**Front Cover** – Rainbow Bay at the Savannah River Site. Inset photographs are marbled salamanders (top) and a green tree frog (bottom). *Photographs are courtesy of David Scott of the University of Georgia’s Savannah River Ecology Laboratory*

**Back Cover** – The Savannah River (which borders South Carolina and Georgia). *Photograph courtesy of SRNS Corporate Communications*

For more information about this report contact:

Teresa Eddy  
Savannah River Nuclear Solutions, LLC  
Building 730-4B  
Aiken, SC  29808  
Telephone:  803-952-8253  
E-mail address: teresa.eddy@srnl.doe.gov

or go to the SRS Environmental Report webpage at http://www.srs.gov/general/pubs/ERsum/index.html and under the SRS Environmental Report for 2016, complete the electronic Customer Satisfaction Survey.

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-08SR22470 with the U.S. Department of Energy. This work was conducted under an agreement with, and funded by, the U.S. Government. Neither the U.S. Government nor its employees, nor any of its contractors or subcontractors or their employees, makes any expressed or implied 1) warranty or assumes any legal liability for the accuracy or completeness - or for the use or results of such use - of any information, product, or process disclosed; or 2) representation that such use or results of such use would not infringe on privately owned rights; or 3) endorsement or recommendation of any specifically identified commercial product, process, or service. Any views and opinions of authors expressed in this document do not necessarily state or reflect those of the U.S. Government, or of its contractors or subcontractors.
SAVANNAH RIVER SITE
Annual Environmental Report

2016 Summary

**WHY THIS REPORT IS IMPORTANT**

This report is a summary of the impacts Savannah River Site (SRS) activities have on the environment and the local community. This summary report is divided into three sections: History and Background, Data Summary, and Community Investment, which collectively highlight SRS's

- Significant environmental accomplishments that support Site missions
- Compliance with environmental laws and regulations
- Public dose from SRS activities
- Monitoring that supports dose calculations and compliance requirements
- Community involvement

The full SRS Annual Environmental Report provides the public with details on compliance, potential radiation dose, and monitoring as a result of SRS operations that potentially affect the well-being of the communities surrounding the Savannah River Site.

Site History and Background
Where is the Savannah River Site?

The Savannah River Site is a U.S. Department of Energy (DOE) facility in the western region of South Carolina, along the Savannah River. The Site is approximately 300 square miles and covers parts of Aiken, Allendale, and Barnwell counties.

The Site’s mission is to operate safely and efficiently and to protect public health and the environment, while supporting the nation’s nuclear deterrent programs. SRS processes and stores nuclear materials in support of national defense and U.S. nuclear nonproliferation commitments.

The Site also develops and deploys technologies to improve the environment and treat solid and liquid nuclear and hazardous wastes left over from the Cold War.

SRS supports diverse natural habitats including pine and hardwood forests, riverine environments, and approximately 400 wetlands.

White-tailed deer, turkeys, eagles, alligators, and many species of snakes, amphibians and songbirds thrive on the Site. SRS also manages endangered species populations of the red-cockaded woodpecker, pondberry, and smooth purple coneflower.

In 1972, SRS was designated as the first National Environmental Research Park, which provided opportunities for studying the environmental impacts of energy and defense-related technologies.
SRS Begins Cold War Legacy in Weapons Material Production

The Atomic Energy Commission, the predecessor to the Department of Energy as the landlord and overseer of the Savannah River Site, built the sprawling production facility in the early 1950s to produce materials essential to create nuclear weapons needed for the nation’s defense during the Cold War.

The Atomic Energy Commission chose the location for the Savannah River Site from a short list of candidate areas near Terre Haute, Indiana; Duluth, Minnesota; and Dallas, Texas. Once tapped, the small South Carolina towns and residents of Ellenton, Dunbarton, and Meyers Mill were relocated, and their streets, fields, and homesteads became the footprint for the sprawling weapons complex. The new site provided jobs to the residents of the surrounding South Carolina and Georgia towns.

E.I. Du Pont de Nemours and Company designed and constructed the new atomic project for the Atomic Energy Commission, realigning its managers and resources to the area.

The U.S. government built five production nuclear reactors, which operated at SRS until 1988. Support facilities were also built, and several of these facilities continue to contribute to Site missions.

To this day, the Site provides significant financial contributions and quality-of-life enhancements to this area and beyond.
Environmental monitoring began at SRS in 1951, even before U.S. Environmental Protection Agency and state regulations required SRS to do so. These studies from the early 1950s serve as a benchmark for the current environmental monitoring program.

As early as 1953, SRS attached air monitors to stacks and pipelines; put air monitoring stations at main facilities; and established different levels of monitoring intensity and frequency, around process areas, the site boundary, and locations as far away as 25 miles from the Site. In general, intensity and frequency decreased with distance from the Site. SRS sampled surface water and sediment in the onsite streams and at multiple locations in the Savannah River. The Site collected food crops from local farms, as well as water samples from open wells from homesteads predating SRS. As SRS advanced air monitoring from beyond the local community to a more regional approach, monitoring stations were set up at distances up to 100 miles from the Site.

Today, there are multiple federal and state environmental laws and regulations and DOE requirements directing activities to monitor and protect the environment and public health.

The changes to the Site mission over the last half century have led to the environmental monitoring program evolving to include those contaminants that will be present in the future. Monitoring equipment, sampling tools, and analysis equipment have also evolved to allow precise measurement of contaminants at the low levels seen in the environment. This supports SRS’ ongoing commitment to protect public health and the environment while performing its missions.
The Site’s current missions are to operate safely and efficiently and to protect public health and the environment, while supporting the nation’s nuclear deterrent programs. Although scaled down from its production days during the Cold War when SRS was key to the nation’s defense, SRS focuses today on waste processing and treatment, environmental cleanup and remediation, tritium processing, and protecting nuclear material.

SRS accomplishes this through the joint effort of the multiple organizations that synergistically perform cleanup and production programs safely and within the purview of environmental protection. The main organizations operating at SRS include

- DOE
- National Nuclear Security Administration
- Savannah River Nuclear Solutions, LLC
- Savannah River National Laboratory
- Savannah River Remediation, LLC
- Centerra-SRS
- Ameresco
- Parsons
- Chicago Bridge and Iron Areva
- MOX Services
- The University of Georgia’s Savannah River Ecology Laboratory
- Savannah River Archaeological Research Program
- U.S. Department of Agriculture’s Forest Service-Savannah River

**Broad-Based Experts Key to Program Success**

- The University of Georgia’s Savannah River Ecology Laboratory
- Savannah River Archaeological Research Program
- U.S. Department of Agriculture’s Forest Service-Savannah River

**2016 SRS Environmental Accomplishments**

- Closed the 8th of 51 radioactive liquid waste underground storage tanks
- Constructed a newly designed SALTSTONE DISPOSAL VAULT to dispose of low-activity waste
- Increased Site energy security by bringing online an additional BIOMASS HEATING PLANT to existing boilers
- Disposed of more than 1.5 million gallons of low-activity waste through the Saltstone facilities
- Immobilized 2.6 million curies of radioactivity through the Defense Waste Processing Facility
- Maintained 100% compliance with the 5 air permits governing operating facilities
Wetlands account for 25%, or almost 49,000 acres, of the total area of the Savannah River Site. This is more than 80% of the wetlands across the entire Department of Energy complex nationwide. Wetlands are an integral component of the SRS environment, and maintaining them is a priority.

The cover photograph of this report is of Rainbow Bay, the location of an amphibian research study led by the University of Georgia’s Savannah River Ecology Laboratory. The Guinness World Records recognizes this 39-year study as the longest-running amphibian study in the world.

There are approximately 400 isolated wetlands on SRS. These wetlands are breeding areas for more than 30 species of frogs, toads, and salamanders.

The isolation of these wetlands has provided a unique opportunity to study the effects of a changing environment on the lifecycle of the amphibians that reside in them.

While research helps us understand the wetlands environment, the SRS Environmental Compliance program ensures the Site complies with regulations associated with activities that may impact wetlands. Central to minimizing wetland impacts is the Nationwide Permits (NWP) program. Under the Clean Water Act, the U.S. Army Corps of Engineers has jurisdiction over the NWP program.

“Our (U.S. Army Corps of Engineers) nationwide permits are an important tool in encouraging project proponents to avoid and minimize impacts to wetlands, streams, and other aquatic resources,” states Maj. Gen. Ed Jackson, Deputy Commanding General for Civil and Emergency Operations.

SRS currently has 5 open permits, which fall under 3 of the 52 NWPs. For those projects that will impact wetlands and do not meet the criteria for an NWP, individual project permits are required to meet requirements as documented in the Clean Water Act.

In 2016, SRS operated under 11 Clean Water Act permits regulating site-wide activities that had the potential to impact streams, wetlands, and other aquatic resources. The SRS nonradiological environmental monitoring program performed more than 3,275 analyses in support of these permits. SRS had a 99.9% compliance rate.
SRS is committed to protecting the environment, such as this wetland.

Data Summary
Central to the nonradiological Environmental Monitoring Program is sampling that determines if SRS is complying with the National Pollutant Discharge Elimination System (NPDES) permits.

South Carolina Department of Health and Environmental Control (SCDHEC) administers the NPDES program to protect surface waters by limiting releases of nonradiological pollutants into bodies of water in the United States. The federal-level Clean Water Act mandates that discharges do not hurt water quality or people’s health.

SRS has two NPDES permits for industrial activities that discharge to surface water, which cover a total of 28 permitted industrial wastewater outfalls and 35 permitted industrial stormwater outfalls. The monitored pollutants and the frequency by which SRS monitors them are specific for each outfall, as the applicable NPDES permit identifies. SRS transmits the results of the wastewater sampling to SCDHEC in required monthly discharge monitoring reports.

SRS performed approximately 3,275 wastewater sample analyses during 2016. Only two of those analyses exceeded NPDES permit limits. That is a **99.9% compliance rate**. One permit limit exceedance was for the monthly average of total suspended solids—the concentration of solid materials that can be trapped in a filter—at the D-01C outfall. SRS collected the monthly sample while water was being removed while closing the D-Area ash basins. The dewatering activity resulted in additional solids being suspended in the outfall waters. While the total suspended solids result was above the monthly average permit limit, it was below the daily maximum permit limit. This was an isolated exceedance, and subsequent sampling yielded analyses below the monthly average total suspended solids permit limit. The second permit limit exceedance was for the daily maximum flow at the K-12 Outfall. This exceedance occurred due to seven inches of recorded rainfall, which increased water flow through the permitted outfall just prior to sampling.

On December 9, 2016, SCDHEC issued a Notice of Violation for the total suspended solids exceedance at the D-01C outfall, but did not assess a penalty. This was the only Notice of Violation SRS had during 2016.
The Environmental Monitoring program examines both radiological and nonradiological constituents that SRS could release into the environment. The sample types collected provide data to evaluate radiation dose to the public and environment, complying with DOE requirements, applicable state and federal regulations, and permits issued to SRS.

In order to determine if SRS radiological operations are impacting public health, the Site starts sampling closest to the sources of potential contamination, continues at the Site boundaries, and ends furthest away within communities surrounding the Site and sometimes as distant as Savannah, Georgia.

Sampling frequencies are based on how often factors may change. For example, collecting air samples from Site stacks is continuous (samples are collected weekly using a filter through which air flows continuously) so any changes in air emissions due to operational changes are measured. On the other hand, SRS collects aquatic food samples annually. This is because radionuclides, if present, will build up in the flesh of the aquatic species over time, even when the concentrations in the water are so low that they cannot be detected.

Tritium is SRS’s primary contributor to the potential dose to the public. As such, it is analyzed in all media collected as part of the SRS radiological environmental monitoring program. The analytical results for the air and water samples collected at the points of release from SRS facilities indicated 2016 tritium releases continued an overall downward trend. Tritium results from surface water samples collected within the Savannah River supported the downward trend. Tritium results from the other media sampled at the Site perimeter and from the Savannah River were consistent with results from the previous 10 years. Results for samples collected within communities surrounding SRS had results that are consistent with results from the previous 10 years with 183 (92.5%) of the 198 results not detected. Decreasing levels of tritium in regards to both distance from the center of SRS and over time are supporting evidence of the Site having a diminishing impact on the environment of the surrounding community.

Monitoring the Environment for Radiological Contaminants

From left, sediment sampling methods and samples
Innovative Equipment Provides Improved Level of Protection for Site Deer Hunters

The Savannah River Site is one of a few Department of Energy Sites that host wildlife hunts within their borders. Each year, beginning in 1965, SRS has provided hunting opportunities for thousands of hunters, who have harvested more than 36,000 animals, through the SRS Deer Hunt Program. As part of this program, SRS monitors each animal harvested to determine the amount of cesium-137 present in the animal and calculates the potential dose to the hunter from consuming the meat from that animal.

For an animal to be released to a hunter, the dose assigned to the animal must be below the SRS release level of 22 mrem. Additionally, an SRS-managed dose-tracking system is in place whereby each hunter is assigned the dose for each animal he or she harvests, an annual dose based on all animals harvested in a single calendar year, and a lifetime dose assigned for all the years the hunter has harvested animals at SRS. The hunter must stay below both annual and lifetime dose release limits to continue to participate in the hunts.

A comprehensive review of the SRS wildlife monitoring program in 2015 identified “a good problem.”

**The Good:** The average cesium-137 concentration in deer has decreased over the years.

**The Problem:** An evaluation of the monitoring equipment indicated that these decreasing concentrations would in the not-too-distant future begin to challenge the limits of the existing monitoring equipment to provide data that could be trusted as the concentrations in the wildlife are getting close to the lowest reliable measurable concentrations of the equipment.

**The Solution:** During 2016, Radiological Environmental Monitoring Program personnel and a team of scientists from the Savannah River National Laboratory (SRNL) worked together for a solution to identify, design, and field test an updated wildlife monitoring system. The updated system, designed, built, and tested by SRNL, is like having a laboratory in the field. The cesium-137 concentrations measured in the field with this new equipment are within 5% of the value measured in an analytical laboratory from samples collected from the animals.

The new system is automated, while the old system was manual, reducing input errors. The new system has a much larger detector that results in a lower detection limit during the same monitoring time frame as the old system, increasing the confidence in the lower concentration readings. The new system produces a spectral record of each measurement versus the old system that yielded a single number, improving quality control of the data.

The updated wildlife monitoring system improves the comparability of the field results to laboratory results, the quality control of the data, and confidence in the low concentration results that are now normal. The improvements to the wildlife monitoring system will ensure SRS continues to reliably measure the dose coming from consuming these animals.
What is Radiation Dose?

Radiation dose to a person is the amount of energy the human body absorbs from a radioactive source located either inside or outside of the body. Radioactive sources typically transfer energy in the form of rays (such as gamma or X-rays) or high-energy particles (such as alpha or beta particles).

Humans, plants, and animals can receive radiation doses from both natural and man-made sources. Radiation can come from as far away as outer space and from as near as the ground on which you are standing. Because it is naturally all around us, we cannot eliminate radiation from our environment.

SRS typically reports radiation dose in a unit of measure called a “millirem” (mrem). The average annual dose for U.S. residents from these sources is 625 mrem. The average dose of naturally occurring radioactive minerals in the ground and water, and cosmic radiation from outer space is 311 mrem. Man-made sources of background radiation include:

- Medical procedures (300 mrem)
- Consumer products (13 mrem)
- Industrial and occupational exposures (1 mrem).

DOE has established dose limits to the public so that operations will not contribute significantly to this average annual background exposure. DOE Order 458.1, Radiation Protection of the Public and the Environment, establishes 100 mrem/yr as the annual dose limit to a member of the public that can come from Site operations.

Exposure to radiation potentially occurs through the following pathways, as the figure illustrates:

- Inhaling through the air
- Ingesting through food and water
- Absorbing through the skin
- Experiencing direct (external) exposure to radionuclides in soil, air, and water
2016 POTENTIAL RADIATION DOSE

In 2016, SRS did not significantly increase potential radiation exposure to the public.

The potential doses from SRS radioactive discharges to air and water were well below regulatory standards for the public and the environment. Compliance with DOE Order 458.1 is discussed in Chapter 6, Radiological Dose Assessment, of the SRS Annual Environmental Report. The potential radiation dose to the public is included in that chapter.

In 2016, the combined dose from air and water pathways—called the “all pathway” dose—was 0.19 mrem, which is well below the DOE public dose limit of 100 mrem/yr. Of this 0.19 mrem/yr dose, 0.15 mrem was from liquid releases, and 0.038 was from releases to the air.

The 2016 all-pathway dose is comparable with the 2015 total dose of 0.18 mrem. SRS attributes this small increase to a slight increase in tritium releases to the air during 2016.

CALCULATING DOSE

When one thinks about the data needed to determine dose, samples of air, water, soil, and food come to mind. However, there are other data types that are also important when determining public dose. These include

- Weather data
- The rate at which water flows in streams and rivers

Wind direction is a component of the atmospheric pathway dose. The Savannah River National Laboratory has a local network of 12 meteorological towers with an extensive database of weather-related information. The network provides the wind direction data.

Flow rates of SRS streams and the Savannah River water are components of the liquid pathway dose. The water samples collected provide information on how much of a radionuclide is present in a liter of stream or river water. To calculate the potential total amount of that radionuclide present during the year, it is necessary to know the amount of water that flowed in the water body for the time period of interest. Both SRS and U.S. Geological Survey collect flow rate information. SRS evaluates the data from the two organizations with the more conservative data used in the liquid pathway dose calculations.

The next time you feel the wind or water on your face, remember it influences these unsung data types that are important to the SRS dose calculations.
STEM at Forefront of SRS Student Programs

The Savannah River Site organizes and funds a variety of science and outreach programs. Each of the following programs piques interest in science, technology, engineering, and math (STEM) through staff dedication and use of unique Site resources.

- **Earth Day:** In 2016, SRS hosted 750 visitors at its booth in Aiken.
- **Traveling Science Demonstration Program:** This science program volunteers Site experts in the sciences to conduct demonstrations and experiments for teachers and students.
- **Savannah River Regional Science and Engineering Fair:** Students compete for excellence in scientific reasoning, creative ability, and technical skill.
- **DOE Savannah River Regional Science Bowl:** SRS is one of four DOE sites that have sponsored these regional contests each of the 25 years since they started.
- **SRS Engineers Teach-Ins:** Engineers, scientists, and technicians visit middle schools in the Aiken-Augusta area and conduct experiments to encourage students to pursue STEM studies and jobs.
- **Future City Competition:** Hundreds of area middle schoolers learn how their working counterparts in engineering and city planning deal with infrastructure and citywide problems.
- **Introduce a Girl to Engineering:** SRS participates in a worldwide campaign to introduce girls to the field of engineering. This year, SRS hosted 55 girls from 27 area middle schools.
- **Central Savannah River Area College Night:** SRS awarded 16 $1,000 scholarships at this event that gives students, parents, and guidance counselors the opportunity to meet with college recruiters.
- **Developing Future Job Candidates:** SRS works with local universities and Historically Black Colleges and Universities to develop and train a future workforce.

Education and Educator-Based Programs

In addition to student programs, SRS supports teachers in the classroom:

- **Innovative Teaching Mini Grants and Students, Teachers Achieving Results Grants:** In 2016, SRS awarded 161 area teachers grants to aid in STEM concepts in the classroom.
- **Science and Technology Enrichment Program:** The program provides teachers and students with hands-on science, mathematics, and technology opportunities through real-world, issues-oriented investigations.
- **National Science Week tours for teachers:** Middle school and high school math and science teachers tour several facilities at SRS to gather teaching information.
The Savannah River Site hosted 22 tours during 2016, allowing more than 1,000 people to see firsthand the historic and operational facilities at SRS that were responsible for producing plutonium and tritium during the Cold War.

Tour participants learn about the Site’s current missions and the focus on the future. Among many sights, tour participants get to view the animals at the University of Georgia’s Savannah River Ecology Laboratory.

SRS holds the free four-hour tours throughout the year. Each tour accommodates up to 50 people. Seats on the commercial buses are filled through reservations on a first-come, first-served basis. Tour participants must be at least 18 years old and be a U.S. citizen.

Tours start at the Aiken County Applied Research Center, located off Highway 278, near New Ellenton.

Sign up: srs.gov/general/tour/public.htm 803-952-8994
The SRS Citizens Advisory Board (CAB) provides advice and recommendations to DOE on environmental restoration, waste management, and other related issues of concern. Citizen members meet six times a year at locations in South Carolina and Georgia that have a proximity-vested interest in the impact of Site operations on their communities.

The board’s membership is carefully considered to reflect a full diversity of viewpoints in the affected community and region. Board members are composed of people who are directly affected by DOE site clean-up activities.

Agency Liaisons from DOE, the U.S. Environmental Protection Agency-Region IV, and the South Carolina Department of Health and Environmental Control participate at the table during CAB meetings.

The various committees within the CAB meet to discuss topics such as environmental clean-up on the Site, budget management, materials handling, historic preservation, and plans for the future uses of the Site.

The Citizens Advisory Board is headed by a chair and vice chair that represent the CAB at Environmental Management Site-Specific Advisory Board meetings and to the public. The remaining board members are divided into four issues-based committees, which include the Waste Management Committee, the Facilities Disposition & Site Remediation Committee, the Nuclear Materials Committee, and the Strategic & Legacy Management Committee.

Meeting schedule: cab.srs.gov 800-249-8155
Environmental Justice Program

Mandated by the U.S. Environmental Protection Agency, the Environmental Justice program at SRS ensures no group of people should bear a disproportionate share of negative environmental consequences resulting from work at the Site.

The concerns these groups express can influence the EPA’s decision-making process associated with setting standards, permitting facilities, awarding grants, and issuing licenses and regulations.

SRS uses programs to enhance engagement from the target communities. One such program is the Teaching Radiation, Energy, and Technology (TREAT) workshop, which gives teachers and members of the public the opportunity to learn about environmental radiation.

Others programs at SRS include community outreach meetings addressing job training, grants, environmental monitoring, and emergency response; student internships on environmental contamination research projects; and acquiring cutting-edge environmental analytical laboratory equipment for the Savannah State University environmental sciences students and students in the DOE-Headquarters Environmental Scholars Program.

SRS Engages Public Support, Involvement

Savannah River Site management is committed to keeping the public informed about Site projects. SRS has built long-term regional support through public and intergovernmental involvement.

The Site achieves stakeholder involvement through a variety of activities that are responsive to input from the public. Some of these are discussed in the previous section, Public Involvement.

Specifically, SRS fosters communication and information exchange with groups with vested interest in the Site through:

- Assisting stakeholder groups with analyzing environmental management plans
- Increasing public awareness of the impact of contaminant releases or potential releases during cleanup
- Allowing community groups to propose alternative plans that may achieve better results
- Explaining how priorities are established for cleanup and safety purposes
SRS Generous with Its Holiday Giving

TOYS FOR TOTS & ANGEL TREE

SRS employees show their generosity year round, but it is during the holidays when their sharing spirit shines the brightest in the lives of area children.

This year, Site employees collected more than 12,000 toys for the Marine Corps’ 2016 Toys for Tots drive, now in its 25th year at the Site.

The annual event is sponsored by SRS construction employees with the support and participation of the DOE-Savannah River and the contractor organizations on site.

Also, for the 16th year, employees sponsored the Salvation Army’s Angel Tree program, enabling SRS employees to adopt 730 area children, giving toys and clothing items specifically to Angel Tree recipients. This program provided more than 21,000 toys to local children.

Projects for Care, Vision, and Serving

When a neighbor needs a hand, Savannah River Site employees generously extend theirs during United Way work days.

Volunteers with Project Vision have helped disabled and senior citizens in Aiken County by repairing hazards at their private residences during a one-day event.

With Project Serve, Site employees provide health and human service organizations with general maintenance help throughout the Aiken-Augusta area. Project Care volunteers do the same in Barnwell.

In addition, SRS organizations provided corporate monetary gifts to add to the success of the holiday program.

TOys for Tots toys: 12,000
Angel Tree children: 730
Angel Tree gifts: 21,000

In addition, SRS organizations provided corporate monetary gifts to add to the success of the holiday program.
To Learn More About the Focus on Environmental Safety:
Visit the SRS website: http://www.srs.gov/general/srs-home.html
View or download the Savannah River Site Environmental Report for 2016:
http://www.srs.gov/general/pubs/ERsum/er16/index.html,