# Environmental Surveillance

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*Environmental surveillance at the Savannah River Site (SRS) is designed to survey and quantify any effects that routine and nonroutine operations could have on the site and on the surrounding area and population. Site surveillance activities are divided into radiological and nonradiological programs.*

As part of SRS's radiological surveillance program, routine surveillance of all applicable radiation exposure pathways is performed on all environmental media (air, rain, surface water, soil, sediment, vegetation, drinking water, food products, wildlife, and aquatic wildlife) that could lead to a measurable annual dose above background at and beyond the site boundary. Radionuclides present in and around the SRS environment may be from a number of sources, including (1) natural background, (2) fallout from historical atmospheric testing of nuclear weapons, (3) nuclear power plant operations, and (4) routine SRS operations.

Nonradioactive environmental surveillance at SRS involves the sampling and analysis of surface water, drinking water, air, sediment, groundwater, and fish. Results from the analyses of surface water, drinking water, sediment, and fish are discussed in this chapter. A description of the groundwater monitoring program and analysis results can be found in chapter 7, "Groundwater."

The Savannah River is monitored by SRS and other groups, including the South Carolina Department of Health and Environmental Control (SCDHEC), the Georgia Department of Natural Resources, Georgia Power Company's Vogtle Electric Generating Plant (VEGP, operating in Georgia), and the City of Savannah, Georgia.

Brief summaries of analytical results are presented in this chapter; complete data sets can be found in tables on the CD (see "Environmental Data/Maps – 2010") housed inside the back cover of this report. Also contained on the CD are maps showing all applicable sampling locations. Tables on the CD are referred to in this chapter as "data table 5–X." Tables in the chapter itself are referred to simply as "table 5–X."

References to detectable amounts or levels of radioactivity within this chapter are synonymous with activity that is greater than the minimum detectable concentration (MDC) for a particular analytical method. The MDC is the smallest amount or concentration that can be distinguished in a sample by a given measurement system at a preselected counting time and at a given confidence level. Representative MDC values for radiological analyses can be found in table 2 ("Representative Minimum Detectable Concentrations for Radiological Analyses") in the "Sampling" section of the CD.

## Radiological Surveillance

### Air

#### Description of Surveillance Program

SRS conducts atmospheric air monitoring both on and off site to determine whether airborne radionuclides have reached the environment in measurable quantities from routine and nonroutine SRS releases, and to verify and modify the models that are used to show compliance with the 10-mrem/year dose limit specified in DOE Order 5400.1, "Radiation Protection of the Public and the Environment." The atmospheric surveillance program is divided into two primary areas: air and rainwater.

The Environmental Monitoring group maintains a network of 15 atmospheric (ambient) surveillance sampling stations in and around SRS to monitor the concentration of tritium and radioactive particulate matter in the air. The surveillance stations are placed at the center of the site; around the site perimeter; at a regional reference location (assumed to be unimpacted by site operations) approximately 25 miles from the site;

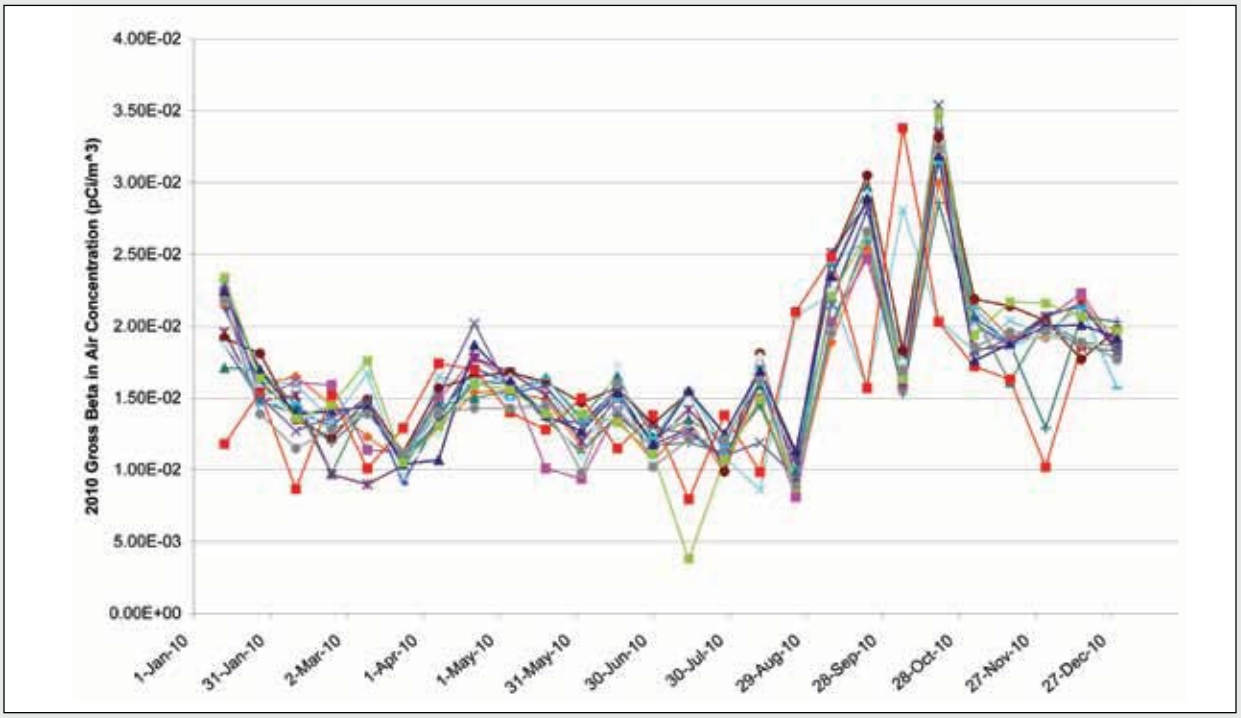


**Figure 5–1 Gross Beta-In-Air Concentrations Measured in Glass Fiber Filters for 15 Locations, 2010**

and in population centers 25 and 100 miles from the site. Placement on the site boundary was designed to ensure that at least one monitoring station is located in every 45-degree sector.

Each air surveillance sampling station consists of the following:

- Glass fiber filter paper for sampling airborne particulates to quantify gamma-emitting radionuclides, gross alpha/beta-emitting radionuclides, total strontium, and the actinides (the elements plutonium, americium, uranium, curium, neptunium, and thorium), sampled/analyzed biweekly
- Charcoal canister for sampling radioiodine and other gamma-emitting radionuclides to complement the glass fiber filter results, sampled biweekly/analyzed annually
- Silica gel for sampling tritiated water vapor, sampled/analyzed biweekly
- Rainwater collection to quantify tritium in rainwater, sampled/analyzed monthly
- Rain ion resin column for sampling rainwater to quantify gamma-emitting radionuclides, gross alpha/beta-emitting radionuclides, total strontium, and the actinides, sampled/analyzed monthly

## Surveillance Results Summary

Except for tritium, no specific radionuclides were routinely detectable—greater than the minimum detectable concentration (MDC) of the analysis method—at the site perimeter in 2010.

Both onsite and offsite radionuclide concentrations were similar to levels observed in previous years (see expanded discussion in paragraphs that follow). Tritium, released as part of routine SRS operations, becomes part of the natural environment. Monitoring ensures that information will be available to determine whether any potential health risk to the surrounding population is created.

**Glass Fiber Filter Airborne Particulates Results (data table 5–1)** Average gross alpha and gross beta results from 2010 generally were higher than those of 2009 (tables 5–1, 5–2). Gross alpha results were consistent with historical results in demonstrating long-term variability. Gross beta results showed elevated levels at every air surveillance station location around September 2010 (figure 5–1). Tests confirmed that the elevated levels were statistically different than the historical levels. With the exception of these data, gross beta results were consistent with historical results in demonstrating long-term variability.

Two out of 363 filter samples for 2010 contained detectable amounts of the manmade gamma-emitting radionuclide cesium-137, which is consistent with the historical results, in which only a small number of air samples have contained detectable cesium-137 activity. As part of SRS routine operations, cesium-137 is released into the atmosphere at quantities well below the derived concentration guide.

During 2010, detectable levels of uranium-234 were observed in nine of 15 air samples, and detectable levels of uranium-238 were observed in 10 of 15 air samples; however, no detectable levels of uranium-235 were observed in any of the 2010 samples. These results are similar to those observed in 2009 and previous years. Uranium is naturally occurring in soil, and therefore expected to be present in low concentrations on some particulate filters. By weight, natural uranium is 99-percent uranium-238, 0.72-percent uranium-235, and 0.0055-percent uranium-234. However, by radioactivity, natural uranium is 48.9-percent uranium-234, 48.9-percent uranium-238, and 2.2-percent uranium-235. Because the analytical method quantifies the radioactivity, uranium-234 and -238 are sometimes detected when uranium-235 is not. Aside from uranium, the only alpha-emitting radionuclide observed was americium-241—in four of 15 air samples. Generally, these concentrations were consistent with historical results. All other alpha-emitting isotopes were below detection levels.

**Charcoal Canister Results (data table 5–2)** No gamma-emitting radionuclides, including radioiodine, were detected in the annual 2010 charcoal canister results; this is consistent with the historical trends.

**Silica Gel Tritium-In-Air Results (data table 5–3)** 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. Tritium-in-air results for 2010 were similar to those observed in 2009, and were consistent with the long-term variability of historical results. Tritium-in-air results showed detectable levels in 108 (28 percent) of the 389 silica gel samples for 2010. As in previous years, the Burial Ground North (BGN) location showed average and maximum concentrations significantly higher than those


**Internal (L) and External Configurations of an Air Surveillance Sampling Station**

**Table 5–1 Average Gross Alpha in Air Filter Results (pCi/m³) 2006–2010**

| Location | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Onsite | 8.79E-04 | 1.10E-03 | 9.45E-04 | 9.53E-04 | 1.17E-03 |
| Perimeter | 1.12E-03 | 1.17E-03 | 9.96E-04 | 1.03E-03 | 1.13E-03 |
| 25-mile | 1.12E-03 | 1.03E-03 | 9.94E-04 | 9.95E-04 | 1.06E-03 |
| 100-mile | 9.99E-04 | 9.99E-04 | 9.12E-04 | 9.89E-04 | 1.13E-03 |
| Overall Average | 1.03E-03 | 1.07E-03 | 9.62E-04 | 9.91E-04 | 1.12E-03 |

**Table 5–2 Average Gross Beta in Air Filter Results (pCi/m³) 2006–2010**

| Location | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|
| Onsite | 1.51E-02 | 1.51E-02 | 1.51E-02 | 1.48E-02 | 1.63E-02 |
| Perimeter | 1.60E-02 | 1.57E-02 | 1.57E-02 | 1.51E-02 | 1.66E-02 |
| 25-mile | 1.53E-02 | 1.56E-02 | 1.56E-02 | 1.56E-02 | 1.69E-02 |
| 100-mile | 1.41E-02 | 1.34E-02 | 1.34E-02 | 1.32E-02 | 1.61E-02 |
| Overall Average | 1.51E-02 | 1.50E-02 | 1.50E-02 | 1.47E-02 | 1.65E-02 |

observed at other locations. BGN concentrations are expected to be higher and more variable because of the location's proximity to both the tritium facilities and to the phytoremediation project near the center of the site; the concentrations are influenced by operations at these facilities. All tritium-in-air samples from the center of the site contained detectable levels of tritium. Beyond the center of the site, tritium-in-air was detected in 82 of 363 samples. As expected, tritium concentrations generally decreased with increasing distance from the tritium facilities (figure 5–2).

## Rainwater

### Description of Surveillance Program

The atmospheric surveillance program also includes rainwater surveillance, which is divided into two parts: sampling for tritium and sampling for deposition (nontritium radionuclides). Tritium analysis is performed at all 15 stations, while seven of these stations are sampled for deposition. The placement of locations for deposition was selected to provide a uniform distribution around the site.

### Surveillance Results Summary

No detectable manmade gamma-emitting radionuclides were observed in rainwater samples during 2010 (data table 5–4).

Gross alpha and gross beta results from 2010 were consistent with those of 2009. In 2010, the average gross alpha and gross beta results generally were slightly lower than in 2009. Annual average gross alpha and gross beta concentrations, as well as individual sample results, are consistent with historical results, which demonstrate long-term variability.

Detectable levels of uranium-234 and uranium-238 were present in 14 of 69 samples, whereas detectable levels of uranium-235 were present in only one (from the D Area location) of the 69 samples. Uranium is naturally occurring in soil, and therefore expected to be present at low concentrations in some deposition samples. Both uranium-234 and uranium-238 results were higher at the D Area perimeter location than at the other site perimeter locations; they also were higher at the BGN (onsite) location. This likely is attributable to the increased airborne particulate matter (dust) present at these locations because of vehicle traffic on nearby dirt roads and fields. Neither plutonium-238 nor plutonium-239 was observed in any of the 69 samples. Americium-241 was observed in six samples (three from the site perimeter, one from the 25-mile location, and two from the 100-mile location). The average concentration of americium-241 was well below the drinking water standard. Six 2010 strontium-89, 90 results were above the MDC—consistent with

results since 2007, when the laboratory implemented a more sensitive analytical protocol. The strontium concentration levels were below regulatory limits.

Tritium in rainwater results showed detectable levels in 41 (21-percent) of the 191 rainwater samples for 2010 (data table 5–5). As in previous years, tritium-in-rain values were highest near the center of the site. All 13 rainwater samples from the center of the site contained detectable tritium. This is consistent with the H Area effluent release points that routinely release tritium. Beyond the center of the site, tritium was detected in 28 rainwater samples—26 from the site perimeter locations and two from the 25-mile location. As with tritium in air, concentrations generally decreased as distance from the effluent release points increased (figure 5–3).

## 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.

The SRS ambient gamma radiation monitoring program is divided into four subprograms, as follows: site perimeter stations, population centers, air surveillance stations, and Vogtle (stations that monitor potential exposures from Georgia Power's VEGP). 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 distance and at the 25- and 100-mile air surveillance stations.

### Surveillance Results Summary

Ambient gamma exposure rates at all TLD monitoring locations show some variation based on normal site-to-

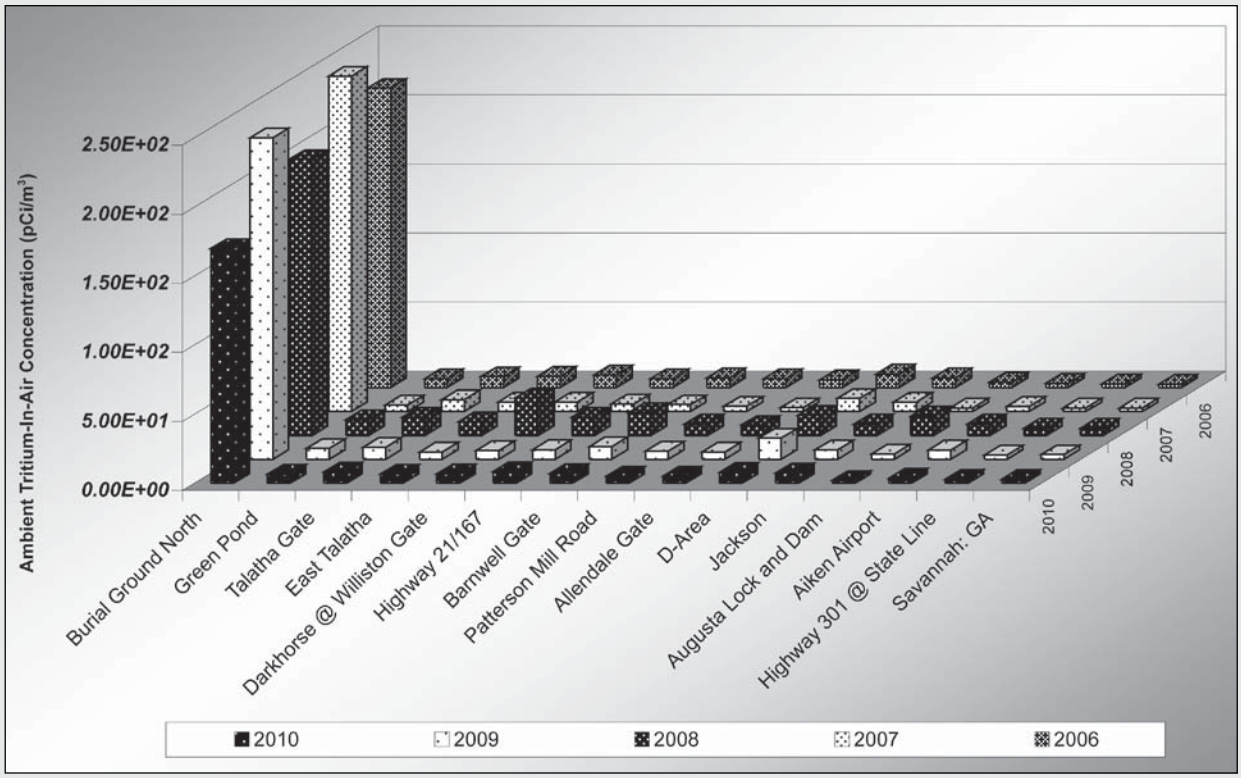


**Figure 5–2 Ambient/Atmospheric Tritium-In-Air Concentrations (pCi/m³), 2006–2010**

site and year-to-year differences in the components of natural ambient gamma radiation exposure levels. In 2010, ambient gamma exposure rates varied between 64 and 129 mrem per year (data table 5–6).

In general, the 2010 ambient gamma radiation monitoring results indicated dose rates slightly higher than those observed at the same locations in 2009, with the exception of the center-of-the-site location, BGN (figure 5–4). The average annual exposure rate was 82 mrem in 2010, compared to 80 mrem in 2009. The total ambient exposure results for the BGN (onsite) location was lower for 2010 (129 mrem per year) than for 2009 (152 mrem/year). However, these results generally are consistent with previously published historical results, and indicate that no significant difference in average annual dose rates is observed between monitoring networks—except in the case of population centers. Ambient dose rates in population centers are slightly elevated compared to the other monitoring networks—as expected—because of factors such as buildings and roadways, which emit low levels of radiation.

## Stormwater Basins

### Description of Surveillance Program

Stormwater accumulating in site stormwater basins is monitored monthly for gross alpha, gross beta, tritium, strontium, gamma-emitting radionuclides, and actinides. Analyses for specific radionuclides are determined by the makeup of the previous releases to the basins.

In 2010, monitoring was conducted at six E Area basins, as well as at the Z Area Basin and F Area Pond 400.

### Surveillance Results Summary

There are no active discharges to site stormwater basins. The primary contributor is rainwater runoff. Rain events did not supply enough water to the E–006 basin for sampling purposes in 2010. The highest mean tritium concentration was measured in the E–005 basin, at 2.58E+04 pCi/L, and was slightly lower than the highest mean tritium concentration at the same location in 2009, which is consistent with the previous 5 years of historical results. No cobalt-60, cesium-137, or curium-244 was detected in any of the basins. Fission products, as well as some actinides, were observed in the basins. Technetium-99 was detected in four locations, averaging less than 2 pCi/L, with the primary actinides (uranium-234, uranium-238, and plutonium-238) measuring a mean average of less than 1 pCi/L. Gross alpha and gross beta activity was detected in all the basins, and the concentrations were compared to those of the previous 5 years to identify any trends. The 2010 values were consistent with historical data of the past 5 years (data table 5–7).

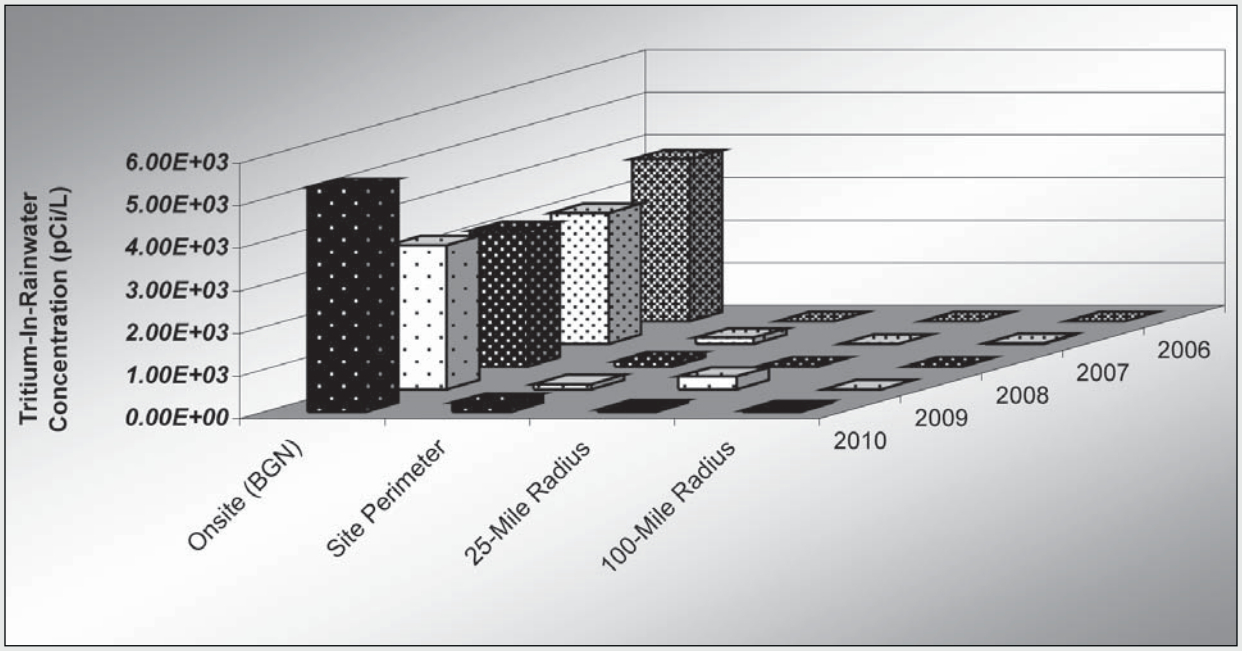


**Figure 5–3 Average Tritium-in-Rainwater Concentrations, 2006–2010**

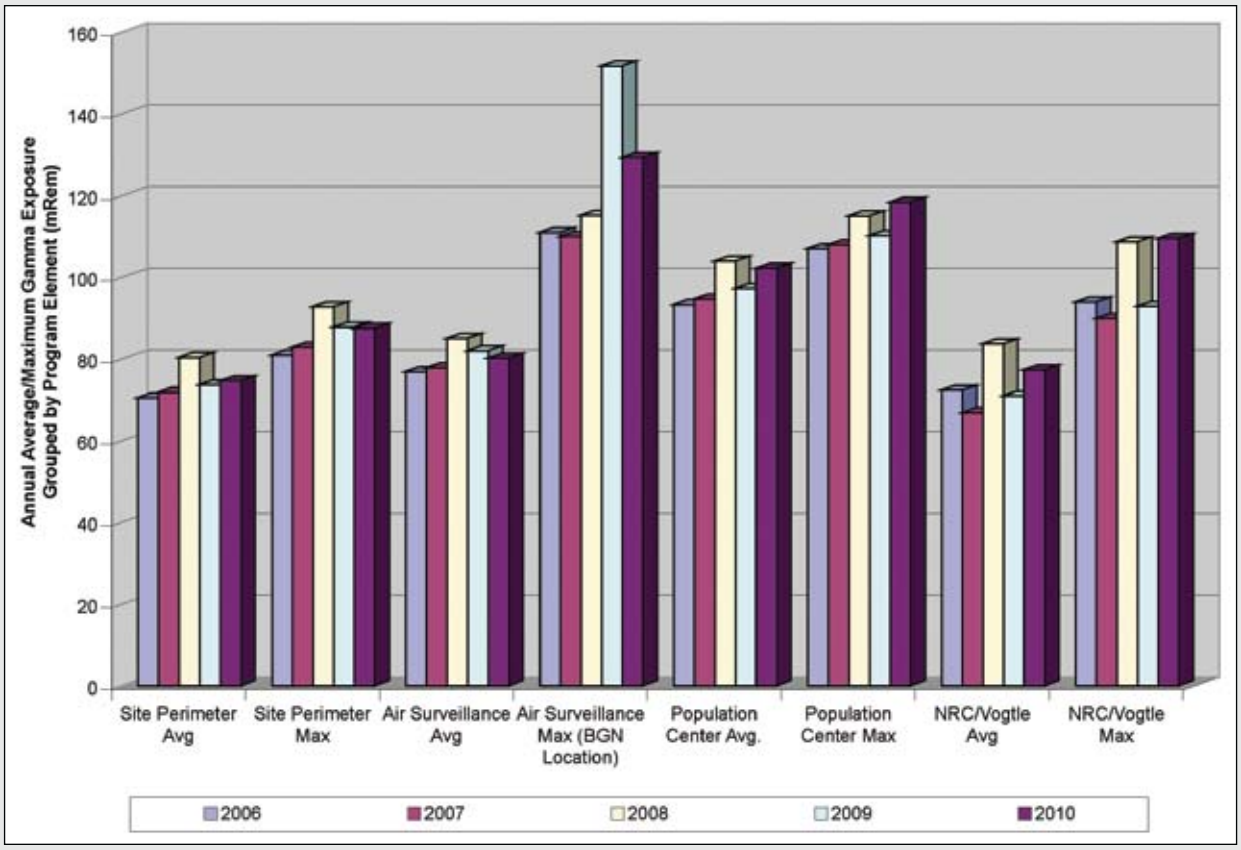


**Figure 5–4 Five-Year Trend of Ambient Annual Average and Maximum Gamma Exposure Levels (in mrem)**

## Streams

### Description of Surveillance Program

Continuous surveillance monitoring of SRS streams is utilized downstream of several process areas to detect and quantify levels of radioactivity in effluents transported to the Savannah River. The five primary streams are Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs. The frequency and types of analyses performed on each sample are based on potential quantity and types of radionuclides likely to be present at the sampling location.

### Surveillance Results Summary

The average 2010 concentrations of gross alpha, gross beta, and tritium in SRS streams are presented in table 5–3. Detectable concentrations of tritium, the predominant radionuclide detected above background levels in SRS streams, were observed at least once at all stream locations in 2010, except at Upper Three Runs–1A (the stream control point). When comparing stream tritium averages for 2010 and 2009, some were slightly higher and others were slightly lower; however, there were no statistically significant differences between the averages of the two years. Overall, tritium concentrations in SRS streams during 2010 were consistent with long-term tritium levels.

Cesium-137 was detected in four of the five major SRS streams at least once—Upper Three Runs, Fourmile Branch, Pen Branch, and Steel Creek. Gross alpha and gross beta activity was detected in all the streams, but concentrations were consistent with levels of recent years. Other radionuclides were observed at locations throughout the site, but were consistent with the source of the material—and exhibited variations similar to those of previous years. No significant trends were observed in 2010 when compared with recent years (data table 5–8), and in most cases, averages were less than 1 pCi/L.

### Seepage Basin and Solid Waste Disposal Facility Radionuclide Migration

To incorporate the migration of radioactivity to site streams into total radioactive release quantities,

**Environmental Monitoring Field Technician Collects Sample from Automated ISCO Sampler at Sampling Location Four Mile–2B**

Environmental Monitoring group personnel continued to monitor and quantify the migration of radioactivity from site seepage basins and the Solid Waste Disposal Facility (SWDF) in 2010 as part of its stream surveillance program. Tritium, strontium-89,90, technetium-99, iodine-129, and cesium-137 were detected in migration releases (data table 5–9).

Figure 5–5 is a graphical representation of releases of tritium via migration to site streams for the years 2001–2010. As can be seen in the figure, migration releases of tritium generally have declined the past 10 years, with year-to-year variability caused mainly by the amount of annual rainfall. Accordingly, during 2010, the total quantity of tritium migrating from site seepage basins and SWDF was 1,058 Ci compared to 1,321 Ci in 2009.

Radioactivity previously deposited in the F Area and H Area seepage basins and SWDF continues to migrate through the groundwater and to outcrop into Fourmile Branch and Upper Three Runs. Groundwater migration from the F Area Seepage basins enters Fourmile Branch between locations FM–3A, FM–2B, and FM–A7. Because of their proximity, migration from the SWDF cannot be distinguished from migration from a part of H Area Basin 4. Estimated migration of tritium into Fourmile Branch in 2010 occurred as follows:

- from F Area seepage basins, 34 Ci—a 26-percent increase from the 2009 total of 27 Ci
- from SWDF and a part of H Area seepage basin 4, 381 Ci—a 28-percent decrease from the 2009 total of 532 Ci
- from H Area seepage basins 1, 2, 3, and most of 4, 85 Ci—a 37-percent decrease from the 2009 total of 135 Ci

The estimated migration from the north side of SWDF and the General Separations Area (GSA) into Upper Three Runs in 2010 was 69 Ci, compared with the 2009 total of 68 Ci—a fluctuation consistent with historical results. (The GSA is in the central part of SRS and contains all waste disposal facilities, chemical separations facilities, and associated high-level waste storage facilities, along with numerous other sources of radioactive material.)

**Table 5–3 Average 2010 Concentrations of Radioactivity in SRS Streams**

| Location | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | Tritium (pCi/L) |
|---|---|---|---|
| *Onsite Downstream Locations* | | | |
| Tims Branch (TB–5) | 1.80E +01 | 6.23E +00 | 4.07E +02 |
| Lower Three Runs (L3R–3) | 3.06E +00 | 2.11E +00 | 2.60E +02 |
| Steel Creek (SC–4) | 2.09E +00 | 2.02E +00 | 2.83E +03 |
| Pen Branch (PB–3) | 8.42E -01 | 1.07E +00 | 3.56E +04 |
| Fourmile Branch (FM–6) | 6.95E -01 | 6.66E +00 | 4.03E +04 |
| Upper Three Runs (U3R–4) | 8.33E +00 | 2.90E +00 | 1.02E +03 |
| *Onsite Control Location (for comparison purposes)* | | | |
| Upper Three Runs (U3R–1A) | 4.74E +00 | 1.94E +00 | 1.93E +02 |

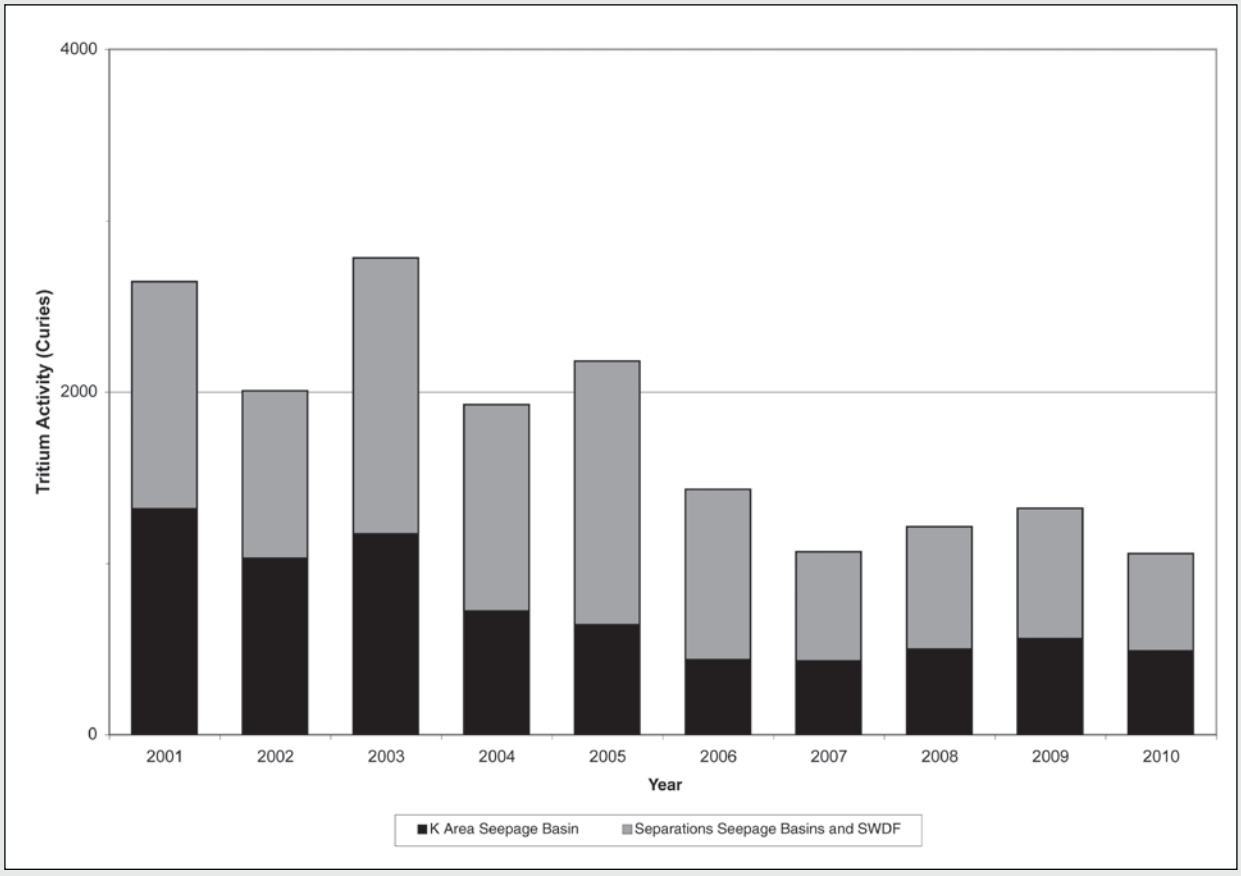


**Figure 5–5 Estimated Tritium Migration from SRS Seepage Basins and SWDF to Site Streams, 2001–2010**

The total amount of strontium-89,90 entering Fourmile Branch from the GSA seepage basins and SWDF during 2010 was estimated to be 26 mCi (table 5–4). Migration releases of strontium-89,90 vary from year to year but have remained below 100 mCi the past 8 years. In 2010, 13 mCi of technetium-99, 23 mCi of iodine-129, and 37 mCi of cesium-137 were estimated to have migrated into Fourmile Branch (table 5–4).

**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. From 1960 until 1992, purges from the K Area disassembly basin were discharged to a percolation field below the K Area retention basin. Tritium migration from the seepage basin and the percolation field is measured annually in Pen Branch. The 2010 estimated migration total of 489 Ci represents a 12.5-percent decrease from the 559 Ci recorded in 2009.

**C Area, L Area, and P Area Seepage Basins** Liquid purges from the C Area, L Area, and P Area disassembly basins were released periodically to their respective seepage basins from the 1950s until 1970. Migration releases from these basins are accounted for in the stream transport totals (see "Tritium Transport in Streams" section of this chapter).

## Migration of Actinides in Streams

Migration of the actinides uranium, plutonium, americium, and curium into site streams no longer is quantified because of the actinides' historically low levels. However, the streams are sampled and analyzed annually for the presence of these actinides. The resulting concentrations are compared to those of previous years to identify any trends. Overall, values for 2010 were consistent with historical data, and generally remained at or below the analytical MDC.

**Table 5–4 Strontium-89,90, Technetium-99, Iodine-129, and Cesium-137 Migration Estimates**

| Radionuclide | Total Activity (millicuries) |
|---|---|
| Strontium-89,90 | 26 |
| Technetium-99 | 13 |
| Iodine-129 | 23 |
| Cesium-137 | 37 |

[a] 1 millicurie = 0.001 Curie

## Savannah River

### Description of Surveillance Program

Continuous surveillance is performed along the Savannah River at locations above and below SRS tributaries, including a location at which liquid discharges from VEGP enter the river.

### Surveillance Results Summary

Five locations along the river continued to serve as environmental surveillance points in 2010. Composite samples are collected weekly at the five river locations and analyzed for gross alpha, gross beta, tritium, and gamma-emitting radionuclides (data table 5–10). The average 2010 concentrations of gross alpha, gross beta, and tritium at river locations are presented in table 5–5. Based on curies (of activity) released, tritium is the predominant radionuclide detected above background levels in the Savannah River. The combined SRS and VEGP tritium concentrations at Savannah River Mile (RM) 118.8 decreased by 12 percent, from 2,350 Ci in 2009 to 2,060 Ci in 2010. These concentration levels are well below the EPA drinking water standard. Detectable levels of gross alpha and gross beta activity were observed at all river sampling locations and were consistent with the averages of the previous 5 years. Cesium-137 was detected in one out of the 265 weekly composite river samples for 2010.

In addition to the weekly composite samples referenced above, SRS collects annual grab samples to provide a more comprehensive suite of radionuclides (strontium-89,90, technetium-99 and actinides). Uranium-234, uranium-238 and americium-241 were quantified in all these grab samples from RM 118.8 and several other locations in 2010. Results were consistent with the averages of the previous 5 years.

## Tritium Transport in Streams

Tritium is introduced into SRS streams and the Savannah River from former production areas on site. Because of the mobility of tritium in water and the quantities of the radionuclide released during the years of SRS operations, a tritium balance has been performed annually since 1960. SRS tritium transport data for 1960–2010 are depicted in figure 5–6, which shows the history of direct releases, stream transport, and river transport, as determined by Environmental Monitoring personnel. The history of tritium transport at SRS is documented in data table 5–11. The balance is evaluated among the following alternative methods of calculation:

- total direct tritium releases, including releases from (1) facility effluent discharges and (2) measured migration of tritium from site seepage basins and SWDF migration (direct releases)
- tritium transport in SRS streams, measured at the last sampling point before entry into the Savannah River (stream transport)
- tritium transport in the Savannah River, measured downriver of SRS (near RM 118.8) after subtraction of any measured contribution above the site (river transport)

The *direct releases* of tritium in 2010 decreased by approximately 18-percent (from 1,559 Ci in 2009 to 1,285 Ci in 2010).

The *stream transport* of tritium in 2010 decreased by approximately 5-percent (from 1,271 Ci in 2009 to 1,205 Ci in 2010).

**Table 5–5 Average 2010 Concentrations of Radioactivity in the Savannah River**

| Location | Gross Alpha (pCi/L) | Gross Beta (pCi/L) | Tritium (pCi/L) |
|---|---|---|---|
| RM–160.0 | 3.83E-01 | 2.20E+00 | 9.83E+01 |
| RM–150.4 | 9.28E-01 | 2.73E+00 | 6.34E+02 |
| RM–150.0 | 3.86E-01 | 2.22E+00 | 2.77E+02 |
| RM–141.5 | 4.87E-01 | 2.19E+00 | 3.62E+02 |
| RM–118.8 | 4.64E-01 | 2.35E+00 | 3.49E+02 |

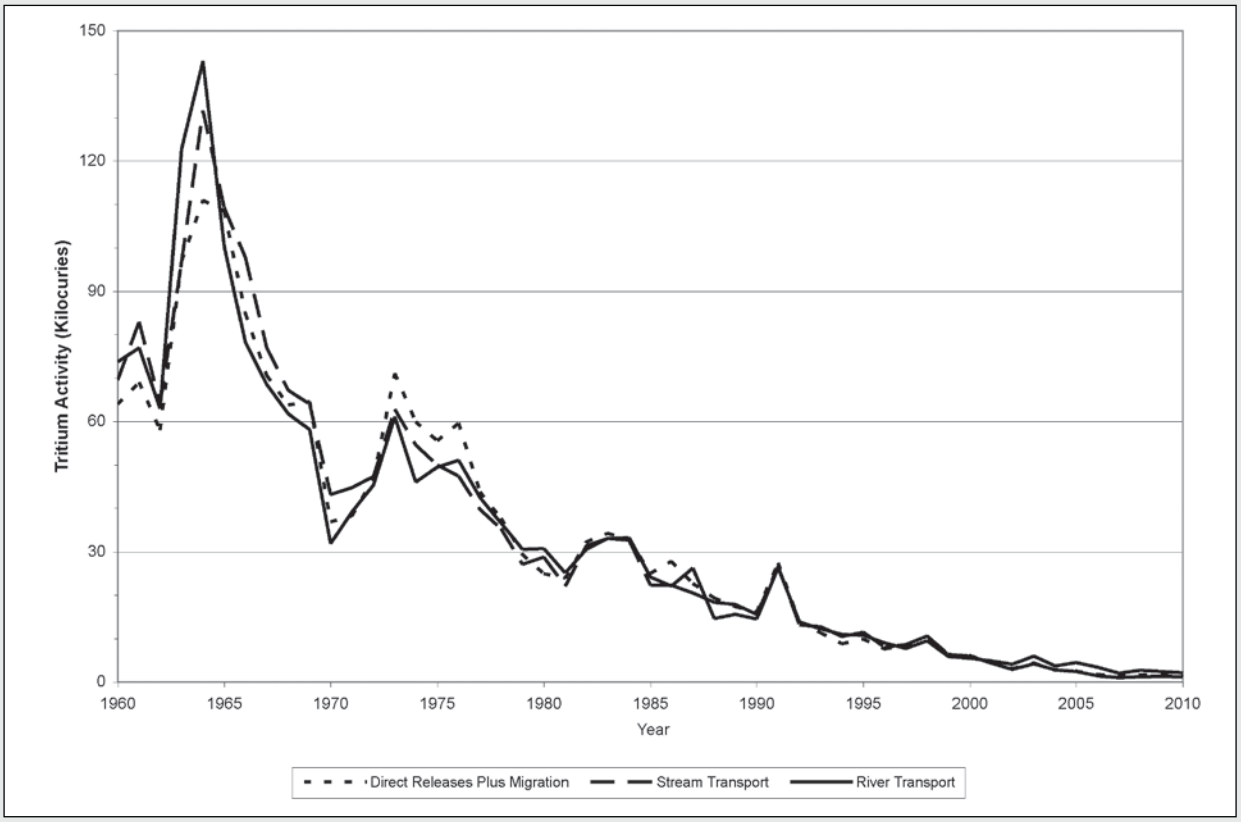


**Figure 5–6 SRS Tritium Transport Summary, 1960–2010**
SRS has maintained a tritium balance of direct releases plus migration, stream transport, and river transport since 1960 in an effort to account for and trend tritium releases in liquid effluents from the site. The general trend over time is attributable to (1) variations in tritium production at the site (production discontinued in the late 1980s); (2) the implementation of effluent controls, such as seepage basins, beginning in the early 1960s; and (3) the continuing depletion and decay of the site's tritium inventory.

The *river transport* of tritium estimated in the Savannah River in 2010 was 2,058 Ci, compared with the previous year's 2,350 Ci. Both VEGP and SRS contributed to these values.

As it has during the past several years, a small but measurable amount of tritium from earlier Energy*Solutions* LLC (formerly Chem-Nuclear Systems) low-level radioactive waste disposal facility operations entered the stream system in 2010. The facility is privately owned and located adjacent to SRS. The amount of tritium entering the system is expected to continue a gradual decline over time. Energy*Solutions* LLC began a program of capping the tritium sources in 1991, thereby reducing the amount of tritium entering the groundwater. The tritium currently in groundwater will continue to decay and dilute as it moves from the source toward Lower Three Runs. Environmental Monitoring and Energy*Solutions* will maintain a monitoring program for Lower Three Runs to evaluate this tritium migration.

## Domestic Water

### Description of Surveillance Program

Environmental Monitoring personnel collected domestic water samples in 2010 from locations at SRS and at water treatment facilities that use Savannah River water. Potable water was analyzed at offsite treatment facilities to ensure that SRS operations did not adversely affect the water supply and to provide voluntary assurance that drinking water did not exceed EPA drinking water standards for radionuclides.

Onsite domestic water sampling consisted of quarterly grab samples at large treatment plants in A Area, D Area, and K Area and annual grab samples at wells and small systems. Composite samples were collected monthly off site from

- the Beaufort-Jasper Water and Sewer Authority's Chelsea and Purrysburg Water Treatment Plants
- the City of Savannah Industrial and Domestic Water Supply Plant

**Environmental Monitoring Field Technician Collects Drinking Water Samples from Beaufort/ Jasper Purrysburg Plant**

- the North Augusta (South Carolina) Water Treatment Plant

### Surveillance Results Summary

All onsite and offsite domestic water samples collected by Environmental Monitoring in 2010 were screened for gross alpha and gross beta concentrations to determine if regulatory limits are exceeded. No domestic water exceeded EPA's 15-pCi/L alpha activity limit or 50-pCi/L beta activity limit. Also, no onsite or offsite domestic water samples exceeded the 20,000-pCi/L EPA tritium limit or the 8-pCi/L strontium-89,90 MDC.

No cesium-137, uranium-235, plutonium-239, or curium-244 was detected in any domestic water samples in 2010. For the 14 onsite samples, detectable levels were observed for strontium-89,90 in two samples, plutonium-238 in seven samples, americium-241 in one sample, uranium-234 in five samples, and uranium-238 in two samples (data table 5–12).

## Terrestrial Food Products

### Description of Surveillance Program

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 the effects, if any, that SRS operations have on them. These foods include milk, meat (beef), fruit (melons or peaches), and green vegetables (collards). 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 validate dose models and determine environmental trends.

Samples of food—including meat, fruit, and a green vegetable—are collected from one location within each of four SRS quadrants and from a location within an extended (to 25 miles beyond the perimeter) southeast quadrant. All food samples are collected annually except milk, which is collected quarterly from six dairies within a 25-mile radius of the site. The food product surveillance program was expanded in 2005 to include secondary crops on a rotating schedule. Cabbage was sampled in 2010 as part of this program. Wheat originally was scheduled to be collected during 2010 as a rotational crop, but was unavailable in all quadrants. Food samples typically are analyzed for the presence of gamma-emitting radionuclides, tritium, strontium-89,90, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239, americium-241, curium-244, gross alpha activity, and gross beta activity. Technetium-99 was added to analytical suite in 2009, and neptunium in 2010.

### Surveillance Results Summary

Terrestrial food product results for collards, cabbage, fruit, and beef appear in data table 5–13; results for milk appear in data table 5–14.

The only gamma-emitting radionuclide detected in food products in 2010 was cesium-137, as follows:

- collards from the northwest and southwest quadrants (0–10 miles from the site)
- cabbage from the northwest and southeast quadrants (0–10 miles from the site)
- fruit from the plant perimeter northwest quadrant
- one milk sample from Barnwell

The levels were consistent with levels observed historically.

Strontium-89,90 was detected in collards and cabbage at all five locations, in milk at two locations (Denmark, South Carolina, and McBean, Georgia), and in fruit at one location (plant perimeter northeast quadrant). Uranium-234 was detected in collards and cabbage at all locations, in fruit at the plant perimeter northeast quadrant, and in beef at the northeast and southwest quadrants 0–10 miles from the site. Uranium-235 was detected in collards at the southeast quadrant 0–10 miles from the site, and cabbage at the northeast, northwest, and southeast quadrants 0–10 miles from the site. Uranium-238 was detected in collards and cabbage

at all locations, in beef at the northeast, northwest, and southeast quadrants 0–10 miles from the site, and in fruit at the plant perimeter northwest quadrant. Plutonium-239 was detected in cabbage at the northeast quadrant 0–10 miles from the site. Curium-244 was detected in beef at the southwest quadrant 0–10 miles from the site. Technetium-99 was detected in cabbage and collards at all locations and in beef at the northeast and northwest quadrants 0–10 miles from the site and at the southeast quadrant 25 miles from the site. Detectable levels of gross beta activity were observed in all food products, while no detectable levels of gross alpha were observed in any of the food products. The 2010 results appeared to be randomly distributed among the monitoring locations, and no underlying spatial distribution was observed.

Tritium in food products is attributed primarily to releases from SRS. Tritium was detected during 2010 in cabbage at four locations from all four quadrants 0–10 miles from the site, in collards at the northeast, southeast, and southwest quadrants 0–10 miles from the site, in fruit at the southeast quadrant 25 miles from the site, and in beef at the northwest quadrant 0–10 miles from the site.

All radiological results on terrestrial food products were consistent with those of previous years.

## Aquatic Food Products

### Description of Surveillance Program

The aquatic food product surveillance program includes fish (freshwater and saltwater) and shellfish. To determine the potential dose and risk to the public from consumption, both types are sampled. Because of a die-off attributed to cold weather in December 2009 and January 2010, no spotted sea trout could be collected. Nine surveillance points for the collection of freshwater fish are located on the Savannah River—from above SRS at Augusta, Georgia, to the coast at Savannah. Composite samples—comprised of three to five fish of a given species—are prepared for each species from each location. Freshwater fish are grouped into one of three categories: bass, panfish (bream), or catfish. Saltwater fish include composites of sea trout, red drum (spottail bass), and mullet. The fish are selected for sampling because they are the most sought-after fish in the Savannah River. Composites are divided into edible (meat and skin only) and nonedible (scales, head, fins, viscera, bone) portions; however, catfish are skinned, and the skin becomes part of the nonedible composite. Analyses conducted on edible and nonedible composites include tritium, gross alpha, gross beta, gamma emitting radionuclides, strontium-89,90, technetium-99, iodine-129, and the actinide series (uranium-234, uranium-235, and uranium-238; neptunium-237; plutonium-238 and plutonium-239; americium-241; and curium-244).

### Surveillance Results Summary

Aquatic food product results for saltwater fish appear in data table 5–15; for freshwater fish, data table 5–16; and for shellfish, data table 5–17.

Gross alpha activity was detected in one nonedible saltwater fish composite of marine mullet at the mouth of the Savannah River; all other saltwater and freshwater edible and nonedible fish composites were below their respective MDCs for gross alpha activity. Gross beta activity was detectable at all locations and was attributed primarily to the naturally occurring radionuclide potassium-40. Cesium-137 and iodine-129 were the only manmade gamma-emitting radionuclide found in Savannah River edible and nonedible fish composites during 2010. Strontium-89,90, uranium-234, uranium-238, plutonium-238, and tritium were detected in freshwater fish at most of the river locations. Concentrations were similar to those of previous years. For the edible fish composites, technetium-99 was detected at 12 river locations and both plutonium-238 and uranium-238 were detected at one river location. Uranium-234, uranium-235, uranium-238, iodine-129, and strontium-89,90 were detected in saltwater fish.

Gross alpha and gross beta activity was detected in shellfish at levels that have been observed historically. Strontium-89,90, uranium-234, uranium-235, uranium-238, and curium-244 also were detected in shellfish. Concentrations were similar to those of previous years.

**Freshwater Fish Collected During Fish Sampling Run**

Calculations of risk from the consumption of fish from the Savannah River can be found in chapter 6 ("Potential Radiation Doses").

## 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, Environmental Monitoring personnel use portable sodium iodide detectors to perform field analyses for cesium-137. 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. SRS established an administrative dose limit of 30 mrem per year in 2006 for the consumption of game animals. This limit, which ensures that no single pathway contributes more than 30 percent to the all-pathway dose limit of 100 mrem, is consistent with DOE guidance. The doses from deer and hog consumption are quantified and reported in chapter 6.

### Surveillance Results Summary

A total of 502 deer and 107 feral hogs were taken during the 2010 site hunts. 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 from all animals ranged from 1 pCi/g to 2.99 pCi/g, while lab measurements ranged from 1 pCi/g to 3.35 pCi/g. The average field cesium-137 concentration was 1.00 pCi/g in deer (with a maximum of 2.99 pCi/g) and 1.00 pCi/g in hogs (with a maximum of 2.14 pCi/g). This range of concentrations is slightly below normal for the site's deer and hog populations. Maximum cesium-137 concentrations in wildlife (deer and hogs) have indicated an overall decreasing trend, as shown in figure 5–7. Average cesium-137 concentrations in deer and hogs for the past five years reveal a similar decreasing trend, as shown in figure 5–8.

The muscle and bone samples from a subset of the animals returned to the lab for cesium-137 analysis

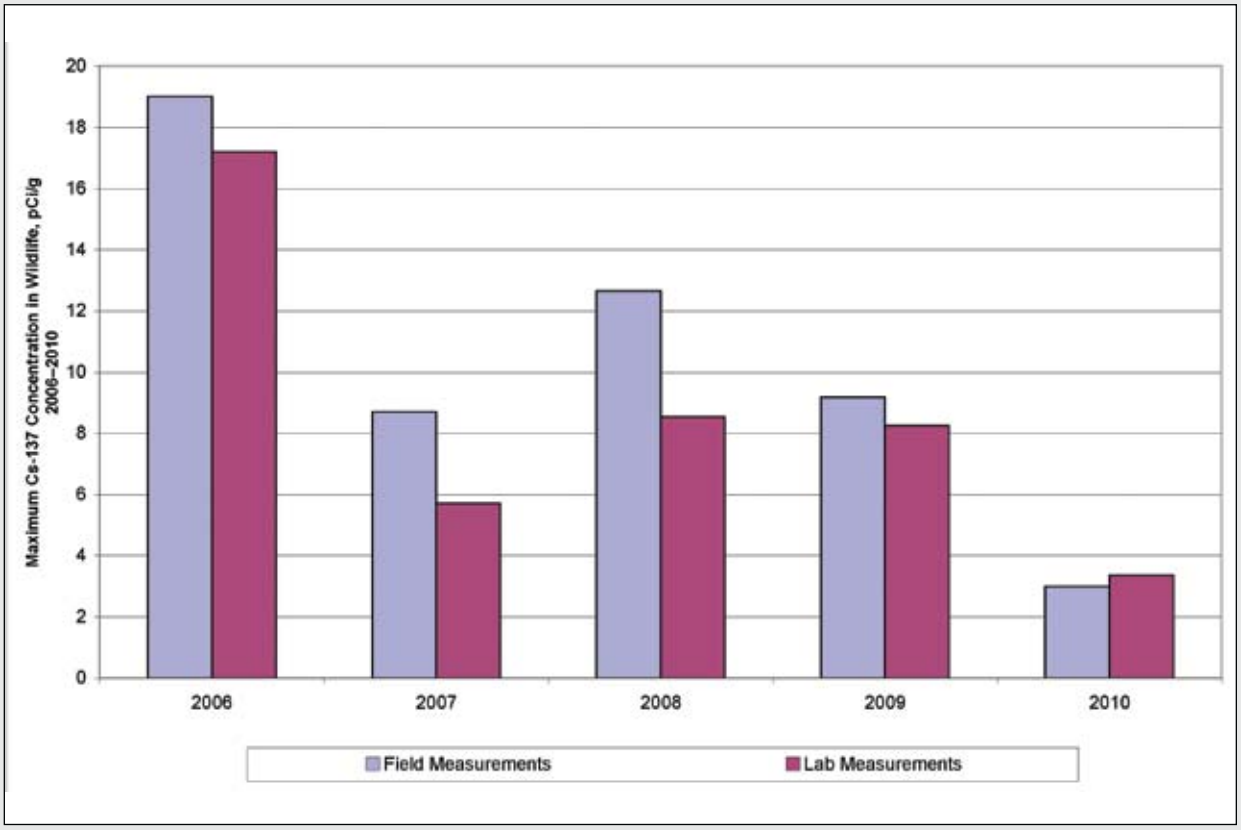


**Figure 5–7 Maximum Cesium-137 Concentrations in Wildlife Field and Lab Measurements (pCi/g), 2006–2010**

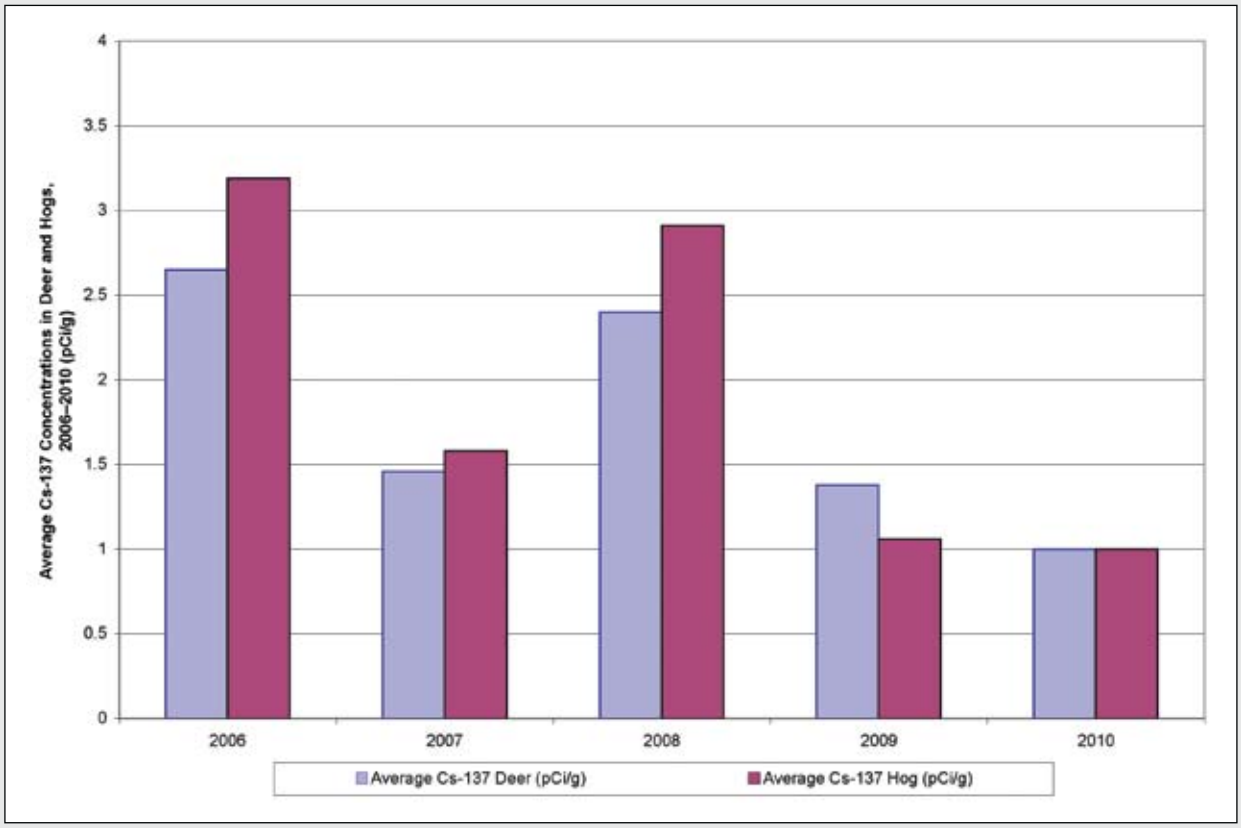


**Figure 5–8 Average Cesium-137 Concentrations in Deer and Hogs (pCi/g), 2006–2010**

also are analyzed for strontium-89,90. Because of its chemistry, strontium is more readily measured in bone than in muscle tissue. In 2010, strontium-89,90 was detected in 33 of 73 deer muscle tissue samples; none was detected in hog muscle tissue samples. These positive results for deer tissue samples were slightly above the MDC for strontium. Lab measurements of strontium-89,90 in bone ranged from below the MDC to 8.78 pCi/g in deer. No strontium-89,90 was detected in any of the hog bone samples for 2010. These results are similar to those of previous years.

## Turkeys/Beavers

### Description of Surveillance Programs

SRS hosted a special turkey hunt during April 2010 for hunters with mobility impairments. Forty-two turkeys were harvested. The average cesium-137 concentration measured in the field was 1.30 pCi/g, which is comparable with the results from previous special hunts.

The U.S. Department of Agriculture Forest Service–Savannah River (USFS–SR) harvests beavers in selected areas within the SRS perimeter to reduce the population and thereby minimize dam-building activities that can result in flood damage to timber stands, to primary and secondary roads, and to railroad beds. USFS–SR harvested 17 beavers in FY2010 from six locations. Because none of these animals were taken from suspect radiological areas, no monitoring was performed, and they were disposed of in an onsite landfill.

## Soil

### Description of Surveillance Program

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

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. Therefore, a direct comparison of data from year to year is not appropriate. However,

**Soil Sampling at Aiken Airport Location**

the data are available in previous environmental reports and can be evaluated over a period of years to determine and analyze long-term trends.

Hand augers or other similar devices are used in soil sample collection to a depth of 3 inches. The samples are analyzed for gamma-emitting radionuclides, strontium-89,90, and the actinides.

### Surveillance Results Summary

In 2010, radionuclides were detected in soil samples from all 21 sampling locations (five onsite, 12 at the perimeter, and four offsite), as follows:

- cesium-137 at 15 locations (two onsite, nine perimeter, four offsite)
- uranium-234 at all 21 locations
- uranium-235 at all 21 locations
- uranium-238 at all 21 locations
- neptunium-237 at five locations (two onsite, three offsite)
- plutonium-238 at eight locations (three onsite, one perimeter, four offsite)
- plutonium-239 at 13 locations (five onsite, four perimeter, four offsite)
- strontium-89,90 at four locations (three perimeter, one offsite)
- americium-241 at five locations (two onsite, two perimeter, one offsite)
- curium-244 at four locations (one onsite, three perimeter)

The concentrations at these locations are consistent with historical results (data table 5–18). Uranium is naturally occurring in soil and therefore expected to be present in soil samples.

## Settleable Solids

### Description of Surveillance Program

Settleable-solids monitoring in effluent water is required to determine—in conjunction with routine sediment monitoring—whether a long-term buildup of radioactive materials occurs in stream systems.

DOE limits on radioactivity levels in settleable solids are 5 pCi/g above background for alpha-emitting radionuclides and 50 pCi/g above background for beta/gamma-emitting radionuclides.

Low total suspended solids (TSS) levels result in a small amount of settleable solids, so an accurate measurement of radioactivity levels in settleable solids is not practical. Based on this, an interpretation of the radioactivity-levels-in-settleable-solids requirement was provided to SRS by DOE in 1995. The interpretation indicated that TSS levels below 40 parts per million (ppm) were considered to be in de-facto compliance with the DOE limits.

To determine compliance with these limits, Environmental Monitoring uses TSS results—gathered as part of the routine National Pollutant Discharge Elimination System (NPDES) monitoring program—from outfalls colocated at or near radiological effluent points. If an outfall shows that TSS levels regularly are greater than 30 ppm, a radioactivity-levels-in-settleable-solids program and an increase in sediment monitoring is implemented.

### Surveillance Results Summary

In 2010, no NPDES TSS sample result exceeded 30 ppm. The highest result was 24 ppm (24 mg/L), collected in April at outfall D–1D. The 2010 NPDES TSS results indicate that overall, SRS remains in compliance with the DOE radioactivity-levels-in-settleable-solids requirement.

## Sediment

### Description of Surveillance Program

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—or because of slight variations in sampling locations—but the data obtained can be used to observe long-term environmental trends.

Sediment samples were collected at eight Savannah River and 19 onsite stream locations in 2010.

### Surveillance Results Summary

Cesium-137 was the only manmade gamma-emitting radionuclide observed in river and stream sediments during 2010. The highest cesium-137 concentration in streams, 105 pCi/g, was detected in sediment from R-Canal (100–R Location); the lowest levels were below detection at nine locations. The highest level from the river, 0.59 pCi/g, was at River Mile 129; the lowest levels were below detection at five locations. Generally, cesium-137 concentrations were 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 swamp areas along the river.Strontium-89,90 was above the MDC in sediment at 11 stream locations in 2010. The maximum detected value was 2.00 pCi/g at the Fourmile Branch Swamp Discharge location.

Plutonium-238 was detected in sediment during 2010 at 10 stream locations and two river locations. The results ranged from a maximum of 1.04 pCi/g at FM–2A at Road 4 to below the MDC at several locations. Plutonium-239 was detected in sediment at 15 stream locations and one river location. The maximum value was 0.0075 pCi/g—at FM–A7A. Uranium-234, uranium-235, and uranium-238 were detected at most locations; the maximum values were 2.47 pCi/g, 0.125 pCi/g, and 2.52 pCi/g, respectively—all at U3R–1A.

The distribution and concentration of radionuclides in river sediment during 2010 were similar to those of previous years (data table 5–19).

Concentrations of all isotopes generally were higher in streams than in the river. As indicated in the earlier discussion of cesium-137, this is to be expected. 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.

## Grassy Vegetation

### Description of Surveillance Program

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 soil and sediment samples to determine the environmental accumulation of radionuclides and to help validate SRS dose models. Vegetation can be contaminated externally by the deposition of airborne radioactive contaminants and internally by uptake, from soil or water, by the roots. Bermuda grass is preferred because of its importance as a pasture grass for dairy herds.

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
- all air sampling locations

**Environmental Monitoring Field Technician Collects Vegetation**

Vegetation samples are analyzed for tritium, gross alpha, gross beta, gamma-emitting radionuclides, strontium-89, 90, and the actinides.

### Surveillance Results Summary

All vegetation surveillance samples are based on dry weight. Radionuclides in the grassy vegetation samples collected during 2010 were detected in all 17 locations (one onsite, 11 at the perimeter, and four offsite), as follows:

- tritium at six locations (one onsite, five perimeter)
- cesium-137 at four locations (perimeter)
- strontium-89,90 at all 17 locations
- uranium-234 at 13 locations (10 perimeter and three offsite)
- uranium-235 at two locations (perimeter)
- uranium-238 at all 17 locations
- plutonium-238 at 12 locations (nine perimeter and three offsite)
- plutonium-239 at one location (perimeter)
- neptunium-237 at 10 locations (one onsite, five perimeter, and four offsite)
- technetium-99 at all 17 locations
- gross beta at all 17 locations

Overall results show a slight increase in radionuclide concentrations from the past several years, but remain consistent with historical results (data table 5–20).

## Savannah River Swamp Surveys

### Description of Surveillance Program

The Creek Plantation, a privately owned land area located along the Savannah River, borders part of the southern boundary of SRS. In the 1960s, an area of the Savannah River Swamp on Creek Plantation—specifically, the area between Steel Creek Landing and Little Hell Landing—was contaminated by SRS operations. During high river levels, water from Steel Creek flowed along the lowlands comprising the swamp, resulting in the deposition of radioactive material. SRS studies estimated that a total of approximately 25 Ci of cesium-137 and 1 Ci of cobalt-60 were deposited in the swamp.

Comprehensive and cursory surveys of the swamp have been conducted periodically since 1974. These surveys measure radioactivity levels to determine changes in the amount and/or distribution of radioactivity in the swamp. A series of 10 sampling trails—ranging from 240 to 3,200 feet in length—was established through the swamp. Fifty-four monitoring locations were designated on the trails to allow for continued monitoring at a consistent set of locations [Fledderman, 2007].

The 2010 survey was designated as a cursory survey, requiring limited media sampling and analysis. Cursory surveys provide assurance that conditions observed during the more detailed comprehensive surveys have not changed significantly. A comprehensive survey (requiring extensive media sampling and analyses) was conducted in 2007 and is planned again for 2012.

### Surveillance Results Summary

As anticipated, based on source term information and historical survey results, cesium-137 was the primary manmade radionuclide detected in the 2010 survey. Cesium-137 was detected in all 40 soil samples while no cobalt-60 was detected in any of these samples. Cesium-137 concentrations varied from a minimum of 0.21 pCi/g to a maximum of 60.4 pCi/g. These levels are comparable with those from previous surveys (data table 5–21). The highest concentrations occurred on trails 1, 2, 4, and 5 (figure 5–9), and concentrations generally decreased with depth. Stronium-89,90 was detected in 23 of the 40 soil samples. The activity ranged from 61.1 pCi/kG to 1,290 pCi/kG.

Cesium-137 was detected in seven of the 10 vegetation samples while no cobalt-60 was detected in any of these samples. Detectable concentrations varied from a minimum of 0.62 pCi/g to a maximum of 10.9 pCi/g. These levels are comparable to results of previous surveys (data table 5–21). Higher concentrations generally were observed on trails 1 and 6 (figure 5–10). Strontium-89,90 was detected in all 10 vegetation samples. The activity ranged from 88.6 pCi/kG to 1,080 pCi/kG.

TLD sets were placed at 54 monitoring sites in the swamp during 2010 to determine ambient gamma exposure rates, and all were retrieved. The exposure time varied from 64 to 69 days. The gamma exposure rates ranged from 0.19 to 0.55 mrem/day, which is consistent with the ranges observed historically (data table 5–22). The highest exposure rates were measured on trails 1, 4, 5, and 9 (figure 5–11). This follows trends observed in previous surveys and in the soil results.

# Nonradiological Surveillance

## Air

SRS does not conduct onsite surveillance for nonradiological ambient air quality. However, to ensure compliance with SCDHEC air quality regulations and standards, SRNL conducted air dispersion modeling for all site sources of criteria pollutants and toxic

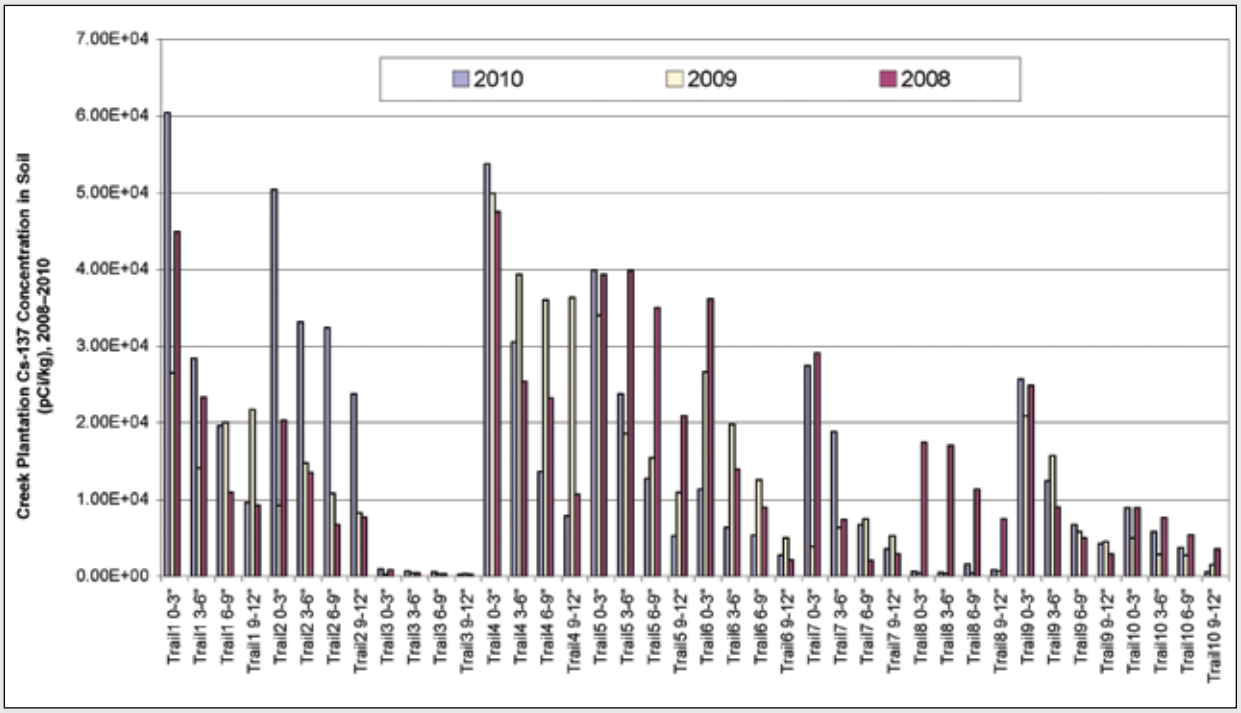


**Figure 5–9 Three-Year Trend Chart of Cesium-137 Concentrations in Soil (pCi/kg)**

air pollutants in 2010. 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 pollutants and toxic air pollutants has demonstrated continued compliance by the site with current applicable 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.

SRNL sponsors a monitoring and collection station in support of the National Mercury Deposition Network of the National Atmospheric Deposition Program (NADP). This network provides data on the geographic distributions and trends of mercury in precipitation. It is the only network providing a long-term record of mercury concentrations in North American precipitation. All monitoring sites follow standard procedures and have uniform precipitation collectors and gauges. In 2009 (the last year for which data is available), the SRNL monitoring station (SC03) was one of 109 sites that satisfied NADP completeness criteria for national mapping of total mercury concentration and wet deposition. Data from this station indicated that the average (volume-weighted) concentration of total mercury in precipitation in 2009 was 8.4 ng/L, and the wet deposition rate was 10.0 µg/m$^2$. Data from 2010 will not be available until the fall of 2011. Additional information on this network is accessible via the following link: http://nadp.sws.uiuc.edu/mdn/.

## Surface Water

SRS streams and the Savannah River are classified by SCDHEC as "Freshwaters," which 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/propagation of a balanced indigenous aquatic community of fauna and flora
- industrial and agricultural uses

Appendix A ("Applicable Guidelines, Standards, and Regulations") of this report provides some of the specific standards used in water quality surveillance, but because not all the standards are quantifiable, they are not tracked at SRS.

### Surveillance Results Summary

Water quality parameters were measured at all 16 sampling locations in site streams and along the Savannah River during 2010, and metals were detected in at least one sample at each location. No samples had detectable pesticides/herbicides. These results continue

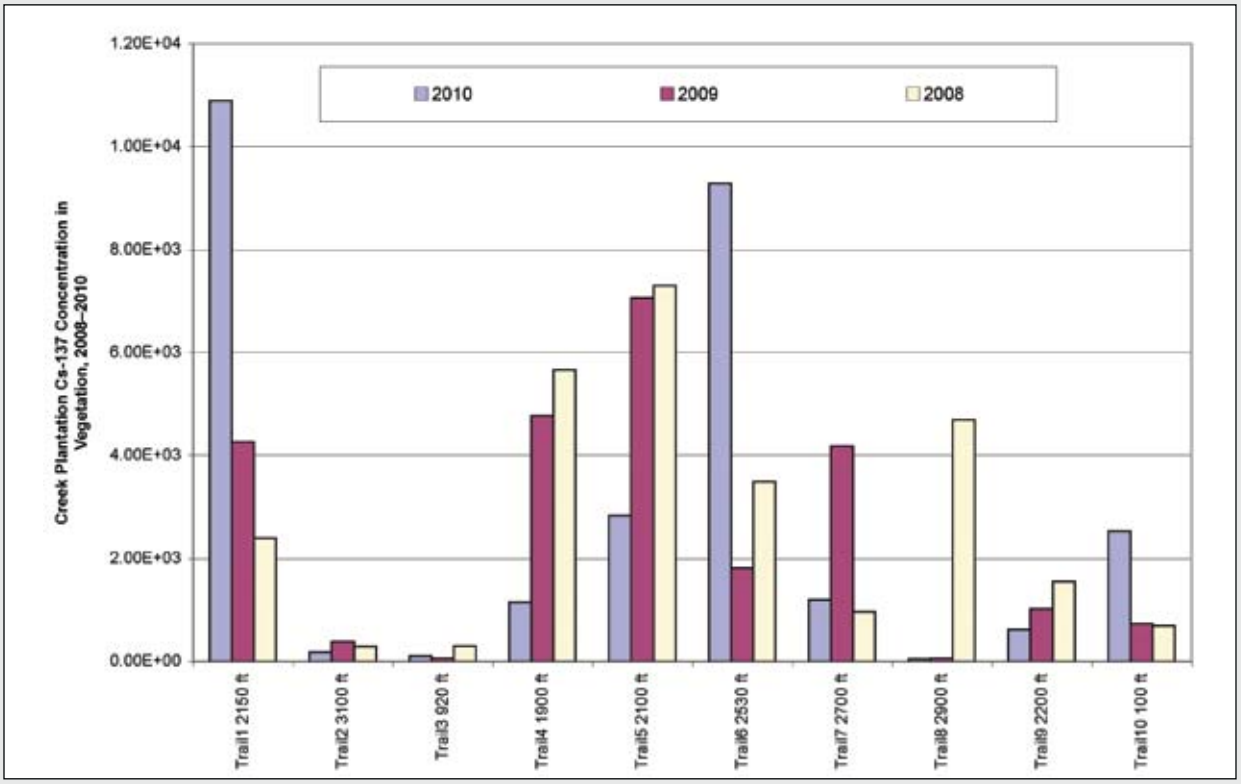


**Figure 5–10 Three-Year Trend Chart of Cesium-137 Concentrations in Vegetation (pCi/kg)**

to indicate that SRS discharges are not significantly affecting the water quality of onsite streams or the river (data table 5–23).

## Drinking Water

Most of the drinking water at SRS is supplied by three systems that have treatment plants in A Area, D Area, and K Area. The site also has 14 small drinking water facilities, each of which serves populations of fewer than 25 persons.

### Surveillance Results Summary

All samples collected from SRS drinking water systems during 2010 were in compliance with SCDHEC and EPA water quality standards. Additional information is provided in the Safe Drinking Water Act section of chapter 3, "Environmental Compliance."

## Sediment

The site's nonradiological sediment surveillance program provides a method to determine the deposition and accumulation of nonradiological contaminants in stream systems. Sample preparation prior to analysis was changed in 2007 from an extraction (toxicity characteristic leaching procedure) to a total sample digestion.

### Surveillance Results Summary

In 2010, as in the previous 5 years, no pesticides or herbicides were found to be above the quantitation limits in sediment samples. Metals analysis results for 2010 also were comparable to those of the previous 5 years (data table 5–24).

## Fish

Environmental Monitoring personnel analyze the flesh of fish caught from the Savannah and Edisto Rivers to determine concentrations of mercury in the fish. In 2008, the addition of metals (arsenic, cadmium, manganese, and antimony) to the analytical suite was completed. The fish analyzed represent the most common edible species of fish in the CSRA (freshwater) and at the mouth of the Savannah River (saltwater).

### Surveillance Results Summary

Mercury analyses were performed in 2010 on 466 fish from the Savannah River and 45 from the Edisto River at West Bank Landing. Concentrations of mercury

generally were slightly lower than those observed in 2009 (data table 5–25). The highest concentrations were found in the Savannah River—in bass at the Upper Three Runs Creek Mouth (1.427 µg/g), in catfish at Steel Creek Mouth (0.446 µg/g), and in bream at the Upper Three Runs Creek Mouth (0.849 µg/g). The highest concentrations found at West Bank Landing were 0.750 µg/g in bass, 0.690 µg/g in bream, and 0.437 µg/g in catfish.

Arsenic and cadmium were below detection levels in all samples. Manganese was detected at all 11 fish sampling locations, with the highest concentration in bream (3.46 µg/g) at Stokes Bluff Landing. Antimony also was detected at all locations, with the highest concentration in bream (1.27µg/g) at the U.S. Highway 301 bridge area (data table 5–26).

## River Water Quality Surveys

### Description of Surveys

Academy of Natural Sciences (ANS) personnel conducted biological and water quality surveys of the Savannah River from 1951 through 2003, when Environmental Monitoring assumed this responsibility. The surveys were 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 looking for

- patterns of biological disturbance geographically associated with the site
- patterns of change over seasons or years that indicate improving or deteriorating conditions

In 2010, Environmental Monitoring conducted macroinvertebrate sampling during the spring and fall, and diatom sampling monthly. The diatom slides were sent to ANS for archiving. No adverse biological impacts have been identified in the Savannah River diatom communities.

Macroinvertebrates collected from river traps during 2009 were similar in species diversity to those documented in surveys during the 1990s. An overall decrease in total populations was observed that likely is associated with low flow in the river and incipient drought conditions. No evidence of adverse biological impacts was found in the observed macroinvertebrate communities. Collections from 2010 will be sorted and archived during 2011.

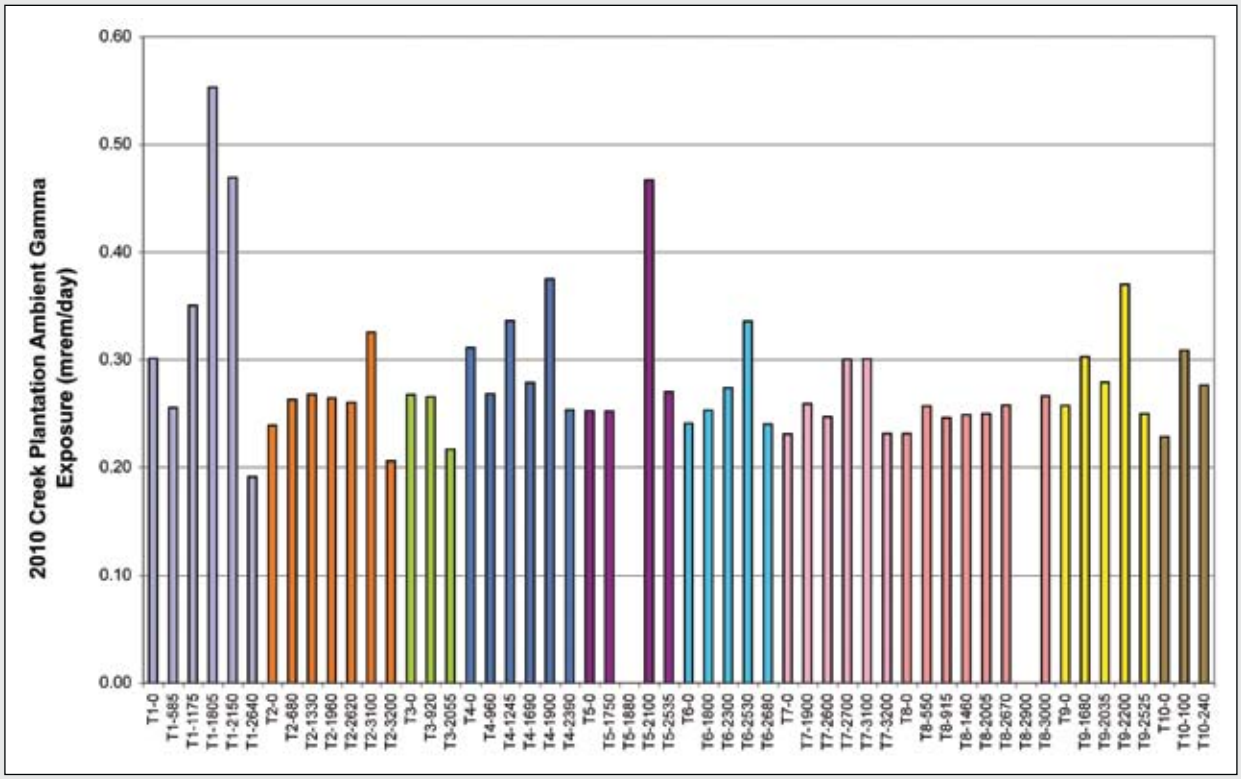


**Figure 5–11 Creek Plantation Ambient Gamma Exposure Rates for 10 Transects (T1–0 Means Trail 1, 0 Feet from Savannah River; T2–680 Means Trail 2, 680 Feet from Savannah River, etc.)**