the primary documentation for the environmental goals and objectives of the SRS and shall be available to the public. It shall be centrally maintained and updated as necessary to reflect the changing needs, missions and goals of the SRS.

The Environmental Management System shall pursue and measure continual improvement in performance by establishing and maintaining documented environmental objectives and targets that correspond to the mission, vision, and core values subscribed to at SRS. The environmental objectives and targets shall be established for each relevant function and level within DOE–SR and all contractors, subcontractors, and other agencies performing work at the SRS for all activities having actual or potentially significant environmental impacts.

DOE–SR and all contractors, subcontractors, and other agencies performing work at the SRS shall:

- Emphasize vigilance of SRS resources, products, waste, and contamination. When a threat to human health or the environment is presented by SRS resources, products, waste, and contamination, DOE–SR and all contractors, subcontractors, and other agencies performing work at the SRS shall undertake all reasonable means to eliminate or mitigate that threat at the earliest practicable opportunity.
- Undertake the management of environmental and natural resources to emphasize vigilance and the prompt undertaking of opportunities for improvement for situations that could pose a significant threat to the quality of the environment or public health.
- Implement a pollution prevention program as a strategy to reduce waste generation and pollution releases, minimize environmental impacts, reduce future waste management and pollution control costs, and improve energy efficiency.
- Conduct operations in compliance with the letter and spirit of all applicable federal, state, and local laws, regulations, statutes and Executive Orders, and DOE Directives or Standards/Requirements Identification Documents, as appropriate.
- Work cooperatively and openly with the appropriate local, state and federal agencies, public stakeholders and site employees to prevent pollution, achieve environmental compliance, conduct cleanup and restoration activities, enhance environmental quality, and ensure the protection of workers and the public health.
- Design, develop, construct, operate, and maintain facilities and operations in a manner that shall be resource-efficient and will protect and improve the quality of the environment for future generations and continue to maintain the SRS as a unique national environmental asset.
- Recognize that the responsibility for quality communication rests with each individual employee and that it shall be the responsibility of all employees to identify and communicate ideas for improving the environmental protection activities and programs of the site.

The Office of External Affairs (DOE–SR/OEA) shall be the primary point of contact between SRS and its public stakeholders.

Adherence to and programmatic implementation of this policy shall be monitored by the DOE–SR Assistant Manager of Environmental Quality (AMEQ) in coordination with the contractors, subcontractors and other agencies performing work on the SRS. An annual evaluation of the Environmental Management System with recommendations for improvement shall be provided to the undersigned managers. *[Editors' note: The names of the signatories that appeared at the end of the full text of the policy have not been included here.]*

Appendix B

Drinking Water Standards

Analyte	Level[a]	Units	Status	Reference[b]
Alachlor	0.002	mg/L	final	CFR, 1993
Aldicarb	0.003	mg/L	final	CFR, 1993
Aldicarb sulfone	0.002	mg/L	final	CFR, 1993
Aldicarb sulfoxide	0.004	mg/L	final	CFR, 1993
Antimony	0.006	mg/L	final	CFR, 1993
Antimony-125	3E+02	pCi/L	interim final	EPA, 1977
Arsenic	0.05	mg/L	final	CFR, 1993
Asbestos	7,000,000	fibers/L[c]	final	CFR, 1993
Atrazine	0.003	mg/L	final	CFR, 1993
Barium	2.0	mg/L	final	CFR, 1993
Barium-140	9E+01	pCi/L	interim final	EPA, 1977
Benzene	0.005	mg/L	final	CFR, 1993
Benzo[a]pyrene	0.0002	mg/L	final	SDWA,1992
Beryllium	0.004	mg/L	final	CFR, 1993
Beryllium-7	6E+03	pCi/L	interim final	EPA, 1977
2-sec–Butyl–4, 6–dinitrophenol (Dinoseb)	0.007	mg/L	final	CFR, 1993
Cadmium	0.005	mg/L	final	CFR, 1993
Carbofuran	0.04	mg/L	final	CFR, 1993
Carbon-14	2E+03	pCi/L	interim final	EPA, 1977
Carbon tetrachloride	0.005	mg/L	final	CFR, 1993
Cerium-141	3E+02	pCi/L	interim final	EPA, 1977
Cesium-137	2E+02	pCi/L	interim final	EPA, 1977
Chlordane	0.002	mg/L	final	CFR, 1993
Chlorobenzene (monochlorobon-zene)	0.1	mg/L	final	CFR, 1993
Chloroethene (Vinyl chloride)	0.002	mg/L	final	CFR, 1993
Chloroform[d]	0.1	mg/L	final	CFR, 1993

a Standards for beta- and gamma-emitting radionuclides are based on the 4-mrem/yr whole-body dose [EPA, 1991].
b References are found on page 219.
c Longer than 10 µm
d The level for total trihalomethanes is set at 0.1 mg/L. Because bromated methanes are rarely detected in SRS groundwater, the Environmental Protection Department (EPD) presumes that most of the trihalomethanes present in site groundwater are chloroform.

Analyte	Level[a]	Units	Status	Reference[b]
Chromium	0.1	mg/L	final	CFR, 1993
Chromium-51	6E+03	pCi/L	interim final	EPA, 1977
Cobalt-58	9E+03	pCi/L	interim final	EPA, 1977
Cobalt-60	1E+02	pCi/L	interim final	EPA, 1977
Cyanide	0.2	mg/L	final	CFR, 1993
Dalapon	0.2	mg/L	final	CFR, 1993
Dibromochloropropane	0.0002	mg/L	final	CFR, 1993
Di (2–ethylhexyl) adipate (Deha)	0.4	mg/L	final	CFR, 1993
Di (2–ethylhexyl) phthalate	0.006	mg/L	final	SDWA,1992
1,2-Dichlorobenzene	0.6	mg/L	final	CFR, 1993
1,4-Dichlorobenzene (p-Dichlorobenzene)	0.075	mg/L	final	CFR, 1993
1,2-Dichloroethane	0.005	mg/L	final	CFR, 1993
cis-1,2-Dichloroethylene	0.07	mg/L	final	CFR, 1993
trans-1,2-Dichloroethylene	0.1	mg/L	final	CFR, 1993
1,1-Dichloroethylene	0.007	mg/L	final	CFR, 1993
Dichloromethane (Methylene chloride)	0.005	mg/L	final	CFR, 1993
2,4-Dichlorophenoxyacetic acid (2,4–D)	0.07	mg/L	final	CFR, 1993
1,2-Dichloropropane	0.005	mg/L	final	CFR, 1993
Dioxin (2,3,7,8–TCDD)	3.00E–08	mg/L	final	CFR, 1993
Diquat	0.02	mg/L	final	CFR, 1993
Endrin	0.002	mg/L	final	CFR, 1993
Endothall	0.1	mg/L	final	CFR, 1993
Ethylbenzene	0.7	mg/L	final	CFR, 1993
Ethylene dibromide	0.00005	mg/L	final	CFR, 1993
Europium-154	2E+02	pCi/L	interim final	EPA, 1977
Europium-155	6E+02	pCi/L	interim final	EPA, 1977
Fluoride	4	mg/L	final	CFR, 1993
Glyphosate	0.7	mg/L	final	CFR, 1993
Gross alpha	15	pCi/L	final	CFR, 1993
Heptachlor	0.0004	mg/L	final	CFR, 1993
Heptachlor epoxide	0.0002	mg/L	final	CFR, 1993
Hexachlorobenzene	0.001	mg/L	final	CFR, 1993

a Standards for beta- and gamma-emitting radionuclides are based on the 4-mrem/yr whole-body dose [EPA, 1991].
b References are found on page 219.

Analyte	Level[a]	Units	Status	Reference[b]
Hexachlorocyclopentadiene	0.05	mg/L	final	CFR, 1993
Iodine-129	1E+00	pCi/L	interim final	EPA, 1977
Iodine-131	3E+00	pCi/L	interim final	EPA, 1977
Iron-55	2E+03	pCi/L	interim final	EPA, 1977
Iron-59	2E+02	pCi/L	interim final	EPA, 1977
Lanthanum-140	6E+01	pCi/L	interim final	EPA, 1977
Lindane	0.0002	mg/L	final	CFR, 1993
Manganese-54	3E+02	pCi/L	interim final	EPA, 1977
Mercury	0.002	mg/L	final	CFR, 1993
Methoxychlor	0.04	mg/L	final	CFR, 1993
Nickel	0.1	mg/L	final	CFR, 1993
Nickel-59	3E+02	pCi/L	interim final	EPA, 1977
Nickel-63	5E+01	pCi/L	interim final	EPA, 1977
Niobium-95	3E+02	pCi/L	interim final	EPA, 1977
Nitrate + Nitrite (As N)	10	mg/L	final	CFR, 1993
Nitrate (as N)	10	mg/L	final	CFR, 1993
Nitrite (as N)	1	mg/L	final	CFR, 1993
Nonvolatile beta	4	mrem/yr	final	CFR, 1993
Oxamyl (Vydate)	0.2	mg/L	final	CFR, 1993
PCBs	0.0005	mg/L	final	CFR, 1993
Pentachlorophenol	0.001	mg/L	final	CFR, 1993
Picloram	0.5	mg/L	final	SDWA,1992
Radium-226/228 (Total)	5	pCi/L	final	CFR, 1993
Ruthenium-103	2E+02	pCi/L	interim final	EPA, 1977
Ruthenium-106	3E+01	pCi/L	interim final	EPA, 1977
Selenium	0.05	mg/L	final	CFR, 1993
Simazine	0.004	mg/L	final	CFR, 1993
Strontium-89	2E+01	pCi/L	interim final	EPA, 1977
Strontium-89/90	4.20E+01[c]	pCi/L	final	CFR, 1993
Strontium-90	8E+00	pCi/L	final	CFR, 1993
Styrene	0.1	mg/L	final	CFR, 1993
Technetium-99	9E+02	pCi/L	interim final	EPA, 1977
Tetrachloroethylene	0.005	mg/L	final	CFR, 1993
Thallium	0.002[d]	mg/L	final	CFR, 1993
Tin-113	3E+02	pCi/L	interim final	EPA, 1977

a Standards for beta- and gamma-emitting radionuclides are based on the 4-mrem/yr whole-body dose [EPA, 1991].
b References are found on page 219.
c For double radionuclide analyses where each separate radionuclide has its own standard, the more stringent standard is used.
d This is the lower of two proposed levels.

Analyte	Level[a]	Units	Status	Reference[b]
Toluene	1.0	mg/L	final	CFR, 1993
Total radium	5	pCi/L	final	CFR, 1993
Toxaphene	0.003	mg/L	final	CFR, 1993
2,4,5-TP (Silvex)	0.05	mg/L	final	CFR, 1993
1,2,4-Trichlorobenzene	0.07	mg/L	final	CFR, 1993
1,1,1-Trichloroethane	0.2	mg/L	final	CFR, 1993
1,1,2-Trichloroethane	0.005	mg/L	final	CFR, 1993
Trichloroethylene	0.005	mg/L	final	CFR, 1993
Total trihalomethanes[c] (includes bromodichloromethane, bromoform, chloroform, and dibromochloromethane)	0.1	mg/L	final	CFR, 1993
Tritium	2E+01	pCi/mL	final	CFR, 1993
Xylenes	10	mg/L	final	CFR, 1993
Zinc-65	3E+02	pCi/L	interim final	EPA. 1977
Zirconium-95	2E+02	pCi/L	interim final	EPA. 1977
Zicronium/Niobium-95[d]	2E+02	pCi/L	interim final	EPA. 1977

a Standards for beta- and gamma-emitting radionuclides are based on the 4-mrem/yr whole-body dose [EPA, 1991].
b References are found on page 219.
c EMS does not test for total trihalomethanes, but each of these analytes is tested separately.
d For double radionuclide analyses where each separate radionuclide has its own standard, the more stringent standard is used.

References

CFR (Code of Federal Regulations), 1993. "National Primary Drinking Water Regulations," *40 CFR, Part 141*, pp. 592–731, Washington, D.C

EPA (U.S. Environmental Protection Agency), 1977. *National Interim Primary Drinking Water Regulations*, EPA-570/9-76-003. Washington, D.C

EPA (U.S. Environmental Protection Agency), 1986. "Water Pollution Control; National Primary Drinking Water Regulations, Radionuclides (Proposed)," *Federal Register*, September, 1986, pp. 34835-34862. Washington, D.C

EPA (U.S. Environmental Protection Agency), 1990. "National Primary and Secondary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Proposed Rule," *Federal Register*, July 25, 1990, pp. 30369-30448, Washington, D.C

EPA (U.S. Environmental Protection Agency), 1991. "National Primary Drinking Water Regulations; Radionuclides; Proposed Rule," *Federal Register*, July 18, 1991, pp. 33052-33127, Washington, D.C.

SDWA (Safe Drinking Water Act—Phase V Rule, Synthetic Organic Chemicals and Inorganic Chemicals), 1992. "National Primary Drinking Water Regulations; Synthetic Organic Chemicals and Inorganic Chemicals; Final Rule," *Federal Register*, July 17, 1992, 57:138:31776, Washington, D.C.

Appendix C

Standard No. 8 Toxic Air Pollutants

Category 1: Low Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (μg/m³)[a]**
Note: For all listings that contain the word "compounds" and for glycol ethers, the following applies: Unless otherwise specified, these listings are defined as including any unique chemical substance that contains the named chemical (i.e., antimony, arsenic, etc.) as part of that chemical infrastructure.		
Acetic Anhydride	108–24–7	500.00
Acetonitrile	75–5–8	1750.00
Ammonium Chloride	12125–2–91	250.00
Antimony Compounds	[b]	2.50
Caprolactam, Vapor	105–60–2	500.00
Caprolactam, Dust	105–60–2	25.00
Chlorine	7782–50–5	75.00
Chloroacetophenone (2–)	532–27–4	7.50
Cyanamide	420–4–2	50.00
Cyanic Acid	420–5–3	500.00
Cyanide	57–12–5	125.00
Cyanide Compounds[c]	[b]	[d]
Cyanoacetamide	107–91–5	125.00
Cyanogen	460–19–5	500.00
Ethanolamine	141–43–5	200.00
Formamide	75–12–7	750.00
Formic Acid	64–18–6	225.00
Furfural	98–1–1	200.00
Hydrochloric Acid (Hydrogen Chloride)	7647–1–0	175.00
Hydrogen Cyanide	74–90–8	250.00
Isopropylamine	75–31–0	300.00
Methyl Ethyl Ketone (2–Butanone)	78–93–3	14750.00
Methyl Methacrylate	80–62–6	10250.00
Methylamine	74–89–5	300.00
Methylene Chloride	75–9–2	8750.00
Methyl–Tert–Butyl Ether	1634–4–4	[d]
Naphthalene	91–20–3	1250.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a μg/m³. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b No CAS number
c XCN where X=H+ or any other group where a formal dissociation may occur. For example, KCN or Ca(CN)2.
d To be determined

Category 1: Low Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m^3)[a]**
Nitric Acid	7697–37–2	125.00
Nitropropane (1–)	108–3–2	2250.00
Phosphoric Acid	7664–38–2	25.00
Propionaldehyde	123–38–6	b
Styrene	100–42–5	5325.00
Titanium Tetrachloride	7550–45–0	2500.00
Trichloroethylene (TCE)	79–1–6	6750.00
Trimethylpentane (2, 2, 4–)	540–84–1	8750.00
Category 2: Moderate Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m^3)[a]**
Acetaldehyde	75–7–0	1800.00
Acrylamide	79–6–1	0.30
Aldicarb	116–6–3	6.00
Allyl Chloride	107–5–1	30.00
Butanethiol	109–79–5	15.00
Cresol	1319–77–3	220.00
Cumene	98–82–8	9.00[c]
Dichlorobenzene (p–)	106–46–7	4500.00
Diethanolamine	111–42–2	129.00
Diethylaniline (N, N–)	121–69–7	250.00
Diisodecyl Phthalate	26761–40–0	50.00
m–Dinitrobenzene	99–65–0	10.00
Dinitro–o–cresol (4, 6–) And Salts	534–52–1	2.00
Dioctyl Phthalate	117–84–0	50.00
Ethanethiol	75–8–1	10.00
Ethyl Benzene	100–41–4	4350.00
Ethyl Chloride	75–0–3	26400.00
Ethylene Dibromide	106–93–4	770.00
Furfuryl Alcohol	98–0–0	400.00
Hexachlorocyclohexane (Multiple Isomers)	608–73–1	5.00
Hexamethylene –1,Diisocyanatohexane (1, 6–)	822–6–0	0.34
Hydrogen Sulfide	7783–6–4	140.00
Hydroquinone	123–31–9	20.00
Isophorone	78–59–1	250.00
Malathion	121–75–5	100.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a µg/m^3. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b To be determined
c Verified reference concentration (RfC) established by the U.S. EPA

Category 2: Moderate Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m³)[a]**
Maleic Anhydride	108–31–6	10.00
Methyl Mercaptan (Methanethiol)	74–93–1	10.00
Methylene Biphenyl Isocyanate	101–68–8	2.00
Methyl Isobutyl Ketone	108–10–1	2050.00
Nitroglycerin	55–63–0	5.00
Oxalic Acid	144–62–7	10.00
Pentachlorophenol	87–86–5	5.00
Phenol	108–95–2	190.00
Phenylenediamine (p–)	106–50–3	1.00
Phenylhydrazine	100–63–0	200.00
Phosgene (Carbonyl Chloride)	75–44–5	4.00
Phosphorus (Yellow Or White)	7723–14–0	0.50
Picric Acid	88–89–1	1.00
Pyrethrum	8003–34–7	50.00
Rotenone	83–79–4	50.00
Sodium Hydroxide	1310–73–2	20.00
Sulfuric Acid	7664–93–9	10.00
Tetrachloroethylene (Perchloroethylene)	127–18–4	3350.00
Toluene Diisocynate	584–84–0	0.40
Toluene–2, 4–Diisocynanate	584–84–9	0.40
Trichlorobenzene (1, 2, 4–)	120–82–1	400.00
Urethane (Carbamic Acid Ethyl Ester)	51–79–6	5000.00
Vinyl Fluoride	75–2–5	19.00
Xylene (Mixed Isomers)	1330–20–7	4350.00
Xylene (m–)	108–38–3	4350.00
Xylene (o–)	95–47–6	4350.00
Xylene (p–)	106–42–3	4350.00
Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m³)[a]**
Acetamide	60–35–5	b
Acetophenone	98–86–2	b
Acetylaminofluorine(2–)	53–96–3	b
Acrolein	107–2–8	1.25
Acrylic Acid	79–10–7	147.50
Acrylonitrile	107–13–1	22.50
Aminodiphenyl(p–)	92–67–1	0.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a µg/m³. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.

b No CAS number

Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (μg/m³)[a]**
Aniline	62–53–3	50.00
Anisidine (o–)	90–4–0	2.50
Anisidine (p–)	104–94–9	2.50
Arsenic Pentoxide	1303–28–2	1.00
Arsenic	7440–38–2	1.00
Benzene	71–43–2	150.00
Benzidine	92–87–5	0.00
Benzotrichloride	98–7–7	300.00
Benzyl Chloride	100–44–7	25.00
Beryllium Oxide	1304–56–9	0.01
Beryllium Sulfate	13510–49–1	0.01
Beryllium	7440–41–7	0.01
Biphenyl	92–52–4	6.00
Bis (Chloromethyl) Ether	542–88–1	0.03
Bis–(2–Ethylhexyl) Phthalate	117–81–7	25.00
Bromoform	75–25–2	25.85
Butadiene (1, 3–)	106–99–0	110.50
Butylamine (n–)	109–73–9	75.00
Cadmium Oxide	1306–19–0	0.25
Cadmium Sulfate	10124–36–4	0.20
Cadmium	7440–43–9	0.25
Calcium Cyanamide Salts (1:1)	156–62–7	2.50
Captan	133–6–2	25.00
Carbaryl	63–25–2	25.00
Carbon Disulfide	75–15–0	150.00
Carbon Tetrachloride	56–23–5	150.00
Carbonyl Sulfide (Carbon Oxysulfide)	463–58–1	12250.00
Catechol	120–80–9	297.00
Chloramben	133–90–4	[b]
Chlordane	57–74–9	2.50
Chloroacetic Acid	79–11–8	900.00
Chlorobenzene	108–90–7	1725.00
Chlorobenzilate	510–15–6	[b]
Chloroform	67–66–3	250.00
Chloromethyl Methyl Ether	107–30–2	[b]
Chloronitrobenzene (p–)	100–0–5	5.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a μg/m³. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.

b No CAS number

Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m^3)[a]**
Chloroprene	126–99–8	175.00
Chromium (+6) Compounds	[b]	2.50
Cobalt Compounds	[b]	0.25
Coke Oven Emissions	b	[c]
Cresols/Cresylic Acid And Mixture	1319–77–3	220.00
Cresol (m–)	108–39–4	110.50
Cresol (o–)	95–48–7	110.50
Cresol (p–)	106–44–5	110.50
D (2,4–), Salts And Esters	94–75–7	50.00
DDE	72–55–9	[c]
Diazomethane	334–88–3	2.00
Dibenzofuran	132–64–9	[c]
Dibromo–3–Chloropropane (1, 2–)	96–12–8	0.05
Dibutyl Phthalate	84–74–2	25.00
Dichlorobenzidine (3, 3–)	91–94–1	0.15
Dichloropropene (1,3–)	542–75–6	7.00[d]
Dichlorvos	62–73–7	4.52
Diethyl Phthalate	84–66–2	25.00
Diethyl Sulfate	64–67–5	[c]
Dimethoxybenzidene (3, 3–)	119–90–4	0.30
Dimethyl Benzidene (3, 3–)	119–93–7	[c]
Dimethyl Carbamoyl Chloride	79–44–7	[c]
Dimethyl Formamide	68–12–2	149.50
Dimethyl Hydrazine (1, 1–)	57–14–7	5.00
Dimethyl Hydrazine (1, 2–)	540–73–8	5.00
Dimethyl Phthalate	131–11–3	25.00
Dimethyl Sulfate	77–78–1	2.50
Dimethylaminoazobenzene (4–)	60–11–7	125.00
Dinitrophenol (2, 4–)	51–28–5	[c]
Dinitrotoluene (2, 4–)	121–14–2	1.50
Dioxane	123–91–1	450.00
Diphenyl Hydrazine (1, 2–)	122–66–7	[c]
Epichlorohydrin	106–89–8	50.00
Epoxybutane (1, 2–) (Butylene Oxide)	106–88–7	[c]
Ethyl Acrylate	140–88–5	102.50

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a µg/m^3. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b No CAS number
c To be determined
d Verified reference concentration (RfC) established by the U.S. EPA

Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (µg/m³)[a]**
Ethylene Dichloride	107–6–2	200.00
Ethylene Glycol	107–21–1	650.00
Ethylene Oxide	75–21–8	10.00
Ethylene Thiourea	96–45–7	[b]
Ethylenimine	151–56–4	5.00
Ethylidene Dichloride (1, 1–Dichloroethane)	75–34–3	2025.00
Formaldehyde	50–0–0	7.50
Glycidaldehyde	7654–34–4	75.00
Glycol Ethers[c]	[d]	[b]
Heptachlor	76–44–8	2.50
Hexachlorobenzene	118–74–1	[b]
Hexachlorobutadiene	87–68–3	1.20
Hexachlorocylopentadiene	77–47–4	0.50
Hexachloroethane	67–72–1	48.50
Hexachloronapthalene	1335–87–1	1.00
Hexamethylphosphoramide	680–31–9	14.50
Hexane	110–54–3	200.00[e]
Hydrazine	302–1–2	0.50
Kepone	143–50–0	0.00
Ketene	463–51–4	4.50
Lead Arsenate	7645–25–2	0.75
Lead(+2) Arsenate	7784–40–9	0.75
Lindane (Hexachlorocyclohexane)	58–89–9	2.50
Manganese Compounds	[d]	25.00
Mercury	7439–97–6	0.25
Methanol (Methyl Alcohol)	67–56–1	1310.00
Methoxychlor	72–43–5	50.00
Methyl Bromide	74–83–9	100.00
Methyl Chloride	74–87–3	515.00
Methyl Chloroform (1, 1, 1–Trichloroethane)	71–55–6	9550.00
Methyl Hydrazine	60–34–4	1.75
Methyl Iodide	74–88–4	58.00
Methyl Isocyanate	624–83–9	0.23
Methylene Bis–2–Dhloroaniline (4, 4–) (Curene)	101–14–4	1.10

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a µg/m³. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b To be determined
c Includes mono- and di-ethers of ethylene glycol, diethylene glycol, and triethylene glycol R–(OCH2CH2)n–OR', where n=1, 2, or 3; R=alkyl or aryl groups; and R' = R, H, or groups which, when removed, yield glycol ethers with the structure: R–(OCH2CH)n–OH. Polymers are excluded from the glycol category.
d No CAS number
e Verified reference concentration (RfC) established by the U.S. EPA

Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration ($\mu g/m^3$)[a]**
Methylenedianiline (4, 4–)	101–77–9	4.00
Mineral Fibers, Fine[b]	c	d
Mineral Oil Mist (Paraffinic)	8012–95–1	25.00
Mirex	2385–85–5	4500.00
a–Naphthylamine	134–32–7	0.00
b–Naphthylamine	91–59–8	0.00
Nickel Carbonyl	13463–39–3	1.75
Nickel Oxide	1313–99–1	5.00
Nickel Sulfate	7786–81–4	5.00
Nickel	7440–2–0	0.50
Nitroaniline (p–)	100–1–6	15.00
Nitrobenzene	98–95–3	25.00
Nitrobiphenyl (4–)	92–93–3	0.00
Nitrogen Mustard	51–75–2	0.00
Nitrophenol (p–)	100–2–7	0.00
Nitropropane (2–)	79–46–9	182.00
Nitrosodimethylamine	62–75–9	0.00
Nitrosomorpholine	59–89–2	5000.00
Nitrosophenol (p–)	104–91–6	0.00
Nitroso–N–Methylurea (N–)	684–93–5	d
Nitrotoluene (p–)	99–99–0	5.50
Octachloronaphthalene	2234–13–1	0.50
Octadecanoic Acid (n–)	57–11–4	d
Paraquat	1910–42–5	0.50
Parathion	56–38–2	0.50
Pentachloronitrobenzene	82–68–8	d
Phosphine	7803–51–2	2.09
Phthalic Anhydride	85–44–9	30.30
Polychlorinated Biphenyls (PCB) (Multiple Compounds)	c	2.50
Polycyclic Organic Matter[e]	c	160.00
Propane Sultone (1, 3–)	1120–71–4	d
B–Propiolactone	57–57–8	7.50
Propoxur	114–26–1	2.50
Propylene Dichloride	78–87–5	1750.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a $\mu g/m^3$. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b Includes mineral fiber emissions from facilities manufacturing or processing glass, rock, and slag fibers (or other mineral derived fibers) of average diameter 1 micrometer or less
c No CAS number
d To be determined
e Includes organic compounds with more than one benzene ring and which have a boiling point greater than or equal to 100 °C.

Category 3: High Toxicity		
Chemical Name	**Chemical Abstract Number (CAS)**	**Maximum Allowable Concentration (μg/m^3)[a]**
Propylene Oxide (1, 2–)	75–56–9	250.00
Propylenimine (1,2–) (Methylaziridine (2–))	75–55–8	23.35
Pyrethrin I	121–21–1	25.00
Pyrethrin II	121–29–9	25.00
Quinoline	91–22–5	b
Quinone	106–51–4	2.00
Selenium Compounds	c	1.00
Styrene Oxide (Phenyloxirane)	96–9–3	b
Tetrachlorinated Dibenzo–P–Dioxins	1746–1–6	0.00
Tetrachloroethane (1, 1, 2, 2–) (Acetylene Tetrachloride)	79–34–5	35.00
Toluene	108–88–3	2000.00
Toluenediamine (2, 4–)	95–80–7	b
Toluidine (o–)	95–53–4	43.85
Toxaphene	8001–35–2	2.50
Trichloroethane (1, 1, 2–)	79–0–5	273.00
Trichlorophenol (2, 4, 5–)	95–95–4	b
Trichlorophenol (2, 4, 6–)	88–6–2	b
Triethylamine	121–44–8	207.00
Trifluralin	1582–9–8	b
Vinyl Acetate	108–5–4	176.00
Vinyl Bromide	593–60–2	100.00
Vinyl Chloride	75–1–4	50.00
Vinylidene Chloride (Dichloroethylene (1, 1–)	75–35–4	99.00
Xylidine	1300–73–8	50.00

a For the purpose of this standard, these values shall be rounded to the nearest hundredth of a μg/m^3. For example, a test or modeled value of 0.005 through 0.01 would be rounded to 0.01, but values less than 0.005 would be rounded to 0.00.
b To be determined
c No CAS number

Appendix D

SRS Environmental Permits

Compiled by Lori Coward
Environmental Protection Department

Listed below are the construction and operating permits held by the Savannah River Site. The permits are divided by type of permit; for each type, the permit number, permit title, and permitted source are provided.

Air Permits

Permit Number	Permit Title
0080–0041–A–CA	VADOSE ZONE SOIL-VAPOR EXTRACTION UNIT; A–014 OUTFALL (GROUNDWATER REMEDIATION), 782–3M
A0080–0041–A–CB	320-GPM AIR STRIPPER, A–002; CATALYTIC OXIDATION UNIT (A–001A OUTFALL); SRTC
0080–0041–A–CC	A-AREA POWERHOUSE EFFLUENT TREATMENT AND REROUTING SYSTEM, 784–A (BAGHOUSE)
0080–0041–A–CD–R1	SOIL-VAPOR EXTRACTION/CATALYTIC OXIDATION UNIT, 731–8A
0080–0041–F–CL	TWO 20,000-GALLON UNDERGROUND STORAGE FUEL TANKS, 254–5F
0080–0041–G–CK	500-KW PORTABLE DIESEL GENERATOR SET, #E–82643; ALL AREAS
0080–0041–G–CL	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #7776; ALL AREAS
0080–0041–G–CM	160-KW PORTABLE DIESEL GENERATOR, SRO # 7947; ALL AREAS
0080–0041–G–CM	160-KW PORTABLE DIESEL GENERATOR, SRO # 7948; ALL AREAS
0080–0041–G–CM	160-KW PORTABLE DIESEL GENERATOR, SRO # 7949; ALL AREAS
0080–0041–G–CM	160-KW PORTABLE DIESEL GENERATOR, SRO # 7950; ALL AREAS
0080–0041–G–CN	790-KW PORTABLE DIESEL GENERATOR, E–82644; ALL AREAS
0080–0041–H–CG	350-KW EMERGENCY POWER DIESEL GENERATOR (254–11H) TO SERVE CONSOLIDATED INCINERATION FACILITY (CIF), 261–H
0080–0041–H–CG	350-KW EMERGENCY POWER DIESEL GENERATOR (254–12H) TO SERVE CONSOLIDATED INCINERATION FACILITY (CIF), 261–H
0080–0041–H–CG–R1	CONSOLIDATED INCINERATION FACILITY (CIF) FOR NONRADIOACTIVE HAZARDOUS WASTE, 261–H
0080–0041–H–CH	MODIFICATION TO 0080–0041–S13; LATE-WASH FACILITY, 241–10H
0080–0041–H–CI	CONSOLIDATED INCINERATION FACILITY (CIF) ASHCRETE PROCESS
0080–0041–H–CK	NEW SOLVENT STORAGE TANK FACILITY (FOUR 30,000-GALLON UNDERGROUND TANKS, NEAR CIF, 261–H)
0080–0041–H–CL	TWO 20,000-GALLON UNDERGROUND STORAGE FUEL TANKS, 254–5H

Air Permits, continued

Permit Number	Permit Title
0080–0041–M–CA	VADOSE ZONE SOIL-VAPOR EXTRACTION UNIT; M-AREA SEWER, 782–5M
0080–0041–M–CB	VADOSE ZONE SOIL-VAPOR EXTRACTION UNIT; M-AREA BASIN, 782–4M
0080–0041–M–CC	VADOSE ZONE SOIL-VAPOR EXTRACTION UNIT; M-AREA SOLVENT STORAGE, 782–6M
0080–0041–M–CD	SOIL-VAPOR EXTRACTION/CATALYTIC OXIDATION UNIT, 782–7M
0080–0041–M–CE	MIXED WASTE VITRIFICATION PROCESS, M-AREA
0080–0041–M–CF–R1	CATALYTIC OXIDATION UNIT TO REDUCE VOC EMISSIONS FROM 610-GPM M–1 AIR STRIPPER, M-AREA
0080–0041–M–CG	MODIFICATION TO MIXED-WASTE VITRIFICATION PROCESS (NOx CONTROL STRATEGIES), M-AREA
0080–0041–M–CH	SOIL-VAPOR EXTRACTION/CATALYTIC OXIDATION UNIT, 782–8M
0080–0041–PORT–CB	15,000-LB/HR PORTABLE PACKAGE STEAM GENERATOR #1, GENERAL SITE
0080–0042–CN	OFFGAS COMPONENTS TEST FACILITY, 678–T
0080–0045–CI	NAVAL FUEL MATERIALS FACILITY (FMF) CEMENT AND FLYASH SILOS AND BAGHOUSE, 247–F
0080–0045–CK	NEW SPECIAL RECOVERY PROCESS WITH CYCLONE, SCRUBBERS, AND HEPA FILTERS, 221–F
0080–0046–CE	150-KW EMERGENCY POWER DIESEL GENERATOR, 254–4H
0080–0046–CH	FUEL PROCESSING FACILITY (FPF) WITH HEPA FILTERS
0080–0048–CB	800-KW EMERGENCY POWER DIESEL GENERATOR–A, 107–3P
0080–0048–CC	800-KW EMERGENCY POWER DIESEL GENERATOR–B, 107–2P
0080–0049–CB	800-KW EMERGENCY POWER DIESEL GENERATOR–A, 107–L
0080–0049–CC	800-KW EMERGENCY POWER DIESEL GENERATOR–B, 107–L
EXEMPTED	12,000-GALLON JET FUEL STORAGE TANK TO SERVE AVIATION OPERATIONS DEPARTMENT FACILITY, B-AREA
0080–0041–A01	71.7 MMBTU/HR COAL BOILER #1; CYCLONES, 784–A
0080–0041–A02	71.7 MMBTU/HR COAL BOILER #2; CYCLONES, 784–A
0080–0041–A03	600-KW EMERGENCY POWER DIESEL GENERATOR, 794–A
0080–0041–A04	400-KW EMERGENCY POWER DIESEL GENERATOR, 773–A
0080–0041–A05	150-KW EMERGENCY POWER DIESEL GENERATOR, 751–2A
0080–0041–A06	400-KW EMERGENCY POWER DIESEL GENERATOR (503–2A) TO SERVE 735–A, 735–11A, 774–A, AND 773–A FEEDERS

Air Permits, continued

Permit Number	Permit Title
0080–0041–A07	200-KW EMERGENCY POWER DIESEL GENERATOR, 703–A (C-WING)
0080–0041–A08	250-KW EMERGENCY POWER DIESEL GENERATOR, 754–4A
0080–0041–A09	455-KW EMERGENCY POWER DIESEL GENERATOR, 720–2A
0080–0041–A10	1250-KW EMERGENCY POWER DIESEL GENERATOR #1, 754–5A (TO SERVE 703–44A)
0080–0041–A11	1250-KW EMERGENCY POWER DIESEL GENERATOR #2, 754–5A (TO SERVE 703–44A)
0080–0041–A14	155-KW EMERGENCY POWER DIESEL GENERATOR, 737–2A (TO SERVE SREL)
0080–0041–C06	365-KW EMERGENCY POWER DIESEL GENERATOR, 183–3C
0080–0041–D05	150-KW EMERGENCY POWER DIESEL GENERATOR, 501–D
0080–0041–F05	URANIUM DISSOLUTION, 221–F
0080–0041–F06	200-KW CONTINUOUS RUNNING DIESEL GENERATOR, 254–5F #1
0080–0041–F07	200-KW CONTINUOUS RUNNING DIESEL GENERATOR, 254–5F #2
0080–0041–F08	175-KW EMERGENCY POWER DIESEL GENERATOR, 772–F #1
0080–0041–F09	175-KW EMERGENCY POWER DIESEL GENERATOR, 772–F #2
0080–0041–F10	350-KW EMERGENCY POWER DIESEL GENERATOR, 241–19F
0080–0041–F11	350-KW EMERGENCY POWER DIESEL GENERATOR, 235–F
0080–0041–F12	350-KW EMERGENCY POWER DIESEL GENERATOR, 254–4F
0080–0041–F13	250-KW EMERGENCY POWER DIESEL GENERATOR, 254–1F
0080–0041–F14	200-KW EMERGENCY POWER DIESEL GENERATOR, 241–74F
0080–0041–F15	600-KW EMERGENCY POWER DIESEL GENERATOR, 292–F
0080–0041–F16	600-KW EMERGENCY POWER DIESEL GENERATOR, 247–1F NAVAL FUEL MATERIALS FACILITY (FMF)
0080–0041–F17	300-KW EMERGENCY POWER DIESEL GENERATOR, 254–7F
0080–0041–F18	415-KW EMERGENCY POWER DIESEL GENERATOR, 772–1F
0080–0041–F19	300-KW EMERGENCY POWER DIESEL GENERATOR, 292–2F
0080–0041–F20	300-KW EMERGENCY POWER DIESEL GENERATOR, 254–9F
0080–0041–F21	1000-KW EMERGENCY POWER DIESEL GENERATOR, 221–F
0080–0041–F22	600-KW EMERGENCY POWER DIESEL GENERATOR, 254–10F
0080–0041–F23	350-KW EMERGENCY POWER DIESEL GENERATOR, 254–8F

Air Permits, continued

Permit Number	Permit Title
0080–0041–F24	NAVAL FUEL MATERIALS FACILITY (FMF) STACK; SCRUBBERS AND HEPA FILTERS, 247–F
0080–0041–F25	NAVAL FUEL MATERIALS FACILITY (FMF) WASTEWATER TREATMENT FACILITY; DEMISTER, 247–F
0080–0041–F26	NINE FINISHING VENTS, NINE SCRUBBERS, AND NINE HEPA FILTERS FOR NAVAL FUEL MATERIALS FACILITY (FMF), 247–F
0080–0041–F27	455-KW EMERGENCY POWER DIESEL GENERATOR, 720–F
0080–0041–G01	WASTE PAINT SOLVENTS DISTILLATION AND CONDENSATION UNIT #1, CARBON SCRUBBER; ALL AREAS
0080–0041–G02	WASTE PAINT SOLVENTS DISTILLATION AND CONDENSATION UNIT #2, CARBON SCRUBBER; ALL AREAS
0080–0041–G03	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–112; ALL AREAS
0080–0041–G04	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–113; ALL AREAS
0080–0041–G05	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–114; ALL AREAS
0080–0041–G06	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–115; ALL AREAS
0080–0041–G07	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–116; ALL AREAS
0080–0041–G08	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–128; ALL AREAS
0080–0041–G09	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–129; ALL AREAS
0080–0041–G10	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–130; ALL AREAS
0080–0041–G11	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–131; ALL AREAS
0080–0041–G12	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SME 52–132; ALL AREAS
0080–0041–G13	200-KW MOBILE EMERGENCY GENERATOR, SME 60–171; ALL AREAS
0080–0041–G14	15,000-LB/HR PORTABLE PACKAGE STEAM GENERATING BOILER #2 (NSPS); ALL AREAS
0080–0041–G15	PORTABLE NORKOT MAXIGRIND 9100 DIESEL-POWERED CHIPPER UNIT, SME 36–25; ALL AREAS
0080–0041–G16	190-KW MOBILE EMERGENCY GENERATOR, SRO # 0391; ALL AREAS
0080–0041–G17	250-KW MOBILE EMERGENCY GENERATOR, SRO # 7835; ALL AREAS
0080–0041–G18	PORTABLE SOIL-VAPOR EXTRACTION UNIT, SRO #5957; ALL AREAS
0080–0041–G19	600-KW MOBILE EMERGENCY DIESEL GENERATOR, SRO #5422
0080–0041–G20	300-KW MOBILE EMERGENCY DIESEL GENERATOR, SRO #5430
0080–0041–G21	300-KW MOBILE EMERGENCY DIESEL GENERATOR, SRO #6455

Air Permits, continued

Permit Number	Permit Title
0080–0041–G22	260-KW MOBILE EMERGENCY GENERATOR, SRO # 7850; ALL AREAS
0080–0041–G23	250-KW MOBILE EMERGENCY GENERATOR, SRO # 7858; ALL AREAS
0080–0041–G24	WASTE PAINT SOLVENTS DISTILLATION AND CONDENSATION UNIT #3, CARBON SCRUBBER; ALL AREAS
0080–0041–G25	WASTE PAINT SOLVENTS DISTILLATION AND CONDENSATION UNIT #4, CARBON SCRUBBER; ALL AREAS
0080–0041–G26	WASTE PAINT SOLVENTS DISTILLATION AND CONDENSATION UNIT #5, CARBON SCRUBBER; ALL AREAS
0080–0041–G27	1000-KW EMERGENCY POWER DIESEL GENERATOR TO SERVE CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF), 654–G
0080–0041–G28	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #5233; ALL AREAS
0080–0041–G29	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #5248; ALL AREAS
0080–0041–G30	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #5278; ALL AREAS
0080–0041–G31	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #6940; ALL AREAS
0080–0041–G32	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #6941; ALL AREAS
0080–0041–G34	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #6944; ALL AREAS
0080–0041–G35	PORTABLE DIESEL-POWERED AIR COMPRESSOR, SRO #6945; ALL AREAS
0080–0041–H01	71.7-MMBTU/HR COAL BOILER #1; 2 CYCLONES, 784–H
0080–0041–H02	71.7-MMBTU/HR COAL BOILER #2; 2 CYCLONES, 784–H
0080–0041–H03	71.7-MMBTU/HR COAL BOILER #3; 2 CYCLONES, 784–H
0080–0041–H04	400-LB/HR TYPE "O" WASTE INCINERATOR, BAGHOUSE, AND HEPA FILTERS (BETA-GAMMA INCINERATOR), 230–H
0080–0041–H05	SEPARATION PROCESS, 221–H
0080–0041–H06	200-KW EMERGENCY POWER DIESEL GENERATOR, 234–4H
0080–0041–H07	200-KW EMERGENCY POWER DIESEL GENERATOR, 299–1H
0080–0041–H08	200-KW EMERGENCY POWER DIESEL GENERATOR, 241–74H
0080–0041–H09	250-KW EMERGENCY POWER DIESEL GENERATOR, 254–1H
0080–0041–H10	275-KW EMERGENCY POWER DIESEL GENERATOR, 254–3H
0080–0041–H11	300-KW EMERGENCY POWER DIESEL GENERATOR, 221–HB
0080–0041–H12	300-KW CONTINUOUSLY RUNNING DIESEL GENERATOR, 254–5H, #1
0080–0041–H13	300-KW CONTINUOUSLY RUNNING DIESEL GENERATOR, 254–5H, #2

Air Permits, continued

Permit Number	Permit Title
0080–0041–H14	300-KW EMERGENCY POWER DIESEL GENERATOR, 232–H
0080–0041–H15	300-KW EMERGENCY POWER DIESEL GENERATOR, 234–H
0080–0041–H16	500-KW EMERGENCY POWER DIESEL GENERATOR, 232–H, #2
0080–0041–H17	500-KW EMERGENCY POWER DIESEL GENERATOR, 254–H
0080–0041–H18	600-KW EMERGENCY POWER DIESEL GENERATOR, 292–H
0080–0041–H19	1000-KW EMERGENCY POWER DIESEL GENERATOR, 221–H
0080–0041–H20	500-KW EMERGENCY POWER DIESEL GENERATOR, 254–8H
0080–0041–H21	400-KW EMERGENCY POWER DIESEL GENERATOR, 254–9H
0080–0041–H22	765-KW EMERGENCY POWER DIESEL GENERATOR (254–10H) TO SERVE 233–H (RTF)
0080–0041–H23	2500-GPM EMERGENCY DIESEL FIRE WATER PUMP #1, 241–125H (ITP)
0080–0041–H24	2500-GPM EMERGENCY DIESEL FIRE WATER PUMP #2, 241–125H (ITP)
0080–0041–H25	455-KW EMERGENCY POWER DIESEL GENERATOR, 720–H
0080–0041–H26	IN-TANK PRECIPITATION (ITP) TANK #48, 241–948H
0080–0041–H27	IN-TANK PRECIPITATION (ITP) TANK #49, 241–949H
0080–0041–H28	IN-TANK PRECIPITATION (ITP) FILTER/STRIPPER BUILDING, 241–96H
0080–0041–H30	IN-TANK PRECIPITATION (ITP) TANK #50, 241–950H
0080–0041–H31	IN-TANK PRECIPITATION (ITP) TANK #22, 241–922H
0080–0041–H32	12,500-GALLON NO. 2 FUEL OIL STORAGE TANK TO SERVE CONSOLIDATED INCINERATION FACILITY (CIF)
0080–0041–K01	194.5-MMBTU/HR COAL BOILER, CYCLONES, UNIT #1
0080–0041–K03	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–1K
0080–0041–K04	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–2K
0080–0041–K05	150-KW EMERGENCY POWER DIESEL GENERATOR #1, 108–4K
0080–0041–K06	150-KW EMERGENCY POWER DIESEL GENERATOR #2, 108–4K
0080–0041–K07	200-KW EMERGENCY POWER DIESEL GENERATOR, 152–7K
0080–0041–K08	365-KW EMERGENCY POWER DIESEL GENERATOR (183–3K) TO SERVE 183–2K, 905–95K, AND 905–106K
0080–0041–K09	520-BHP EMERGENCY DIESEL BOOSTER PUMP, 191–K (SERVING 105–K)
0080–0041–K10	800-KW EMERGENCY POWER DIESEL GENERATOR–A, 107–K

Air Permits, continued

Permit Number	Permit Title
0080–0041–K11	800-KW EMERGENCY POWER DIESEL GENERATOR–B, 107–K
0080–0041–K12	76.8-MMBTU/HR NO. 2 FUEL OIL-FIRED BOILER (NSPS SOURCE), K-AREA
0080–0041–K13	38-MMBTU/HR NO. 2 FUEL OIL-FIRED PACKAGE STEAM GENERATOR RATED AT 30,000 LB/HR STEAM PRODUCTION (NSPS SOURCE), K-AREA
0080–0041–K14	2500-GPM (375-BHP) EMERGENCY FIRE WATER PUMP, 192–2K
0080–0041–K15	30,000-GALLON #2 FUEL OIL STORAGE TANK, 500–02; 184–2K (NSPS SOURCE)
0080–0041–K15	30,000-GALLON #2 FUEL OIL STORAGE TANK, 500–03; 184–2K (NSPS SOURCE)
0080–0041–L01	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–1L
0080–0041–L02	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–2L
0080–0041–L03	520-BHP EMERGENCY DIESEL BOOSTER PUMP, 191–L
0080–0041–L04	150-KW EMERGENCY POWER DIESEL GENERATOR #1, 108–4L
0080–0041–L05	150-KW EMERGENCY POWER DIESEL GENERATOR #2, 108–4L
0080–0041–L06	200-KW EMERGENCY POWER DIESEL GENERATOR, 152–7L
0080–0041–L07	365-KW EMERGENCY POWER DIESEL GENERATOR, 183–3L
0080–0041–M02	ALUMINUM TUBE CLEANING WITH NITRIC ACID, 321–M
0080–0041–M03	200-KW EMERGENCY POWER DIESEL GENERATOR, 320–M (REPLACED 150-KW GENERATOR)
0080–0041–M04	610-GPM M–1 AIR STRIPPER, M-AREA
0080–0041–N01	2500-GPM (370-BHP) DIESEL FIRE PUMP, CENTRAL SHOPS (MATERIALS MANAGEMENT RECEIVING AND STORAGE)
0080–0041–P02	194.5-MMBTU/HR COAL BOILER, CYCLONES, 184–P #2
0080–0041–P03	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–1P
0080–0041–P04	1250-KW EMERGENCY POWER DIESEL GENERATOR, 108–2P
0080–0041–P05	150-KW EMERGENCY POWER DIESEL GENERATOR, 108–4P, #1
0080–0041–P06	150-KW EMERGENCY POWER DIESEL GENERATOR, 108–4P, #2
0080–0041–P07	200-KW EMERGENCY POWER DIESEL GENERATOR, 152–7P
0080–0041–P08	365-KW EMERGENCY POWER DIESEL GENERATOR, 183–2P
0080–0041–P09	520 BHP EMERGENCY DIESEL BOOSTER PUMP, 191–P (SERVING 105–P)
0080–0041–S05	2050-KW EMERGENCY POWER DIESEL GENERATOR #1, 292–S

Air Permits, continued

Permit Number	Permit Title
0080–0041–S06	2050-KW EMERGENCY POWER DIESEL GENERATOR #2, 292–S
0080–0041–S07	261-BHP EMERGENCY FIRE WATER PUMP, 980–S
0080–0041–S08	DWPF VITRIFICATION BUILDING (PROVIDES VENTILATION FOR PERSONNEL CORRIDOR, LABORATORIES, WELD TEST, AND CHEMICAL STORAGE TANKS – ZONE 2, 221–S); HEPA FILTER
0080–0041–S09	DWPF PROCESS STACK (PROVIDES VENTILATION FOR PROCESS CELLS, PROCESS VESSEL VENT AND MELTER OFF–GAS – ZONE 1, 291–S); SAND FILTER
0080–0041–S10	DWPF COLD-FEEDS FACILITY (CHEMICAL STORAGE TANKS FOR FORMIC ACID, HYDROXYLAMINE NITRATE, OXALIC ACID, NITRIC ACID, SODIUM HYDROXIDE AND A GLASS-FRIT HANDLING SYSTEM WITH BAGHOUSE, 422–S)
0080–0041–S11	DWPF 150,000-GALLON ORGANIC WASTE STORAGE TANK VENT (BENZENE STORAGE, 430–S); INTERNAL FLOATING ROOF WITH PRIMARY AND SECONDARY SEALS, NITROGEN BLANKET, AND HEPA FILTER
0080–0041–S12	DWPF LOW-POINT PUMP PIT (TRANSFER OF RADIOACTIVE SLURRIES AND SOLUTIONS, 511–S); HEPA FILTERS
0080–0041–T02	PORTABLE 300-KW EMERGENCY POWER DIESEL GENERATOR, SRO #0392
0080–0041–T03	300-KW EMERGENCY POWER DIESEL GENERATOR, 672–T
0080–0041–T06	1000-KW EMERGENCY POWER DIESEL GENERATOR, 654–1T
0080–0041–T07	300-KW EMERGENCY POWER DIESEL GENERATOR (654–T) TO SERVE 678–T
0080–0041–Z01	425-KW EMERGENCY POWER DIESEL GENERATOR, 956–Z
0080–0041–Z02	SILO TO STORE CEMENT OR SLAG, WITH BAGHOUSE, 205–Z
0080–0041–Z03	THREE FLYASH/CEMENT SILOS WITH BAGHOUSE, 205–Z
0080–0041–Z04	WEIGH HOPPER WITH BAGHOUSE, 205–Z
0080–0041–Z05	TWO PREMIX AIR BLENDERS WITH BAGHOUSE, 205–Z
0080–0041–Z06	PREMIX FEED BIN WITH BAGHOUSE, 210–Z
0080–0041–Z07	GROUT MIXER WITH BAGHOUSE, SCRUBBER, AND TWO HEPA FILTERS (ONE IN SERVICE, ONE ON STANDBY) TO INCLUDE VOC EMISSIONS FROM STACK, 210–Z
0080–0041–Z08	LOW-POINT DRAIN TANK VENT WITH HEPA FILTER, 551–Z
EXEMPTED	2500-GPM (370-BHP) DIESEL FIRE PUMP, 902–5B
EXEMPTED	2500-GPM (266-BHP) DIESEL FIRE PUMP NO. 1, 902–3F
EXEMPTED	2500-GPM (266-BHP) DIESEL FIRE PUMP NO. 2, 902–3F
EXEMPTED	250-KW EMERGENCY DIESEL GENERATOR, TELEPHONE SWITCH STATION, 702–A

U.S. Army Corps of Engineers 404 Permit (Dredge and Fill)

Permit Number	Permit Title
09–1D–311	SAVANNAH RIVER SITE BOAT RAMP UPGRADE

U.S. Army Corps of Engineers Nationwide Permits

Permit Number	Permit Title
NWP #3	REPLACEMENT OF BRIDGE 603–13G ON UPPER TINKER CREEK, AIKEN COUNTY, SC
NWP #3	REPLACEMENT OF BRIDGES 603–2G AND 603–3G ACROSS UPPER THREE RUNS CREEK, AIKEN COUNTY, SC
NWP #3	BRIDGE REPLACEMENTS AT ROAD 8–1 AND ROAD 2–1 ON UPPER THREE RUNS CREEK, AIKEN COUNTY, SC
NWP #26	EROSION CONTROL PROJECT IN THE F–2 OUTFALL CHANNEL TO UPPER THREE RUNS CREEK
NWP #26	CONSTRUCTION OF A BRIDGE OVER LOWER THREE RUNS CREEK, BARNWELL COUNTY
NWP #26	INSTALLATION OF FOOTING AND STEPS TO ACCESS WELLS IN WETLANDS NEAR TNX-AREA

Domestic Water Permits

The South Carolina Department of Health and Environmental Control (SCDHEC) has granted Westinghouse Savannah River Company's Environmental Protection Department the authority—now under the General Construction Permit Program (GCP), formerly under the Modified Permitting Program (MPP)—to review domestic water construction permit application packages and to issue domestic water construction and operating permits on behalf of SCDHEC. Several South Carolina municipalities have similar agreements with SCDHEC. All domestic water permits listed in this report that begin with "G" fall under the GCP; those that begin with "M" fall under the MPP.

Permit Number	Permit Title
200092	DOMESTIC WATER DEEP WELLS, 905–104L AND 904–105L, TO SERVE L-AREA
200279	DOMESTIC WATER DEEP WELL, 905–120P, TO SERVE P-AREA
201715	DOMESTIC WATER DEEP WELL, 905–107G, TO SERVE RAILROAD CLASSIFICATION YARD
202822	DOMESTIC WATER SYSTEM (TEST WELL #1, "DIVISION A") TO SERVE D-AREA
202822A1	DOMESTIC WATER SYSTEM (PUMP, PIPING, TREATMENT, STORAGE TANK) TO SERVE D-AREA
202915	DOMESTIC WATER WELL AND DISTRIBUTION SYSTEM TO SERVE CONSTRUCTION SUPPORT AREA, S-AREA
203427	SODIUM HYPOCHLORITE SYSTEM, 280–F
203467	SODIUM HYPOCHLORITE SYSTEM, 280–H
203590	DOMESTIC WATER WELL, 905–126G, TO SERVE 100-AREA FIRE STATION, 709–1G (INTERSECTION OF ROAD C AND ROAD 7)

Domestic Water Permits, continued

Permit Number	Permit Title
203628	DOMESTIC WATER WELL, 905–118G, TO SERVE PISTOL RANGE (REPLACED WELL 905–11G)
203638	DOMESTIC WATER WELL, 905–117G, TO SERVE ALLENDALE BARRICADE (REPLACED WELL 905–6G)
203786	DOMESTIC WATER WELL, 905–114G, TO SERVE RIVER WATER PUMPING STATION, 681–3G (REPLACED WELL 905–4G)
204138	DOMESTIC WATER DEEP WELL, 905–106K, TO SERVE K-AREA (REPLACED WELL 905–94K)
204198	DOMESTIC WATER DEEP WELL, 905–119H, TO SERVE H-AREA (REPLACED WELL 905–66H)
205142	POLYPHOSPHATE SYSTEMS, 200–F AREA
205217	UPGRADE INSTRUMENTATION 280–1H (CAUSTIC FEED SYSTEM); (F-Area also covered under this permit)
205217	UPGRADE INSTRUMENTATION 280–1F (CAUSTIC FEED SYSTEM); (H-Area also covered under this permit)
205702	POLYPHOSPHATE SYSTEMS, 200–H AREA
205877	DOMESTIC WATER WELL, 905–116G, PIPING AND STORAGE TANK TO SERVE AUGUSTA BARRICADE, 701–6G (REPLACED WELL 905–10G)
206474	DOMESTIC WATER TEST WELL, 905–136G, TO SERVE CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF)
206474A1	DOMESTIC WATER SYSTEM (PUMP, WELLHEAD PIPING, TREATMENT, TANK AND DISTRIBUTION SYSTEM) TO SERVE CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF)
206501	DOMESTIC WATER DEEP WELL, 905–125B (TEST WELL) TO SERVE B-AREA (REPLACES WELL 905–59B)
206501A1	DOMESTIC WATER DEEP WELL, 905–125B, (PUMP/PIPING/TREATMENT) TO SERVE B-AREA
206575	DOMESTIC WATER DEEP WELLS, 905–112G AND 905–113G, TO SERVE A-AREA AND M-AREA
207853	DOMESTIC WATER SYSTEM (BACKUP TEST WELL) TO SERVE D-AREA
207853A1	DOMESTIC WATER SYSTEM (BACKUP PUMP, PIPING, TREATMENT, STORAGE TANK) TO SERVE D-AREA
208425	DOMESTIC WATER TEST WELL, 905–108G, TO SERVE ADVANCED TACTICAL TRAINING ACADEMY (ATTA), 617–G
208425AI	DOMESTIC WATER SYSTEM (PUMP, PIPING, TREATMENT, TANK) TO SERVE ADVANCED TACTICAL TRAINING ACADEMY (ATTA), 617–G
208434	DOMESTIC WATER SYSTEMS (WELLS, PIPING, TREATMENT) TO SERVE ROAD 2 BARRICADE, 701–8G (WELL 905–111G); ROAD 3 BARRICADE, 701–12G (WELL 905–110G); AND ROAD 6 BARRICADE, 701–13G (WELL 905–109G)

Domestic Water Permits, continued

Permit Number	Permit Title
208866	DOMESTIC WATER WELL, 905–115G, TO SERVE AIKEN BARRICADE, 701–5G (REPLACED WELL 905–69G)
209191	DOMESTIC WATER TEST WELL, 905–131G, TO SERVE SREL PAR POND LABORATORY, 737–G
209191A1	DOMESTIC WATER SYSTEM (PUMP, PIPING, TREATMENT, STORAGE TANK) TO SERVE SREL PAR POND LABORATORY, 737–G
209454	DOMESTIC WATER WELLS, 905–96G AND 905–97G, TO SERVE TNX-AREA
210657	DOMESTIC WATER DEEP WELL, 905–103F, AND DISTRIBUTION SYSTEM TO SERVE F-AREA (REPLACED WELL 905–39F)
210966	DOMESTIC WATER UPGRADE, PHASE II, ZONE 5 (A-AREA CENTRAL TREATMENT PLANT)
212745	DOMESTIC WATER DEEP WELLS, 905–1 AND 905–2, TO SERVE S-AREA
304134	TNX-AREA DOMESTIC WATER TREATMENT PLANT MODIFICATIONS
306376	500,000-GALLON DOMESTIC WATER ELEVATED STORAGE TANK TO SERVE A-AREA/B-AREA (DOMESTIC WATER UPGRADE, PHASE II, ZONE 4)
306386	650,000-GALLON DOMESTIC WATER ELEVATED STORAGE TANK TO SERVE C/CS-AREA (DOMESTIC WATER UPGRADE, PHASE II, ZONE 4)
400203	TNX AREA HYDRO-PNEUMATIC DOMESTIC WATER STORAGE TANK
400347	DOMESTIC WATER HEADERS, TNX AREA
400737	DOMESTIC WATER SYSTEM (PUMP, PIPING, STORAGE TANK) TO SERVE Z-AREA
401118	DOMESTIC WATER LINE TO SERVE NEW WASTE TRANSFER FACILITY (NWTF), 241–102H
401354	250,000-GALLON DOMESTIC WATER STORAGE TANK, A-AREA
401446	DOMESTIC WATER LINE TO SERVE PRODUCTION CONTROL FACILITY, 772–1F
401654	B-AREA DOMESTIC WATER TREATMENT PLANT MODIFICATIONS
402186	DOMESTIC WATER LINES TO SERVE S-AREA
402343	H-AREA BACKUP BOOSTER PUMP ("AS-BUILT")
402874	SEGREGATED DOMESTIC WATER SUPPLY, 300/700 AREA, PHASE I
402925–RI	DOMESTIC WATER LINES TO SERVE TEMPORARY CONSTRUCTION BUILDINGS, S-AREA
403434	SEGREGATED DOMESTIC WATER SUPPLY, 300/700 AREA, PHASE II
404608	DOMESTIC WATER LINE TO SERVE 717–K
404618	DOMESTIC WATER LINE TO SERVE 705–C

Domestic Water Permits, continued

Permit Number	Permit Title
405184	DOMESTIC WATER LINE TO SERVE 773–41A AND 773–42A
405556	DOMESTIC WATER LINES TO SERVE H-AREA
405566	DOMESTIC WATER SYSTEM UPGRADE, 200–F
406137	DOMESTIC WATER LINE TO SERVE INTERIM STORAGE AND RE-DRUMMING FACILITY, 645–1N AND 645–2N (FORMERLY 709–1G AND 709–2G)
406871E1	DOMESTIC WATER LINE TO SERVE B-AREA ENGINEERING CENTER, 730–B
407705M	DOMESTIC WATER LINE TO SERVE C-AREA COMBINED DOMESTIC/FIRE SYSTEM
407830	DOMESTIC WATER LINE TO SERVE N-AREA MATERIAL MANAGEMENT RECEIVING AND STORAGE FACILITIES (MMRSF), 731–N THROUGH 731–4N
408035M	DOMESTIC WATER LINE TO SERVE B-AREA ENGINEERING AND OPERATIONS SUPPORT FACILITY
408221	K-AREA DOMESTIC WATER TREATMENT AND DISTRIBUTION SYSTEM UPGRADE
408285	DOMESTIC WATER LINE TO SERVE TNX-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 607–41T
408505M	DOMESTIC WATER UPGRADE, PHASE I (D-AREA)
408552	K-AREA FILTER BACKWASH SYSTEM
408595	DOMESTIC WATER LINE TO SERVE CONSTRUCTION OFFICE BUILDING, 305–1M
409115M	DOMESTIC WATER UPGRADE, PHASE I (B-AREA)
409125M	DOMESTIC WATER UPGRADE, PHASE I (A-AREA)
409484	DOMESTIC WATER LINE TO SERVE REACTOR SIMULATOR FACILITY, 707–C
409955	DOMESTIC WATER AND FIRE PROTECTION LINES TO SERVE HELICOPTER FACILITY, 703–5G AND 703–6G
410155M	DOMESTIC WATER UPGRADE, PHASE I (N-AREA)
410406	DOMESTIC WATER LINE TO SERVE VEHICLE PROTECTION SHELTER SAFETY SHOWER AND EYE WASH STATION, 777–A
410956	DOMESTIC WATER UPGRADE, PHASE II, ZONE 5 (B-AREA BOOSTER PUMP AND WATER TREATMENT PLANT MODIFICATIONS)
411337	SODIUM HYPOCHLORITE SYSTEM, 780–1A
411357	DOMESTIC WATER LINE TO SERVE THREE SAFETY SHOWERS AT ETF–H LIFT STATION
411995	DOMESTIC WATER LINE TO SERVE 340–M AND 341–M

Domestic Water Permits, continued

Permit Number	Permit Title
412255	DOMESTIC WATER LINE FROM DOMESTIC WATER DEEP WELLS (905–112G AND 905–113G) TO SERVE A-AREA AND M-AREA
412917	DOMESTIC WATER LINE TO SERVE F-AREA/H-AREA ETF CONTROL BUILDING, 241–84H, AND F-AREA/H-AREA ETF TREATMENT BUILDING, 241–81H
510255	MODIFICATION TO D-AREA DOMESTIC WATER SYSTEM (SODIUM ALUMINATE FEED SYSTEM)
603505	FORESTRY AREA DOMESTIC WATER TREATMENT PLANT MODIFICATIONS (SODA ASH FEED SYSTEM)
LS–1–W	DOMESTIC WATER LINE TO SERVE TRITIUM FACILITIES SUPPORT BUILDING, 235–H
LS–106–W	DOMESTIC WATER LINE TO SERVE CONSTRUCTION SUPPORT FACILITIES AT DWPF AUXILIARY PUMP PIT, S-AREA
LS–11–W	DOMESTIC WATER LINE TO SERVE NAVAL FUEL MATERIALS FACILITY (FMF), 247–F
LS–115–W	DOMESTIC WATER LINE TO SERVE CENTRAL SHOPS ADMINISTRATION BUILDING (CSAB), 704–3N
LS–118–W	DOMESTIC WATER LINE TO SERVE 719–4A
LS–119–W	DOMESTIC WATER LINE TO SERVE 730–M
LS–139–W	DOMESTIC WATER LINE TO SERVE REPLACEMENT TRITIUM FACILITY (RTF), 233–H AND 249–H
LS–168–W	DOMESTIC WATER LINE TO SERVE SUPPORT SERVICES BUILDING, 716–2A
LS–178–W	DOMESTIC WATER LINE TO SERVE COMPUTER REPAIR BUILDING, 722–5A
LS–185–W	DOMESTIC WATER LINE TO SERVE 703–41A
LS–187–W	DOMESTIC WATER LINE TO SERVE THREE SAFETY SHOWERS AT THE ETF–F LIFT STATION
LS–232–W	TEMPORARY DOMESTIC WATER LINE TO SERVE TOILET TRAILER, 704–47S; OFFICES, 704–44S, 704–45S, AND 704–46S (FORMERLY FPF CONSTRUCTION ENGINEERS' OFFICES, 225–1H, 225–2H, AND 225–3H); TOILET TRAILER, 704–47H; AND OFFICES, 704–27H, 704–32H, 704–37H, AND 704–42H
LS–233–W	TEMPORARY DOMESTIC WATER LINE TO SERVE F-AREA/H-AREA ETF TOILET TRAILER, 704–46H
LS–238–W	DOMESTIC WATER LINE TO SERVE SECURITY FACILITIES; ENTRY CONTROL FACILITY (ECF), 701–3H; AND CENTRAL ALARM STATION (CAS), 720–H
LS–25–W	DOMESTIC WATER LINE TO SERVE C-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 607–9C
LS–264–W	DOMESTIC WATER LINE TO SERVE CONSTRUCTION QUALITY ASSURANCE OFFICE BUILDING, 704–1N

Domestic Water Permits, continued

Permit Number	Permit Title
LS–265–W	DOMESTIC WATER LINE TO SERVE EQUIPMENT STORAGE AND HEALTH PROTECTION (HP) FACILITY, 221–25F
LS–4–W	DOMESTIC WATER LINE TO SERVE OFFICE BUILDING, 703–41A
LS–43–W	"AS BUILT" DOMESTIC WATER LINE TO SERVE 773–A, 773–41A, AND 773–42A
LS–55–W	DOMESTIC WATER LINE TO SERVE N-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 607–38N
LS–56–W	DOMESTIC WATER LINE TO SERVE H-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 607–20H
LS–57–W	DOMESTIC WATER LINE TO SERVE RADIOLOGICAL AND ENVIRONMENTAL SUPPORT FACILITY, 735–11A
LS–60–W	DOMESTIC WATER LINE TO SERVE 704–S ADMINISTRATION BUILDING
LS–61–W	DOMESTIC WATER LINE TO SERVE S-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 980–S
LS–7–W	DOMESTIC WATER LINE TO SERVE NAVAL FUEL MATERIALS FACILITY (FMF), 221–17F AND 221–18F
LS–8–W	DOMESTIC WATER LINE TO SERVE 703–4A, 703–6A, AND 703–34A
LS–81–W	DOMESTIC WATER LINE TO SERVE CONSTRUCTION ADMINISTRATION OFFICE BUILDING, 704–6C
LS–82–W	DOMESTIC WATER LINE TO SERVE B-AREA SANITARY WASTEWATER TREATMENT PLANT CHEMICAL FEED FACILITY, 607–2B
LS–91009	DOMESTIC WATER LINE TO SERVE TEMPORARY MODULAR OFFICE TRAILERS, 245–F THROUGH 245–12F
LS89002	DOMESTIC WATER AND FIRE PROTECTION LINES TO SERVE TEMPORARY MODULAR OFFICES, 706–8C THROUGH 706–19C AND 703–1C THROUGH 703–28C
LS89008	EXPANSION OF DOMESTIC WATER AND FIRE PROTECTION TO SERVE MODULAR OFFICES, B-AREA
LS89016	RELOCATION OF DOMESTIC WATER LINE AT L-AREA SANITARY FLOW EQUALIZATION BASIN
LS89017	DOMESTIC WATER LINE TO SERVE TEMPORARY MODULAR OFFICE TRAILERS, 707–7K THROUGH 707–19K
LS89020	BLOCK VALVE INSTALLATION ON 200–F AREA DOMESTIC WATER WELL HEADER
LS89028	DOMESTIC WATER LINE TO SERVE GENERAL PHYSICS OFFICE, 777–18A
LS89029	DOMESTIC WATER LINE TO SERVE MATERIAL MANAGEMENT, RECEIVING, AND STORAGE FACILITIES (MMRSF) FIRE WATER STORAGE TANK MAKEUP WATER SYSTEM, 681–17N AND 681–18N

Domestic Water Permits, continued

Permit Number	Permit Title
LS91001	DOMESTIC WATER LINE TO SERVE TEMPORARY MODULAR OFFICE TRAILERS, 773–62A THROUGH 773–70A
LS91005	DOMESTIC WATER LINE TO FILL IN-TANK PRECIPITATION (ITP) FIRE TANK, 241–20H
LS91006	DOMESTIC WATER LINE TO FILL IN-TANK PRECIPITATION (ITP) FIRE TANK, 241–21H
LS91007	DOMESTIC WATER LINE REROUTE TO SERVE SAFETY SHOWER/EYEWASH STATIONS AT REPLACEMENT HIGH-LEVEL EVAPORATOR, H-AREA
LS91010	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, B-AREA
LS91011	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, 3/700-AREA
LS91012	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, C-AREA
LS91013	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, N-AREA
LS91014	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, D-AREA
LS91015	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, FORESTRY AREA
LS91016	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, L-AREA
LS91017	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, P-AREA
LS91018	DOMESTIC WATER SYSTEMS INSTRUMENTS UPGRADE, RAILROAD YARD
G0018	DOMESTIC WATER LINE TO SERVE SAVANNAH RIVER ENVIRONMENTAL FIELD LABS, BUILDINGS 760–24G, 760–25G, 760–26G, AND 760–27G
G0028	E-ROAD DOMESTIC WATER SUPPLY LINE TO IN-TANK PRECIPITATION (ITP)
G0038	DOMESTIC WATER LINE TO SERVE TEMPORARY RESTROOM TRAILER, 245–12F
G0077	DOMESTIC WATER LINE TO SERVE TRITIUM ADMINISTRATION FACILITY, 246–H
G0016	DOMESTIC WATER UPGRADE, PHASE II, ZONE 1 (B-AREA, A-AREA, AND FORESTRY AREA CONNECTOR)
G0017	DOMESTIC WATER LINE TO SERVE SREL DISTANT LEARNING CENTER, 737–27A
G0026	DOMESTIC WATER UPGRADE, PHASE II, ZONE 2 (B-AREA, F-AREA, C-AREA, N-AREA, H-AREA, S-AREA, Z-AREA, AND FORESTRY AREA CONNECTOR)
G0027	DOMESTIC WATER UPGRADE, PHASE III (K-AREA TO L-AREA CONNECTOR)
G0036	DOMESTIC WATER UPGRADE, PHASE II, ZONE 3 (D-AREA AND TNX-AREA CONNECTOR)
G0037	DOMESTIC WATER LINE TO SERVE THREE RIVERS REGIONAL LANDFILL

Domestic Water Permits, continued

Permit Number	Permit Title
G0046	DOMESTIC WATER LINE TO SERVE DWPF LATE-WASH FACILITY RESTROOM UNIT, 512–8S
G0047	DOMESTIC WATER LINE TO SERVE CIF MODULAR RESTROOM UNIT, 261–6H
G0056	DOMESTIC WATER LINE TO SERVE H-AREA MEDICAL FACILITY, 719–H
G0057	DOMESTIC WATER LINE TO SERVE HWCTR PROJECT RESTROOM FACILITY, 703–21B
G0066	DOMESTIC WATER LINE TO SERVE SMALL-ANIMAL CARE FACILITY, 737–24A
G0067	DOMESTIC WATER LINE TO SERVE B-AREA RFI MOBILE LABORATORIES, 704–21B, 704–22B, AND 704–23B
G0076	DOMESTIC WATER LINE TO SERVE SOLID WASTE MANAGEMENT FACILITIES ACCESS (RESTROOM FACILITY, 704–32E)
M0075	DOMESTIC WATER LINE TO SERVE WASTE MANAGEMENT OFFICE AND STORAGE BUILDING, 241–102H
G0086	DOMESTIC WATER LINE TO SERVE T AND T RESTROOM TRAILER, 704–46H
M0012E2	DOMESTIC WATER LINE TO SERVE B-AREA FIRE PROTECTION SUPPLY SYSTEM
M0013	DOMESTIC WATER LINE TO SERVE 221–S NITRIC TANK SAFETY SHOWER/ EYEWASH STATION
M0014E1	DOMESTIC WATER LINE TO SERVE TRAINING CENTER, 766–H (FORMERLY 225–H)
M0016	DOMESTIC WATER UPGRADE, PHASE I (TNX-AREA)
M0022	DOMESTIC WATER LINE TO SERVE PORTABLE BOILER INSTALLATION, 183–2P
M0023E1	DOMESTIC WATER LINE TO SERVE CONSOLIDATED INCINERATION FACILITY (CIF), 261–H
M0024	DOMESTIC WATER LINE REROUTE TO SERVE ESSENTIAL MATERIALS WAREHOUSE, 315–M
M0025R2	DOMESTIC WATER LINE TO SERVE DWPF LATE-WASH FACILITY
M0032	DOMESTIC WATER LINE TO SERVE PORTABLE BOILER INSTALLATION, 183–2K
M0033E1	DOMESTIC WATER LINE TO SERVE F-AREA AND E-ROAD FIRE PROTECTION SUPPLY
M0034	DOMESTIC WATER LINE TO SERVE FORESTRY AREA RESTROOM TRAILER, 760–21G
M0035	DOMESTIC WATER UPGRADE, PHASE I (FORESTRY AREA)
M0042E1	DOMESTIC WATER LINE TO SERVE LUNCHROOM TRAILER, 773–72A
M0043	DOMESTIC WATER LINE TO SERVE OPERATION SUPPORT BUILDING, 704–2H

Domestic Water Permits, continued

Permit Number	Permit Title
M0044	DOMESTIC WATER LINE TO SERVE ASBESTOS ABATEMENT SHOWERS, 412–D AND 413–D
M0045	DOMESTIC WATER LINE TO SERVE 704–8T
M0052	DOMESTIC WATER LINE TO SERVE LUNCHROOM TRAILER, 740–16A
M0053	DOMESTIC WATER LINE TO SERVE 221–S LAB TRAILERS SAFETY SHOWER/ EYEWASH STATION
M0054E1	DOMESTIC WATER LINE TO SERVE B-AREA UTILITIES UPGRADE, 735–4B AND 735–2B
M0055	DOMESTIC WATER LINE TO SERVE SRFS EDUCATION TRAILER RESTROOMS, 760–22G
M0063R1	DOMESTIC WATER LINE TO SERVE ADMINISTRATIVE SUPPORT BUILDING, 708–1B
M0064E1	DOMESTIC WATER LINE TO SERVE COMPRESSED-GAS STORAGE FACILITY, 731–6N
M0065	K-AREA DOMESTIC WATER LOOP COMPLETION
M0072E2	DOMESTIC WATER LINE TO SERVE FLAMMABLE STORAGE FACILITY, 731–5N
M0073E1	DOMESTIC WATER LINE TO SERVE SAFEGUARDS AND HEALTH PROTECTION SHOP, 228–H
M0074R1	DOMESTIC WATER LINE TO SERVE SAFETY SHOWER/EYEWASH STATION, 421–6D
M0082	DOMESTIC WATER LINE TO SERVE CENTRAL SERVICES WORKS ENGINEERING (CSWE) FACILITY, 717–11A
M0083	DOMESTIC WATER LINE TO SERVE RESTROOM TRAILER, 704–11K
M0084E1	DOMESTIC WATER LINE TO SERVE TYPE III TANK SALT REMOVAL CONTROL BUILDING, 241–2H
M0085	DOMESTIC WATER LINE TO SERVE FORESTRY SERVICE BUILDING, 760–15G
M0092	DOMESTIC WATER LINE TO SERVE ENGINEERING SUPPORT BUILDING, 707–7F
M0093	D-AREA BACKUP WELL CONNECTOR
M0102	DOMESTIC WATER LINE TO SERVE TEMPORARY MODULAR OFFICES, 233–20H AND 233–21H
M0103E1	DOMESTIC WATER LINE TO SERVE DRINKING WATER FOUNTAIN, 740–4A
M0112	DOMESTIC WATER LINE TO SERVE TEMPORARY MODULAR OFFICES, 742–G AND 742–1G THROUGH 742–14G
M0113	DOMESTIC WATER LINE TO SERVE 704–11K, 704–12K, AND 705–K

Domestic Water Permits, continued

Permit Number	Permit Title
M0122	DOMESTIC WATER LINE TO SERVE SRTC MODULAR RESTROOM UNIT, 773–71A
M0123E1	DOMESTIC WATER LINE TO SERVE SAFETY SHOWER/EYEWASH STATIONS, 673–T, 678–T, AND 679–8T

Industrial Wastewater Permits

Permit Number	Permit Title
12888	METALLURGICAL LABORATORY NEUTRALIZATION FACILITY, 723–A
16119	F-AREA/H-AREA ETF PERMANENT pH ADJUSTMENT SYSTEM
10253	M-AREA 610-GPM AIR STRIPPER
10287	LIQUID EFFLUENT TREATMENT FACILITIES (LETF), 300–M
10349	672–T TNX PROCESS SEWER TO OUTFALL X–008
10358	S-AREA OIL/WATER SEPARATOR
10389	M-AREA DRAIN LINE
10475	NONCONTACT COOLING WATER DIVERSION, 300–M AREA
10696	INTERIM SLUDGE STORAGE TANK, M-AREA
10765	WASTEWATER NEUTRALIZATION FACILITY, 704–B
10949	TRADE-WASTE FLOW EQUALIZATION TANK, 607–18A, FOR SILVER RECOVERY, 703–43A
11406	FIRE BRIGADE TRAINING FACILITIES OIL/WATER SEPARATOR, 411–D
11411	DWPF TREATED EFFLUENT LINE, S-AREA
11413	DWPF CHEMICAL TREATMENT FACILITY, S-AREA
11497	PRODUCTION CONTROL FACILITY SANITARY/PROCESS SEWER, 772–1F
11498	FLOW MONITORING STATION FOR NPDES OUTFALL L–007
11588	POWERHOUSE EFFLUENT DIVERSION TO ASH BASIN; 400–D (H-Area also covered under this permit)
11588	POWERHOUSE EFFLUENT DIVERSION TO ASH BASIN; 200–H (D-Area also covered under this permit)
11589	POWERHOUSE EFFLUENT DIVERSION TO ASH BASIN, 184–P
12622	ORGANICS REMOVAL FACILITY (ORF), TNX-AREA
12633	TNX-AREA EFFLUENT TREATMENT PLANT (ETP)
12683	INDUSTRIAL WASTEWATER TREATMENT FACILITY TO SERVE Z-AREA SALTSTONE MANUFACTURING FACILITY

Industrial Wastewater Permits, continued

Permit Number	Permit Title
12782	REPLACEMENT TRITIUM FACILITY (RTF) PROCESS SEWER
12870	F-AREA/H-AREA ETF, 241–81H
12894	FILTRATE HOLD-TANK COVERS, M-AREA
12973	P-AREA NEUTRALIZATION FACILITY, 183–2P
13105	F-AREA/H-AREA ETF PROCESS SEWER LINES, F-AREA (H-Area also covered under this permit)
13105	F-AREA/H-AREA ETF PROCESS SEWER LINES, H-AREA (F-Area also covered under this permit)
13154	FLOW MEASUREMENT DEVICE, L-AREA
13354	D-AREA NEUTRALIZATION FACILITY, 483–1D
13355	F-AREA NEUTRALIZATION FACILITY, 280–1F
13356	H-AREA NEUTRALIZATION FACILITY, 280–H
13357	K-AREA NEUTRALIZATION FACILITY, 183–2K
13431	FLUME AT M–004 OUTFALL
13735	INDUSTRIAL WASTEWATER pH CONTROL SYSTEM, 211–F
13978	TNX-AREA ION EXCHANGE FACILITY
14020	MERCURY AND ORGANIC REMOVAL FACILITY FOR F-AREA/H-AREA ETF
14100	REPAIR ASH BASIN DIKE, 488–1D
14218	NPDES OUTFALL STRUCTURES, F–012 AND F–013 (FLOW MONITORING WEIR BOX STRUCTURES)
14219	NPDES OUTFALL STRUCTURES, H–017 AND H–018 (MONITORING WEIR BOX STRUCTURES)
14338	“AS-BUILT” H–Z INTERAREA SALT SOLUTION TRANSFER LINE
14379	UPPER THREE RUNS CREEK DIFFUSER FOR F-AREA/H-AREA ETF OUTFALL, H–016
14520	“AS-BUILT” F-AREA/H-AREA ETF TANK 50
14624	EXISTING F-AREA/H-AREA ETF AREA PROCESS SEWER LINES, F-AREA (H-Area also covered under this permit)
14624	EXISTING F-AREA/H-AREA ETF AREA PROCESS SEWER LINES, H-AREA (F-Area also covered under this permit)
14832	MODIFICATION TO M-AREA LIQUID EFFLUENT TREATMENT FACILITIES (LETF); SUPERNATANT TRANSFER AND POLYMER ADDITION SYSTEMS
15256	EVAPORATOR RECYCLE LINE FOR F-AREA/H-AREA ETF

Industrial Wastewater Permits, continued

Permit Number	Permit Title
15467	UPGRADE PROCESS SEWERS, 211–F/H ETF, F-AREA (H-Area also covered under this permit)
15467	UPGRADE PROCESS SEWERS, 211–F/H ETF, H-AREA (F-Area also covered under this permit)
15892	F-AREA/H-AREA ETF INTERIM pH ADJUSTMENT SYSTEM (CAUSTIC AND ACID SUPPLY)
16449	K-REACTOR EMERGENCY RETENTION BASIN PERCOLATION DRAIN FIELD
16783	"AS BUILT" DWPF INDUSTRIAL WASTEWATER TREATMENT FACILITY, S-AREA
16785	K-AREA NATURAL DRAFT COOLING TOWER THERMAL MITIGATION
16797	(70-GPM AIR STRIPPER) PROTOTYPE AIR STRIPPER COLUMN RELOCATION AND RECOVERY WELL INSTALLATION
17022	D-AREA NEUTRALIZATION FACILITY UPGRADE, 483–1D
17424–IW	"AS BUILT" F-AREA HIGH-LEVEL RADIOACTIVE WASTE TANK FARM (H-Area also covered under this permit)
17424–IW	"AS BUILT" H-AREA HIGH LEVEL RADIOACTIVE WASTE TANK FARM (F-Area also covered under this permit)
17434–IW	TNX-AREA TRICKLE-FLOW BIOREACTOR UNIT
17588–IW	MOBILE TRICKLE-FLOW BIOREACTOR SYSTEM
17596–IW	DWPF PRECIPITATE-FEED LATE-WASH FACILITY
17614–IW	250-GPM AIR STRIPPER (A–002), SRTC
17765–IW	INVESTIGATION-DERIVED WASTE (IDW) TRANSFER STATION AT F-AREA/H-AREA ETF
17816–IW	MODIFICATION TO 735–11A LAB BUILDING PROCESS SEWER SYSTEM NEUTRALIZATION FACILITY, 607–17A
17903–IW	784–A TEMPORARY BOILER-BLOWDOWN TRANSFER SYSTEM
17911–IW	F-AREA SEEPAGE BASINS GROUNDWATER REMEDIATION (EXTRACTION/ INJECTION PIPING NETWORK)
17912–IW	H-AREA SEEPAGE BASINS GROUNDWATER REMEDIATION (EXTRACTION/ INJECTION PIPING NETWORK)
17938–IW	GROUNDWATER OPERABLE UNIT (GWOU) AIR STRIPPER, TNX-AREA
17980–IW	"AS BUILT" 299–H MAINTENANCE AND DECONTAMINATION FACILITY WASTE COLLECTION TANK AND CONVEYANCE SYSTEM
17998–IW	A-AREA POWERHOUSE EFFLUENT REROUTE SYSTEM, 784–A
18052–IW	F-AREA SEEPAGE BASINS GROUNDWATER REMEDIATION (WASTEWATER TREATMENT UNIT)

Industrial Wastewater Permits, continued

Permit Number	Permit Title
18053–IW	H-AREA SEEPAGE BASINS GROUNDWATER REMEDIATION (WASTEWATER TREATMENT UNIT)
18078–IW	483–6D SURGE BASIN LINER REPLACEMENT
7289	"AS BUILT" WASTEWATER TREATMENT FACILITIES, A-AREA (M-Area also covered under this permit)
7289	"AS BUILT" WASTEWATER TREATMENT FACILITIES, M-AREA (A-Area also covered under this permit)
7290	"AS BUILT" WASTEWATER TREATMENT FACILITIES, F-AREA
7291	"AS BUILT" WASTEWATER TREATMENT FACILITIES, H-AREA
7292	"AS BUILT" WASTEWATER TREATMENT FACILITIES, P-AREA
7293	"AS BUILT" WASTEWATER TREATMENT FACILITIES, K-AREA
7294	"AS BUILT" WASTEWATER TREATMENT FACILITIES, C-AREA
7295	"AS BUILT" WASTEWATER TREATMENT FACILITIES, D-AREA
7296	"AS BUILT" WASTEWATER TREATMENT FACILITIES, N-AREA
LS–112–S	FIRE TRAINING FACILITY PROCESS SEWER, 904–D
LS–42–S	INERT L-FACILITY LOADING DOCK SEWER RELOCATION, 234–H
LOA–7/10/95	M-AREA PROCESS WASTE INTERIM TREATMENT/STORAGE FACILITY (PWIT/SF) SLUDGE VENDOR TREATMENT PROCESS; MODIFICATION TO M-AREA LIQUID EFFLUENT TREATMENT FACILITY (LETF)

NPDES – Discharge Permit

Permit Number	Permit Title
SC0000175	33 INDUSTRIAL WASTEWATER OUTFALLS AT SAVANNAH RIVER SITE

NPDES – General Utility Water Permit

Permit Number	Permit Title
SCG250162	ONE GENERAL UTILITY WATER OUTFALL AT SAVANNAH RIVER SITE

NPDES – No-Discharge Permit

Permit Number	Permit Title
ND0072125	SRS SANITARY SLUDGE LAND APPLICATION SITE, FORESTS (SLUDGE FROM ALL SWTPs)

NPDES – Stormwater Permits

Permit Number	Permit Title
SCR000000	52 INDUSTRIAL STORMWATER OUTFALLS AT SAVANNAH RIVER SITE
SCR100000	10 NPDES-PERMITTED CONSTRUCTION STORMWATER SITES AT SAVANNAH RIVER SITE

RCRA Permit

Permit Number	Permit Title
SCI80008989	SEVEN PERMITTED RCRA FACILITIES AT SAVANNAH RIVER SITE

Sanitary Wastewater Permits

Permit Number	Permit Title
02–91040041	SEPTIC TANK AND TILE FIELD TO SERVE OFFICE BUILDING, 704–56H (also known as 5002–H)
02–92080098	SEPTIC TANK AND TILE FIELD TO SERVE SREL PAR POND LABORATORY, 737–G
10132–P	SEPTIC TANK AND TILE FIELD TO SERVE TOILET TRAILER, 704–47S, AND OFFICES, 704–44S, 704–45S, AND 704–46S (FORMERLY FPF CONSTRUCTION ENGINEERS' OFFICES, 225–1H, 225–2H, AND 225–3H)
10236	SANITARY SEWER SYSTEM (LIFT STATION AND SEWER LINE) TO SERVE CHANGE STATION FACILITY, 241–58H
10314	DWPF CONSTRUCTION SITE SANITARY SEWER SYSTEM, S-AREA
10499	SANITARY SEWER TO SERVE DWPF, 200–S
10521	CHEMICAL FEED FACILITY (607–16A) FOR A-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7–1A, 607–7–2A, AND 607–23A
10522	CHEMICAL FEED FACILITY (607–19F) FOR F-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7F AND 607–21F
10523	CHEMICAL FEED FACILITY (607–20H) FOR H-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7H AND 607–21H
10524	CHEMICAL FEED FACILITY (607–22P) FOR P-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7P AND 607–23P
10525	CHEMICAL FEED FACILITY (607–38N) FOR N-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–18N AND 607–42N
10526	CHEMICAL FEED FACILITY (607–14D) FOR D-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–15D
10530	TNX-AREA 20,000-GALLON SANITARY WASTEWATER TREATMENT PLANT, 607–40T
10533	SEPTIC TANK AND TILE FIELD (607–54G) TO SERVE DEER HUNT BUILDING, 760–12G
10825	SANITARY SEWER LIFT STATION (607–19A) TO SERVE 730–A

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
11407	SANITARY SEWER LIFT STATION TO SERVE 321–M CHANGE ROOM
11442	SANITARY SEWER SYSTEM (LIFT STATION AND SEWER LINE) TO SERVE ECR/ICR CONTROL HOUSE, 241–82H
11687	SEPTIC TANK AND TILE FIELD TO SERVE WACKENHUT HELICOPTER FACILITY, 703–5B
11755	SEPTIC TANK AND TILE FIELD TO SERVE 100-AREA FIRE STATION, 709–1G (INTERSECTION OF ROAD C AND ROAD 7)
11847	EFFLUENT WEIR FOR TNX-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–40T
12386	SANITARY SEWER TO SERVE 730–M
12695	SANITARY SEWER TO SERVE REPLACEMENT TRITIUM FACILITY (RTF), 233–H
12725	45,000-GALLON SANITARY FLOW EQUALIZATION BASIN (607–18F) FOR SANITARY WASTEWATER TREATMENT PLANTS, 607–7F AND 607–21F (PHASE III)
12910	H-AREA 30,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–21H
13155	NAVAL FUEL MATERIALS FACILITY (FMF) FLOW MEASUREMENT DEVICE; OUTFALL F–003(A)
13156	SANITARY SEWER TO SERVE 716–2A
13157	SANITARY SEWER TO SERVE COMPUTER REPAIR BUILDING, 722–5A
13175	97,500-GALLON SANITARY FLOW EQUALIZATION BASIN (607–22A) FOR SANITARY WASTEWATER TREATMENT PLANTS, 607–7–1A, 607–7–2A, AND 607–23A
13291	SEPTIC TANK AND TILE FIELD TO SERVE AUXILIARY PUMP PIT
13430	F-AREA 30,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–21F
13538	SEPTIC TANK AND TILE FIELD TO SERVE K-AREA COOLING TOWER CONSTRUCTION TRAILER
13539	SEPTIC TANK AND TILE FIELD TO SERVE K-AREA COOLING TOWER ECR/ICR BUILDING, 153–1K
13717	SEPTIC TANK (831–1Z) AND TILE FIELD (831–2Z) TO SERVE Z-AREA
14311	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR C-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–7C
14312	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR K-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–17K
14313	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR L-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–16L
14314	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR P-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7P AND 607–23P

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
14315	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR F-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7F AND 607–21F
14316	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR H-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7H AND 607–21H
14317	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR S-AREA SANITARY WASTEWATER TREATMENT PLANTS, 831–1S AND 831–2S
14318	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR D-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–15D
14319	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR B-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–1B
14320	INTERIM SODIUM HYPOCHLORITE DISINFECTION SYSTEM (607–8A) FOR A-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7–1A, 607–7–2A, AND 607–23A
14322	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR N-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–18N AND 607–42N
14323	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR NAVAL FUEL MATERIALS FACILITY (FMF) SANITARY WASTEWATER TREATMENT PLANT, 607–17F
14324	INTERIM SODIUM HYPOCHLORITE DISINFECTION FOR TNX-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–40T
14407	D-AREA 20,000-GPD SANITARY WASTEWATER TREATMENT PLANT EXPANSION, 607–15D
14443	SEPTIC TANK AND TILE FIELD TO SERVE 241–102H
15005	A-AREA 65,000-GPD SANITARY WASTEWATER TREATMENT PLANT EXPANSION, 607–23A
15049	35,000-GALLON SANITARY FLOW EQUALIZATION BASIN (607–19G) FOR N-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–18G AND 607–42G
15416	12,000-GALLON SANITARY FLOW EQUALIZATION BASIN (607–16K) FOR SANITARY WASTEWATER TREATMENT PLANT, 607–17K
15417	11,000-GALLON SANITARY FLOW EQUALIZATION BASIN (607–24P) FOR P-AREA SANITARY WASTEWATER TREATMENT PLANTS, 607–7P AND 607–23P
15418	17,500-GALLON SANITARY FLOW EQUALIZATION BASIN (607–15L) FOR SANITARY WASTEWATER TREATMENT PLANT, 607–16L
15419	SANITARY SEWER LIFT STATION TO SERVE REPLACEMENT TRITIUM FACILITY (RTF)
15444	SANITARY SEWER LIFT STATION TO SERVE 341–M
15506	15,000-GALLON SANITARY FLOW EQUALIZATION BASIN (607–22F) FOR NAVAL FUEL MATERIALS FACILITY (FMF) SANITARY WASTEWATER TREATMENT PLANT, 607–17F

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
15530	27,500-GALLON SANITARY FLOW EQUALIZATION BASIN (607–4C) FOR SANITARY WASTEWATER TREATMENT PLANT, 607–7C
15740	SANITARY SEWER SYSTEM EXPANSION (TWO LIFT STATIONS AND SEWER LINE) TO SERVE C-AREA
16477	SANITARY SEWER TO SERVE N-AREA MATERIAL MANAGEMENT RECEIVING AND STORAGE FACILITIES (MMRSF), 731–N THROUGH 731–4N
16784	TNX-AREA SANITARY WASTEWATER TREATMENT PLANT (607–40T) EFFLUENT REROUTE FROM OUTFALLS X–013 TO X–008A
16961	SANITARY SEWER LINE FROM MATERIAL MANAGEMENT RECEIVING AND STORAGE FACILITIES (MMRSF) TO N-AREA SANITARY WASTEWATER TREATMENT PLANT
17057	B-AREA 80,000-GPD SANITARY WASTEWATER TREATMENT PLANT UPGRADE, 607–4B (INCLUDES 40,000-GALLON FLOW EQUALIZATION BASIN)
17059	SANITARY SEWER TO SERVE B-AREA ENGINEERING CENTER, 730–B
17156	FLOW CONTROL BOXES FOR TNX-AREA SANITARY WASTEWATER TREATMENT PLANT, 607–40T
17157	FLOW CONTROL BOXES FOR H-AREA SANITARY WASTEWATER TREATMENT FACILITIES, 607–7H AND 607–21H
17232	SANITARY SEWER TO SERVE 705–3C
17273–IW	SANITARY SEWER TO SERVE 704–49S OFFICE BUILDING
17278–IW	SANITARY SEWER TO SERVE 730–1M OFFICE BUILDING
17279–IW	SANITARY SEWER TO SERVE 705–K OFFICE BUILDING
17383–IW	SANITARY SEWER TO SERVE REPLACEMENT TRITIUM FACILITY (RTF) TRAILERS 233–20H AND 233–21H
17419–IW	SANITARY SEWER TO SERVE H-AREA TRAILERS, 742–10G THROUGH 742–12G
17499–IW	SANITARY SEWER AND LIFT STATION TO SERVE 704–2H
17528–IW	SANITARY SEWER TO SERVE ENGINEERING SUPPORT FACILITY, 730–1B, AND OPERATIONS SUPPORT FACILITIES, 730–2B AND 730–4B
17604–IW	SANITARY SEWER TO SERVE SITE TRAINING BUILDING, 766–H (FORMERLY 225–H)
17643–IW	COLLECTION SYSTEM FOR CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF), ZONE 1A (FROM C ROAD [INCLUDING LS–3000A] TO CSWTF)
17646–IW	COLLECTION SYSTEM FOR CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF), ZONE 1A (FROM LS–4000C TO LS–3000A)

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
17656–IW	SANITARY SEWER TO SERVE HEALTH PROTECTION INSTRUMENT CALIBRATION FACILITY, 735–2B, AND NEW WHOLE BODY COUNTER FACILITY, 735–4B
17676–IW	SANITARY SEWER TO SERVE 241–2H
17679–IW	1,050,000-GPD CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF) TO SERVE A-AREA, B-AREA, C-AREA, F-AREA, H-AREA, N-AREA, N/F-AREA, AND S-AREA
17682–IW	SANITARY SEWER REROUTE TO SERVE SREL LIBRARY ADDITION, 737–A
17683–IW	COLLECTION SYSTEM FOR CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF), ZONE 1B (B-AREA, F-AREA, H-AREA, AND S-AREA)
17690–IW	COLLECTION SYSTEM FOR CENTRAL SANITARY WASTEWATER TREATMENT FACILITY (CSWTF), ZONE 2 (A-AREA, C-AREA, AND N-AREA)
17715–IW	UV DISINFECTION SYSTEM FOR D-AREA SANITARY WASTEWATER TREATMENT PLANT
17719–IW	UV DISINFECTION SYSTEM FOR P-AREA SANITARY WASTEWATER TREATMENT PLANT
17721–IW	UV DISINFECTION SYSTEM FOR K-AREA SANITARY WASTEWATER TREATMENT PLANT
17722–IW	UV DISINFECTION SYSTEM FOR TNX-AREA SANITARY WASTEWATER TREATMENT PLANT
17726–IW	UV DISINFECTION SYSTEM FOR L-AREA SANITARY WASTEWATER TREATMENT PLANT
17842–IW	SANITARY SEWER AND LIFT STATION TO SERVE SREL ANIMAL HOLDING FACILITIES
17955–IW	SANITARY SEWER TO SERVE 241–102H
17956–IW	SANITARY SEWER TO SERVE 703–5B
17981–IW	SANITARY SEWER TO SERVE H-AREA MEDICAL FACILITY, 719–H
1995020076	SEPTIC TANK AND TILE FIELD TO SERVE CENTRAL STAGING AREA, 704–13G
1995020100	SEPTIC TANK AND TILE FIELD TO SERVE CONSOLIDATED INCINERATION FACILITY (CIF), 261–H
1996110048	SEPTIC TANK/TILE FIELD SERVING SOLID WASTE MANAGEMENT FACILITIES ACCESS (RESTROOM FACILITY 704–32E)
7947	L-AREA 35,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–16L
8611–P	SEPTIC TANK AND TILE FIELD TO SERVE INTERIM STORAGE AND RE-DRUMMING FACILITY, 645–1N (FORMERLY 709–1G), N-AREA
8670	K-AREA 24,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–17K

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
8928	NAVAL FUEL MATERIALS FACILITY (FMF) 30,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–17F
9256P	SEPTIC TANK AND TILE FIELD TO SERVE LANDFILL MONITORING BUILDING, 642–E
9326	H-AREA 60,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–7H (F-Area, N-Area, and P-Area also covered under this permit)
9326	P-AREA 10,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–23P (F-Area, H-Area, and N-Area also covered under this permit)
9326	N-AREA 30,000-GPD (607–18G) AND 40,000-GPD (607–42G) SANITARY WASTE-WATER TREATMENT PLANTS (F-Area, H-Area, and P-Area also covered under this permit)
9326	F-AREA 60,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–7F (H-Area, N-Area, and P-Area also covered under this permit)
9694	SANITARY SEWER SYSTEM (LIFT STATION AND SEWER LINE) TO SERVE 773–41A AND 773–42A
9888	TWO 12,000-GPD SANITARY WASTEWATER TREATMENT PLANTS, S-AREA, 831–1S AND 831–2S
9940	SANITARY SEWER TO SERVE REACTOR SIMULATOR FACILITY, 707–C
9983	C-AREA 55,000-GPD SANITARY WASTEWATER TREATMENT PLANT, 607–7C
9998	SEPTIC TANK AND TILE FIELD TO SERVE F-AREA/H-AREA ETF CONTROL BUILDING, 241–84H
LS–10–S	SANITARY SEWER TO SERVE NAVAL FUEL MATERIALS FACILITY (FMF), 247–F AND 248–F
LS–129–S	SANITARY SEWER TO SERVE 719–4A
LS–134–S	DWPF SANITARY SEWER LINE MODIFICATION, S-AREA
LS–149–S	SANITARY SEWER TO SERVE TNX-AREA EFFLUENT TREATMENT PLANT, 904–T
LS–158–S	SANITARY SEWER TO SERVE 3/700 CONSTRUCTION FACILITY
LS–2–S	SANITARY SEWER TO SERVE TRITIUM FACILITY SUPPORT BUILDING, 235–H
LS–206–S	SEWER PIPE AND MANHOLE, 704–1T
LS–227–S	SANITARY SEWER TO SERVE 705–C
LS–228–S	SANITARY SEWER TO SERVE 717–K
LS–239–S	SANITARY SEWER TO SERVE SECURITY FACILITIES: ENTRY CONTROL FACILITY (ECF), 701–4F, AND CENTRAL ALARM STATION (CAS), 720–F
LS–240–S	SANITARY SEWER TO SERVE 720–2A (3/700 AREA SECURITY UPGRADE, PACAS FACILITY)

Sanitary Wastewater Permits, continued

Permit Number	Permit Title
LS–244–S	SANITARY SEWER TO SERVE SECURITY FACILITIES: ENTRY CONTROL FACILITY (ECF), 701–3H, AND CENTRAL ALARM STATION (CAS), 720–H
LS–256–S	MACERATOR FOR F-AREA SANITARY FLOW EQUALIZATION BASIN, 607–18F
LS–275–S	SANITARY SEWER TO SERVE EQUIPMENT STORAGE AND HEALTH PROTECTION FACILITY, 221–25F
LS–3–S	SANITARY SEWER TO SERVE 703–41A
LS–32–S	SANITARY SEWER TO SERVE WACKENHUT BUILDINGS, 703–B AND 703–1B
LS–335–S	SANITARY SEWER TO SERVE TEMPORARY MODULAR OFFICE TRAILERS, 704–7K THROUGH 704–19K
LS–336–S	“AS BUILT” OIL/WATER SEPARATOR, 716–A
LS–337–S	“AS BUILT” OIL/WATER SEPARATOR, 722–4A
LS–35–S	SANITARY SEWER RELOCATION TO SERVE 735–11A
LS–351–S	SANITARY SEWER TO SERVE TEMPORARY MODULAR OFFICE TRAILERS, 245–F THROUGH 245–12F
LS–352–S	SANITARY SEWER TO SERVE N-AREA NEW-EMPLOYEE PROCESSING CENTER
LS–354–S	SANITARY SEWER TO SERVE TO SERVE GENERAL PHYSICS OFFICE, 777–18A
LS–52–S	SANITARY SEWER TO SERVE 707–H
LS–53–S	SANITARY SEWER TO SERVE M-AREA CONSTRUCTION OFFICE BUILDING
LS–62–S	SANITARY SEWER RELOCATION TO SERVE 717–F
LS–78–S	SANITARY SEWER TO SERVE C-AREA CONSTRUCTION ADMINISTRATION BUILDING
LS–79–S	SANITARY SEWER TO SERVE N-AREA ELECTRICAL OFFICE BUILDING
LS–80–S	SANITARY SEWER TO SERVE N-AREA RECEIVING AND STORES WAREHOUSE

SCDHEC Navigable Waters Permits

Permit Number	Permit Title
09–1D–311–W	SAVANNAH RIVER SITE BOAT RAMP UPGRADE
SC 96–003	BRIDGE REPLACEMENTS AT ROAD C AND ROAD F AND UTILITY RELOCATION OVER UPPER THREE RUNS CREEK, AIKEN COUNTY, SC
SC 96–031	BRIDGE REPLACEMENTS AT ROAD 8–1 AND ROAD 2–1 ON UPPER THREE RUNS CREEK, AIKEN COUNTY, SC
SC 97–045	CONSTRUCTION OF A BRIDGE OVER LOWER THREE RUNS CREEK, BARNWELL COUNTY, SC

SCDHEC 401 (Water Quality) Permits

Permit Number	Permit Title
09–1D–311–W	SAVANNAH RIVER SITE BOAT RAMP UPGRADE
SC 88–D–005	F-AREA/H-AREA ETF DIFFUSER

Solid Waste Permits

Permit Number	Permit Title
025500–1120	SANITARY LANDFILL
025500–1601	D–F STEAM-LINE INDUSTRIAL SOLID WASTE LANDFILL (ASBESTOS)
025500–1602	F-AREA INERT-MATERIALS LANDFILL (RAILROAD-TIE PILE)
025500–1603	Z-AREA SALTSTONE DISPOSAL FACILITY
025800–1901	BURMA ROAD INERT-MATERIALS LANDFILL

Underground Injection Control Permits

Permit Number	Permit Title
103R	INJECTION/EXTRACTION BIOREMEDIATION PROJECT NEAR THE M-AREA SETTLING BASIN (One Class V.A.–G experimental technology injection well, AMH–1, to remove TCE and PCE using methane solutions)
201M	PURGE-WATER MANAGEMENT SYSTEM DEMONSTRATION, M-AREA (One Class V.A.–G experimental technology injection well, MCB–5; Phase II, demonstrate unit at a "contaminated" well)
211	F-AREA SEEPAGE BASIN GROUNDWATER REMEDIATION (Ten Class V.A.–I aquifer remediation injection wells, FIN–1 through FIN–10)
215	GROUNDWATER OPERABLE UNIT (GWOU) RECIRCULATION WELL, TNX-AREA (One Class V.A.–I corrective-action injection well, TVR–1)
216	TRACER TEST AT THE M–AREA SETTLING BASIN (ONE CLASS V.A.–G EXPERIMENTAL TECHNOLOGY INJECTION WELL)
223	H-AREA SEEPAGE BASIN GROUNDWATER REMEDIATION (Ten Class V.A.–I aquifer remediation injection wells, HIN–1 through HIN–10)
225	IN-SITU BIOREMEDIATION AT 108–3C (Eight Class V.A.–I aquifer remediation injection wells)
237	IN-SITU BIOREMEDIATION AT 108–3L (Eleven Class V.A.–I aquifer remediation injection wells, 104 through 114)
245	H-AREA COLLOID STUDY INJECTION TEST; SERIES I (One Class V.A.–G experimental technology injection well, HIW–IID)
245IV	F-AREA NANOFILTRATION DEMONSTRATION CONTINUATION (Ten Class V.A.–I aquifer remediation injection wells, FIN–1 through FIN–10)
256	D-AREA OIL SEEPAGE BASIN SOIL BIOVENTING REMEDIATION SYSTEM (Two Class V.A.–I aquifer remediation horizontal injection wells, DOB–1HW and DOB–2HW)

Underground Injection Control Permits, continued

Permit Number	Permit Title
257	SANITARY LANDFILL IN-SITU BIOREMEDIATION (Two Class V.A.–G experimental technology horizontal injection wells, SLH–1 and SLH–2)
258	A/M SOUTHERN SECTOR GROUNDWATER REMEDIATION (Twelve Class V.A.–I aquifer remediation vertical recirculation wells, SSR–001 through SSR–012)
258M	MODIFICATION TO A-AREA/M-AREA SOUTHERN SECTOR GROUNDWATER REMEDIATION: GROUNDWATER MIGRATION TESTING AT RECIRCULATION WELL SSR–012 (One Class V.A.–I aquifer remediation well)
267	GEOCLEANSE PROCESS DEMONSTRATION NEAR THE M-AREA SEEPAGE BASIN (Four Class V.A.–I aquifer remediation wells, MOX–1 through MOX–4, to remove pure-phase DNAPL)
273	TRACER TEST AT THE 321–M SOLVENT STORAGE TANK AREA CHARACTERIZATION (Ten Class V.A.–G experimental technology injection wells, MVC–7, MVC–8, AND CPT–321–1 through CPT–321–8)
282	GROUNDWATER MIGRATION TESTING AT MONITORING WELL MSB–74B (One Class V.A.–I aquifer remediation well; part of A-Area/M-Area southern-sector groundwater remediation)

Underground Storage Tank Permits

Permit Number	Permit Title
N–02–GF–09465	N-AREA 15,000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 728–N
N–02–GF–09465	N-AREA 15,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 728–N
N–02–GF–09466	N-AREA 15,000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 716–7N
N–02–GF–09466	N-AREA 15,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 716–7N
N–02–GF–09468	RAILROAD YARD 10,000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–1G
N–02–GF–09469	S-AREA 15,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK #1, 200–S
N–02–GF–09469	S-AREA 15,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK #2, 200–S
N–02–GF–09473	H-AREA 13,300-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 619–H
N–02–GF–09473	H-AREA 20,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 254–5H #1
N–02–GF–09473	H-AREA 20,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 254–5H #2
N–02–GF–09473	F-AREA 13,300-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 619–F

Underground Storage Tank Permits, continued

Permit Number	Permit Title
N–02–GF–09473	F-AREA 20,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 254–5F #1
N–02–GF–09473	F-AREA 20,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 254–5F #2
N–02–GF–09476	A-AREA 5,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 754–5A
N–02–GF–09476	A-AREA 5,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 703–A
N–02–GF–09479	B-AREA 10,000-GALLON UNDERGROUND AVIATION FUEL STORAGE TANK, 703–5B
P–02–GF–09467	FORESTRY AREA 2000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 620–G (A)
P–02–GF–09467	FORESTRY AREA 2000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 620–G (B)
P–02–GF–10838	H-AREA 10,000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–2G (A-Area, C-Area, K-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	L-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–L (A-Area, C-Area, H-Area, K-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	C-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–C (A-Area, H-Area, K-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	K-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–K (A-Area, C-Area, H-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	P-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–P (A-Area, C-Area, H-Area, K-Area, L-Area, and N-Area also covered under this permit)
P–02–GF–10838	A-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–AA (C-Area, H-Area, K-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	A-AREA 5000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 715–AB (C-Area, H-Area, K-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	A-AREA 5000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–AC (C-Area, H-Area, K-Area, L-Area, N-Area, and P-Area also covered under this permit)
P–02–GF–10838	N-AREA 10,000-GALLON UNDERGROUND GASOLINE STORAGE TANK, 715–N #1 (A-Area, C-Area, H-Area, K-Area, L-Area, and P-Area also covered under this permit)

Underground Storage Tank Permits, continued

Permit Number	Permit Title
P–02–GF–10838	N-AREA 10,000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 715–N #2 (A-Area, C-Area, H-Area, K-Area, L-Area, and P-Area also covered under this permit)
P–02–GF–12476	A-AREA 5000-GALLON UNDERGROUND DIESEL FUEL STORAGE TANK, 754–6A

Appendix E

Radionuclide and Chemical Nomenclature

Nomenclature and Half-Life for Radionuclides

Radionuclide	Symbol	Half-Life[a,b]
Americium-241	Am-241	432.7 y
Americium-243	Am-243	7.37E3 y
Antimony-125	Sb-125	2.758 y
Argon-41	Ar-41	1.82 h
Beryllium-7	Be-7	53.28 d
Californium-252	Cf-252	2.638 y
Carbon-14	C-14	5,730 y
Cerium-141	Ce-141	32.50 d
Cerium-144	Ce-144	284.6 d
Cesium-134	Cs-134	2.065 y
Cesium-137	Cs-137	30.17 y
Cobalt-58	Co-58	70.88 d
Cobalt-60	Co-60	5.271 y
Curium-242	Cm-242	162.8 d
Curium-244	Cm-244	18.1 y
Iodine-129	I-129	1.57E7 y
Iodine-131	I-131	8.04 d
Krypton-85	Kr-85	10.73 y
Krypton-88	Kr-88	2.84 h
Manganese-54	Mn-54	312.2 d
Niobium-95	Nb-95	34.97 d
Osmium-185	Os-185	93.6 d
Phosphorus-32	P-32	14.28 d
Polonium-210	Po-210	138.38 d
Plutonium-238	Pu-238	87.7 y
Plutonium-239	Pu-239	2.41E4 y
Potassium-40	K-40	1.28E9 y
Promethium-147	Pm-147	2.6234 y
Ruthenium-103	Ru-103	39.27 d
Ruthenium-106	Ru-106	1.020 y
Selenium-75	Se-75	119.78 d
Strontium-89	Sr-89	50.52 d
Strontium-90	Sr-90	29.1 y
Technetium-99	Tc-99	2.13E5 y
Tritium	H-3	12.3 y
Uranium-235	U-235	7.04E8 y
Uranium-238	U-238	4.47E9 y
Xenon-133	Xe-133	5.243 d
Xenon-135	Xe-135	9.10 h
Yttrium-90	Y-90	2.67 d
Zirconium-95	Zr-95	64.02 d

Nomenclature for Common Chemical Analyses

Analysis	Symbol
Biochemical Oxygen Demand	BOD
Chemical Oxygen Demand	COD
Dissolved Oxygen	DO
Particulate Matter <10 microns	PM_{10}
Polychlorinated Biphenyl	PCB
Perchloroethylene	PCE
Tetrachloroethylene	TCE
Total Dissolved Solids	TDS
Total Organic Carbon	TOC
Total Organic Halogens	TOH
Total Phosphates	TPO_4
Total Solids	TS
Total Suspended Solids	TSS
Volatile Organic Compound	VOC

a h = hour; d = day; y = year
b Reference: Chart of the Nuclides, 14th edition, revised to April 1988, General Electric Company

Nomenclature for Elements and Chemical Constituents

Constituent	Symbol	Constituent	Symbol
Aluminum	Al	Mercury	Hg
Ammonia	NH_3	Nickel	Ni
Antimony	Sb	Nitrogen	N
Arsenic	As	Nitrate	NO_3
Barium	Ba	Nitrite	NO_2
Beryllium	Be	Oxygen	O
Cadmium	Cd	Ozone	O_3
Calcium	Ca	Phosphorus	P
Calcium Carbonate	$CaCO_3$	Phosphate	PO_4
Carbon	C	Potassium	K
Chlorine	Cl	Radium	Ra
Chromium	Cr	Rhenium	Re
Cobalt	Co	Selenium	Se
Copper	Cu	Silver	Ag
Fluorine	F	Sodium	Na
Iron	Fe	Sulfate	SO_4
Lead	Pb	Sulfur Dioxide	SO_2
Lithium	Li	Thallium	Tl
Magnesium	Mg	Uranium	U
Manganese	Mn	Vanadium	V
		Zinc	Zn

Appendix F

Environmental Monitoring Reports

Reports of the routine environmental monitoring program at the Savannah River Site (SRS) have been prepared periodically since before construction of the site in 1951. The monitoring report numbering system and titles have been changed several times to reflect the evolving progress in the concepts of environmental monitoring. The amount of detailed information contained in the reports also varies from time to time and probably reflects the relative importance and emphasis given to topics by different authors.

Except for July–December 1953, reports were issued semiannually from 1951 to 1962, then annually beginning in 1963. Attempts to locate a report for July–December 1953 have been unsuccessful. The onsite report was discontinued in 1985, when the onsite and offsite reports were merged into a single publication.

Some of the monitoring reports originally contained secret information, primarily radioactive release values that could be related to production rates. The secret information in these reports was deleted in the mid-1970s, and a deleted version (DEL) of the report was issued.

Onsite Reports

Natural Radioactivity Content of the Savannah River Plant

DP27	Jun 1951–Jan 1953		

Works Technical Department Data Record, Health Physics Site Survey Data

DPSPU 54–11–12	Jan–Jul 1953	No report	Jul–Dec 1953

Radioactivity in the Environment of the Savannah River Plant

DP92	Jan–Jul 1954		

Semiannual Progress Report–Regional

DPSP 55–25–34	Jul–Dec 1954	DPSP 56–25–13	Jan–Jun 1955

Health Physics Regional Monitoring

DPSP 56–25–54 (DEL)	Jul–Dec 1955	DPSPU 60–11–9	Jul–Dec 1959
DPSP 56–25–4 (DEL)	Jan–Jun 1956	DPSP 60–25–26 (DEL)	Jan–Jun 1960
DPSP 57–25–15 (DEL)	Jul–Dec 1956	DPSP 61–25–4 (DEL)	Jul–Dec 1960
DPSP 57–25–43 (DEL)	Jan–Jun 1957	DPSP 62–25–2 (DEL)	Jan–Jun 1961
DPSP 58–25–17 (DEL)	Jul–Dec 1957	DPSP 62–25–9 (DEL)	Jul–Dec 1961
DPSP 58–25–38 (DEL)	Jan–Jun 1958	DPSP 63–25–3 (DEL)	Jan–Jun 1962
DPSPU 59–11–23	Jul–Dec 1958	DPSP 63–25–10 (DEL)	Jul–Dec 1962
DPSPU 59–11–30	Jan–Jun 1959		

Environmental Monitoring at the Savannah River Plant

DPSPU 64–11–12	Jan–Dec 1963	DPST 71–302	Jan–Dec 1970
DPST 65–302	Jan–Dec 1964	DPSPU 72–302	Jan–Dec 1971
DPST 66–302	Jan–Dec 1965	DPSPU 73–302	Jan–Dec 1972
DPST 67–302	Jan–Dec 1966	DPSPU 74–302	Jan–Dec 1973
DPST 68–302	Jan–Dec 1967	DPSPU 75–302	Jan–Dec 1974
DPST 69–302	Jan–Dec 1968	DPSPU 76–302	Jan–Dec 1975
DPST 70–302	Jan–Dec 1969	DPSPU 77–302	Jan–Dec 1976

Environmental Monitoring at the Savannah River Plant (cont.)

DPSPU 78–302	Jan–Dec 1977	DPSPU 82–302	Jan–Dec 1981
DPSPU 79–302	Jan–Dec 1978	DPSPU 83–302	Jan–Dec 1982
DPSPU 80–302	Jan–Dec 1979	DPSPU 84–302	Jan–Dec 1983
DPSPU 81–302	Jan–Dec 1980	DPSPU 85–302	Jan–Dec 1984

Offsite Reports

Results of the environmental monitoring program that affected the offsite environment have been reported to the public since 1959. These reports contained data from the site boundary and beyond. The offsite report was discontinued in 1985, when the on- and offsite reports were merged into a single publication. A listing of the offsite reports follows.

The Effect of the Savannah River Plant on Environmental Radioactivity

No document number	Jan–Mar 1960	DPST 65–30–2	Jan–Jun 1965
No document number	Apr–Jun 1960	DPST 66–30–1	Jul–Dec 1965
No document number	Jul–Sep 1960	DPST 66–30–2	Jan–Jun 1966
No document number	Oct–Dec 1960	DPST 67–30–1	Jul–Dec 1966
No document number	Jan–Mar 1961	DPST 67–30–2	Jan–Jun 1967
No document number	Apr–Jun 1961	DPST 68–30–1	Jul–Dec 1967
No document number	Jul–Sep 1961	DPST 68–30–2	Jan–Jun 1968
DPSPU 62–30–11	Oct–Dec 1961	DPST 69–30–1	Jul–Dec 1968
DPSPU 62–30–24	Jan–Jun 1962	DPST 69–30–2	Jan–Jun 1969
DPSPU 63–30–12	Jul–Dec 1962	DPST 70–30–1	Jul–Dec 1969
DPSPU 63–30–1	Jan–Jun 1963	DPST 70–30–2	Jan–Jun 1970
DPSPU 64–30–1	Jul–Dec 1963	DPST 71–30–1	Jul–Dec 1970
DPSPU 64–30–2	Jan–Jun 1964	DPST 71–30–16	Jan–Jun 1971
DPSPU 65–30–1	Jul–Dec 1964		

Environmental Monitoring in the Vicinity of the Savannah River Plant

DPSPU 72–30–1	Jan–Dec 1971	DPSPU 79–30–1	Jan–Dec 1978
DPSPU 73–30–1	Jan–Dec 1972	DPSPU 80–30–1	Jan–Dec 1979
DPSPU 74–30–1	Jan–Dec 1973	DPSPU 81–30–1	Jan–Dec 1980
DPSPU 75–30–1	Jan–Dec 1974	DPSPU 82–30–1	Jan–Dec 1981
DPSPU 76–30–1	Jan–Dec 1975	DPSPU 83–30–1	Jan–Dec 1982
DPSPU 77–30–1	Jan–Dec 1976	DPSPU 84–30–1	Jan–Dec 1983
DPSPU 78–30–1	Jan–Dec 1977		

Savannah River Plant Environmental Report

DPSPU 85–30–1	Jan–Dec 1984

Combined Onsite and Offsite Reports

In 1985, the onsite and offsite environmental monitoring reports were merged into a single publication. A listing of these reports follows.

Savannah River Site Environmental Report

DPSPU 86–30–1	Jan–Dec 1985	WSRC–TR–92–186	Jan–Dec 1991
DPSPU 87–30–1	Jan–Dec 1986	WSRC–TR–93–075	Jan–Dec 1992
DPSPU 88–30–1	Jan–Dec 1987	WSRC–TR–94–075	Jan–Dec 1993
WSRC–RP–89–59–1a	Jan–Dec 1988	WSRC–TR–95–075	Jan–Dec 1994
WSRC–IM–90–60	Jan–Dec 1989	WSRC–TR–96–0075	Jan–Dec 1995
WSRC–IM–91–28	Jan–Dec 1990	WSRC–TR–97–0171	Jan–Dec 1996

Savannah River Site Environmental Data

WSRC–TR–93–077	Jan–Dec 1992	WSRC–TR–96–0077	Jan–Dec 1995
WSRC–TR–94–077	Jan–Dec 1993	WSRC–TR–97–0077	Jan–Dec 1996
WSRC–TR–95–077	Jan–Dec 1994		

Appendix G

Errata from 1996 Report

The following information was reported incorrectly in the Savannah River Site Environmental Report for 1996 *(WSRC–TR–97–0171)*:

Page xxv, right column, first paragraph, second line: The reference to 55,700 curies (2.1E+15 Bq) should have been to 55,300 curies (2.0E+15 Bq).

Page 44, right column, first full paragraph: The reference to ICRP Publication 42 should have been to ICRP Publication 43.

Page 57, left column, fourth full paragraph, first sentence: The reference to 70 additional waste storage tanks should have been to 85 additional waste storage tanks.

Page 62, right column, second line from top: The date noted for placing the E.P. 927 sampler back into service should have been May 28.

Page 72, table 5–1, "Total" column: The U-235 total should have been 8.88E–05.

Page 92, left column, third full paragraph, last sentence: The number of locations in 1997 should have been six.

Page 123, table 8–3 heading: The parenthetical reference to D-Area should have been to H-Area.

Page 123, left column, second full paragraph, next-to-last sentence: The reference to fuel oil consumption should have been "for the diesel engines operated in 1995."

Page 130, right column, fourth full paragraph, first sentence: The number of drinking water systems should have been 27.

Page 170, figure 11–1, second bulleted item: The name and number of the document listed should have been "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," ANSI/ASQC E–4–1994.

Page 173, right column, last sentence: The sentence should have read "For the third quarter, the results from Shealy for aluminum and copper were significantly less than the results from Weston."

Errata from 1995 Report

The following information was reported incorrectly in the Savannah River Site Environmental Report for 1995 *(WSRC–TR–96–0075)*:

Page 38, right column, first full paragraph: The reference to ICRP Publication 42 should have been to ICRP Publication 43.

Glossary

A

accuracy – Closeness of the result of a measurement to the true value of the quantity.

activity – See radioactivity.

air flow – Rate of flow, measured by mass or volume per unit of time.

air stripping – Process used to decontaminate groundwater by pumping the water to the surface,"stripping" or evaporating the chemicals in a specially-designed tower, and pumping the cleansed water back to the environment.

alkalinity – Alkalinity is a measure of the buffering capacity of water, and since pH has a direct effect on organisms as well as an indirect effect on the toxicity of certain other pollutants in the water, the buffering capacity is important to water quality.

alpha particle – Positively charged particle emitted from the nucleus of an atom having the same charge and mass as that of a helium nucleus (two protons and two neutrons).

ambient air – Surrounding atmosphere as it exists around people, plants, and structures.

analyte – Constituent or parameter that is being analyzed.

analytical detection limit – Lowest reasonably accurate concentration of an analyte that can be detected; this value varies depending on the method, instrument, and dilution used.

anion – Negatively charged ion.

anomaly – Deviation beyond normal variations.

aquifer – Saturated, permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients.

Atomic Energy Commission – Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian application. It was abolished by the Energy Reorganization Act of 1974 and succeeded by the Energy Research and Development Administration (now part of the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission).

B

bailer – Container lowered into a well to remove water. The bailer is allowed to fill with water and then is removed from the well.

best available technology – Technology that is the best available at the time to treat waste. See best available demonstrated technology.

best management practices – Sound engineering practices that are not, however, required by regulation or by law.

beta particle – Negatively charged particle emitted from the nucleus of an atom. It has a mass and charge equal to those of an electron.

blank – Control sample that is identical, in principle, to the sample of interest, except that the substance being analyzed is absent. In such cases, the measured value or signal for the substance being analyzed is believed to be due to artifacts. Under certain circumstances, that value may be subtracted from the measured value to give a net result reflecting the amount of the substance in the sample. The Environmental Protection Agency does not permit the subtraction of blank results in Environmental Protection Agency-regulated analyses.

blind blank – Sample container of deionized water sent to a laboratory under an alias name as a quality control check.

blind replicate – In the Environmental Monitoring Section groundwater monitoring program, a second sample taken from the same well at the same time as the primary sample, assigned an alias well name, and sent to a laboratory for analysis (as an unknown to the analyst).

blind sample – Control sample of known concentration in which the expected values of the constituent are unknown to the analyst.

borrow pit – Excavation dug to provide material such as sand and gravel (borrow) to be used as fill elsewhere.

C

calibration – Determination of variance from a standard of accuracy of a measuring instrument to ascertain necessary correction factors.

Carolina bay – Type of shallow depression commonly found on the coastal Carolina plains. Carolina bays are typically circular or oval. Some are wet or marshy, while others are dry.

cation – Positively charged ion.

Central Savannah River Area (CSRA) – Eighteen-county area in Georgia and South Carolina surrounding Augusta, Georgia. The Savannah River Site is included in the Central Savannah River Area. Counties are Richmond, Columbia, McDuffie, Burke, Emanuel, Glascock, Jenkins, Jefferson, Lincoln, Screven, Taliaferro, Warren, and Wilkes in Georgia and Aiken, Edgefield, Allendale, Barnwell, and McCormick in South Carolina.

chain-of-custody – Form that documents sample collection, transport, analysis, and disposal.

chemical oxygen demand – Indicates the quantity of oxidizable materials present in a water and varies with water composition, concentrations of reagent, temperature, period of contact, and other factors.

chlorocarbons – Compounds of carbon and chlorine, or carbon, hydrogen, and chlorine, such as carbon tetrachloride, chloroform, tetrachloroethylene, etc. They are among the most significant and widespread environmental contaminants. Classified as hazardous wastes, chlorocarbons may have a tendency to cause detrimental effects, such as birth defects.

cleanup – Actions taken to deal with release or potential release of hazardous substances. This may mean complete removal of the substance; it also may mean stabilizing, containing, or otherwise treating the substance so that it does not affect human health or the environment.

closure – Control of a hazardous waste management facility under Resource Conservation and Recovery Act requirements.

compliance – Fulfillment of applicable requirements of a plan or schedule ordered or approved by government authority.

composite – Blending of more than one portion to make a sample for analysis.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – This act addresses the cleanup of hazardous substances and establishes a National Priorities List of sites targeted for assessment and, if necessary, restoration (commonly known as "Superfund").

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-reportable release – Release to the environment that exceeds reportable quantities as defined by the Comprehensive Environmental Response, Compensation, and Liability Act.

concentration – Amount of a substance contained in a unit volume or mass of a sample.

conductivity – Measure of water's capacity to convey an electric current. This property is related to the total concentration of the ionized substances in a water and the temperature at which the measurement is made.

contamination – Deposition of unwanted material on the surfaces of structures, areas, objects, or personnel.

cosmic radiation – Ionizing radiation with very high energies, originating outside the earth's atmosphere. Cosmic radiation is one source contributing to natural background radiation.

count – Signal that announces an ionization event within a counter; a measure of the radiation from an object or device.

criteria pollutant – any of the pollutants commonly used as indices for air quality that can have a serious effect on human health and the environment, including sulfur dioxide, nitrogen dioxide, total suspended particulates, PM_{10}, carbon monoxide, ozone, gaseous fluorides, and lead.

curie – Unit of radioactivity. One curie is defined as 3.7 x 10^{10} (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

kilocurie (kCi) – 10^3 Ci, one thousand curies; 3.7 x 10^{13} disintegrations per second.

millicurie (mCi) – 10^{-3} Ci, one-thousandth of a curie; 3.7 x 10^7 disintegrations per second.

microcurie (μCi) – 10^{-6} Ci, one-millionth of a curie; 3.7 x 10^4 disintegrations per second.

picocurie (pCi) – 10^{-12} Ci, one-trillionth of a curie; 0.037 disintegrations per second.

D

decay (radioactive) – Spontaneous transformation of one radionuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same radionuclide.

decay time – Time taken by a quantity to decay to a stated fraction of its initial value.

deactivation and decommissioning – Program that reduces the environmental and safety risks of surplus facilities at SRS.

derived concentration guide – Concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (i.e., ingestion of water, submersion in air or inhalation), would result in either an effective dose equivalent of 0.1 rem (1 mSv) or a dose equivalent of 5 rem (50 mSv) to any tissue, including skin and lens of the eye. The guides for radionuclides in air and water are given in Department of Energy Order 5400.5.

detection limit – See analytical detection limit, lower limit of detection, minimum detectable concentration.

detector – Material or device (instrument) that is sensitive to radiation and can produce a signal suitable for measurement or analysis.

diatometer – Diatom collection equipment consisting of a series of microscope slides in a holder that is used to determine the amount of algae in a water system.

diatoms – Unicellular or colonial algae of the class Bacillariophyceae, having siliceous cell walls with two overlapping, symmetrical parts. Diatoms represent the predominant periphyton (attached algae) in most water bodies and have been shown to be reliable indicators of water quality.

disintegration (nuclear) – Spontaneous nuclear transformation (radioactivity) characterized by the emission of energy and/or mass from the nucleus of an atom.

dissolved oxygen – Desirable indicator of satisfactory water quality in terms of low residuals of biologically available organic materials. Dissolved oxygen prevents the chemical reduction and subsequent leaching of iron and manganese from sediments.

dose – Energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram in any medium.

absorbed dose – Quantity of radiation energy absorbed by an organ, divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (1 rad=0.01Gy).

dose equivalent – Product of the absorbed dose (rad) in tissue and a quality factor. Dose equivalent is expressed in units of rem (or sievert) (1 rem=0.01 sievert).

committed dose equivalent – Calculated total dose equivalent to a tissue or organ over a 50-year period after known intake of a radionuclide into the body. Contributions from external dose are not included. Committed dose equivalent is expressed in units of rem (or sievert).

committed effective dose equivalent – Sum of the committed dose equivalents to various tissues in the body, each multiplied by the appropriate weighting factor. Committed effective dose equivalent is expressed in units of rem (or sievert).

effective dose equivalent – Sum of the dose equivalents received by all organs or tissues of the body after each one has been multiplied by an appropriate weighting factor. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent attributable to sources external to the body.

collective dose equivalent/collective effective dose equivalent – Sums of the dose equivalents or effective dose equivalents of all individuals in an exposed population within a 50-mile (80-km) radius, and expressed in units of person-rem (or person-sievert). When the collective dose equivalent of interest is for a specific organ, the units would be organ-rem (or organ-sievert). The 50-mile distance is measured from a point located centrally with respect to major facilities or DOE program activities.

dosimeter – Portable detection device for measuring the total accumulated exposure to ionizing radiation.

downgradient – In the direction of decreasing hydrostatic head.

drinking water standards – Federal primary drinking water standards, both proposed and final, as set forth by EPA.

duplicate result – Result derived by taking a portion of a primary sample and performing the identical analysis on that portion as is performed on the primary sample.

E

effluent – Liquid or gaseous waste discharge to the environment.

effluent monitoring – Collection and analysis of samples or measurements of liquid and gaseous effluents for purposes of characterizing and quantifying the release of contaminants, assessing radiation exposures of members of the public, and demonstrating compliance with applicable standards.

environmental monitoring – Program at Savannah River Site that includes effluent monitoring and environmental surveillance with dual purpose of (1) showing compliance with federal, state, and local regulations, as well as with U.S. Department of Energy orders, and (2) monitoring any effects of site operations on onsite and offsite natural resources and on human health.

environmental restoration – Department of Energy program that directs the assessment and cleanup of inactive waste units and groundwater (remediation) contaminated as a result of nuclear-related activities.

environmental surveillance – Collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media from Department of Energy sites and their environs and the measurement of external radiation for purposes of demonstrating compliance with applicable standards, assessing radiation exposures to members of the public, and assessing effects, if any, on the local environment.

exceedance – Term used by the Environmental Protection Agency and the South Carolina Department of Health and Environmental Control that denotes a report value is more than the upper guide limit. This term is found on the Discharge Monitoring Report forms that are submitted to the Environmental Protection Agency or the South Carolina Department of Health and Environmental Control.

exposure (radiation) – Incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is that exposure to ionizing radiation which takes place during a person's working hours. Population exposure is the exposure to the total number of persons who inhabit an area.

exposure pathway – Route that materials follow to get to the environment and then to people.

external radiation – Exposure to ionizing radiation when the radiation source is located outside the body.

F

fallout – See worldwide fallout.

fecal coliform – Coliform group comprises all of the aerobic, nonspore-forming, rod-shaped bacteria. The test determines the presence or absence of coliform organisms.

Federal Facility Agreement (FFA) – Agreement negotiated among the Department of Energy, the Environmental Protection Agency, and the South Carolina Department of Health and Environmental Control, specifying how the Savannah River Site will address contamination or potential contamination to meet regulatory requirements at the Savannah River Site waste units identified for evaluation and, if necessary, cleanup.

feral hog – Hog that has reverted to the wild state from domestication.

field blank – Sample container of deionized water generated by filling the sample container at the sample location and treated as a groundwater sample.

G

gamma ray – High-energy, short wavelength electromagnetic radiation emitted from the nucleus of an excited atom. Gamma rays are identical to X-rays except for the source of the emission.

gamma-emitting radionuclide – Radionuclide that emits gamma rays.

gamma spectrometry – System consisting of a detector, associated electronics, and a multichannel analyzer that is used to analyze samples for gamma-emitting radionuclides.

grab sample – Sample collected instantaneously with a glass or plastic bottle placed below the water surface to collect surface water samples (also called dip samples).

H

half-life (radiological) – Time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life.

heavy water – Water in which the molecules contain oxygen and deuterium, an isotope of hydrogen that is heavier than ordinary hydrogen.

hydraulic gradient – Difference in hydraulic head over a specified distance.

hydraulic head – Elevation of the water in a well or piezometer.

hydrology – Science that treats the occurrence, circulation, distribution, and properties of the waters of the earth, and their reaction with the environment.

I

in situ – In its original place. Field measurements taken without removing the sample from its origin; remediation performed while groundwater remains below the surface.

inorganic – Involving matter other than plant or animal.

internal radiation – Internal radiation occurs when natural radionuclides enter the body by ingestion of foods, milk, and water, and by inhalation. Radon is the major contributor to the annual dose equivalent for internal radionuclides.

ion – Atom or compound that carries an electrical charge.

ion exchange – Process in which a solution containing soluble ions is passed over a solid ion exchange column that removes the soluble ions by exchanging them with labile ions from the surface of the column. The process is reversible so that the trapped ions are removed (eluted) from the column and the column is regenerated.

irradiation – Exposure to radiation.

isotopes – Forms of an element having the same number of protons in their nuclei but differing in the number of neutrons.

long-lived isotope – Radionuclide that decays at such a slow rate that a quantity of it will exist for an extended period (half-life is greater than three years).

short-lived isotope – Radionuclide that decays so rapidly that a given quantity is transformed almost completely into decay products within a short period (half-life is two days or less).

L

laboratory blank – Deionized water sample generated by the laboratory; a laboratory blank is analyzed with each batch of samples as an in-house check of analytical procedures. Also called an internal blank.

lower limit of detection – Smallest concentration/amount of analyte that can be reliably detected in a sample at a 95 percent confidence level.

M

macroinvertebrates – Size-based classification used for a variety of insects and other small invertebrates; as defined by the Environmental Protection Agency, those organisms that are retained by a No. 30 (590 micron) U.S. Standard Sieve.

macrophyte – A plant that can be observed with the naked eye.

manmade radiation – Radiation sources such as consumer products, medical procedures, and nuclear industry.

maximally exposed individual – Hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

mean relative difference – Percentage error based on statistical analysis.

mercury – Silver-white, liquid metal solidifying at –38.9 °C to form a tin-white, ductile, malleable mass. It is widely distributed in the environment and biologically is a nonessential or nonbeneficial element. Human poisoning due to this highly toxic element has been clinically recognized.

migration – Transfer or movement of a material through the air, soil, or groundwater.

minimum detectable concentration – Smallest amount or concentration of a radionuclide that can be distinguished in a sample by a given measurement system at a preselected counting time and at a given confidence level.

monitoring – Process whereby the quantity and quality of factors that can affect the environment and/or human health are measured periodically in order to regulate and control potential impacts.

N

natural radiation – Radiation arising from cosmic and other naturally occurring radionuclide (such as radon) sources present in the environment.

nonpoint source – any source that does not meet the definition for point source (National Emission Standards for Hazardous Air Pollutants radionuclide program).

nonroutine radioactive release – Unplanned or nonscheduled release of radioactivity to the environment.

nuclide – Atom specified by its atomic weight, atomic number, and energy state. A radionuclide is a radioactive nuclide.

O

organic – Of, relating to, or derived from living organisms (plant or animal).

outcrop – Place where groundwater is discharged to the surface. Springs, swamps, and beds of streams and rivers are the outcrops of the water table.

outfall – Point of discharge (e.g., drain or pipe) of wastewater or other effluents into a ditch, pond, or river.

P

parameter – Analytical constituent; chemical compound(s) or property for which an analytical request may be submitted.

permeability – Physical property that describes the ease with which water may move through the pore spaces and cracks in a solid.

person-rem – Collective dose to a population group. For example, a dose of one rem to 10 individuals results in a collective dose of 10 person-rem.

pH – Measure of the hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0–6, basic solutions have a pH > 7, and neutral solutions have a pH = 7.

piezometer – Instrument used to measure the potentiometric surface of the groundwater. Also, a well designed for this purpose.

plume – Volume of contaminated air or water originating at a point-source emission (e.g., a smokestack) or a waste source (e.g., a hazardous waste disposal site).

point source – stack or vent (National Emission Standards for Hazardous Air Pollutants radionuclide program).

population dose – See collective dose equivalent under dose.

process sewer – Pipe or drain, generally located underground, used to carry off process water and/or waste matter.

process water – Water used within a system process.

purge – To remove water prior to sampling, generally by pumping or bailing.

Q

quality assurance (QA) – In the Environmental Monitoring System program, QA consists of the system whereby the laboratory can assure clients and other outside entities, such as government agencies and accrediting bodies, that the laboratory is generating data of proven and known quality.

quality control (QC) – In the Environmental Monitoring System program, QC refers to those operations undertaken in the laboratory to ensure that the data produced are generated within known probability limits of accuracy and precision.

R

rad – Unit of absorbed dose deposited in a volume of material.

radioactivity – Spontaneous emission of radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope.

radioisotopes – Radioactive isotopes.

radionuclide – Unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

real-time instrumentation – Operation in which programmed responses to an event are essentially simultaneous with the event itself.

reforestation – Process of planting new trees on land once forested.

release – Any discharge to the environment. Environment is broadly defined as any water, land, or ambient air.

rem – Unit of dose equivalent (absorbed dose in rads × the radiation quality factor). Dose equivalent is frequently reported in units of millirem (mrem) which is one-thousandth of a rem.

remediation – Assessment and cleanup of Department of Energy sites contaminated with waste as a result of past activities. See environmental restoration.

replicate – In the Environmental Monitoring Section groundwater monitoring program, a second sample from the same well taken at the same time as the primary sample and sent to the same laboratory for analysis.

Resource Conservation and Recovery Act (RCRA) – Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes. This act also requires corrective action for releases of hazardous waste at inactive waste units.

Resource Conservation and Recovery Act (RCRA) site – Solid waste management unit under Resource Conservation and Recovery Act regulation. See Resource Conservation and Recovery Act.

retention basin – Unlined basin used for emergency, temporary storage of potentially contaminated cooling water from chemical separations activities.

RFI Program – RCRA Facility Investigation Program; Environmental Protection Agency-regulated investigation of a solid waste management unit with regard to its potential impact on the environment.

RFI/RI Program – RCRA Facility Investigation/Remedial Investigation Program. At the Savannah River Site, the expansion of the RFI Program to include Comprehensive Environmental Response, Compensation, and Liability Act and hazardous substance regulations.

roentgen – Unit of exposure from X- or gamma rays. One roentgen equals 2.58×10^{-4} coulombs per kilogram of air.

routine radioactive release – Planned or scheduled release of radioactivity to the environment.

S

seep – Area, generally small, where water moves slowly to the land surface.

seepage basin – Excavation that receives wastewater. Insoluble materials settle out on the floor of the basin and soluble materials seep with the water through the soil column where they are removed partially by ion exchange with the soil. Construction may include dikes to prevent overflow or surface runoff.

sensitivity – Capability of methodology or instruments to discriminate between samples with differing concentrations or containing varying amounts of analyte.

settling basin – Temporary holding basin (excavation) that receives wastewater which is subsequently discharged.

Sievert (Sv) – SI (International System of Units) unit of dose equivalent, 1 Sv=100 rem.

site stream – Any natural stream on the Savannah River Site. Surface drainage of the site is via these streams to the Savannah River.

source – Point or object from which radiation or contamination emanates.

source check – Radioactive source with a known amount of radioactivity used to check the performance of the radiation detector instrument.

source term – Quantity of radioactivity released in a set period of time that is traceable to the starting point of an effluent stream or migration pathway.

spent nuclear fuel – used fuel elements from reactors.

spike – Addition of a known amount of reference material containing the analyte of interest to a blank sample.

split sample – Two samples taken at the same time and sent to two different laboratories for analysis.

stable – Not radioactive or not easily decomposed or otherwise modified chemically.

stack – Vertical pipe or flue designed to exhaust airborne gases and suspended particulate matter.

standard deviation – Indication of the dispersion of a set of results around their average.

stormwater runoff – Surface streams that appear after precipitation.

Superfund – see Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

supernate – Portion of a liquid above settled materials in a tank or other vessel.

surface water – All water on the surface of the earth, as distinguished from groundwater.

T

tank farm – Installation of interconnected underground tanks for storage of high-level radioactive liquid wastes.

temperature – Thermal state of a body considered with its ability to communicate heat to other bodies.

terrestrial radiation – Ionizing radiation emitted from radioactive materials, primarily potassium-40, thorium, and uranium, in the earth's soils. Terrestrial radiation contributes to natural background radiation.

thermoluminescent dosimeter (TLD) – Device used to measure external gamma radiation.

total dissolved solids – Dissolved solids and total dissolved solids are terms generally associated with freshwater systems and consist of inorganic salts, small amounts of organic matter and dissolved materials.

total phosphorus – When concentrations exceed 25 mg/L at the time of the spring turnover on a volume-weighted basis in lakes or reservoirs, it may occasionally stimulate excessive or nuisance growths of algae and other aquatic plants.

total suspended particulates – Refers to the concentration of particulates in suspension in the air irrespective of the nature, source, or size of the particulates.

transport pathway – pathway by which a released contaminant physically is transported from its point of discharge to a point of potential exposure to humans. Typical transport pathways include the atmosphere, surface water, and groundwater.

transuranic waste – Solid radioactive waste containing primarily alpha-emitting elements heavier than uranium.

turbidity – Measure of the concentration of sediment or suspended particles in solution.

V

vitrification – Process of changing into glass.

volatile organic compounds – Broad range of organic compounds, commonly halogenated, that vaporize at ambient, or relatively low, temperatures (e.g., acetone, benzene, chloroform, and methyl alcohol).

W

waste management – The Department of Energy uses this term to refer to the safe, effective management of various kinds of nonhazardous, hazardous, and radioactive waste generated on site.

waste unit – Inactive area that is known to have received contamination or had a release to the environment.

water table – Planar, underground surface beneath which earth materials, as soil or rock, are saturated with water.

weighting factor – Value used to calculate dose equivalents. It is tissue specific and represents the fraction of the total health risk resulting from uniform, whole-body irradiation that could be contributed to that particular tissue. The weighting factors used in this report are recommended by the International Commission on Radiological Protection (Publication 26).

wetlands – Lowland area, such as a marsh or swamp, inundated or saturated by surface or groundwater sufficiently to support hydrophytic vegetation typically adapted for life in saturated soils.

wind rose – Diagram in which statistical information concerning direction and speed of the wind at a location is summarized.

worldwide fallout – Radioactive debris from atmospheric weapons tests that has been deposited on the earth's surface after being airborne and cycling around the earth.

References

Bebbington, 1990 Bebbington, W.P., 1990, *History of Du Pont at the Savannah River Site*, E.I. du Pont de Nemours and Company, Wilmington, Del.

BEIR V, 1990 National Research Council, 1990, *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V Report, Washington, D.C., 1982.

Blohm, 1995 Blohm, J.D., 1995, *Pen Branch Stream Corridor and Delta Wetlands Change Assessment, Savannah River Site*, EGG–11265–1013, Savannah River Site, Aiken, S.C. (available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal, Springfield, Va. 22161)

Bowers, 1997 Bowers, C.F., 1997, *Reptile and Amphibian Characterization of Pen Branch at the Beginning of Restoration*, M.S. Thesis, Department of Forest Resources, Clemson University, Clemson, S.C.

Buffington et al., 1997 Buffington, J.M., J.C. Kilgo, R.A. Sargent, K.V. Miller, and B.R. Chapman, 1997, "A Comparison of Bird Communities in Bottomland Hardwood Forests of Different Successional Stages," *The Wilson Bulletin*, Allen Press, Lawrence, Kan.

CAB, 1994–1995 Savannah River Site Citizens Advisory Board, *Annual Report 1994–1995*, Savannah River Site, Aiken, S.C.

Carlton et al., 1994 Carlton, W.H., C.E. Murphy, Jr., and A.G. Evans, 1994, "Radiocesium in the Savannah River Site Environment," *Health Physics*, Volume 67, Number 3, Williams & Wilkins, Baltimore, Md.

Chen, 1996 Chen, Juo-Fu, 1996, *Critical Contaminant/Critical Pathway Analysis - Surface Water Transport for Nonradioactive Contaminants (U)*, WSRC–RP–96–555, Savannah River Site, Aiken, S.C.

Cook, 1997 Cook, et al., 1997, "Composite Analysis – E-Area Vaults and Saltstone Disposal Facilities," WSRC–RP–97–311, Rev. 0, Savannah River Site, Aiken, S.C.

Davis et al., 1989 Davis, H.A., D.K. Martin, and J.L. Todd, 1989, *Savannah River Site Environmental Report for 1988*, WSRC–RP–89–59–1, Savannah River Site, Aiken, S.C.

DOE, 1988 U.S. Department of Energy, 1988, *External and Internal Dose Conversion Factors for Calculation of Dose to the Public*, DOE/EH–0070&71, U.S. Department of Energy, Washington, D.C.

DOE, 1990 U.S. Department of Energy, 1990, *Final Environmental Impact Statement, Continued Operation of K-, L-, and P-Reactors, Savannah River Site, Aiken, South Carolina*, DOE/EIS–0147.

DOE, 1991 U.S. Department of Energy, 1991, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH–0173T, National Technical Information Service, Springfield, Va.

DOE, 1992 U.S. Department of Energy, 1992, *Mitigation Action Plan, 1992 Annual Update, Continued Operation of K-, L-, and P-Reactors, Environmental Impact Statement, DOE/EIS–0147.*

DOE, 1996 U.S. Department of Energy, 1996, *Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, Record of Decision, Washington, D.C.

DOE, 1996b U.S. Department of Energy, 1996, *Industrial Wastewater Closure Plan for F- and H-Area High-Level Waste Tank Systems*, Rev. 1, Savannah River Site, Aiken, S.C.

DOE EM, 1991 U.S. Department of Energy Office of Environmental Restoration and Waste Management, 1991, *Environmental Restoration and Waste Management (EM) Program An Introduction*, DOE/EM–0013P, U.S. Department of Energy, Washington, D.C.

Dulohery, 1996 Dulohery, N.J., C.S. Bunton, C.C. Trettin, and W.H. McKee, Jr., 1996, *Reforestation of the Pen Branch Corridor and Delta*, WSRC–TR–96–0005, U.S. Department of Agriculture Forest Service, Establishment Report, Center for Forested Wetlands Research, Charleston, S.C.

EPA, 1989 U.S. Environmental Protection Agency, 1989, "National Emission Standards for Hazardous Air Pollutants; Radionuclides," *Title 40 Code of Federal Regulations, Part 61, Volume 54, No. 240*, Washington, D.C.

EPA, 1991 U.S. Environmental Protection Agency, 1991, *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* Supplemental Guidance *"Standard Default Exposure Factors,"* OSWER Directive: 9285.6–03, Washington, D.C.

EPA, 1995 U.S. Environmental Protection Agency, 1995, *Health Effects Assessment Summary Tables FY 1995, 11/95 Supplement*, Publication 9200.6–303 (95–1), Washington, D.C.

Fact Sheet, 1995 Westinghouse Savannah River Company, 1992, "Environmental Restoration," *Fact Sheet*, WSRC–MS–96–0623, Savannah River Site, Aiken, S.C.

Fact Sheet, 1996a Westinghouse Savannah River Company, 1996, "Savannah River Site," *Fact Sheet*, WSRC–MS–96–0620, Rev 1, Savannah River Site, Aiken, S.C.

Fact Sheet, 1996b Westinghouse Savannah River Company, 1996, "Savannah River Ecology Laboratory," *Fact Sheet*, WSRC–MS–97–0231, Savannah River Site, Aiken, S.C.

Fact Sheet, 1996c Westinghouse Savannah River Company, 1996, "High-Level Waste Processing Facilities," *Fact Sheet*, WSRC–MS–96–0619, Rev 1, Savannah River Site, Aiken, S.C.

Fact Sheet, 1996d Westinghouse Savannah River Company, 1996, "H Canyon," *Fact Sheet*, WSRC–MS–97–0228, Savannah River Site, Aiken, S.C.

Flach, 1996 Flach, G.P., et al, 1996, "Groundwater Flow and Tritium Migration from the SRS Old Burial Ground to Fourmile Branch (U)," Savannah River Site, Aiken, S.C.

Fledderman, 1995 Fledderman, P.D., 1995, Interview with William G. Weil, Water Operations Superintendent - City of Savannah Industrial and Domestic Water Supply, January 9, 1995, Savannah, Ga.

Hamby, 1991 Hamby, D.M., 1991, *Land and Water Use Characteristics in the Vicinity of the Savannah River Site (U)*, WSRC–RP–91–17, Savannah River Site, Aiken, S.C.

Hamby, 1993 Hamby, D.M., 1993, "A Probabilistic Estimation of Atmospheric Tritium Dose," *Health Physics*, Volume 65, Number 1, Williams & Wilkins, Baltimore, Md.

Hamby and Bauer, 1994 Hamby, D.M., and L.R. Bauer, 1994, "The Vegetation-to-air Concentration Ratio in a Specific Activity Atmospheric Tritium Model," *Health Physics*, Volume 66, Number 3, Williams & Wilkins, Baltimore, Md.

Hunter, 1990 Hunter, C.H., 1990, *A Climatological Description of the Savannah River Site*, WSRC–RP–89–313, Savannah River Site, Aiken, S.C.

ICRP, 1990 International Commission on Radiation Protection, 1990, Recommendations of the ICRP, Publication 60, Elmsford, N.Y.

Jannik, 1997 Jannik, 1997, *"Assessment of SRS Radiological Liquid and Airborne Contaminants and Pathways (U)"*, WSRC–TR–97–0152, Savannah River Site, Aiken, S.C.

Klaassen et al., 1986 Klaassen, C.D., M.D. Amdur, and J. Doull (editors), 1986, *Casarett and Doull's Toxicology, The Basic Science of Poisons*, third edition, MacMillan Pharmacology 33:120–126, New York, N.Y.

Looney, 1993 Looney, B.B., et al, 1993, *Projected Tritium Releases from F & H Area Seepage Basins and the Solid Waste Disposal Facilities to Fourmile Branch (U)*, WSRC–RP–93–459, Savannah River Site, Aiken, S.C.

NCRP, 1987 National Council on Radiation Protection and Measurements, 1987, *Ionizing Radiation Exposure of the Population of the United States*, NCRP Report No. 93, Bethesda, Md.

Nelson, 1996 Nelson, E.A., ed., 1996, *The Restoration of Pen Branch: Defining and Measuring the Progress of a Thermally Impacted Stream Becoming a Functional Wetland Ecosystem*, WSRC–MS–96–0257X, Savannah River Site, Aiken, S.C.

NRC, 1977 U.S. Nuclear Regulatory Commission, 1977, *Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50*, Appendix I, Revision 1, Washington, D.C.

SCDHEC, 1985 South Carolina Department of Health and Environmental Control, 1985, Savannah River Plant, Aiken, Allendale, and Barnwell Counties, NPDES Permit 0000175, Columbia, S.C.

SCDHEC, 1993 South Carolina Department of Health and Environmental Control, 1993, *South Carolina State Primary Drinking Water Regulations R.61–68*, "Water Classifications and Standards," Columbia, S.C.

Soldat et al., 1974 Soldat, J.K., N.M. Robinson, and D.A. Baker, 1974, *Models and Computer Codes for Evaluating Environmental Radiation Doses*, BNWL–1754, Battelle Pacific Northwest Laboratories.

SRFS, 1982 Savannah River Forest Station, 1982, "Thirty Years of Progress," *Savannah River Forest Station Savannah River Plant Newspaper*, January 1982, Savannah River Forest Station, Department of Agriculture, Aiken, S.C.

SRS Data, 1997 Environmental Protection Department Environmental Monitoring Section, 1997, *Savannah River Site Environmental Data for 1997*, WSRC–TR–97–00324, Savannah River Site, Aiken, S.C.

SRS EM Program, 1995 *Savannah River Site Environmental Monitoring Section Plans and Procedures*, WSRC–3Q1–2, Volume 1, Section 1100, Savannah River Site, Aiken, S.C.

Stewart, 1997 Stewart, J., *"Health Effects of SRS Non-Radiological Air Emissions, 1997,"* Savannah River Site, Aiken, S.C.

SWD, 1997 *Pollution Prevention—Everybody's Business*, 1997, Solid Waste Division, Westinghouse Savannah River Company, Dunaway & Fletcher, North Augusta, S.C.

WHO, 1990 World Health Organization, 1990, *Environmental Health Criteria 101: Methylmercury*, Geneva, Switzerland.

WSRC, 1996 Westinghouse Savannah River Company, 1996, *Comprehensive Review of Environmental Monitoring Programs at Savannah River Site (U)*, WSRC-RP-96-308, Savannah River Site, Aiken, S.C.

WSRC, 1997 Westinghouse Savannah River Company, 1997, *Removal Site Evaluation Report for the Ford Building Seepage Basin (904–91G) (U)*, WSRC–RP–97–129, Savannah River Site, Aiken, S.C.

Index

A

B

C

D

T

U

V

W

Z

Units of Measure	
Symbol	**Name**
Temperature	
°C	degrees Centigrade
°F	degrees Fahrenheit
Time	
d	day
h	hour
y	year
Length	
cm	centimeter
ft	foot
in.	inch
km	kilometer
m	meter
mm	millimeter
µm	micrometer
Mass	
g	gram
kg	kilogram
mg	milligram
µg	microgram
Area	
mi^2	square mile
ft^2	square foot
Volume	
gal	gallon
L	liter
mL	milliliter

Units of Measure	
Symbol	**Name**
Concentration	
ppb	parts per billion
ppm	parts per million
Rate	
cfs	cubic feet per second
gpm	gallons per minute
Conductivity	
µmho	micromho
Radioactivity	
Ci	curie
cpm	counts per minute
mCi	millicurie
µCi	microcurie
pCi	picocurie
Bq	becquerel
Radiation Dose	
mrad	millirad
mrem	millirem
Sv	sievert
mSv	millisievert
µSv	microsievert
R	roentgen
mR	milliroentgen
µR	microroentgen
Gy	gray

Fractions and Multiples of Units

Multiple	Decimal Equivalent	Prefix	Symbol	Report Format
10^6	1,000,000	mega-	M	E+06
10^3	1,000	kilo-	k	E+03
10^2	100	hecto-	h	E+02
10	10	deka-	da	E+01
10^{-1}	0.1	deci-	d	E–01
10^{-2}	0.01	centi-	c	E–02
10^{-3}	0.001	milli-	m	E–03
10^{-6}	0.000001	micro-	μ	E–06
10^{-9}	0.000000001	nano-	n	E–09
10^{-12}	0.000000000001	pico-	p	E–12
10^{-15}	0.000000000000001	femto-	f	E–15
10^{-18}	0.000000000000000001	atto-	a	E–18

Conversion Table (Units of Radiation Measure)

Current System	*Systéme International*	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = 3.7×10^{10}Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv

Conversion Table

Multiply	By	To Obtain	Multiply	By	To Obtain
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.4536	kg	kg	2.205	lb
liq qt-U.S.	0.946	L	L	1.057	liq qt-U.S.
ft^2	0.093	m^2	m^2	10.764	ft^2
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.31	ft^3
d/m	0.450	pCi	pCi	2.22	d/m
pCi	10^{-6}	μCi	μCi	10^6	pCi
pCi/L (water)	10^{-9}	μCi/mL (water)	μCi/mL (water)	10^9	pCi/L (water)
pCi/m^3 (air)	10^{-12}	μCi/mL (air)	μCi/mL (air)	10^{12}	pCi/m^3 (air)

SAFETY • RESPONSIBILITY • SECURITY

SRS

SAVANNAH RIVER SITE

Please call DOE counterpart, Mary Langford, at 5-8014 !

class/EC/DOE

OSR 14-357 (Rev 3-30-93)
Stores: 26-12801

Westinghouse Savannah River Company
Document Approval Sheet

Document No. WSRC-TR-97-00322

UC/C Number UC-702

Title: Savannah River Site Environmental Report for 1997

Primary Author/Contact (Must be WSRC)	Location	Phone No.	Position
Margaret Arnett	735-11A	5-2654	Sr. Technical Editor

Organization Code	Organization (No Abbreviations)
QE 110	Environmental Monitoring Section

Other Authors: Al Mamatey (5-3363)

Keywords: Environmental Monitoring

Retention Period:

Type of Record: ☒ Lifetime ☐ Nonpermanent

Intended Usage: ☒ Report ☐ Software ☐ Conference/Meeting/Presentation ☐ Other ______

Document Type: ☐ Abstract ☐ Paper ☒ Technical

No. of Copies:

Deadline:

Conference/Meeting/Presentation

☐ Published Proceedings ☐ Other ______

Meeting/Journal Title (No Abbreviations):

Meeting Address (City, State, Country):

Meeting Date(s) ______ (m/d/y) thru ______ (m/d/y)

Sponsor:

Reports

☐ Quarterly ☐ Semiannual ☒ Annual ☐ Final ☐ Topical ☐ Phase I ☐ Phase II ☐ Other ______

Refs OK

Report Dates 1/1/97 thru 12/31/97

I understand that for the information in this paper to be given external disbribution, approvals by both WSRC and, as appropriate, DOE-SR are required. Distribution (verbally or published) must be in accordance with policies set forth in WSRC management requirements and procedures (MRP 3.25) and in DOE-SR orders, and the content of the external distribution must be limited to that actually approved.

Margaret W. Arnett — Author's Signature

5/21/98 — Date

Approvals by Author's Organization

Derivative Classifier	Classification	Topic	Distribution
Barton Mauff	U	~~Annual~~ Environmental Rept.	☒ Unlimited ☐ Limited (Explain below.)

Explanations: Please call DOE counterpart, Mary Langford, at 5-8014!

Manager's Name	Manager's Signature	Date
Bob Lorenz	Bob Lorenz	5/21/98

Classification Information (To be completed by Classification Reviewer)

Classification (Check one for each)

	S	C	UCNI	U
Overall	☐	☐	☐	☒
Abstract	☐	☐	☐	☐
Title	☐	☐	☐	☒
Cover Letter	☐	☐	☐	☐

Classification Guide Topics: No Export Control Concerns.
R. L. SHANKLE
CLASSIFICATION ANALYST
R L Shankle 5/28/98

WSRC Classification Officer's Name	WSRC Classification Officer's Signature	Date
R. L. SHANKLE CLASSIFICATION ANALYST	R L Shankle	5/28/98

Publications Use Only

Date Received	Date Assigned
Publications Manager	Editor

Westinghouse
Savannah River Company

P.O. Box 616
Aiken, SC 29802

May 28, 1998

WSRC-TR-97-00322
MSD-STI-97-2869

Ms. W. F. Perrin, Technical Information Officer
U. S. Department of Energy - Savannah River Operations Office

Dear Ms. Perrin:

REQUEST FOR APPROVAL TO RELEASE SCIENTIFIC/TECHNICAL INFORMATION

The attached document is submitted for classification and technical approvals for the purpose of external release. Please complete Part II of this letter and return the letter to the undersigned by 6/17/98. The document has been reviewed for classification and export control by a WSRC Classification staff member and has been determined to be Unclassified.

Trish Baughman for
Jeanne E. Sellers, WSRC STI Program Manager

I. DETAILS OF REQUEST FOR RELEASE

Document Number: WSRC-TR-97-00322
Author's Name: M. Arnett
Location: 735-11A Phone 5-2654
Department: Environmental Monitoring Section
Document Title: Savannah River Site Environmental Report for 1997

Presentation/Publication: Report
Meeting/Journal:
Location: N/A
Meeting Date:

OSTI Reportable

II. DOE-SR ACTION

Date Received by TIO 5/28/98

Corrections have been made 6/24/98

- [ ] Approved for Release
- [x] Approved Upon Completion of Changes
- [ ] Approved with Remarks
- [ ] Not Approved
- [ ] Revise and Resubmit to DOE-SR

Remarks: See changes (3 pages) attached and also issue this report in separate numbered book per M. Langford DOE 5-8014

W. F. Perrin
W. F. Perrin, Technical Information Officer, DOE-SR

6/12/98
Date

OSR 25-82-W# (4-89)
Stores: 26-15460.00

Author: Mary-M Langford at SRCCAD1
Date: 6/24/98 8:29 AM
Priority: Normal
Receipt Requested
TO: Sharon Lybrand at SRCCA07
CC: Georgia Knight at SRCCAD4, Arthurb Gould at SRCCAD2
Subject: Environmental Report comments

Sharon,

For your information, all reviewer comments on the SRS Environmental Report for 1997 (WSRC-TR-97-00322) have been resolved.

Plese let me know if you need me to document this with a hard copy and signature.

Thank you for your help in expediting approval of the report.

Mary Langford

Document Title:	***SRS Environmental Report for 1997 – Final Review***
Reviewer Name:	**G. Whitney**
Telephone:	**5-1447**
Fax:	
Date Review Completed:	**5/29/98**

#	Pg.	Section	Comment and Recommended Change
			CHAPTERS 10 & 11 - Did not see documentation of changes to QA/QC Program in either Chapter
	35	Chapter 2	Left Column – Groundwater was assessed in 1996; Effluent Monitoring and Environmental Surveillance was assessed in 1997 (5/19-6/5/97)

Document Title:	***SRS Environmental Report for 1997***
Reviewer Name:	**Wade Whitaker**
Telephone:	**5-5966**
Fax:	
Date Review Completed:	**6/2/98**

#	Pg.	Section	Comment and Recommended Change
1	18	RCRA 3004(u) Program	Change lines 7, 8, and 9 to, "CERCLA requirements in the Federal Facility Agreement (FFA). The integration ...".

Document Title:	***SRS Environmental Report for 1997 – Final Review***
Reviewer Name:Keith	
Telephone:5-7768	
Fax:	
Date Review Completed:	

#	Pg.	Section	Comment and Recommended Change
1	62	SWM	Sanitary Waste – Change 5864 tons to 5885 tons
			Low-Level Waste – Change 402,375 to 660,550 cu ft
			Hazardous Waste—Change 13,540 to 34,356 cu ft
			Mixed wasye –Change 608 to 16, 471 cu ft
2	63	SWM	Transuranic Waste —2nd para—Change 43,800 to 350,000 cu ft
			3rd Para—-delete "dewatered" and "repacked". Add the word –vented- in place of "repacked".
			Add this sentence at the end of Para 3...Shipments to WIPP are scheduled to commence in FY 99.
			4th Para –2nd Sentence –Add –1996—after the word during.

DOE F 1332.15# (2/96) (p. 1 of 4) (All other versions are obsolete.)

OMB Control No. 1910-1400

U.S. DEPARTMENT OF ENERGY
ANNOUNCEMENT AND DISTRIBUTION OF DEPARTMENT OF ENERGY (DOE) SCIENTIFIC AND TECHNICAL INFORMATION (STI)

(When submitting form, input should be typed, not handwritten.)

PART I Information Product Identification

A. Identifiers

1. Product/Report Nos. WSRC-TR-97-00322

2. Award/Contract Nos. DE-AC09-96SR18500

3. Title

Savannah River Site Environmental Report for 1997

(Grantees and Awardees skip to Part 1.B.)

4. Funding Office(s) DOE-SR

5. B&R Code(s) ____

6. Project ID(s) ____

7. CRADA Nos. ____

8. UC/C Category(ies) UC-702

9. Information Product Filename ____

B. Information Product Description

✓ **1. Report**

a. Type ____ Quarterly ____ Semiannual ✓ Annual ____ Final ____ Topical

____ Other *(Specify)* ____

b. Dates covered *(mm/dd/yyyy)* 1 / 1 / 97 thru 12 / 31 / 97

____ **2. Conference**

a. Type ____ Conference paper ____ Published proceedings ____ Other *(Specify)* ____

b. Conference title *(No abbreviations)* ____

c. Conference location *(city/state/country)* ____

d. Conference dates *(mm/dd/yyyy)* ____ thru ____ / ____ / ____

e. Conference sponsor(s) ____

____ **3. Software** *(Note: Additional forms are required. Follow instructions provided with this form.)*

____ **4. Other** *(Provide complete description.)* ____

C. Information Product Format

____ **1. Product not submitted to OSTI** *(i.e., electronic version)* ____

a. Location (FTP, URL, etc.) ____

b. File format ____SGML ____ HTML ____ Postscript ____ PDF ____TIFFG4 ____Other *(Specify)* ____

c. SGML bibliographic record available ____ With product ____ Separately *(Specify)* ____

____ **2. Product submitted to OSTI** *(i.e., electronic, paper, audiovisual, or computer medium)*

a. Number of copies

✓ (1) Two for unclassified processing ____ (2) ____ copies for program unclassified distribution

____ (3) One for classified processing ____ (4) ____ copies for standard classified distribution

____ (5) ____ copies for OSTI to reproduce *(Complete part C.3.)*

____ (6) Other *(Complete part C.3.)*

b. SGML bibliographic record submitted to OSTI ____ With product ____ Separately *(Specify)* ____

c. Method of transmittal to OSTI

____ **(1) Electronic** *(e.g., FTP, E-mail) (Note: Transmit only unclassified unlimited information not subject to access limitations over open systems. Contact OSTI for further information.)*

(a) File format ____SGML ____ HTML ____ Postscript ____ PDF ____ TIFFG4 ____Other *(Specify)* ____

____ **(2) Computer medium** *(e.g., magnetic tape or diskette) (Complete all. Provide a separate electronic or print abstract.)*

(a) Quantity/type *(Specify)* ____

(b) Machine compatibility *(Specify)* ____

(c) Operating system *(Specify)* ____

(d) File format ____ SGML____HTML ____ Postscript ____PDF ____ TIFFG4 ____ Other *(Specify)* ____

____ **(3) Audiovisual Material** *(Complete all. Provide a separate electronic or print abstract.)*

(a) Quantity/type *(Specify)* ____

(b) Machine compatibility *(Specify)* ____

(c) Sound ____Yes ____ No (d) Color ____Yes ____ No (e) Playing time ____

✓ **(4) Paper**

____ **3. Additional Instructions/explanations** ____

D. Contact *(Person knowledgeable about the information product and its submission)*

Name Jeanne E. Sellers Position Manager, STI Phone (803) 725-2321

Organization Westinghouse Savannah River Company E-Mail jeanne.sellers@srs.gov

(DOE/DOE Contractors complete; Grantees and Awardees complete as instructed by contracting officer)

A. Recommendations *(Mark at least one)*

✓ 1. **Unlimited Announcement** *(Available to U.S. and non-U.S. public)*

___ 2. **Unlimited Announcement/U.S. Dissemination Only**

___ 3. **Classified** *(Standard announcement)*

___ 4. **OpenNet**

a. Non-NTIS Availability *(Required if not available from NTIS)*

(1) Accession Number ________ (2) Document Location ________

b. Field Office Acronym SR

c. Declassification date (mm/dd/yyyy) ___/___/___ ___Sanitized ___ Never classified

___ 5. **Special Handling** *(Legal basis must be noted below.)*

___ a. Copyrighted material ___ All ___ Part *(Specify)* ________

___ b. Unclassified Controlled Nuclear Information (UCNI)

___ c. Export Control/ITAR/EAR

___ d. Temporary hold pending patent review

___ e. Translation of copyrighted material

___ f. Small Business Innovation Research (SBIR) Release date *(mm/dd/yyyy)* ___/___/___

___ g. Small Business Technology Transfer (STTR) *Release date (mm/dd/yyyy)* ___/___/___

___ h. Proprietary

___ i. Protected CRADA information Release date *(mm/dd/yyyy)* ___/___/___

___ j. Official Use Only (OUO)

___ k. Program-Directed Special Handling *(Specify)* ________

___ l. Other *(Specify)* ________

B. Releasing Official

1. **Patent Clearance** *(Mark one)*

___ a. Submitted for DOE patent clearance Date submitted (mm/dd/yyyy ___ ___ ___

___ b. DOE patent clearance has been granted

✓ c DOE patent clearance not required

2. **Released by** Name Murray Baxter, WSRC Intellectual Property Rights Attorney Date *(mmdd/yyyy)* ___ ___ ___

Phone (803) 952-6558 E-mail ________

PART III Bibliographic Information

(Note: Providing the following information is optional. For information products that are to be included in the OpenNet Database, the following *information will be used for the OpenNet Database records. For all information products, it will be used in announcing those products, as appropriate, to other parts of the DOE community.)*

A. Personal Author/Affiliation M. Arnett ; Westinghouse Savannah River Company

B. Performing Organization Westinghouse Savannah River SC US

C. Date of Publication *(mm/dd/yyyy)* 5/28/98

D. Pages/Size 500

E. Abstract

The mission at the Savannah River Site has changed from the production of nuclear weapons materials for national defense to the management of waste, restoration of the environment, and the development of industry in and around the site.

F. Subject Terms Environmental Monitoring, Effluent Monitoring, Environmental Surveillance, Radiation Dose,

G. OpenNet Document Type ☐ Audiovisual Material ☐ Book ☐ Conference ☐ Correspondance ☐ Data ☐ Dissertation/Thesis

H. OpenNet Document Categories

I. OpenNet Addressee