South Carolina Department of Health and Environmental Control

Environmental Surveillance Oversight Program
Data Report for 2005

DHEC
PROMOTE PROTECT PROSPER
South Carolina Department of Health and Environmental Control

Region 5
Environmental Quality Control
Serving: Aiken, Allendale, Bamberg, Barnwell, Calhoun, and Orangeburg Counties
Promoting Health, Protecting the Environment

Region 5 EQC
206 Beaufort Street NE,
Aiken, SC 29801
(803) 641-7670 Fax (803) 641-7675

Introduction

To provide effective and comprehensive oversight of the Savannah River Site (SRS), the South Carolina Department of Health and Environmental Control (SCDHEC) utilizes a number of different mechanisms including permitting, routine regulatory inspections of site facilities, and participation in formal agreements with SRS like the Remediation and Environmental Monitoring grant. This grant program includes the Federal Facility Agreement (FFA) grant which oversees the site cleanup, the site treatment plan grant, the foreign research reactor/spent nuclear fuel grant, and the Agreement In Principal grant which involves Environmental Surveillance Oversight Monitoring (ESOP), and nuclear emergency response.

The ESOP supports and complements SCDHEC's comprehensive regulatory program by focusing on those activities not supported or covered through our normal regulatory framework. The primary function of the ESOP is to evaluate the effectiveness of SRS monitoring activities. To accomplish this function, the ESOP conducts non-regulatory monitoring activities on and around the SRS, conducts evaluations of the SRS monitoring program and provides an independent source of information to the public pertaining to levels of contaminants in the environment from historical and current SRS operations.

This report includes a description of the ESOP's monitoring activities and summarizes the findings of the ESOP from the 2005 calendar year monitoring period

Table of Contents

Table of Contents

Table of Contents

List of Illustrations

Illustrations

Maps

Tables and Figures

Return to Table of Contents

List of Data Tables

Return to TOC

Sampling Location Information

Note: Quadrant locations for DOE-SR Environmental perimeter random soil samples collected in 2005. These locations were randomly selected from a quadrant system established by the U.S. Department of Interior on a 7.5' topographical map of South Carolina revision 10/92.

DOE-SR Environmental Perimeter		**Quadrant (Quad) Limits**
Random Quadrants Within SRS Perimeter "E"		
Quad Designation	**7.5' Quad Name**	**Latitude by Lat and Longitude by Long**
E1X	Furman	3237.5 by 3245 and -8107.5 by -8115
E2	Barnwell	3307.5 by 3315 and -8115 by -8122.5
E3X	New Ellenton, SE	3315 by 3322.5 and -8130 by -8137.5
E4	Aiken	3330 by 3337.5 and -8137.5 by -8145
E5	Ehrhardt	3300 by 3307.5 and -8100 by -8107.5
E6	Foxtown	3337.5 by 3345 and -8130 by -8137.5
E7X&B24X	Emory	3352.5 by 3400 and -8137.5 by -8145
E8	HarleysMillPond	3330 by 3337.5 and -8107.5 by -8115
E9	Monetta	3345 by 3352.5 and -8130 by -8137.5
E10	Norway West	3322.5 by 3330 and -8107.5 by -8115
E11	North	3330 by 3337.5 and -8100 by -8107.5
E12	Colliers	3337.5 by 3345 and -8200 by -8207.5
E13	Norway East	3325.5 by 3330 and -8100 by -8107.5
E14X	Jackson	3315 by 3322.5 and -8145 by -8152.5
E15X	Evans	3330 by 3337.5 and -8207.5 by -8215
E16	Denmark	3315 by 3322.5 and -8107.5 by -8115
E17X&B25X	Orangeburg S.	3322.5 by 3330 and -8045 by -8052.5
E18	Midway	3315 by 3322.5 and -8052.5 by -8100
E19X	Mechanics Hill	3315 by 3322.5 and -8152.5 by -8200
E20	Kitchens Mill	3330 by 3337.5 and -8122.5 by -8130
E21	Clear Pond	3307.5 by 3315and -8100 by -8107.5
E22X&B26X	Grays	3237.5 by 3245 and -8100 by -8107.5
E23	Kildaire	3230 by 3237.5 and -8122.5 by -8130
E24	Long Branch	3315 by 3322.5 and -8122.5 by -8130
E25	Clarks Hill	3337.5 by 3345 and -8207.5 by -8215
E26X&B27X	Parksville	3345 by 3352.5 and -8207.5 by -8215
E27	Roper's Crossroads	3337.5 by 3345 and -8152.5 by -8200
E28	Salley	3330 by 3337.5 and -8115 by -8122.5
E29	Allendale	3300 by 3307.5 and -8115 by -8122.5
E30	Graniteville	3330 by 3337.5 and -8145 by -8152.5
E31	Oakwood	3330 by 3337.5 and -8130 by -8137.5

1. The randomly selected quadrants are from a United States Department of Interior 7.5 Minute Topographic Map Printed by the South Carolina Land Resources Commission, Rv 10/92.
2. "**X**" in any designated ID represents the presence of an **exclusion zone** of either a state border, 50 mi. limit bisector line that splits the quad area into an environmental side and a background side, or occurrence of random pick area within 10 miles of a nuclear facility.
3. "**E**" means this is a pick selected for SRS perimeter random environmental sampling.
4. "**B**" means this is a background pick outside of the 50 mile SRS perimeter limit.

Return to TOC

Sampling Location Information

Note: Quadrant locations for South Carolina background random soil samples collected in 2005. These locations were randomly selected from a quadrant system established by the U.S. Department of Interior on a 7.5' topographical map of South Carolina revision 10/92.

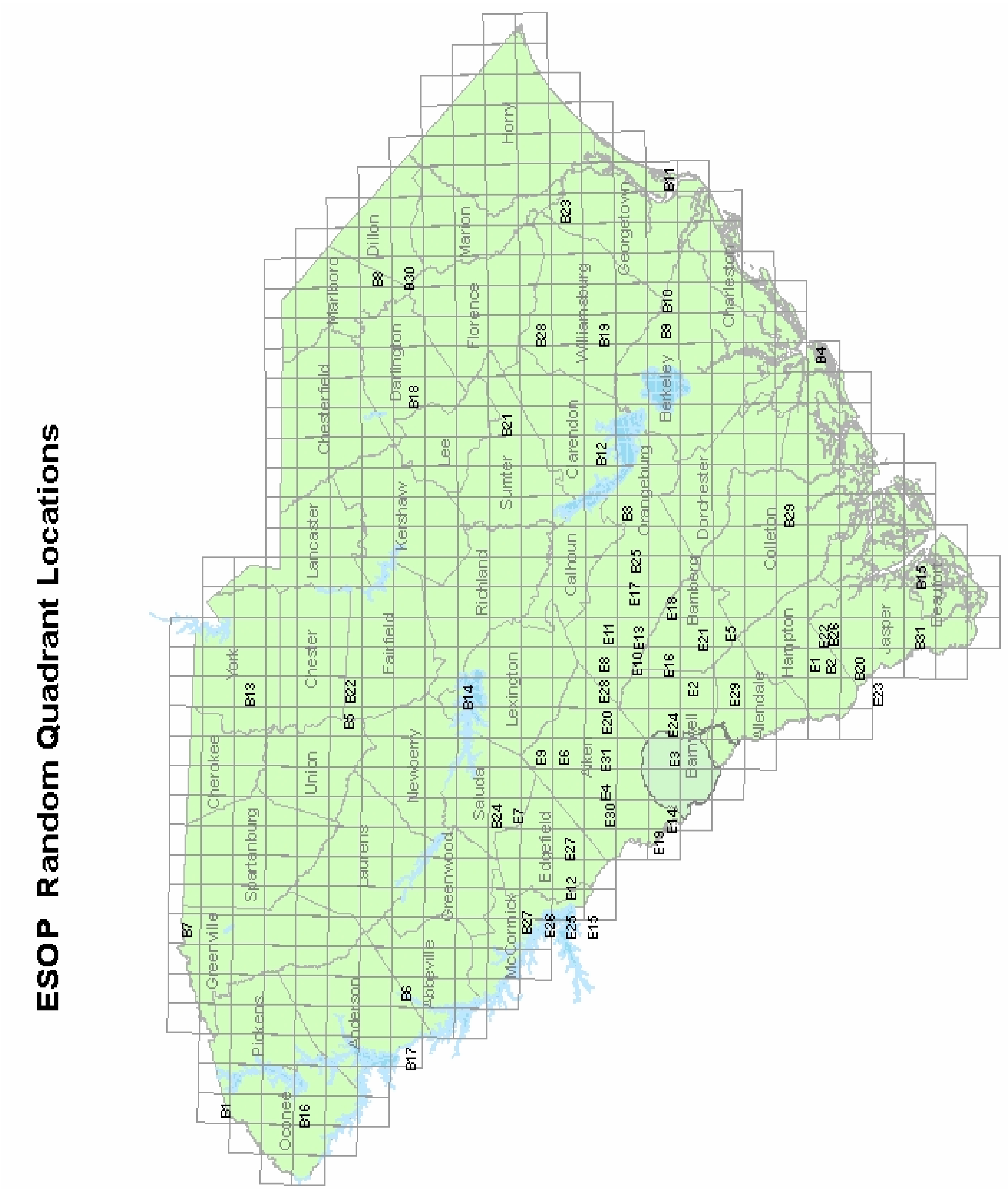
South Carolina Background		**Quadrant (Quad) Limits**
Random Quadrants for the S.C. Bkg "B"		**Outside of the 50-mile SRS Perimeter Zone.**
Quad Designation	**7.5' Quad Name**	**Latitude by Lat and Longitude by Long**
B1X	Cashiers	3500 by 3507.5 and -8300 by -8307.5
B2X&E1X	Furman	3237.5 by 3245 and -8107.5 by -8115
B3	Felderville	3322.5 by 3330 and -8030 by -8037.5
B4	James Is.	3237.5 by 3245 and -7952.5 by -8000
B5	Carlisle	3430 by 3437.5 and -8122.5 by -8130
B6	Antreville	3415 by 3422.5 and -8230 by -8237.5
B7X	Saluda	3507.5 by 3515 and -8215 by -8222.5
B8	Bingham	3422.5 by 3430 and -7930 by -7937.5
B9	Alvin	3315 by 3322.5 and -7945 by -7952.5
B10	Jamestown	3315 by 3322.5 and -7937.5 by -7945
B11	North Is.	3315 by 3322.5 and -7907.5 by -7915
B12	Summerton	3330 by 3337.5 and -8015 by -8022.5
B13	Sharon	3452.5 by 3500 and -8115 by -8122.5
B14X	Lake Murray E	3400 by 3407.5 and -8115 by -8122.5
B15	Spring Is.	3215 by 3222.5 and -8045 by -8052.5
B16X	Westminster	3437.5 by 3445 and -8300 by -8307.5
B17X	Hartwell Dam	3415 by 3422.5 and -8245 by -8252.5
B18X	Hartsville South	3415 by 3422.5 and -8000 by -8007.5
B19	Salters	3330 by 3337.5 and -7945 by -7952.5
B20X	Pineland	3230 by 3237.5 and -8107.5 by -8115
B21	Mayesville	3352.5 by 3400 and -8007.5 by -8015
B22	Carlisle SE	3430 by 3437.5 and -8115 by -8122.5
B23	Outland	3337.5 by 3345 and -7915 by -7922.5
B24X&E7X	Emory	3352.5 by 3400 and -8137.5 by -8145
B25X&E17X	Orangeburg S.	3322.5 by 3330 and -8045 by -8052.5
B26X&E22X	Grays	3237.5 by 3245 and -8100 by -8107.5
B27X&E26X	Parksville	3345 by 3352.5 and -8207.5 by -8215
B28	Lake City West	3345 by 3352.5 and -7945 by -7952.5
B29	Neyles	3245 by 3252.5 and -8030 by -8037.5
B30	Oak Grove	3415 by 3422.5 and -7930 by -7937.5
B31	Hardeeville	3215 by 3222.5 and -8100 by -8107.5

1. The randomly selected quadrants are from a United States Department of Interior 7.5 Minute Topographic Map Printed by the South Carolina Land Resources Commission, Rv 10/92.
2. "**X**" in any designated ID represents the presence of an **exclusion zone** of either a state border, 50 mi. limit bisector line that splits the quad area into an environmental side and a background side, or occurrence of random pick area within 10 miles of a nuclear facility.
3. "**E**" means this is a pick selected for SRS perimeter random environmental sampling.
4. "**B**" means this is a background pick outside of the 50 mile SRS perimeter limit.

(Return to TOC)

Sampling Location Information

Map 1. Savannah River Site perimeter and South Carolina background random sampling locations.



1.1 Radiological Atmospheric Monitoring

(Return to TOC)

1.1.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) provides independent quantitative monitoring of ambient atmospheric radionuclide releases associated with the Savannah River Site (SRS). It also provides monitoring of atmospheric media on a routine basis to measure radionuclide concentrations in the surrounding environment and to identify trends that may require further investigation. Radiological atmospheric monitoring sites are established to provide spatial coverage of the project area (Map 2, section 1.1.2).

The ESOP air monitoring capabilities in 2005 included air monitoring stations with the capacity for sample collection of glass fiber filters, precipitation, and silica gel columns, and thermoluminescent dosimeters (TLDs). The glass fiber filters were used to collect total airborne particulates. Particulates were screened weekly for gross alpha and gross beta emitting activity. Precipitation, when present, was sampled and analyzed monthly for tritium. Silica gel distillates of atmospheric moisture were analyzed monthly for tritium. TLDs were collected and analyzed every quarter for ambient beta/gamma levels. ESOP emphasizes monitoring for radionuclides in atmospheric media around the SRS at potential public exposure locations. A background air monitoring station was established in Beaufort, SC to provide data on ambient radiation for baseline and trend analysis.

ESOP data collected substantiated historically reported Department of Energy-Savannah River (DOE-SR) values for radionuclides in the ambient environment at or near the SRS boundary.

In general, average ESOP atmospheric radiological monitoring results at the SRS boundary are slightly different than DOE-SR reported average values. Variations in atmospheric radiological monitoring results between SCDHEC and DOE-SR are likely a result of differences in monitoring locations, local meteorological conditions, frequency and number of locations.

In summary, no United States Environmental Protection Agency (EPA) air standards were exceeded at the monitored locations and there were no elevations of radiological pollutant concentrations associated with SRS operations. Sampling results by ESOP indicate that SRS activities had a measurable, but an inconsequential impact on local air quality.

RESULTS AND DISCUSSION

Total Suspended Particulates (TSP)

Routine weekly data for TSP can be found in section 1.1.4.

Alpha

During the 2005 sampling period, gross alpha activity ranged from 0.001 to 0.008 pCi/m^3. Values in this range are typically associated with naturally occurring alpha-emitting radionuclides, primarily as decay products of radon (Kathren 1984), and are considered normal. If gross alpha counts are above the range of 0.7 pCi/m^3, which is the action level according to

Rhonda Sears of The United States Environmental Protection Agency (EPA), the filters are analyzed for specific radioisotopes. The average gross alpha nuclide concentration in 2005 was 0.003 pCi/m^3. These results are comparable to the measurable airborne radionuclide alpha activity on the DOE site in Hanford, Washington in 2004. The average alpha concentration at the Hanford site perimeter was 0.005 pCi/m^3.

Beta

During the 2005 sampling period, gross beta concentrations ranged from 0.008 to 0.093 pCi/m^3. Values in this range are typically associated with naturally occurring beta-emitting radionuclides, primarily as decay products of radon (Kathren 1984). Small seasonal variations at each monitoring location have been consistent with historically reported ESOP values (SCDHEC, 2004). The EPA, Office of Radiation and Indoor Air, uses gross beta counts as an indicator to determine if additional analyses will be performed. A gamma scan is performed if the gross beta activity exceeds 1 pCi/m^3. This is the tiering of definitive analyses that is used for all total suspended particulate sampling associated with the Environmental Radiation Ambient Monitoring System (ERAMS). The ERAMS is comprised of a nationwide network of sampling stations that identify trends in the accumulation of long-lived radionuclides in the environment (USEPA, 2004a). Figure 1, section 1.1.3 shows average gross beta activity for SRS perimeter locations and illustrates trending of gross beta values for ESOP and DOE-SR (WSRC, 2006). The average gross beta concentration reported by ESOP in 2005 was 0.023 pCi/m^3. These results are also similar to the measurable airborne beta activity on the DOE site in Hanford, Washington in 2004. The average beta concentration at the perimeter of the Hanford site was 0.017 pCi/m^3.

Ambient Beta/Gamma

SCDHEC conducts ambient beta/gamma monitoring through the deployment of TLDs around the perimeter of the SRS. During the sampling period, ESOP external radiation levels at monitored locations were lower than levels reported by DOE-SR (WSRC, 2006). Ambient beta/gamma levels measured with TLDs are provided for all quarters of 2005 in section 1.1.4. It should be noted that 4 mrem are subtracted from the reported result for each TLD to account for the transcontinental flight from South Carolina to California and back (Walter, 1995). Corrected values are reported in section 1.1.4. The average ambient beta/gamma activity in 2005 was 28.0 mrems.

Figure 2, section 1.1.3 shows trends at the SRS perimeter for averaged ambient beta/gamma values for DOE-SR (WSRC, 2005) and ESOP. ESOP averaged ambient beta/gamma values for 1999 and 2000 represent three quarters of data while all others represent four quarters.

Tritium

Tritium in air values reported by ESOP are the result of using the historical means of calculating an air concentration of tritium based on a generic absolute humidity of 11.5 grams of atmospheric moisture per cubic meter. Section 1.1.4 includes ESOP atmospheric moisture data analyzed in 2004. Averaged ESOP air tritium activity was consistently lower than the DOE-SR measured activity although well within the same order-of-magnitude.

Average atmospheric tritium activity at the SRS perimeter reported by ESOP for 2005 was higher than for 2004. Figure 3, section 1.1.3 illustrates trending of atmospheric tritium activity for ESOP and DOE-SR as measured and calculated at the SRS perimeter.

The DOE-SR average measured value for tritium activity in air at the SRS boundary was 10.0 pCi/m^3 (WSRC, 2006). The DOE-SR calculated value for tritium activity at the SRS boundary was 8.0 $pCi/m^{3.}$ The ESOP average measured activity for tritium was 6.0 pCi/m^3. DOE-SR average measured values for tritium in atmospheric moisture were higher than ESOP averaged measured values for the SRS perimeter. This may be attributed to a dilution that occurs when desiccants are used for collecting atmospheric moisture for tritium analysis. In a recent study, tritium concentrations in air, as determined using desiccants, can result in under-reporting of air tritium concentrations by factors of 1.4 to 2.6 (Rosson et al, 2000). Prior to deployment in the field, silica-gel desiccant is dried to remove any moisture. However, a small percentage of water remains in the desiccant. This results in a slight dilution of the collected sample that is reflected in the distillate. DOE-SR has implemented a correction factor for tritium-in-air measurements using silica-gel (WSRC 2006). This could explain why the 2005 DOE-SR average measured activity is higher than ESOP average reported measured activity. Another factor that may contribute to the lower ESOP air tritium values is that only two of the monitoring stations are exactly on the SRS perimeter (property line), while the other three points used for this comparison are located approximately two miles from the SRS property line.

The majority of the analytical results for tritium in rainwater were below the LLD. The maximum reported value, 794 pCi/L from the New Ellenton, SC air monitoring station, was collected on August 3, 2005. Section 1.1.4 includes rainwater tritium data for all monitoring locations.

Summary Statistics

All summary statistics are given in section 1.1.5

The average gross alpha activity reported by ESOP at the site perimeters was 0.003 pCi/m^3. The average gross beta activity reported by ESOP at the site perimeter was 0.023 pCi/m^3. The average gross alpha and beta activity reported by DOE-SR at the SRS boundary was 0.0011 pCi/m^3 and 0.0146 pCi/m^3 respectively. Average atmospheric tritium activity at the SRS perimeter reported by ESOP was 5.0 pCi/m^3. The DOE-SR average measured value for tritium activity in air at the SRS boundary was 10.0 pCi/m^3.

CONCLUSIONS AND RECOMMENDATIONS

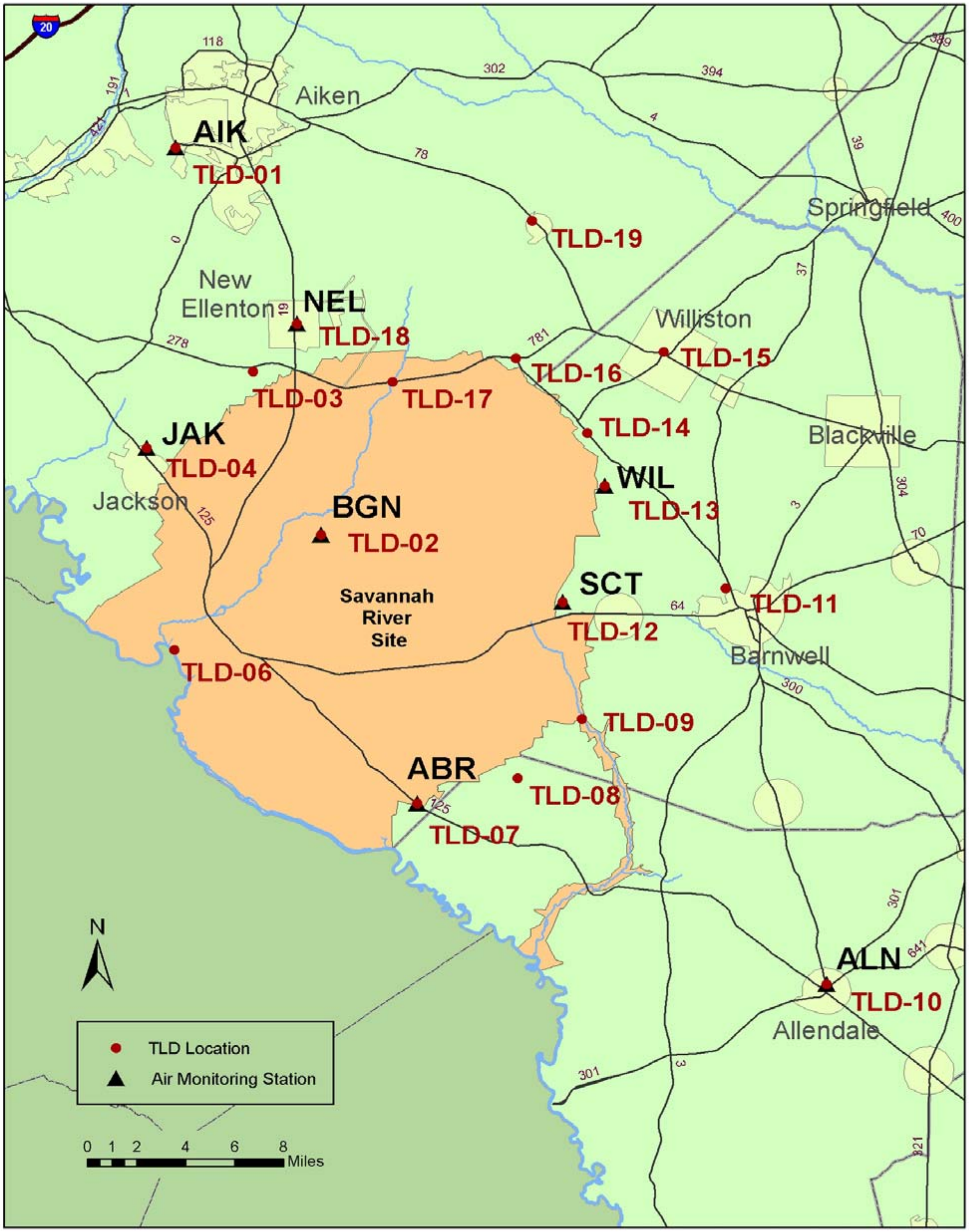
All ESOP data collected confirmed historically reported DOE-SR values for radionuclides in the ambient environment at the SRS boundary with no anomalous data noted for any monitored parameters. ESOP air and precipitation tritium data were consistently lower than the DOE-SR measured values, although within the same order-of-magnitude. The state of South Carolina, in conjunction with DOE-SR, is evaluating several ways to enhance monitoring of atmospheric tritium.

ESOP is planning to install additional equipment in the winter of 2005-2006 and modify air tritium calculations to account for the residual moisture in the desiccant matrix to more precisely account for actual air tritium concentrations.

No EPA air standards were exceeded at the monitored locations and there were no elevations of radiological pollutant concentrations associated with SRS operations. Sampling results by ESOP indicate that SRS activities did have a measurable impact on local air quality.

1.1.2 (Return to TOC)

Map 2. Radiological Atmospheric Monitoring Locations



1.1.3 Tables and Figures

[(Return to TOC)]

Radiological Atmospheric Monitoring

Figure 1 Average Gross Beta for TSP at the SRS Perimeter

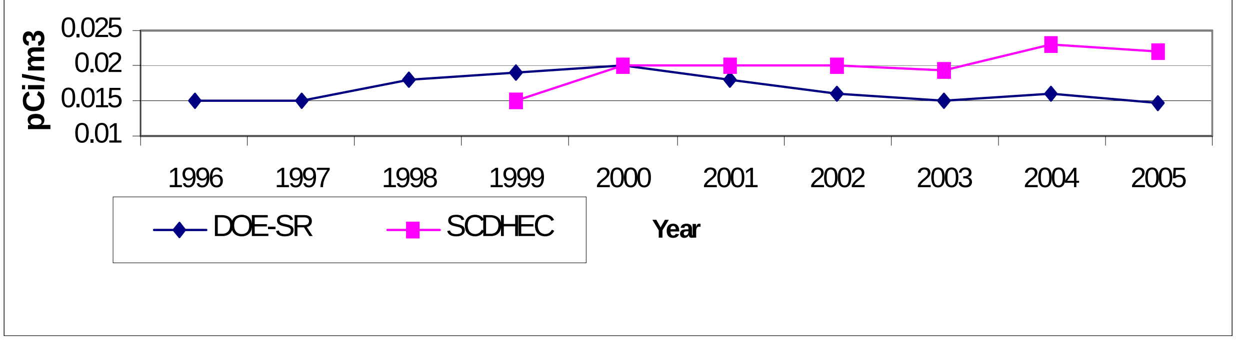


Figure 2 Average Ambient Beta/Gamma at the SRS Perimeter

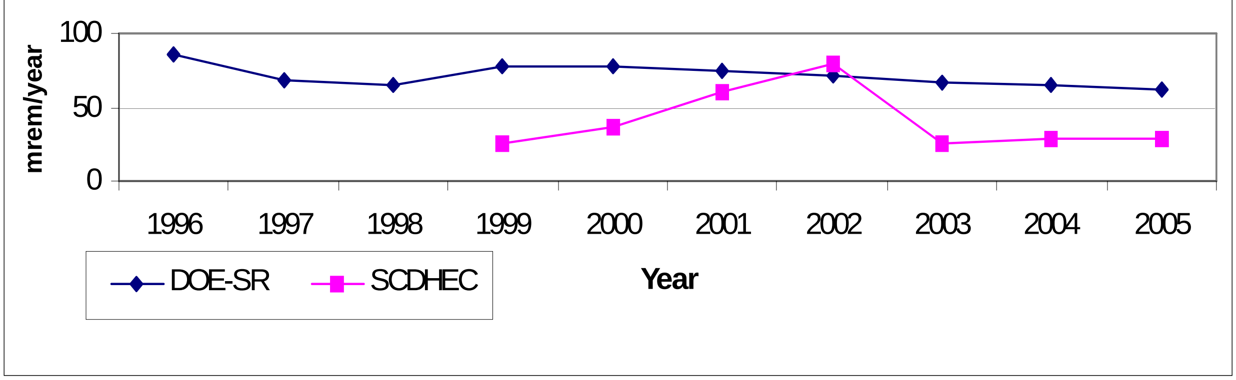
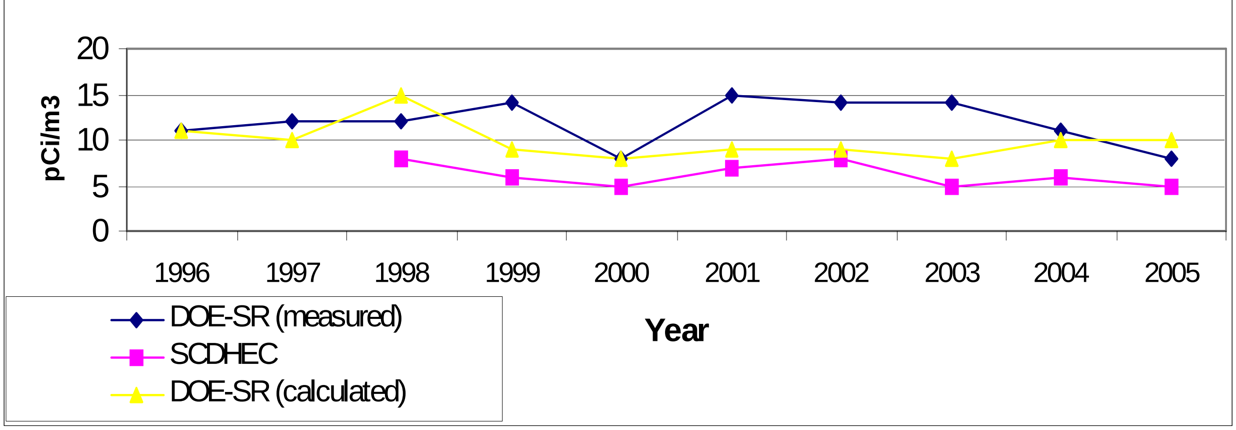


Figure 3 Average Atmospheric Tritium at the SRS Perimeter



1.1.4 Data

(Return to TOC)

Radiological Atmospheric Monitoring Data

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Aiken Elementary Water Tower (AIK)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.005	0.001	0.015	0.001				
1/11/2005	0.003	0.001	0.016	0.002				
1/18/2005	0.006	0.001	0.022	0.002				
1/25/2005	0.005	0.001	0.021	0.002	4.45	1.14	<195	
2/2/2005	0.004	0.001	0.017	0.001				
2/8/2005	0.003	0.001	0.016	0.002				
2/15/2005	0.006	0.001	0.025	0.002				
2/22/2005	0.004	0.001	0.021	0.002	4.20	1.12	<193	
3/1/2005	0.003	0.001	0.017	0.002				
3/8/2005	0.004	0.001	0.023	0.002				
3/15/2005	0.003	0.001	0.014	0.001				
3/22/2005	0.003	0.001	0.020	0.002	<2.25		<196	
3/29/2005	0.002	0.001	0.014	0.001				
4/5/2005	0.002	0.001	0.019	0.002				
4/12/2005	0.003	0.001	0.017	0.002				
4/19/2005	0.002	0.001	0.020	0.002	2.74	1.01	<183	
4/26/2005	0.003	0.001	0.022	0.002				
5/3/2005	0.003	0.001	0.019	0.002				
5/9/2005	0.003	0.001	0.026	0.002				
5/16/2005	0.004	0.001	0.027	0.002	<2.11		<184	
5/23/2005	0.011	0.001	0.030	0.002				
5/31/2005	0.002	0.001	0.016	0.001				
6/8/2005	0.001	0.001	0.012	0.001	2.75	0.99	<178	
6/14/2005	0.001	0.001	0.014	0.002				
6/20/2005	0.003	0.001	0.021	0.002				
6/27/2005	0.003	0.001	0.024	0.002	<2.04		<178	
7/5/2005	0.001	0.001	0.014	0.001				
7/12/2005	0.002	0.001	0.014	0.002				
7/19/2005	0.005	0.001	0.013	0.001	2.61	0.99	<181	
7/26/2005	0.005	0.001	0.028	0.002				
8/2/2005	0.003	0.001	0.030	0.002				
8/9/2005	0.003	0.001	0.027	0.002	<2.09		<182	
8/15/2005	0.003	0.001	0.017	0.002				
8/23/2005	0.002	0.001	0.023	0.002				
8/31/2005	0.003	0.001	0.029	0.002	<2.04		<178	
9/7/2005	0.002	0.001	0.020	0.002				
9/21/2005	0.003	0.001	0.028	0.001				
9/27/2005	0.003	0.001	0.026	0.002	3.80	1.04	NS	NA
10/4/2005	0.003	0.001	0.026	0.002				
10/11/2005	0.001	0.001	0.010	0.001				
10/18/2005	0.005	0.001	0.025	0.002				
10/26/2005	0.006	0.001	0.035	0.002	3.06	0.99	<177	
11/2/2005	0.003	0.001	0.025	0.002				
11/8/2005	0.002	0.001	0.026	0.002				
11/16/2005	0.002	0.001	0.026	0.002				
11/22/2005	0.003	0.001	0.022	0.002				
11/30/2005	0.003	0.001	0.022	0.002	3.07	1.05	<189	
12/7/2005	0.002	0.001	0.025	0.002				
12/13/2005	0.014	0.002	0.045	0.003				
12/20/2005	0.003	0.001	0.028	0.002				
12/28/2005	0.004	0.001	0.029	0.002	<2.01		<175	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location: New Ellenton, SC (NEL)								
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.006	0.001	0.021	0.002				
1/11/2005	0.004	0.001	0.021	0.002				
1/18/2005	0.006	0.001	0.021	0.002				
1/25/2005	0.006	0.001	0.028	0.002	3.30	1.09	<195	
2/2/2005	0.004	0.001	0.014	0.001				
2/8/2005	0.004	0.001	0.019	0.002				
2/15/2005	0.005	0.001	0.029	0.002				
2/22/2005	0.004	0.001	0.024	0.002	5.38	1.16	<193	
3/1/2005	0.003	0.001	0.018	0.002				
3/8/2005	0.004	0.001	0.025	0.002				
3/15/2005	0.003	0.001	0.017	0.002				
3/22/2005	0.004	0.001	0.023	0.002	<2.25		<196	
3/29/2005	0.002	0.001	0.014	0.002				
4/5/2005	0.003	0.001	0.021	0.002				
4/12/2005	0.002	0.001	0.019	0.002				
4/19/2005	0.003	0.001	0.020	0.002	4.68	1.09	794	109
4/26/2005	0.003	0.001	0.029	0.002				
5/3/2005	0.003	0.001	0.020	0.002				
5/9/2005	0.002	0.001	0.031	0.002				
5/16/2005	0.003	0.001	0.031	0.002	<2.12		319	
5/23/2005	0.007	0.001	0.024	0.002				
5/31/2005	0.002	0.001	0.020	0.002				
6/8/2005	0.001	0.001	0.015	0.002	3.45	1.02	222	85
6/14/2005	0.001	0.001	0.016	0.002				
6/20/2005	0.003	0.001	0.025	0.002				
6/27/2005	0.003	0.001	0.024	0.002	2.05	0.95	<178	
7/5/2005	0.001	0.001	0.014	0.001				
7/12/2005	0.001	0.001	0.014	0.002				
7/19/2005	0.004	0.001	0.014	0.002	3.44	1.04	<181	
7/26/2005	<0.001	NA	0.016	0.001				
8/2/2005	0.003	0.001	0.030	0.002				
8/9/2005	0.002	0.001	0.024	0.002	8.97	1.27	<182	
8/15/2005	0.002	0.001	0.016	0.002				
8/23/2005	0.002	0.001	0.023	0.002				
8/31/2005	0.003	0.001	0.028	0.002	5.18	1.09	330	90
9/7/2005	0.002	0.001	0.022	0.002				
9/21/2005	0.001	0.001	0.008	0.001				
9/27/2005	0.004	0.001	0.023	0.002	2.98	1.00	NS	NA
10/4/2005	NS	NA	NS	NA				
10/11/2005	0.001	0.001	0.097	0.001				
10/18/2005	0.004	0.001	0.028	0.002				
10/26/2005	0.004	0.001	0.034	0.002	2.09	0.95	<177	
11/2/2005	0.003	0.001	0.025	0.002				
11/8/2005	0.003	0.001	0.028	0.002				
11/16/2005	0.002	0.001	0.021	0.002				
11/22/2005	0.003	0.001	0.023	0.002				
11/30/2005	0.003	0.001	0.024	0.002	2.62	1.04	218	89
12/7/2005	0.003	0.001	0.028	0.002				
12/13/2005	0.013	0.002	0.039	0.002				
12/20/2005	0.003	0.001	0.027	0.002				
12/28/2005	0.005	0.001	0.035	0.002	3.65	1.01	<175	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Jackson, SC (JAK)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m3	+- 2 sigma	pCi/m3	+- 2 sigma	pCi/m3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.005	0.001	0.018	0.002				
1/11/2005	0.004	0.001	0.017	0.002				
1/18/2005	0.004	0.001	0.017	0.002				
1/25/2005	0.006	0.001	0.024	0.002	4.60	1.13	<195	
2/2/2005	0.003	0.001	0.017	0.002				
2/8/2005	0.003	0.001	0.015	0.002				
2/15/2005	0.005	0.001	0.024	0.002				
2/22/2005	0.004	0.001	0.019	0.002	3.58	1.09	<193	
3/1/2005	0.002	0.001	0.020	0.002				
3/8/2005	0.003	0.001	0.020	0.002				
3/15/2005	0.003	0.001	0.015	0.002				
3/22/2005	0.003	0.001	0.019	0.002	2.26	1.04	<196	
3/29/2005	0.002	0.001	0.013	0.001				
4/5/2005	0.001	0.001	0.019	0.002				
4/12/2005	0.002	0.001	0.016	0.002				
4/19/2005	0.003	0.001	0.017	0.002	2.20	0.99	224	87
4/26/2005	0.003	0.001	0.025	0.002				
5/3/2005	0.002	0.001	0.023	0.003				
5/9/2005	0.002	0.001	0.024	0.002				
5/16/2005	0.003	0.001	0.026	0.002	6.60	1.17	<184	
5/23/2005	0.006	0.001	0.023	0.002				
5/31/2005	0.001	0.001	0.018	0.002				
6/8/2005	0.001	0.001	0.012	0.001	5.55	1.10	<178	
6/14/2005	0.001	0.001	0.012	0.002				
6/21/2005	0.002	0.001	0.018	0.002				
6/27/2005	0.002	0.001	0.026	0.002	7.94	1.19	348	91
7/5/2005	<0.001	NA	0.013	0.002				
7/12/2005	0.002	0.001	0.015	0.002				
7/19/2005	0.004	0.001	0.017	0.002	3.88	1.04	<181	
7/26/2005	<0.001	NA	<0.001	NA				
8/2/2005	0.002	0.001	0.003	0.002				
8/9/2005	0.003	0.001	0.029	0.002	4.80	1.09	<182	
8/15/2005	0.002	0.001	0.017	0.002				
8/23/2005	0.002	0.001	0.022	0.002				
8/31/2005	0.003	0.001	0.029	0.002	4.69	1.07	224	85
9/7/2005	0.003	0.001	0.023	0.002				
9/21/2005	0.003	0.001	0.031	0.001				
9/27/2005	0.003	0.001	0.024	0.002	3.92	1.04	NS	NA
10/4/2005	0.002	0.001	0.027	0.002				
10/11/2005	0.001	0.001	0.010	0.001				
10/18/2005	0.005	0.001	0.030	0.002				
10/26/2005	0.005	0.001	0.038	0.002	2.63	0.98	<177	
11/2/2005	0.004	0.001	0.026	0.002				
11/8/2005	0.004	0.001	0.033	0.002				
11/16/2005	0.003	0.001	0.021	0.002				
11/22/2005	0.001	0.001	0.025	0.002				
11/30/2005	0.003	0.001	0.027	0.002	3.30	1.04	<189	
12/7/2005	0.004	0.001	0.033	0.002				
12/13/2005	0.013	0.002	0.041	0.003				
12/20/2005	0.004	0.001	0.031	0.002				
12/28/2005	0.006	0.001	0.036	0.002	4.96	1.07	<175	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Allendale Barricade (ABR)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.006	0.001	0.022	0.002				
1/11/2005	0.004	0.001	0.020	0.002				
1/18/2005	0.004	0.001	0.018	0.002				
1/25/2005	0.007	0.001	0.027	0.002	<2.24		<195	
2/2/2005	0.004	0.001	0.017	0.002				
2/8/2005	0.003	0.001	0.016	0.002				
2/15/2005	0.005	0.001	0.027	0.002				
2/22/2005	0.004	0.001	0.024	0.002	2.42	1.04	<193	
3/1/2005	0.003	0.001	0.020	0.002				
3/8/2005	0.005	0.001	0.024	0.002				
3/15/2005	0.003	0.001	0.016	0.002				
3/22/2005	0.003	0.001	0.022	0.002	5.51	1.17	<196	
3/29/2005	0.001	0.001	0.018	0.002				
4/5/2005	0.002	0.001	0.020	0.002				
4/12/2005	0.003	0.001	0.018	0.002				
4/19/2005	0.002	0.001	0.019	0.002	3.48	1.05	<183	
4/26/2005	0.003	0.001	0.024	0.002				
5/3/2005	0.002	0.001	0.019	0.002				
5/9/2005	0.002	0.001	0.027	0.002				
5/16/2005	0.003	0.001	0.028	0.002	5.78	1.14	<184	
5/23/2005	0.001	0.001	0.020	0.003				
5/31/2005	NS	NA	NS	NA				
6/8/2005	0.000	0.001	0.014	0.003	2.07	0.95	188	84
6/14/2005	0.002	0.001	0.014	0.002				
6/21/2005	0.002	0.001	0.017	0.002				
6/27/2005	0.003	0.001	0.027	0.002	3.38	1.01	<178	
7/5/2005	0.001	0.001	0.013	0.001				
7/12/2005	0.002	0.001	0.014	0.002				
7/19/2005	0.004	0.001	0.014	0.002	<2.08		<181	
7/26/2005	0.003	0.001	0.025	0.002				
8/2/2005	0.002	0.001	0.024	0.002				
8/9/2005	0.002	0.001	0.023	0.002	<2.09		<182	
8/15/2005	0.001	0.001	0.012	0.002				
8/15/2005	0.002	0.001	0.013	0.002				
8/23/2005	0.002	0.001	0.020	0.002				
8/31/2005	0.002	0.001	0.024	0.002	2.70	0.99	<178	
9/7/2005	0.002	0.001	0.017	0.002				
9/21/2005	0.003	0.001	0.026	0.001				
9/27/2005	0.004	0.001	0.021	0.002	2.28	0.98	NS	NA
10/4/2005	0.002	0.001	0.022	0.002				
10/11/2005	0.001	0.001	0.068	0.001				
10/18/2005	0.004	0.001	0.026	0.002				
10/26/2005	0.004	0.001	0.031	0.002	3.11	1.00	<177	
11/2/2005	0.002	0.001	0.020	0.002				
11/8/2005	0.009	0.001	0.043	0.003				
11/16/2005	0.003	0.001	0.027	0.002				
11/22/2005	0.002	0.001	0.020	0.002				
11/30/2005	0.002	0.001	0.015	0.001	2.48	1.02	<189	
12/7/2005	0.002	0.001	0.022	0.002				
12/13/2005	0.009	0.001	0.031	0.002				
12/20/2005	0.003	0.001	0.019	0.002				
12/28/2005	0.003	0.001	0.024	0.002	7.58	1.17	<175	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location: Allendale, SC (ALN)

Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.006	0.001	0.023	0.002				
1/11/2005	0.005	0.001	0.019	0.002				
1/18/2005	0.005	0.001	0.020	0.002				
1/25/2005	0.006	0.001	0.026	0.002	<2.24		<195	
2/2/2005	0.005	0.001	0.002	0.002				
2/8/2005	0.004	0.001	0.017	0.002				
2/15/2005	0.006	0.001	0.025	0.002				
2/22/2005	0.004	0.001	0.025	0.002	2.84	93	<193	
3/1/2005	0.003	0.001	0.017	0.002				
3/8/2005	0.005	0.001	0.026	0.002				
3/15/2005	0.002	0.001	0.017	0.002				
3/22/2005	0.003	0.001	0.022	0.002	<2.25		<196	
3/29/2005	0.002	0.001	0.013	0.002				
4/5/2005	0.003	0.001	0.024	0.002				
4/12/2005	0.003	0.001	0.021	0.002				
4/19/2005	0.003	0.001	0.021	0.002	<2.10		<183	
4/26/2005	0.003	0.001	0.028	0.002				
5/3/2005	0.002	0.001	0.017	0.002				
5/9/2005	0.002	0.001	0.029	0.002				
5/16/2005	0.003	0.001	0.030	0.002	<2.11		<184	
5/23/2005	0.006	0.001	0.027	0.002				
5/31/2005	0.002	0.001	0.021	0.002				
6/8/2005	0.001	0.001	0.013	0.002	<2.04		<178	
6/14/2005	0.001	0.001	0.015	0.002				
6/21/2005	0.002	0.001	0.019	0.002				
6/27/2005	0.003	0.001	0.027	0.002	<2.04		195	84
7/5/2005	0.001	0.001	0.012	0.001				
7/12/2005	0.001	0.001	0.015	0.002				
7/19/2005	0.003	0.001	0.016	0.002	<2.08		<181	
7/26/2005	0.004	0.001	0.025	0.002				
8/2/2005	0.002	0.001	0.033	0.002				
8/9/2005	0.002	0.001	0.020	0.002	<2.09		<182	
8/15/2005	0.002	0.001	0.017	0.002				
8/23/2005	0.003	0.001	0.025	0.002				
8/31/2005	0.003	0.001	0.030	0.002	<2.04		<178	
9/7/2005	0.002	0.001	0.021	0.002				
9/21/2005	0.003	0.001	0.027	0.001				
9/27/2005	0.004	0.001	0.025	0.002	<2.08		NS	NA
10/4/2005	0.002	0.001	0.027	0.002				
10/11/2005	0.001	0.001	0.010	0.001				
10/18/2005	0.005	0.001	0.031	0.002				
10/26/2005	0.004	0.001	0.034	0.002	<2.05		<177	
11/2/2005	0.003	0.001	0.028	0.002				
11/8/2005	0.008	0.001	0.038	0.003				
11/16/2005	0.004	0.001	0.026	0.002				
11/22/2005	0.002	0.001	0.022	0.002				
11/30/2005	0.003	0.001	0.027	0.002	<2.17		<189	
12/7/2005	0.003	0.001	0.031	0.002				
12/13/2005	0.013	0.002	0.042	0.003				
12/20/2005	0.004	0.001	0.029	0.002				
12/28/2005	0.005	0.001	0.034	0.002	<2.04		<175	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Snelling, SC (SCT)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.006	0.001	0.024	0.002				
1/11/2005	0.004	0.001	0.021	0.002				
1/18/2005	0.006	0.001	0.020	0.002				
1/25/2005	0.006	0.001	0.026	0.002	<2.27		239	97
2/2/2005	0.004	0.001	0.019	0.002				
2/8/2005	0.004	0.001	0.017	0.002				
2/15/2005	0.007	0.001	0.026	0.002				
2/22/2005	0.004	0.001	0.023	0.002	8.57	1.28	<193	
3/1/2005	0.003	0.001	0.018	0.002				
3/8/2005	0.005	0.001	0.024	0.002				
3/15/2005	0.003	0.001	0.015	0.002				
3/22/2005	0.003	0.001	0.022	0.002	5.90	1.18	<196	
3/29/2005	0.002	0.001	0.014	0.002				
4/5/2005	0.003	0.001	0.021	0.002				
4/12/2005	0.002	0.001	0.019	0.002				
4/19/2005	0.002	0.001	0.020	0.002	3.62	1.05	<183	
4/26/2005	0.002	0.001	0.025	0.002				
5/3/2005	0.002	0.001	0.021	0.002				
5/9/2005	0.003	0.001	0.027	0.002				
5/16/2005	0.002	0.001	0.035	0.002	10.56	1.31	<184	
5/23/2005	0.008	0.001	0.029	0.002				
5/31/2005	0.002	0.001	0.019	0.002				
6/8/2005	0.001	0.001	0.013	0.001	2.25	0.96	<178	
6/14/2005	0.001	0.001	0.016	0.002				
6/20/2005	0.003	0.001	0.025	0.002				
6/27/2005	0.003	0.001	0.030	0.002	3.31	1.01	<178	
7/5/2005	0.001	0.001	0.012	0.001				
7/12/2005	0.002	0.001	0.016	0.002				
7/19/2005	0.004	0.001	0.017	0.002	2.71	1.00	<181	
7/26/2005	0.004	0.001	0.026	0.002				
8/2/2005	0.004	0.001	0.035	0.002				
8/9/2005	0.003	0.001	0.025	0.002	2.35	0.99	<182	
8/15/2005	0.002	0.001	0.017	0.002				
8/23/2005	0.002	0.001	0.025	0.002				
8/31/2005	0.003	0.001	0.031	0.001	2.54	0.98	<178	
9/7/2005	0.002	0.001	0.021	0.002				
9/21/2005	0.003	0.001	0.031	0.001				
9/27/2005	0.004	0.001	0.025	0.002	6.18	1.13	NS	NA
10/4/2005	0.003	0.001	0.026	0.002				
10/11/2005	0.001	0.001	0.083	0.001				
10/18/2005	0.005	0.001	0.029	0.002				
10/26/2005	0.004	0.001	0.035	0.002	6.37	1.13	<177	
11/2/2005	0.004	0.001	0.028	0.002				
11/8/2005	0.003	0.001	0.019	0.002				
11/16/2005	0.002	0.001	0.014	0.001				
11/22/2005	0.002	0.001	0.026	0.002				
11/30/2005	0.003	0.001	0.026	0.002	11.49	1.36	323	93
12/7/2005	0.003	0.001	0.033	0.002				
12/13/2005	0.015	0.002	0.044	0.003				
12/20/2005	0.004	0.001	0.028	0.002				
12/28/2005	0.005	0.001	0.035	0.002	2.86	0.98	<179	

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Burial Ground North (SRS)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/m^3	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.007	0.001	0.026	0.002				
1/11/2005	0.005	0.001	0.023	0.002				
1/18/2005	0.006	0.001	0.022	0.002				
1/25/2005	0.007	0.001	0.031	0.002	172.19	4.00	NS	NA
2/2/2005	0.004	0.001	0.016	0.001				
2/8/2005	0.004	0.001	0.020	0.002				
2/15/2005	0.006	0.001	0.025	0.002				
2/22/2005	0.005	0.001	0.024	0.002	120.75	3.38	NS	NA
3/1/2005	0.003	0.001	0.019	0.002				
3/8/2005	0.004	0.001	0.025	0.002				
3/15/2005	0.002	0.001	0.017	0.002				
3/22/2005	0.004	0.001	0.022	0.002	146.68	3.74	1374	131
3/29/2005	0.002	0.001	0.015	0.002				
4/5/2005	0.002	0.001	0.023	0.002				
4/12/2005	0.003	0.001	0.020	0.002				
4/19/2005	0.002	0.001	0.020	0.002	146.83	3.70	1347	128
4/26/2005	0.002	0.001	0.029	0.002				
5/3/2005	0.002	0.001	0.022	0.002				
5/9/2005	0.002	0.001	0.030	0.002				
5/16/2005	0.003	0.001	0.032	0.002	171.59	4.00	530	100
5/23/2005	0.008	0.001	0.028	0.002				
5/31/2005	0.002	0.001	0.021	0.002				
6/8/2005	0.001	0.001	0.013	0.001	122.72	3.40	1379	127
6/14/2005	0.001	0.001	0.015	0.002				
6/20/2005	0.002	0.001	0.024	0.002				
6/27/2005	0.003	0.001	0.028	0.002	149.34	3.74	1346	126
7/5/2005	<0.001	NA	0.014	0.001				
7/12/2005	0.001	0.001	0.015	0.002				
7/19/2005	0.006	0.001	0.018	0.002	124.36	3.43	2425	156
7/26/2005	0.005	0.001	0.029	0.002				
8/2/2005	0.003	0.001	0.032	0.002				
8/9/2005	0.002	0.001	0.024	0.002	160.55	3.88	1964	145
8/15/2005	0.002	0.001	0.017	0.002				
8/23/2005	0.003	0.001	0.026	0.002				
8/31/2005	<LLD	NA	0.028	0.001	161.15	3.88	2094	147
9/7/2005	<LLD	NA	0.013	0.002				
9/21/2005	0.003	0.001	0.032	0.002				
9/27/2005	0.003	0.001	0.023	0.002	328.11	5.42	NS	NA
10/4/2005	0.003	0.001	0.029	0.002				
10/11/2005	0.001	0.001	0.010	0.001				
10/18/2005	0.004	0.001	0.031	0.002				
10/26/2005	0.004	0.001	0.033	0.002	313.88	5.28	6176	229
11/2/2005	0.004	0.001	0.032	0.002				
11/8/2005	0.004	0.001	0.036	0.002				
11/16/2005	0.003	0.001	0.028	0.002				
11/22/2005	0.001	0.001	0.023	0.002				
11/30/2005	0.003	0.001	0.024	0.002	347.33	5.55	3644	184
12/7/2005	0.002	0.001	0.028	0.002				
12/13/2005	0.012	0.002	0.043	0.003				
12/20/2005	0.003	0.001	0.023	0.002				
12/28/2005	0.003	0.001	0.032	0.002	174.23	3.97	3537	179

Radiological Atmospheric Monitoring
Routine Atmospheric Monitoring Data

(Return to TOC)

Sample Location:	Williston, SC (WIL)							
Date	Gross Alpha in Air		Gross Beta in Air		Tritium in Air		Tritium in Rain	
	pCi/m³	+- 2 sigma	pCi/m³	+- 2 sigma	pCi/m³	+- 2 sigma	pCi/L	+- 2 sigma
1/5/2005	0.003	0.001	0.023	0.002				
1/11/2005	0.005	0.001	0.019	0.002				
1/18/2005	0.005	0.001	0.020	0.002				
1/25/2005	0.006	0.001	0.024	0.002	7.03	1.21	<195	
2/2/2005	0.004	0.001	0.017	0.001				
2/8/2005	0.004	0.001	0.020	0.002				
2/15/2005	0.006	0.001	0.023	0.002				
2/22/2005	0.004	0.001	0.025	0.002	9.06	1.29	<193	
3/1/2005	0.004	0.001	0.017	0.002				
3/8/2005	0.005	0.001	0.025	0.002				
3/15/2005	0.002	0.001	0.016	0.002				
3/22/2005	0.004	0.001	0.022	0.002	4.39	1.15	<196	
3/29/2005	0.002	0.001	0.017	0.002				
4/5/2005	0.003	0.001	0.023	0.002				
4/12/2005	0.002	0.001	0.019	0.002				
4/19/2005	0.002	0.001	0.024	0.002	<2.10		<183	
4/26/2005	0.001	0.001	0.016	0.002				
5/3/2005	0.002	0.001	0.022	0.002				
5/9/2005	0.003	0.001	0.027	0.002				
5/16/2005	0.002	0.001	0.030	0.002	19.30	1.57	329	92
5/23/2005	0.002	0.001	0.023	0.003				
5/31/2005	0.001	0.001	0.018	0.002				
6/8/2005	0.001	0.001	0.014	0.001	<2.04		200	84
6/14/2005	0.002	0.001	0.015	0.002				
6/20/2005	0.003	0.001	0.021	0.002				
6/27/2005	0.002	0.001	0.020	0.002	3.01	1.01	<178	
7/5/2005	<0.002	NA	0.011	0.001				
7/12/2005	<0.002	NA	0.014	0.002				
7/19/2005	0.002	0.002	0.015	0.004	2.20	0.98	<181	
7/26/2005	0.002	0.001	0.023	0.002				
8/2/2005	0.003	0.001	0.029	0.002				
8/9/2005	0.002	0.001	0.025	0.002	5.21	1.10	<182	
8/15/2005	<0.004	NA	0.014	0.005				
8/23/2005	0.002	0.001	0.023	0.002				
8/31/2005	0.003	0.001	0.032	0.002	9.09	1.24	<178	
9/7/2005	0.002	0.001	0.019	0.002				
9/21/2005	0.003	0.001	0.028	0.001				
9/27/2005	0.004	0.001	0.022	0.002	5.15	1.24	NS	NA
10/4/2005	0.004	0.001	0.025	0.002				
10/11/2005	0.001	0.001	0.009	0.001				
10/18/2005	0.004	0.001	0.028	0.002				
10/26/2005	0.005	0.001	0.038	0.002	5.54	1.09	<177	
11/2/2005	0.003	0.001	0.025	0.002				
11/8/2005	0.002	0.001	0.030	0.002				
11/16/2005	0.004	0.001	0.026	0.002				
11/22/2005	0.002	0.001	0.020	0.002				
11/30/2005	0.003	0.001	0.026	0.002	5.57	1.14	<189	
12/7/2005	0.002	0.001	0.027	0.002				
12/13/2005	0.010	0.001	0.031	0.002				
12/20/2005	0.004	0.001	0.026	0.002				
12/28/2005	0.006	0.001	0.041	0.002	3.10	0.99	<175	

Radiological Atmospheric Monitoring
Quarterly Atmospheric Ambient Beta/Gamma Data

(Return to TOC)

Sample Location	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
	mrem	mrem	mrem	mrem	mrem
Co-located with Aiken Air Station	23.00	23.00	28.00	23.00	97.00
E Area	38.00	27.00	41.00	39.00	145.00
Green Pond	25.00	28.00	29.00	27.00	109.00
Co-located with Jackson Air Station	24.00	25.00	27.00	25.00	101.00
Crackerneck Gate	27.00	28.00	33.00	30.00	118.00
TNX Boat Ramp	33.00	30.00	26.00	32.00	121.00
Co-located with Allendale Barricade	29.00	22.00	28.00	24.00	103.00
Junction of Millet Road and Round Tree Road	27.00	29.00	32.00	N/S	88.00
Patterson Mill road At Lower Three Runs Creek	31.00	29.00	33.00	31.00	124.00
Co-located with Allendale Air station	27.00	25.00	29.00	25.00	106.00
Barnwell Airport	29.00	25.00	30.00	27.00	111.00
Co-located with Snelling Air station	29.00	27.00	31.00	29.00	116.00
Co-located with Williston Air station	30.00	26.00	29.00	26.00	111.00
Bates cemetery	27.00	25.00	28.00	27.00	107.00
Williston Police Department	30.00	28.00	30.00	31.00	119.00
Junction of US 278 and SC 781	28.00	26.00	30.00	27.00	111.00
US 278 near Upper Three Runs Creek	32.00	33.00	35.00	N/S	100.00
Co-located with New Ellenton Air Station	30.00	26.00	25.00	27.00	108.00
Windsor Post Office	25.00	26.00	32.00	27.00	110.00

1.1.5 Summary Statistics
Radiological Atmospheric Monitoring

(Return to TOC)

Statistical Review Of Radiological Monitoring at Aiken Elementary Water Tower (AIK)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in Rain
Mean	0.003	0.021	3.43	<MDA
Std Dev	0.002	0.007	0.71	N/A
Median	0.003	0.022	3.06	<MDA
Min	0.001	0.010	2.61	<MDA
Max	0.014	0.043	4.45	<MDA

Statistical Review Of Radiological Monitoring at New Ellenton, SC (NEL)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	4.4	416
Std Dev	0.002	0.012	1.9	239
Median	0.003	0.023	3.4	319
Min	0.001	0.008	2.1	218
Max	0.013	0.097	9.0	794

Statistical Review Of Radiological Monitoring at Jackson, SC (JAK)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.020	4.4	265
Std Dev	0.002	0.008	1.9	72
Median	0.003	0.022	3.4	224
Min	0.001	0.003	2.1	224
Max	0.013	0.041	9.0	348

Statistical Review Of Radiological Monitoring at Allendale Barricade (ABR)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.021	3.4	N/A
Std Dev	0.002	0.009	1.3	N/A
Median	0.003	0.020	2.9	188
Min	0.001	0.012	2.0	188
Max	0.009	0.068	5.7	188

Summary Statistics
Radiological Atmospheric Monitoring

(Return to TOC)

Statistical Review Of Radiological Monitoring at Allendale, SC (ALN)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.024	N/A	<MDA
Std Dev	0.002	0.011	N/A	N/A
Median	0.003	0.025	2.84	<MDA
Min	0.001	0.012	2.84	<MDA
Max	0.015	0.083	2.84	<MDA

Statistical Review Of Radiological Monitoring at Snelling, SC (SCT)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	4.7	239
Std Dev	0.002	0.006	3.2	59
Median	0.003	0.022	3.6	281
Min	0.001	0.011	2.2	239
Max	0.008	0.045	11.4	323

Statistical Review Of Radiological Monitoring at Williston, SC (WIL)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.021	7.1	373
Std Dev	0.002	0.006	4.6	119
Median	0.003	0.023	5.4	358
Min	0.001	0.009	2.2	228
Max	0.010	0.041	19.3	537

Statistical Review of Radiological monitoring at Burial Grounds North, SRS (BGN)				
	Gross Alpha	Gross Beta	Tritium in Air	Tritium in rain
Mean	0.003	0.023	164.0	1557
Std Dev	0.002	0.007	78.8	1586
Median	0.003	0.024	160.9	1964
Min	0.001	0.010	120.8	530
Max	0.012	0.043	347.3	6176

Summary Statistics
Radiological Atmospheric Monitoring
Ambient TLD Beta/Gamma

(Return to TOC)

Sample Location	Yearly Avg	Std Dev	Min	Max	Median
	mrem	mrem	mrem	mrem	
Co-located with Aiken Air Station	24.25	2.50	23.00	28.00	23.00
E Area	36.25	6.29	27.00	41.00	38.50
Green Pond	27.25	1.71	25.00	29.00	25.00
Co-located with Jackson Air Station	25.25	1.26	24.00	27.00	25.00
Crackerneck Gate	29.50	2.65	27.00	33.00	29.00
TNX Boat Ramp	30.25	3.10	26.00	33.00	31.00
Co-located with Allendale Barricade	25.75	3.30	24.00	29.00	26.00
Junction of Millet Road and Round Tree Road	22.00	2.52	27.00	32.00	29.00
Patterson Mill road At Lower Three Runs Creek	31.00	1.63	29.00	33.00	31.00
Co-located with Allendale Air station	26.50	1.91	25.00	29.00	26.00
Barnwell Airport	27.75	2.22	25.00	30.00	28.00
Co-located with Snelling Air station	29.00	1.63	27.00	31.00	29.00
Co-located with Williston Air station	27.75	2.06	26.00	30.00	27.50
Bates cemetery	26.75	1.26	25.00	28.00	27.00
Williston Police Department	30.00	1.26	28.00	31.00	30.00
Junction of US 278 and SC 781	27.75	1.71	26.00	30.00	27.50
US 278 near Upper Three Runs Creek	25.00	1.53	32.00	35.00	33.00
Co-located with New Ellenton Air Station	27.00	2.16	25.00	30.00	26.50
Windsor Post Office	27.50	3.11	25.00	32.00	26.50

2.1 Ambient Groundwater Monitoring (Return to TOC)

2.1.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) evaluates ambient groundwater quality adjacent to the Savannah River Site (SRS) to develop offsite water quality information and determine if contaminants have migrated off SRS. The study area includes SRS and a 10-mile perimeter from the SRS boundary in South Carolina (Map 3, section 2.1.2). ESOP evaluates five aquifer zones within the study area, from the shallow water table to confined aquifers more than 1400 feet deep. ESOP collects samples from different portions of the network on a five-year cycle. In 2005, ESOP sampled 15 wells from the northern and northwestern portions of the study area. ESOP analyzed non-filtered groundwater for basic water quality parameters, metals, and tritium in addition to alpha-emitting, beta-emitting, and gamma-emitting radioisotopes.

This report will continue to be provided to the public on an annual basis as an independent source of regional groundwater information associated with historical ESOP and SRS data.

RESULTS AND DISCUSSION

While few technical difficulties were encountered within the Ambient Groundwater Monitoring Network (AGMN) during sample collection, some field measurements were not obtained due to field meter failure (section 2.1.4). In the case of meter failure, a minimum of three (3) well volumes were purged prior to collecting samples.

Based on a review of the analytical data, various contaminants were detected in 15 wells sampled. Two of the 15 wells contained contaminants (Table 1, section 2.1.3) in excess of the United States Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCL) of 5 picocuries per liter (pCi/L) for radium - 226/228 (combined).

Because the Department of Energy-Savannah River (DOE-SR) collects groundwater samples from a different monitoring well network, direct comparisons could not be made to their findings in the latest DOE-SR report (WSRC, 2006). However, statistical results acquired from ESOP perimeter and background sampling locations tend to support DOE-SR findings that radiological and nonradiological contaminants associated with SRS activities have not migrated off the SRS via the groundwater route. Analytical results are summarized in section 2.1.4.

Metals

The presence of metals in the environment can be attributed to man-made processes and/or the natural decay of deposits. With the exception of lead, a review of the following metal contaminants detected indicates that their presence is most likely due to the erosion of natural deposits.

Barium was detected at a concentration of 0.056 milligrams per liter (mg/L) in well D02014. The MCL for barium is 2 mg/L. Based upon the hydraulically up-gradient distance of this well from SRS centrally located process areas, it is unlikely that this contaminant is related to SRS activities.

Cadmium was detected at a concentration of 0.00017 mg/L in well D02013. The MCL for cadmium is 0.005 mg/L. The source of Cadmium is most likely due to the erosion of natural deposits and is unlikely related to SRS activities.

Copper was detected at concentrations of 0.01 mg/L, 0.014 mg/L, and 0.02 mg/L in wells G02107, G02111, and G06163 respectively. The MCL for copper is 1.3 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of these wells from SRS process areas, it is unlikely that this contaminant is related to SRS activities.

Lead was detected at concentrations of 0.012 mg/L and 0.0072 mg/L in wells G02141 & G02111 respectively. The MCL for lead is 0.015 mg/L. Based upon the SRS general groundwater flow direction and the hydraulically cross-gradient distance of these wells from SRS process areas, it is unlikely that this contaminant is related to SRS activities. The lead concentration in these wells is probably due to the corrosion of well construction material or formation chemistry interactions.

Anions

Nitrate was detected at concentrations well below the 10 mg/L MCL in 11 monitoring wells (section 2.1.4). The presence of nitrate is most likely due to the erosion of natural deposits and/or runoff from fertilizer use. Once in the soil, nitrate is very mobile due to its water solubility trait and therefore moves easily through the soil matrix at a speed comparable to groundwater flow velocity.

Radionuclides

Gross alpha was detected at concentrations at or below the 15 pCi/L MCL in 12 of the 15 monitoring wells that were analyzed (Figure 1, section 2.1.3). As the presence of naturally occurring radionuclides has been well documented in the groundwater regime across the state, the concentrations of gross alpha are probably due to the natural decay process of uranium deposits within the subsurface. Calculation of summary statistics revealed a gross alpha average of 4.49 pCi/L (+/- 4.11 pCi/L) for the SRS 50-mile perimeter population and an average of 4.88 pCi/L (+/- 3.96 pCi/L) for the South Carolina background population. Also, the statistical assumption that the relative populations of background and perimeter concentrations are the same was not disproved. However, an approximation of the number of samples to support this conclusion at the 95% confidence level indicated that more sampling is needed.

Gross non-volatile beta was detected at concentrations below the 4 mrem/yr or 8 pCi/L MCL in two of the 15 monitoring wells that were analyzed (section 2.1.4). As the presence of naturally occurring radionuclides has been well documented in the groundwater regime across the state, the concentrations of gross beta are probably due to the natural decay process of uranium deposits within the subsurface. Calculation of summary statistics revealed a gross beta average of 3.70 pCi/L (+/- 1.37 pCi/L) for the South Carolina background population. Also, the statistical assumption that the relative populations of background and perimeter concentrations are the same was not disproved. However, an approximation of the number of samples to support this conclusion at the 95% confidence level indicated that more sampling is needed.

Radium-226/228 was detected at concentrations above the 5 pCi/L MCL in two of the 15 wells that were analyzed (section 2.1.4). The concentrations in wells G02141 and G06163 were 11.56 pCi/L and 9.70 pCi/L, respectively. Wells G02141 and G06163 are no longer being utilized as public drinking water sources. Also, various combinations of uranium, radium-226, and radium-228 were detected at concentrations < 5.0 pCi/L in the 15 monitoring wells that were analyzed. As the presence of naturally occurring radionuclides (i.e., uranium, radium-226/228) has been well documented in the groundwater regime across the state, the concentrations of uranium, radium-226, and radium-228 are probably due to the natural decay process of uranium deposits within the subsurface. This naturally occurring radioisotope information will be shared with other SCDHEC programs for tracking and public awareness purposes.

Tritium was detected at concentrations well below the 20,000 pCi/L MCL for drinking water in nine monitoring wells (Figure 2, section 2.1.3). The highest detectable concentration was 389 pCi/L in G02141. Tritium is produced naturally in the upper atmosphere when cosmic rays strike air molecules. Pre-atomic atmospheric background levels ranged between 5 to 10 tritium units (TU) where a TU = 3.2 pCi/L. In addition, pre-atomic background levels for groundwater were less than 0.8 TU (Hurst, n.d.). With the advent of nuclear fission technology, subsequent above ground testing of nuclear weapons produced atmospheric tritium levels over 1000 TU by the mid-1960s. Since then, additional environmental sources of tritium have been generated from nuclear reactors and in special production reactors where the isotope lithium-6 is bombarded to produce tritium (USEPA website.). As a result, fallout and rainfall events have allowed tritiated water to enter the hydrologic cycle. Consequently, historical background groundwater tritium levels rose in excess of 50 TU. While tritium does decay with time (half-life of 12.43 years), concentrations still remain in excess of pre-atomic levels (Hurst, n.d.).

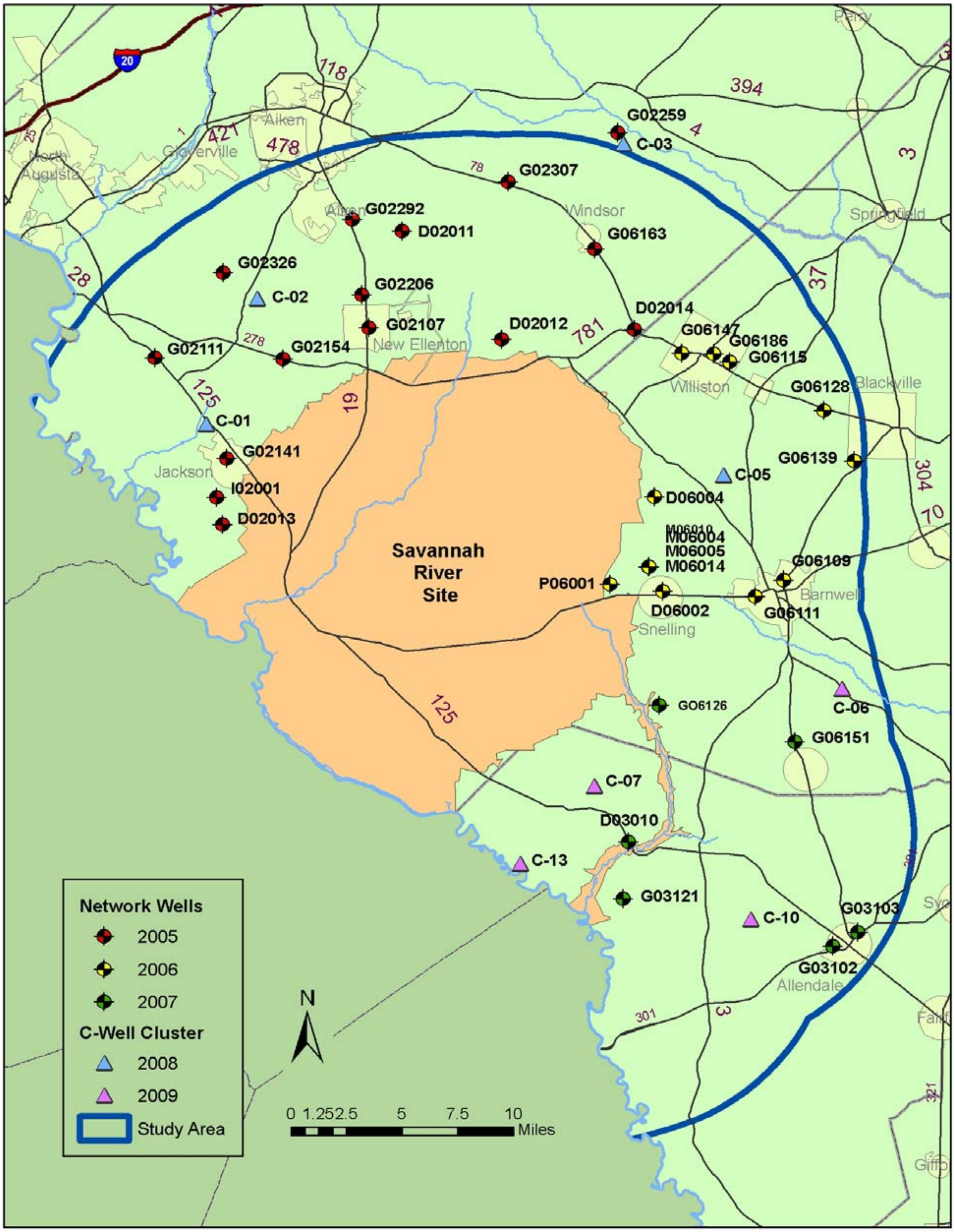
Calculation of summary statistics revealed a tritium average of 278.44 pCi/L (+/- 54.16 pCi/L) for the SRS 50-mile perimeter population. This above background tritium average is most likely attributable to atmospheric emissions from nuclear facilities located within the 50-mile perimeter of the center of SRS.

CONCLUSIONS AND RECOMMENDATIONS

A review of the analytical data revealed various nonradiological and radiological constituents in all 15 wells sampled. Two of the wells exceeded the EPA MCL for radium-226/228. As the AGMP is on a rotating sampling schedule, reporting trends in data is limited at this time. However, a comparison between past (SCDHEC, 2001) and current ESOP data revealed that lead concentrations have decreased below the EPA's "action level" of 0.015 mg/L (Figure 3, section 2.1.3) and the tritium levels have varied slightly (Figure 4, section 2.1.3). Variations in tritium levels are most likely attributable to seasonal rainfall events.

2.1.2
Map 3. Ambient Groundwater Network

(Return to TOC)



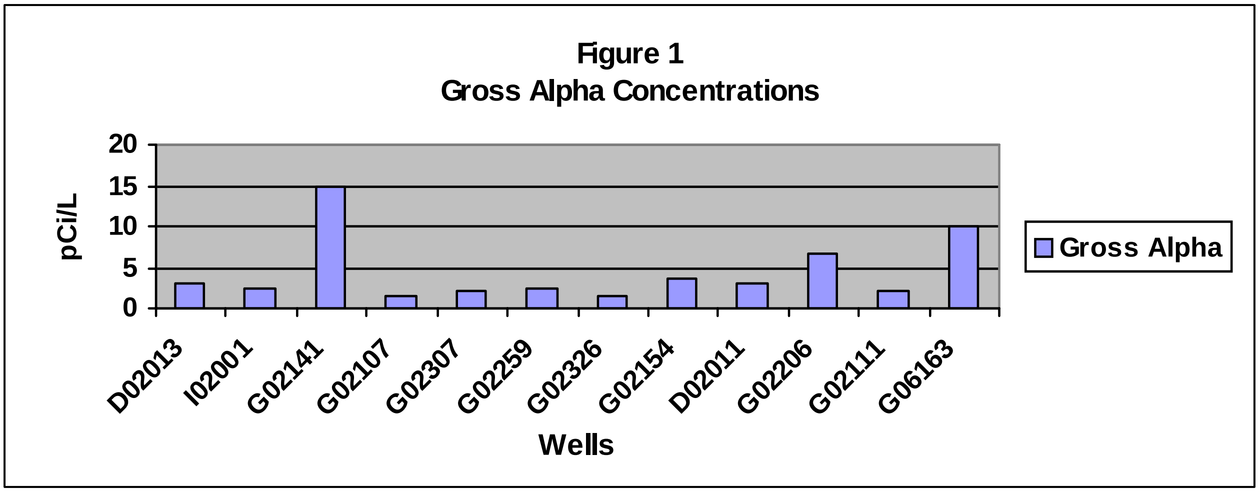
2.1.3 Tables and Figures

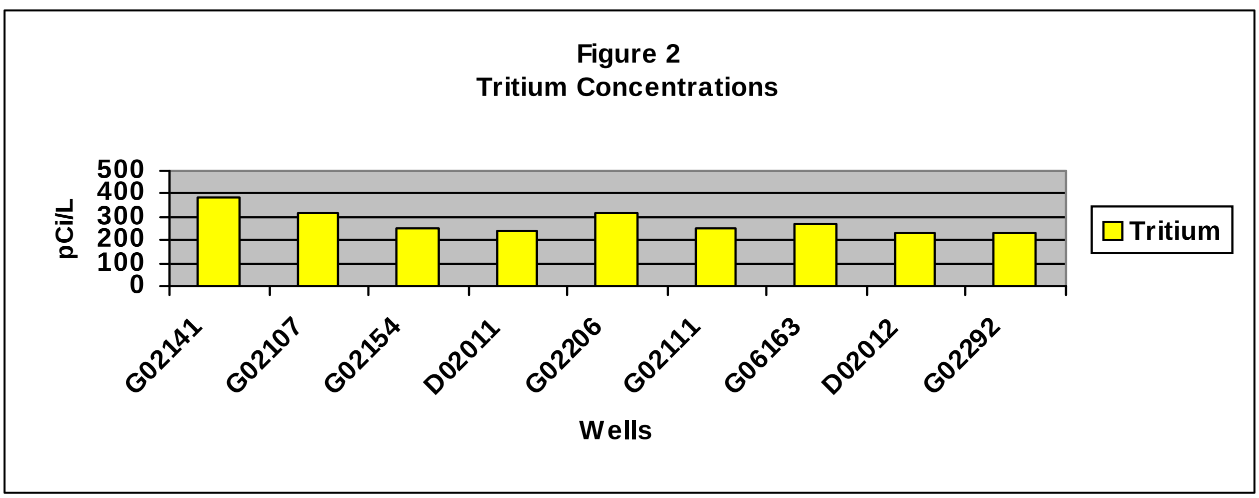
(Return to TOC)

Ambient Groundwater Monitoring

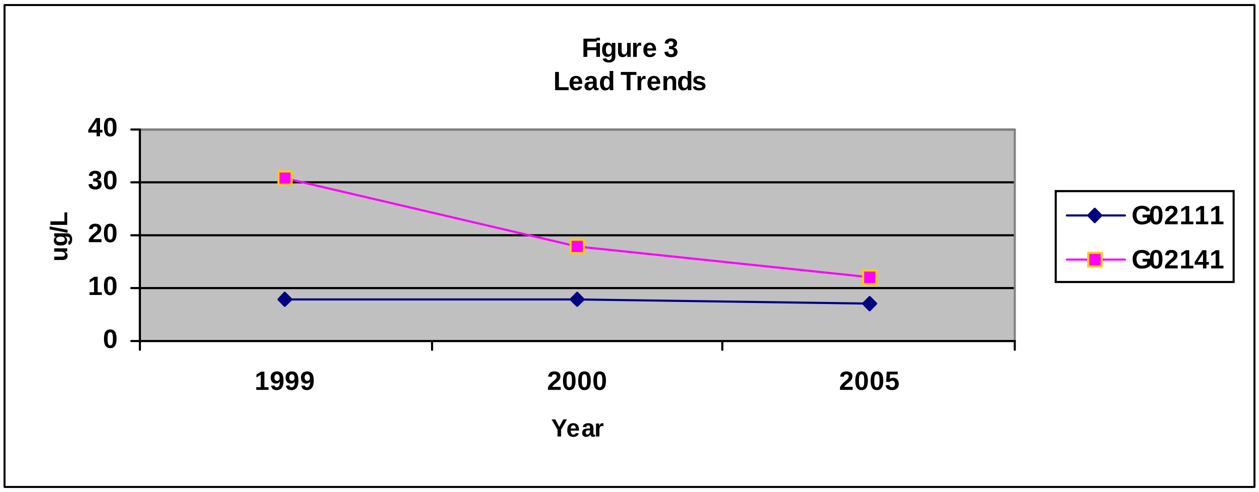
Table 1. Summary of Contaminants Detected Above an Established MCL in 2005.

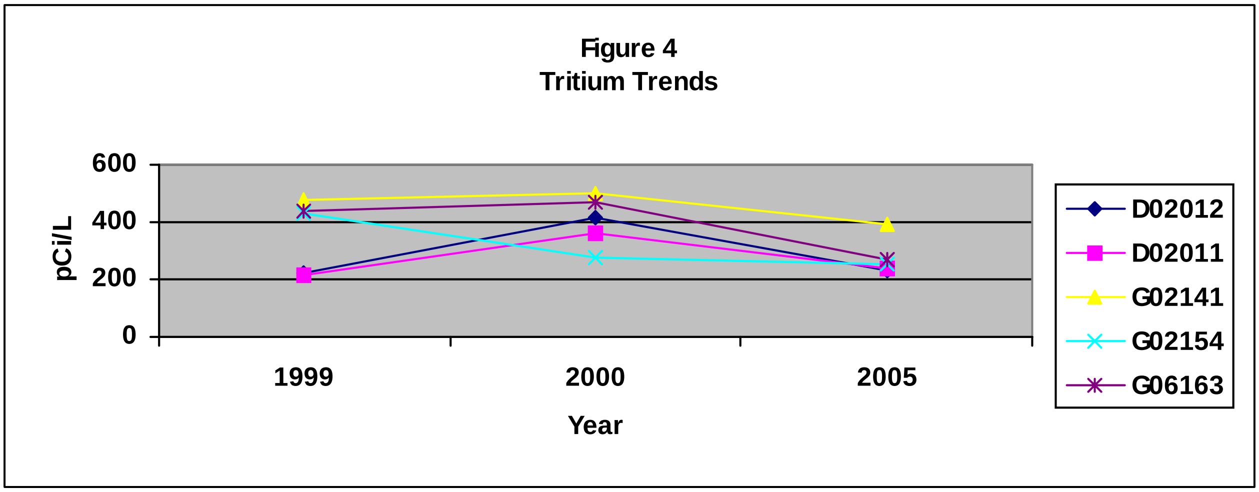
Well No.	Well Name	Analyte	MCL	Concentration	Aquifer
G02141	Jackson	Ra-226/228 (combined)	5 pCi/L	11.56 pCi/L	SP
G06163	Mitchum MHP (abandoned)	Ra-226/228 (combined)	5 pCi/L	9.70 pCi/L	SP





Tables and Figures
Ambient Groundwater Monitoring





2.1.4 Data

(Return to TOC)

Ambient Groundwater Monitoring Data

Ambient Groundwater Monitoring Data

	Well Number:		D02013		I02001		G02141	
	Sample Date:		04/26/05		04/26/05		05/03/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	#	NA	#	NA	19.2	NA
	pH	(S.U.)	#	NA	#	NA	3.89	NA
	Conductivity	(mS/cm)	#	NA	#	NA	0.058	NA
	Dissolved Oxygen	(mg/L)	#	NA	#	NA	9.63	NA
	Turbidity	(NTU)	#	NA	#	NA	1	NA
	Background Radiation	(uR/hr)	9.98	NA	7.48	NA	13.3	NA
	Sample Radiation	(uR/hr)	14.97	NA	16.63	NA	9.14	NA
Chemistry	Alkalinity	(mg/L)	0	NA	<1.0	NA	<1.0	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA	<1.0	NA
	Hardness (calculated)	(mg/L)	2.1	NA	2	NA	6.6	NA
	pH, Lab	(S.U.)	4.4	NA	4.8	NA	5	NA
	Specific Conductance (@25C)	(umhos/cm)	34	NA	21.6	NA	42.6	NA
	Total Dissolved Solids	(mg/L)	20	NA	24	NA	43	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	<0.020	NA	<0.020	NA	0.02	NA
	Chloride	(mg/L)	2.2	NA	2.2	NA	3.2	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	0.023	NA	0.1	NA	2.8	NA
	Nitrate	(mg/L)	0.023	NA	0.1	NA	0	NA
	Ammonia	(mg/L)	0.1	NA	0.09	NA	0.051	NA
	Total Kjeldahl Nitrogen	(mg/L)	0.15	NA	0.18	NA	0.2	NA
	Phosphate, Ortho.	(mg/L)	*	NA	*	NA	<0.020	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA	<0.050	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	0.00017	NA	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.5	NA	0.37	NA	1.4	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Copper	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Iron	(mg/L)	<0.020	NA	0.021	NA	<0.020	NA
	Lead	(mg/L)	<0.0050	NA	<0.0050	NA	0.012	NA
	Magnesium	(mg/L)	0.2	NA	0.25	NA	0.76	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA	<1.0	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	3.7	NA	4.1	NA	3.5	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	1.0	NA	1.3	NA	2.8	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	0.03	NA	<0.010	NA	0.026	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		D02013		I02001		G02141	
	Sample Date:		04/26/05		04/26/05		05/03/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<173	NA	<173	NA	389	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	2.95E+00	NA	2.52E+00	NA	1.50E+01	NA
	±2	(sigma)	1.14E+00		1.06E+00		2.53E+00	
	LLD	(pCi/L)	6.88E-01		6.90E-01		7.14E-01	
	Gross Non-volatile Beta	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	LLD	(pCi/L)	2.32E+00		2.32E+00		2.33E+00	
	Beryllium-7	(pCi/L)	<2.689E+01	NA	<2.729E+01	NA	<2.892E+01	NA
	±2	(sigma)						
	MDA	pCi/L)						
	Sodium-22	(pCi/L)	<2.212E+00	NA	<1.765E+00	NA	<2.006E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Potassium-40	(pCi/L)	<3.727E+01	NA	<3.536E+01	NA	<3.469E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Manganese-54	(pCi/L)	<2.083E+00	NA	<2.186E+00	NA	<2.080E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-58	(pCi/L)	<2.932E+00	NA	<2.505E+00	NA	<2.261E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-60	(pCi/L)	<2.020E+00	NA	<1.864E+00	NA	<2.103E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zinc-65	(pCi/L)	<4.290E+00	NA	<4.637E+00	NA	<4.265E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Yitrium-88	(pCi/L)	<2.503E+00	NA	<2.219E+00	NA	<2.334E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zirconium-95	(pCi/L)	<5.323E+00	NA	<5.499E+00	NA	<5.116E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Ruthenium-103	(pCi/L)	<4.274E+00	NA	<4.149E+00	NA	<3.772E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:
1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		D02013		I02001		G02141	
	Sample Date:		04/26/05		04/26/05		05/03/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<6.250E+00	NA	<5.497E+00	NA	<5.320E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Iodine-131	(pCi/L)	<9.563E+01	NA	<9.235E+01	NA	<5.016E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-134	(pCi/L)	<2.117E+00	NA	<2.212E+00	NA	<1.963E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-137	(pCi/L)	<2.087E+00	NA	<1.907E+00	NA	<2.225E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cerium-144	(pCi/L)	<1.966E+01	NA	<1.720E+01	NA	<1.841E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-152	(pCi/L)	<6.158E+00	NA	<6.700E+00	NA	<6.504E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-154	(pCi/L)	<4.599E+00	NA	<4.733E+00	NA	<4.392E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-155	(pCi/L)	<8.029E+00	NA	<8.018E+00	NA	<7.964E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-212	(pCi/L)	<4.184E+00	NA	<3.983E+00	NA	<4.223E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-214	(pCi/L)	<6.187E+00	NA	<4.794E+00	NA	<6.029E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Actinium-228	(pCi/L)	<9.098E+00	NA	<8.772E+00	NA	<9.883E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Thorium-234	(pCi/L)	<5.585E+01	NA	<5.675E+01	NA	<5.389E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Americium-241	(pCi/L)	<1.337E+01	NA	<1.242E+01	NA	<1.314E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02107		G02307		G02259	
	Sample Date:		05/05/05		05/12/05		05/17/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	17.9	NA	20.2	NA	#	NA
	pH	(S.U.)	4.35	NA	6.91	NA	#	NA
	Conductivity	(mS/cm)	0.031	NA	0.18	NA	#	NA
	Dissolved Oxygen	(mg/L)	11.39	NA	10.26	NA	#	NA
	Turbidity	(NTU)	#	NA	0	NA	#	NA
	Background Radiation	(uR/hr)	13.3	NA	12.27	NA	19.97	NA
	Sample Radiation	(uR/hr)	9.47	NA	14.14	NA	10.81	NA
Chemistry	Alkalinity	(mg/L)	<1.0	NA	53	NA	<1.0	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA	0	NA
	Hardness (calculated)	(mg/L)	1.8	NA	<1.0	NA	1.1	NA
	pH, Lab	(S.U.)	5.7	NA	7.2	NA	4.5	NA
	Specific Conductance (@25C)	(umhos/cm)	19.3	NA	158	NA	27	NA
	Total Dissolved Solids	(mg/L)	26	NA	130	NA	16	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	0.021	NA	<0.020	NA	<0.020	NA
	Chloride	(mg/L)	2.5	NA	1.8	NA	1.9	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	<0.020	NA		NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	0.8	NA	<0.020	NA	<0.020	NA
	Nitrate	(mg/L)	0.8	NA		NA	<0.020	NA
	Ammonia	(mg/L)	<0.050	NA	0.15	NA	0.086	NA
	Total Kjeldahl Nitrogen	(mg/L)	0.12	NA	*	NA	0.19	NA
	Phosphate, Ortho.	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA	<0.050	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	NA	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.35	NA	0.16	NA	0.2	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Copper	(mg/L)	0.01	NA	<0.010	NA	<0.010	NA
	Iron	(mg/L)	<0.020	NA	0.16	NA	<0.020	NA
	Lead	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Magnesium	(mg/L)	0.23	NA	0.11	NA	0.1	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA	<1.0	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	2.9	NA	1.9	NA	<0.050	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	1.6	NA	26	NA	0.75	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	<0.010	NA	0.011	NA	<0.010	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02107		G02307		G02259	
	Sample Date:		05/05/05		05/12/05		05/17/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	322	NA	<173	NA	<173	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	1.65E+00	NA	2.12E+00	NA	2.48E+00	NA
	±2	(sigma)	8.93E-01		1.21E+00		1.05E+00	
	LLD	(pCi/L)	6.99E-01		9.90E-01		6.80E-01	
	Gross Non-volatile Beta	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	LLD	(pCi/L)	2.33E+00		2.37E+00		2.32E+00	
	Beryllium-7	(pCi/L)	<2.739E+01	NA	<2.308E+01	NA	<3.991E+01	NA
	±2	(sigma)						
	MDA	pCi/L)						
	Sodium-22	(pCi/L)	<1.998E+00	NA	<2.101E+00	NA	<3.033E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Potassium-40	(pCi/L)	<3.665E+01	NA	<3.660E+01	NA	<8.179E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Manganese-54	(pCi/L)	<1.838E+00	NA	<1.848E+00	NA	<3.169E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-58	(pCi/L)	<2.616E+00	NA	<2.685E+00	NA	<4.065E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-60	(pCi/L)	<1.771E+00	NA	<2.090E+00	NA	<2.908E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zinc-65	(pCi/L)	<4.042E+00	NA	<4.401E+00	NA	<6.632E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Yitrium-88	(pCi/L)	<2.580E+00	NA	<2.300E+00	NA	<2.541E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zirconium-95	(pCi/L)	<5.405E+00	NA	<3.480E+00	NA	<7.262E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Ruthenium-103	(pCi/L)	<3.557E+00	NA	<3.334E+00	NA	<5.282E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:
1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02107		G02307		G02259	
	Sample Date:		05/05/05		05/12/05		05/17/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<5.344E+00	NA	<5.632E+00	NA	<1.106E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Iodine-131	(pCi/L)	<4.628E+01	NA	<2.845E+01	NA	<2.961E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-134	(pCi/L)	<1.991E+00	NA	<1.930E+00	NA	<3.292E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-137	(pCi/L)	<2.019E+00	NA	<1.994E+00	NA	<3.656E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cerium-144	(pCi/L)	<1.762E+01	NA	<1.827E+01	NA	<4.164E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-152	(pCi/L)	<6.198E+00	NA	<6.341E+00	NA	<1.274E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-154	(pCi/L)	<4.469E+00	NA	<4.575E+00	NA	<8.429E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-155	(pCi/L)	<7.453E+00	NA	<7.874E+00	NA	<1.956E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-212	(pCi/L)	<4.040E+00	NA	<4.195E+00	NA	<8.824E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-214	(pCi/L)	<4.865E+00	NA	<5.480E+00	NA	<9.504E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Actinium-228	(pCi/L)	<8.639E+00	NA	<9.795E+00	NA	<1.605E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Thorium-234	(pCi/L)	<5.361E+01	NA	<5.395E+01	NA	<1.121E+02	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Americium-241	(pCi/L)	<1.310E+01	NA	<1.216E+01	NA	<3.504E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02326		G02154		D02011	
	Sample Date:		05/19/05		05/24/05		05/26/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	19.5	NA		NA	18.6	NA
	pH	(S.U.)	4.61	NA		NA	4.39	NA
	Conductivity	(mS/cm)	x	NA		NA	0.02	NA
	Dissolved Oxygen	(mg/L)	9.4	NA		NA	12.73	NA
	Turbidity	(NTU)	x	NA		NA	x	NA
	Background Radiation	(uR/hr)	23.3	NA	22.4	NA	10.81	NA
	Sample Radiation	(uR/hr)	18.29	NA	8.31	NA	8.31	NA
Chemistry	Alkalinity	(mg/L)	5.8	NA	35	NA	<1.0	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA	0	NA
	Hardness (calculated)	(mg/L)	2.4	NA	2.1	NA	2.2	NA
	pH, Lab	(S.U.)	5.7	NA	7	NA	5.0	NA
	Specific Conductance (@25C)	(umhos/cm)	23.8	NA	77.5	NA	25.3	NA
	Total Dissolved Solids	(mg/L)	17	NA	50	NA	26	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	*	NA	*	NA	*	NA
	Chloride	(mg/L)	2.8	NA	2.1	NA	3.1	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	*	NA	<0.020	NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	0.034	NA	0.71	NA	0.87	NA
	Nitrate	(mg/L)		NA	0.71	NA	0.87	NA
	Ammonia	(mg/L)	<0.050	NA	<0.050	NA	0.11	NA
	Total Kjeldahl Nitrogen	(mg/L)	0.17	NA	0.32	NA	0.62	NA
	Phosphate, Ortho.	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA	<0.050	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	NA	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.64	NA	0.45	NA	0.31	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Copper	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Iron	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Lead	(mg/L)	<0.005	NA	<0.0050	NA	<0.0050	NA
	Magnesium	(mg/L)	0.19	NA	0.23	NA	0.34	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA	<1.0	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	0.056	NA	0.066	NA	<0.050	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	2.4	NA	16	NA	1.6	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02326		G02154		D02011	
	Sample Date:		05/19/05		05/24/05		05/26/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	<173	NA	251	NA	236	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	1.62E+00	NA	3.70E+00	NA	3.10E+00	NA
	±2	(sigma)	8.74E-01		1.36E+00		1.17E+00	
	LLD	(pCi/L)	6.85E-01		7.85E-01		6.88E-01	
	Gross Non-volatile Beta	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	LLD	(pCi/L)	2.32E+00		2.34E+00		2.32E+00	
	Beryllium-7	(pCi/L)	<4.240E+01	NA	<4.163E+01	NA	<4.026E+01	NA
	±2	(sigma)						
	MDA	pCi/L)						
	Sodium-22	(pCi/L)	<3.178E+00	NA	<3.068E+00	NA	<3.035E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Potassium-40	(pCi/L)	<8.278E+01	NA	<2.603E+01	NA	<8.447E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Manganese-54	(pCi/L)	<3.210E+00	NA	<3.449E+00	NA	<3.261E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-58	(pCi/L)	<3.920E+00	NA	<3.536E+00	NA	<3.790E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-60	(pCi/L)	<3.013E+00	NA	<3.078E+00	NA	<2.841E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zinc-65	(pCi/L)	<6.724E+00	NA	<7.049E+00	NA	<6.660E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Yitrium-88	(pCi/L)	<2.813E+00	NA	<2.807E+00	NA	<2.864E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zirconium-95	(pCi/L)	<7.228E+00	NA	<7.339E+00	NA	<6.651E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Ruthenium-103	(pCi/L)	<5.705E+00	NA	<4.941E+00	NA	<4.938E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:
1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02326		G02154		D02011	
	Sample Date:		05/19/05		05/24/05		05/26/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<1.105E+01	NA	<1.123E+01	NA	<1.114E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Iodine-131	(pCi/L)	<3.378E+01	NA	<2.261E+01	NA	<1.932E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-134	(pCi/L)	<3.495E+00	NA	<3.608E+00	NA	<3.496E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-137	(pCi/L)	<3.425E+00	NA	<3.647E+00	NA	<3.586E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cerium-144	(pCi/L)	<4.271E+01	NA	<4.216E+01	NA	<4.172E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-152	(pCi/L)	<1.282E+01	NA	<1.280E+01	NA	<1.273E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-154	(pCi/L)	<8.869E+00	NA	<8.565E+00	NA	<8.473E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-155	(pCi/L)	<1.966E+00	NA	<1.916E+01	NA	<1.962E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-212	(pCi/L)	<9.139E+00	NA	<8.814E+00	NA	<9.081E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-214	(pCi/L)	<9.697E+00	NA	<9.514E+00	NA	<9.860E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Actinium-228	(pCi/L)	<1.583E+01	NA	<1.672E+01	NA	<1.703E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Thorium-234	(pCi/L)	<1.127E+02	NA	<1.134E+02	NA	<1.157E+02	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Americium-241	(pCi/L)	<3.651E+01	NA	<3.644E+01	NA	<3.689E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02206		Blind Dup-01		G02111	
	Sample Date:		05/31/05		05/31/05		05/31/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	19.1	NA	NA	NA	19.3	NA
	pH	(S.U.)	4.46	NA	NA	NA	4.52	NA
	Conductivity	(mS/cm)	0.036	NA	NA	NA	0.042	NA
	Dissolved Oxygen	(mg/L)	9.64	NA	NA	NA	10.02	NA
	Turbidity	(NTU)	x	NA	NA	NA	x	NA
	Background Radiation	(uR/hr)	16.63	NA	NA	NA	8.31	NA
	Sample Radiation	(uR/hr)	9.98	NA	NA	NA	9.98	NA
Chemistry	Alkalinity	(mg/L)	<1.0	NA	<1.0	NA	<1.0	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA	0	NA
	Hardness (calculated)	(mg/L)	4.3	NA	2.9	NA	5.4	NA
	pH, Lab	(S.U.)	4.9	NA	5.0	NA	5.0	NA
	Specific Conductance (@25C)	(umhos/cm)	36.1	NA	36.2	NA	41.5	NA
	Total Dissolved Solids	(mg/L)	31	NA	32	NA	43	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	*	NA	*	NA	*	NA
	Chloride	(mg/L)	5.5	NA	4.9	NA	3.4	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	2.1	NA	2.1	NA	2.3	NA
	Nitrate	(mg/L)	2.1	NA	2.1	NA	2.3	NA
	Ammonia	(mg/L)	<0.050	NA	<0.050	NA	<0.050	NA
	Total Kjeldahl Nitrogen	(mg/L)	0.12	NA	0.13	NA	0.15	NA
	Phosphate, Ortho.	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA	<0.050	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	NA	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.9	NA	0.39	NA	1.1	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Copper	(mg/L)	<0.010	NA	<0.010	NA	0.014	NA
	Iron	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Lead	(mg/L)	<0.0050	NA	<0.0050	NA	0.0072	NA
	Magnesium	(mg/L)	0.51	NA	0.46	NA	0.64	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA	<1.0	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	0.23	NA	0.081	NA	0.08	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	30	NA	3.1	NA	2.7	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	0.066	NA	<0.010	NA	0.26	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02206		Blind Dup-01		G02111	
	Sample Date:		05/31/05		05/31/05		05/31/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	320	NA	358	NA	250	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	6.64E+00	NA	6.21E+00	@	2.14E+00	NA
	±2	(sigma)	1.79E+00		1.73E+00		1.29E+00	
	LLD	(pCi/L)	1.82E+00		1.81E+00		1.87E+00	
	Gross Non-volatile Beta	(pCi/L)	2.72E+00	NA	3.06E+00	@	<LLD	NA
	±2	(sigma)	1.49E+00		1.51E+00			
	LLD	(pCi/L)	2.44E+00		2.44E+00		2.44E+00	
	Beryllium-7	(pCi/L)	<4.104E+01	NA	<4.180E+01	@	<4.106E+01	NA
	±2	(sigma)						
	MDA	pCi/L)						
	Sodium-22	(pCi/L)	<2.853E+00	NA	<3.189E+00	@	<3.358E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Potassium-40	(pCi/L)	<2.832E+01	NA	<2.676E+01	@	<2.206E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Manganese-54	(pCi/L)	<3.546E+00	NA	<3.251E+00	@	<3.562E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-58	(pCi/L)	<3.875E+00	NA	<3.704E+00	@	<3.920E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cobalt-60	(pCi/L)	<3.032E+00	NA	<3.011E+00	@	<3.089E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zinc-65	(pCi/L)	<7.234E+00	NA	<7.140E+00	@	<6.906E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Yitrium-88	(pCi/L)	<2.729E+00	NA	<2.834E+00	@	<2.880E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Zirconium-95	(pCi/L)	<7.192E+00	NA	<7.451E+00	@	<7.298E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Ruthenium-103	(pCi/L)	<5.377E+00	NA	<5.264E+00	@	<5.429E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02206		Blind Dup-01		G02111	
	Sample Date:		05/31/05		05/31/05		05/31/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<4.248E+00	NA	<4.503E+00	@	<1.114E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Iodine-131	(pCi/L)	<2.800E+01	NA	<2.917E+01	@	<2.832E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-134	(pCi/L)	<3.614E+00	NA	<3.614E+00	@	<3.654E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cesium-137	(pCi/L)	<3.670E+00	NA	<3.741E+00	@	<3.618E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Cerium-144	(pCi/L)	<4.422E+01	NA	<4.373E+01	@	<4.302E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-152	(pCi/L)	<1.273E+01	NA	<1.292E+01	@	<1.271E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-154	(pCi/L)	<7.925E+00	NA	<8.867E+00	@	<9.336E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Europium-155	(pCi/L)	<1.946E+01	NA	<2.022E+01	@	<1.951E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-212	(pCi/L)	<9.211E+00	NA	<9.040E+00	@	<9.505E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Lead-214	(pCi/L)	<1.007E+01	NA	<9.971E+00	@	<9.764E+00	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Actinium-228	(pCi/L)	<1.734E+01	NA	<1.785E+01	@	<1.698E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Thorium-234	(pCi/L)	<1.174E+02	NA	<1.180E+02	@	<1.178E+02	NA
	±2	(sigma)						
	MDA	(pCi/L)						
	Americium-241	(pCi/L)	<3.795E+01	NA	<3.700E+01	@	<3.700E+01	NA
	±2	(sigma)						
	MDA	(pCi/L)						

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G06163		D02012		D02348	
	Sample Date:		06/07/05		06/16/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	20.6	NA	19.4	NA	19.5	NA
	pH	(S.U.)	4.68	NA	4.47	NA	6.2	NA
	Conductivity	(mS/cm)	0.029	NA	0.039	NA	0.097	NA
	Dissolved Oxygen	(mg/L)	10.42	NA	9.34	NA	5.2	NA
	Turbidity	(NTU)	x	NA	x	NA	x	NA
	Background Radiation	(uR/hr)	24.1	NA	22.4	NA	11.64	NA
	Sample Radiation	(uR/hr)	6.65	NA	9.14	NA	16.63	NA
Chemistry	Alkalinity	(mg/L)	<1.0	NA	<1.0	NA	39	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA	0	NA
	Hardness (calculated)	(mg/L)	4.4	NA	7.1	NA	41	NA
	pH, Lab	(S.U.)	5.1	NA	5.1	NA	6.4	NA
	Specific Conductance (@25C)	(umhos/cm)	29.1	NA	34.5	NA	86.6	NA
	Total Dissolved Solids	(mg/L)	27	NA	28	NA	94	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	*	NA	0.038	NA	0.032	NA
	Chloride	(mg/L)	3.1	NA	4.6	NA	1.8	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	1.5	NA	1.1	NA	0.58	NA
	Nitrate	(mg/L)	1.5	NA	1.1	NA	0.58	NA
	Ammonia	(mg/L)	<0.050	NA	<0.050	NA	0.059	NA
	Total Kjeldahl Nitrogen	(mg/L)	0.12	NA	0.12	NA	<0.10	NA
	Phosphate, Ortho.	(mg/L)	<0.020	NA	<0.020	NA	0.037	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA	0.056	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	NA	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.82	NA	1.7	NA	16	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Copper	(mg/L)	0.02	NA	<0.010	NA	<0.010	NA
	Iron	(mg/L)	0.022	NA	<0.020	NA	0.081	NA
	Lead	(mg/L)	<0.0050	NA	<0.0050	NA	<0.0050	NA
	Magnesium	(mg/L)	0.57	NA	0.69	NA	0.37	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA	1.1	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	3.1	NA	1.8	NA	16	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	2	NA	1.8	NA	1.2	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	0.015	NA	0.072	NA	0.024	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G06163		D02012		D02348	
	Sample Date:		06/07/05		06/16/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	273	NA	234	NA	<189	NA
	±2	(sigma)						
	Gross Alpha	(pCi/L)	1.00E+01	NA	<LLD	NA	<LLD	NA
	±2	(sigma)	2.02E+00					
	LLD	(pCi/L)	1.78E+00		1.80E+00		2.44E+00	
	Gross Non-volatile Beta	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	LLD	(pCi/L)	2.99E+00		3.00E+00		3.03E+00	
	Beryllium-7	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	pCi/L)	4.737E+01		4.340E+01		3.883E+01	
	Sodium-22	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.083E+00		2.976E+00		2.844E+00	
	Potassium-40	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.329E+01		6.981E+01		7.219E+01	
	Manganese-54	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.318E+00		3.092E+00		2.887E+00	
	Cobalt-58	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.093E+00		3.999E+00		3.470E+00	
	Cobalt-60	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.864E+00		2.501E+00		2.782E+00	
	Zinc-65	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	7.717E+00		5.990E+00		6.125E+00	
	Yitrium-88	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	2.606E+00		2.967E+00		2.187E+00	
	Zirconium-95	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.089E+00		7.019E+00		6.689E+00	
	Ruthenium-103	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	6.735E+00		5.686E+00		5.167E+00	

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G06163		D02012		D02348	
	Sample Date:		06/07/05		06/16/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.090E+01		1.043E+01		1.077E+01	
	Iodine-131	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.247E+01		3.896E+01		2.596E+01	
	Cesium-134	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.570E+00		3.218E+00		3.359E+00	
	Cesium-137	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.717E+00		3.369E+00		3.624E+00	
	Cerium-144	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	4.458E+01		4.046E+01		3.978E+01	
	Europium-152	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.250E+01		1.180E+01		1.215E+01	
	Europium-154	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.499E+00		8.221E+00		7.925E+00	
	Europium-155	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.951E+01		1.940E+01		1.955E+01	
	Lead-212	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	8.886E+00		8.054E+00		8.390E+00	
	Lead-214	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	9.955E+00		9.194E+00		8.882E+00	
	Actinium-228	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.576E+01		1.489E+01		1.427E+01	
	Thorium-234	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	1.142E+02		1.124E+02		1.119E+02	
	Americium-241	(pCi/L)	<LLD	NA	<LLD	NA	<LLD	NA
	±2	(sigma)						
	MDA	(pCi/L)	3.731E+01		3.668E+01		3.587E+01	

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02291		Blind Dup-02	
	Sample Date:		06/21/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved
Field Measurements	Temperature	(C)	20	NA	NA	NA
	pH	(S.U.)	6.43	NA	NA	NA
	Conductivity	(mS/cm)	0.128	NA	NA	NA
	Dissolved Oxygen	(mg/L)	5.33	NA	NA	NA
	Turbidity	(NTU)	x	NA	NA	NA
	Background Radiation	(uR/hr)	13.3	NA	NA	NA
	Sample Radiation	(uR/hr)	10.81	NA	NA	NA
Chemistry	Alkalinity	(mg/L)	36	NA	35	NA
	Pth. Alkalinity	(mg/L)	0	NA	0	NA
	Hardness (calculated)	(mg/L)	3.8	NA	4.2	NA
	pH, Lab	(S.U.)	6.6	NA	6.6	NA
	Specific Conductance (@25C)	(umhos/cm)	114	NA	108	NA
	Total Dissolved Solids	(mg/L)	83	NA	76	NA
	Total Organic Carbon	(mg/L)	<2.0	NA	<2.0	NA
	Bromide	(mg/L)	<0.020	NA	<0.020	NA
	Chloride	(mg/L)	7.1	NA	6.5	NA
	Fluoride	(mg/L)	<0.10	NA	<0.10	NA
	Nitrite	(mg/L)	<0.020	NA	<0.020	NA
	Nitrate/Nitrite	(mg/L)	2.6	NA	2.7	NA
	Nitrate	(mg/L)	2.6	NA	2.7	NA
	Ammonia	(mg/L)	0.064	NA	<0.050	NA
	Total Kjeldahl Nitrogen	(mg/L)	<0.10	NA	<0.10	NA
	Phosphate, Ortho.	(mg/L)	0.02	NA	0.02	NA
	Sulfate	(mg/L)	<5.0	NA	<5.0	NA
Metals	Aluminum	(mg/L)	<0.10	NA	<0.10	NA
	Antimony	(mg/L)	<0.0030	NA	<0.0030	NA
	Arsenic	(mg/L)	<0.0050	NA	<0.0050	NA
	Barium	(mg/L)	<0.050	NA	<0.050	NA
	Boron	(mg/L)	<0.10	NA	<0.10	NA
	Beryllium	(mg/L)	<0.0030	NA	<0.0030	NA
	Cadmium	(mg/L)	<0.00010	NA	<0.00010	NA
	Calcium	(mg/L)	0.86	NA	1	NA
	Chromium	(mg/L)	<0.010	NA	<0.010	NA
	Cobalt	(mg/L)	<0.020	NA	<0.020	NA
	Copper	(mg/L)	<0.010	NA	0.015	NA
	Iron	(mg/L)	0.02	NA	0.027	NA
	Lead	(mg/L)	<0.0050	NA	<0.0050	NA
	Magnesium	(mg/L)	0.41	NA	0.4	NA
	Manganese	(mg/L)	<0.010	NA	<0.010	NA
	Mercury	(mg/L)	<0.00020	NA	<0.00020	NA
	Nickel	(mg/L)	<0.020	NA	<0.020	NA
	Potassium	(mg/L)	<1.0	NA	<1.0	NA
	Selenium	(mg/L)	<0.0020	NA	<0.0020	NA
	Silicon	(mg/L)	2.8	NA	2.8	NA
	Silver	(mg/L)	<0.030	NA	<0.030	NA
	Sodium	(mg/L)	21	NA	19	NA
	Thallium	(mg/L)	<0.0010	NA	<0.0010	NA
	Vanadium	(mg/L)	<0.020	NA	<0.020	NA
	Zinc	(mg/L)	<0.010	NA	0.03	NA

Notes:

1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02291		Blind Dup-02	
	Sample Date:		06/21/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved
Radionuclides	Tritium	(pCi/L)	231	NA	<189	NA
	±2	(sigma)				
	Gross Alpha	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	LLD	(pCi/L)	3.60E+00		2.14E+00	
	Gross Non-volatile Beta	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	LLD	(pCi/L)	3.09E+00		3.02E+00	
	Beryllium-7	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	pCi/L)	3.918E+01		4.138E+01	
	Sodium-22	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	2.910E+00		2.717E+00	
	Potassium-40	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	7.284E+01		7.642E+01	
	Manganese-54	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	2.987E+00		3.229E+00	
	Cobalt-58	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	3.713E+00		3.619E+00	
	Cobalt-60	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	2.753E+00		2.551E+00	
	Zinc-65	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	6.817E+00		6.618E+00	
	Yitrium-88	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	2.507E+00		2.259E+00	
	Zirconium-95	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	7.289E+00		7.361E+00	
	Ruthenium-103	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	4.941E+00		5.071E+00	

Notes:
1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		G02291		Blind Dup-02	
	Sample Date:		06/21/05		06/21/05	
	Sample Type:		Total	Dissolved	Total	Dissolved
Radionuclides	Antimony-125	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	1.100E+01		1.093E+01	
	Iodine-131	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	2.559E+01		2.778E+01	
	Cesium-134	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	3.239E+00		3.412E+00	
	Cesium-137	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	3.507E+00		3.705E+00	
	Cerium-144	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	4.071E+01		4.034E+01	
	Europium-152	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	1.172E+01		1.214E+01	
	Europium-154	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	8.072E+00		7.585E+00	
	Europium-155	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	1.890E+01		1.905E+01	
	Lead-212	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	8.576E+00		8.308E+00	
	Lead-214	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	9.146E+00		8.801E+00	
	Actinium-228	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	1.436E+01		1.560E+01	
	Thorium-234	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	1.119E+02		1.126E+02	
	Americium-241	(pCi/L)	<LLD	NA	<LLD	NA
	±2	(sigma)				
	MDA	(pCi/L)	3.655E+01		3.827E+01	

Notes:
1. NA =Not Analyzed
2. ND = No Detect
3. * = analytical Problem
4. @ = not enough water pressure to filter
5. # = Artesian Well
6. x = field meter problems
7. Shaded areas = no data

Ambient Groundwater Monitoring Data

	Well Number:		D02013	I02001	G02141	G02107
	Sample Date:		04/26/05	04/26/05	05/03/05	05/05/05
Field Measurements	Temperature	(C)			19.2	17.9
	pH	(S.U.)			3.89	4.35
	Conductivity	(mS/cm)			0.058	0.031
	Dissolved Oxygen	(mg/L)			9.63	11.39
	Turbidity	(NTU)			1	
	Background Radiation	(uR/hr)	9.98	7.48	13.3	13.3
	Sample Radiation	(uR/hr)	14.97	16.63	9.14	9.47
	Total Uranium	(pCi/L)	3.42E-01	2.45E-01	2.50E-02	4.74E-02
	±2	(sigma)	3.5E-02	2.5E-02	2.9E-03	5.20E-03
	MDA	(pCi/L)	8.48E-02	7.79E-02	7.68E-02	8.00E-02
	Radium-226	(pCi/L)	6.33E-01	7.29E-01	8.80E+00	6.2E-01
	±2	(sigma)	1.80E-01	2.00E-01	1.20E+00	1.80E-01
	MDA	(pCi/L)	1.48E-01	1.21E-01	5.12E-02	1.23E-01
	Radium-228	(pCi/L)	1.79E+00	1.46E+00	2.76E+00	8.27E-01
	±2	(sigma)	4.70E-01	4.30E-01	6.60E-01	3.20E-01
	MDA	(pCi/L)	4.23E-01	4.46E-01	4.23E-01	4.58E-01

	Well Number:		G02307	G02259	G02326	G02154
	Sample Date:		05/12/05	05/17/05	05/19/05	05/24/05
Field Measurements	Temperature	(C)	20.2		19.5	
	pH	(S.U.)	6.91		4.61	
	Conductivity	(mS/cm)	0.18		x	
	Dissolved Oxygen	(mg/L)	10.26		9.4	
	Turbidity	(NTU)	0		x	
	Background Radiation	(uR/hr)	12.27	19.97	23.3	22.4
	Sample Radiation	(uR/hr)	14.14	10.81	18.29	8.31
	Total Uranium	(pCi/L)	2.34E-01	2.61E-01	1.85E-01	1.10E-01
	±2	(sigma)	2.40E-02	2.70E-02	1.90E-02	1.10E-02
	MDA	(pCi/L)	7.82E-02	8.22E-02	8.59E-02	8.66E-02
	Radium-226	(pCi/L)	6.24E-01	5.51E-01	3.34E-01	9.47E-01
	±2	(sigma)	1.80E-01	2.32E-01	1.84E-01	2.80E-01
	MDA	(pCi/L)	7.95E-02	2.96E-01	2.59E-01	3.01E-01
	Radium-228	(pCi/L)	1.26E+00	1.45E+00	9.09E-01	1.69E+00
	±2	(sigma)	3.80E-01	2.90E-01	2.10E-01	2.70E-01
	MDA	(pCi/L)	4.15E-01	5.90E-01	3.84E-01	4.34E-01

Notes:
1. Shaded Areas indicate no data collected
2. NA = Not Analyzed
3. x = ESOP field DO probe not working

Ambient Groundwater Monitoring Data

	Well Number:		D02011	G02206	DUP-01	G02111
	Sample Date:		05/26/05	05/31/05	NA	05/31/05
Field Measurements	Temperature	(C)	18.6	19.1		19.3
	pH	(S.U.)	4.39	4.46		4.52
	Conductivity	(mS/cm)	0.02	0.036		0.042
	Dissolved Oxygen	(mg/L)	12.73	9.64		10.02
	Turbidity	(NTU)	x	x		x
	Background Radiation	(uR/hr)	10.81	16.63		8.31
	Sample Radiation	(uR/hr)	8.31	9.98		9.98
	Total Uranium	(pCi/L)	7.20E-02	7.19E-02	7.46E-02	5.48E-02
	±2	(sigma)	7.60E-03	7.60E-03	7.80E-03	5.70E-03
	MDA	(pCi/L)	8.60E-02	7.28E-02	8.12E-02	7.33E-02
	Radium-226	(pCi/L)	1.29E+00	2.5E+00	2.34E+00	6.94E-01
	±2	(sigma)	3.20E-01	3.58E-01	3.56E-01	1.89E-01
	MDA	(pCi/L)	3.11E-01	2.46E-01	2.55E-01	2.01E-01
	Radium-228	(pCi/L)	1.19E+00	1.28E+00	1.75E+00	1.78E+00
	±2	(sigma)	2.46E-01	2.63E-01	2.47E-01	2.99E-01
	MDA	(pCi/L)	5.47E-01	6.03E-01	5.59E-01	6.59E-01

	Well Number:		G06163	D02012	D02348	G02291	DUP-02
	Sample Date:		06/07/05	06/16/05	06/21/05	06/21/05	06/21/05
Field Measurements	Temperature	(C)	20.6	19.4	19.5	20.0	NA
	pH	(S.U.)	4.68	4.47	6.2	6.43	NA
	Conductivity	(mS/cm)	0.029	0.039	0.097	0.128	NA
	Dissolved Oxygen	(mg/L)	10.42	9.34	5.2	5.33	NA
	Turbidity	(NTU)	x	x	x	x	NA
	Background Radiation	(uR/hr)	24.1	22.4	11.64	13.3	NA
	Sample Radiation	(uR/hr)	6.65	9.14	16.63	10.81	NA
	Total Uranium	(pCi/L)	1.20E-01	2.78E-02	2.01E-02	6.58E-02	6.90E-02
	±2	(sigma)	1.20E-02	2.90E-03	2.10E-02	6.80E-03	7.10E-03
	MDA	(pCi/L)	8.70E-02	7.01E-02	8.73E-02	8.70E-02	8.15E-02
	Radium-226	(pCi/L)	8.79E+00	1.07E+00	1.25E-01	7.88E-01	8.58E-01
	±2	(sigma)	6.86E-01	2.44E-01	1.14E-01	2.17E-01	2.27E-01
	MDA	(pCi/L)	2.50E-01	2.16E-01	1.83E-01	2.16E-01	2.22E-01
	Radium-228	(pCi/L)	9.17E-01	7.11E-01	9.24E-02	0.00E+00	7.67E-01
	±2	(sigma)	2.23E-01	2.20E-01	1.73E-01	2.01E-01	1.94E-01
	MDA	(pCi/L)	6.28E-01	5.23E-01	6.67E-01	7.47E-01	5.96E-01

Notes:
1. Shaded Areas indicate no data collected
2. NA = Not Analyzed
3. x = ESOP field DO probe not working

2.1.5 Summary Statistics
Ambient Groundwater Monitoring

(Return to TOC)

Nonrandom Perimter

Analyte	Statistics	Concentration (pCi/L)
Gross Alpha	Average	4.49
	Standard Deviation	4.11
	Median	2.74
Gross Non-volatile Beta	Average	N/A
	Standard Deviation	N/A
	Median	N/A
Tritium	Average	278.44
	Standard Deviation	54.16
	Median	251.00

* NRB - only had one detect for gross beta

Random Background

Analyte	Statistics	Concentration (pCi/L)
Gross Alpha	Average	4.88
	Standard Deviation	3.96
	Median	2.82
Gross Non-volatile Beta	Average	3.70
	Standard Deviation	1.37
	Median	2.91
Tritium	Average	N/A
	Standard Deviation	N/A
	Median	N/A

*RP - only had one detect for gross alpha & beta

2.2 Drinking Water Quality Monitoring

(Return to TOC)

2.2.1 Summary

The South Carolina Department of Health and Environmental Control (SCDHEC) currently monitors all community water systems for various contaminants, including radionuclides. SCDHEC requires monitoring for man-made and naturally occurring radionuclides for a minimum of four consecutive quarters during system start-up. Monitoring continues quarterly if the running average exceeds the United States Environmental Protection Agency (EPA) maximum contamination level (MCL). Monitoring is reduced to once every four years if activities are below the MCL. SCDHEC has expanded this monitoring by sampling selected systems biannually and collecting monthly composites of raw surface water from water treatment plants that use the lower portion of the Savannah River.

The SCDHEC Environmental Surveillance and Oversight Program (ESOP) Drinking Water Monitoring Project evaluates drinking water quality to provide assurance to the public that community drinking water systems adjacent to the Savannah River Site (SRS) and Vogtle Electrical Generating Plant (VEGP) have not been impacted by radiological constituents. The project objectives are to collect monthly composite raw surface water samples from water treatment plants using the lower portion of the Savannah River, and to collect biannually grab samples from selected community drinking water systems within 30 miles of SRS (Map 4, section 2.2.2). ESOP analyzes samples for gross alpha, nonvolatile beta, gamma-emitting radionuclides, and tritium.

The Department of Energy-Savannah River (DOE-SR) historically sampled 19 water systems semi-annually for radiological constituents. Routine sampling ended on the 16 community drinking water systems in mid-1996 when this sampling element was discontinued from the DOE-SR monitoring program. The remaining three, which use surface water sources, are currently being sampled by DOE-SR.

The ESOP study area was established as a 30-mile radius circle centered in SRS. All community drinking water systems in the study area were identified using the SCDHEC Geographical Information System (GIS). Of the systems selected, 17 were mostly groundwater fed and three were surface water fed systems. These systems serve approximately 220,000 customers with approximately 96,000 receiving their water from groundwater sources (Table 1, section 2.2.3). Monthly and biannual samples were labeled, preserved, and transferred to a laboratory with a chain-of-custody. Samples were submitted to the Region 5 Aiken Environmental Quality Control (EQC) Laboratory for tritium analysis. SCDHEC Radiological Environmental Monitoring Division (REMD) conducted gamma spectroscopy, gross alpha, and gross nonvolatile beta analyses. All data collected was verified, validated, and stored in project files and spreadsheets.

The ESOP Drinking Water Monitoring Project continues to be an important source of essential data for assessing human health exposure pathways. ESOP will continue sampling to provide the public with an independent source of radiological data for drinking water systems.

RESULTS AND DISCUSSION

Community Drinking Water System Results

Based on a review of the analytical data, five of the 18 community drinking water systems sampled had tritium activities above the Lower Limit of Detection (LLD) (section 2.2.4). The detected activities ranged from 179 to 342 pCi/L. These tritium activities are measurable but not significant when compared with the 20,000 picocuries per liter (pCi/L) EPA maximum contaminant level (MCL) (USEPA, 2002a). The most consistent detections are found in the three locations closest to SRS. Elevated tritium activities can be attributed to the atmospheric fallout from the nuclear facilities present within the study area. The tritium activity is potentially due to rainwater infiltration into the unconsolidated aquifer that is present in this area. Tritium trending data for community drinking water systems is shown in Figure 1, section 2.2.3.

Gamma-emitting radionuclides were not detected above the Minimum Detectable Activity (MDA). Gross alpha was detected in five samples. All gross alpha samples were below the EPA MCL of 15 pCi/L (USEPA, 2002a). If gross alpha and non-volatile beta exceed the trigger levels of >15 pCi/L or > 8 pCi/L respectively, they will be re-analyzed for isotopic parameters. The majority of the gross alpha that was detected was from a well in Jackson. The Town of Jackson gross alpha detection is due to radium. The town is currently working on adding a new well to alleviate the situation.

Raw Surface Water Results

Based on a review of the raw surface water data from the Savannah River, tritium was detected above the LLD in all of the raw water intakes. Tritium activity in these samples had an average of 408 ± 172.22 picocuries/liter (pCi/L) and ranged from <177 to 678 pCi/L. Of the background, North Augusta, raw water composites only two were above the LLD. Tritium activity in these two North Augusta samples had an average of 374.0 ± 247.49 pCi/L. Tritium activity in the two downstream intakes, Beaufort/Jasper and City of Savannah samples had an average of 413 ± 144.79 pCi/L. The detectable tritium in the background raw surface water location was within one standard deviation of the downstream raw water locations. Section 2.2.4 summarizes the tritium activities for the raw water composites. Tritium trending data for surface water fed drinking water systems is shown in Figure 2, section 2.2.3.

To better explain the river flow fluctuations throughout the year and minimize the effect this has on data collected throughout the year, a data averaging process known as normalizing was used to get the "snapshot" of the 2005 data collected. Tritium activities were normalized to the average monthly river discharge at a United States Geological Survey (USGS) gauging station near the Beaufort-Jasper intake (SCDNR, 2005). After normalization, the two downstream intakes (Beaufort/Jasper and City of Savannah) had an average of 388.0 ± 239.70 curies/month and ranged from <LLD to 945.0 curies/month. The averages of the monthly composites were used to estimate the annual transport of tritium down the Savannah River. Based on ESOP raw surface water sampling from the Beaufort-Jasper, and City of Savannah, approximately 4660 curies of tritium were transported down the river during 2005 (section 2.2.4). Both SRS and Vogtle Electrical generating Plant (VEGP) contributed to the tritium concentration found in the Savannah River.

Gamma-emitting radionuclides were not detected above the Cs-137 MDA for the monthly raw surface water composite samples. Gross alpha was detected above the MDA at Beaufort/Jasper. The yearly average was 1.475 ± 0.49 pCi/L and ranged from <1.03 to 2.13 pCi/L. Gross non-volatile beta was detected in both North Augusta and Beaufort/Jasper. The yearly average was 3.256 ± 0.47 pCi/L and ranged from <2.17 to 3.89 pCi/L. Analytical results for the raw surface water composite samples are summarized in section 2.2.4.

Community Drinking Water and Raw Surface Water Statistical Comparison

The gross alpha detectable average for community drinking water systems in 2005 was 5.91 ± 5.74 pCi/L. Raw surface water had only one system, which detected gross alpha in 2005. The average detection in Beaufort/Jasper was 1.475 ± 0.49 pCi/L. The non-volatile beta detectable average for community drinking water systems was 3.53 ± 1.28 pCi/L and 3.244 ± 0.47 pCi/L in raw surface water. The tritium detectable average for community drinking water systems was 231.20 ± 47.29 pCi/L. The tritium detectable average for the raw surface water background location, North Augusta, was 374.0 ± 247.49 pCi/L.

The detectable gross alpha in raw surface water was low and within one standard deviation of levels periodically detected in community drinking water systems. As the presence of naturally occurring radionuclides has been well documented in the groundwater regime across the state, the concentrations of gross alpha may be due to the natural decay process of uranium deposits within the subsurface. The detectable gross non-volatile beta in raw surface water was also low and within one standard deviation of levels periodically detected in community drinking water systems. There were no detectable gamma-emitting radionuclides found in either raw surface water or community drinking water systems in 2005. The detectable tritium in the background raw surface water location was within one standard deviation of community drinking water systems.

Summary statistics are given in section 2.2.5.

DOE-SR Data Comparison

DOE-SR conducts monthly composite sampling at the three water treatment plants using the Savannah River. Based on the DOE-SR 2005 annual report, tritium in the two downstream raw water intakes averaged 470.5 pCi/L and ranged from 190 to 924 pCi/L (WSRC, 2006).

Based on the DOE-SR sampling effort, an estimated 5300 curies of tritium were transported down the Savannah River in 2005. The SCDHEC normalized detection estimate, based on raw water samples collected at North Augusta, Beaufort-Jasper, and City of Savannah water systems, was 4660 curies compared to the DOE-SR estimate of 5300 curies of tritium released in 2005.

DOE-SR detected tritium levels have been consistently slightly higher than ESOP. Although tritium continues to be the most abundant radionuclide in the Savannah River, the tritium levels have been consistently decreasing over the past five years. A comparison of ESOP and DOE-SR tritium trending data is shown in Figure 3, section 2.2.3.

Gross alpha, nonvolatile beta, and gamma-emitting radionuclides detected by DOE-SR were below SCDHEC MCLs.

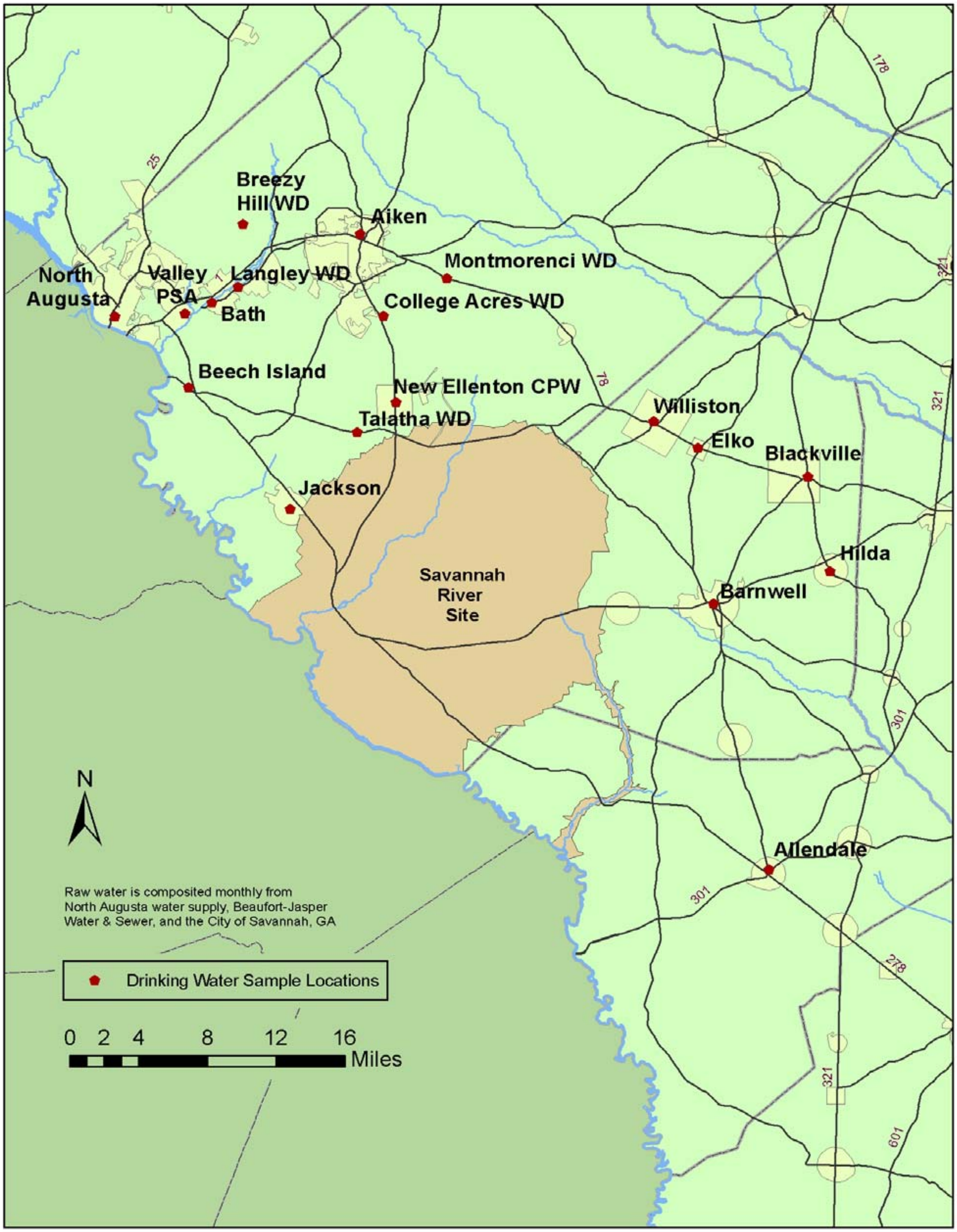
CONCLUSIONS AND RECOMMENDATIONS

Tritium continues to be the most abundant radionuclide detected in public drinking water supplies potentially impacted by SRS and VEGP. It was detected in both community drinking water and surface water systems. However, these tritium activities were relatively low considering the 20,000 pCi/L MCL for drinking water. Gross alpha, gross beta, and gamma-emitting radionuclides were not detected at activities above their respective MCLs. ESOP detected approximately 87.92 percent of the tritium released by Plant Vogtle and SRS without detecting any drinking water exceedences. Comparative analysis with DOE-SR for community drinking water systems cannot be done, because DOE-SR does not sample systems off of the Savannah River Site.

A copy of the analytical data reports and sample log sheets are contained in the project file. ESOP will continue sampling to provide the public with an independent source of radiological data for community drinking water systems. More background samples will be taken in the future to give a better idea of what naturally occurring radioactivity levels are in South Carolina. The data from these samples will be used in statistical analysis with the routine samples.

2.2.2 Map 4. Drinking Water Quality Monitoring Locations

(Return to TOC)



2.2.3 Tables and Figures

(Return to TOC)

Drinking Water Quality Monitoring

Table 1.0 Drinking Water Systems Sampled by ESOP

System Number	System Name	Number of Taps	Population Served
0210001	Aiken	16,633	38,021
0210002	Jackson	1,294	3,602
0210007	New Ellenton	1,951	4,242
0220001	Langley Water District	403	1,088
0220002	College Acres Public Water District	527	1,350
0220003	Bath Water District	314	1,064
0220004	Beech Island	2,890	7,436
0220005	Talatha Water District	576	1,553
0220006	Breezy Hill Water District	4,631	11,377
0220008	Montmorenci Water District	1,183	2,957
0220012	Valley Public Service Authority	3,270	6,818
0310001	Allendale	1,512	4,052
0610001	Barnwell	2,121	5,527
0610002	Williston	1,600	3,307
0610003	Blackville	1,041	2,973
0610004	Hilda	131	466
0610005	Elko	150	462
0210003R	North Augusta Surface Water	10,885	28,443
0720003R	Beaufort-Jasper Surface Water	37,453	83,696
SAVR	City of Savannah Surface Water (Industrial)	35	10,619
	TOTAL	88,600	219,053
	Approx. Groundwater	44,227	96,295
	Approx. Surface water	48,373	122,758

Tables and Figures
Drinking Water Quality Monitoring

(Return to TOC)

Figure 1. Tritium Trending Data for Community Drinking Water Systems

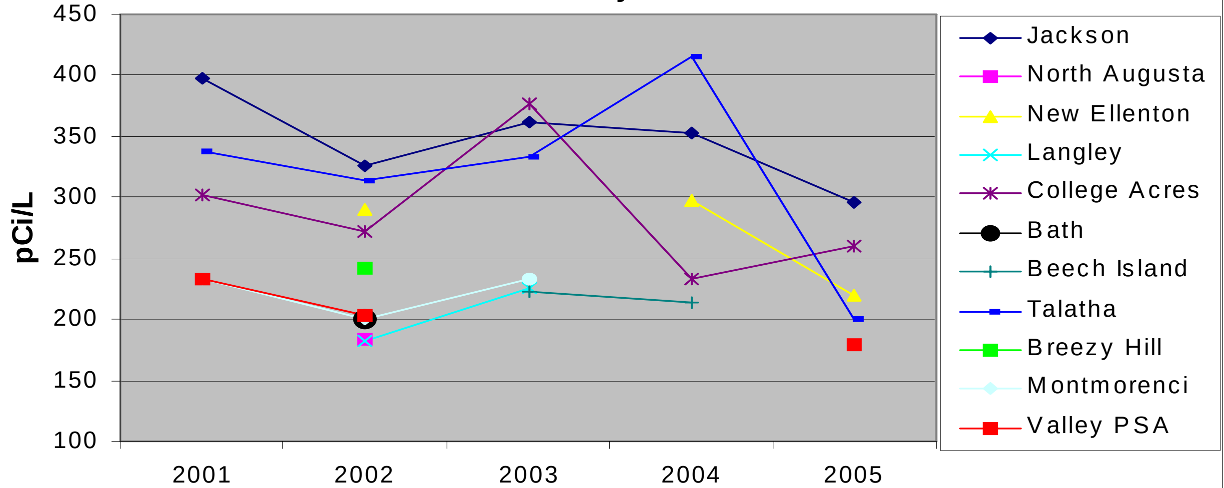


Figure 2. ESOP Yearly Tritium Averages in Surface Water

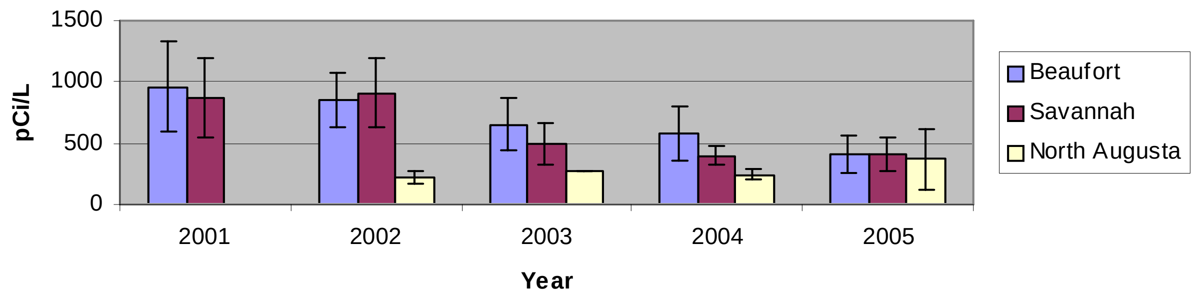
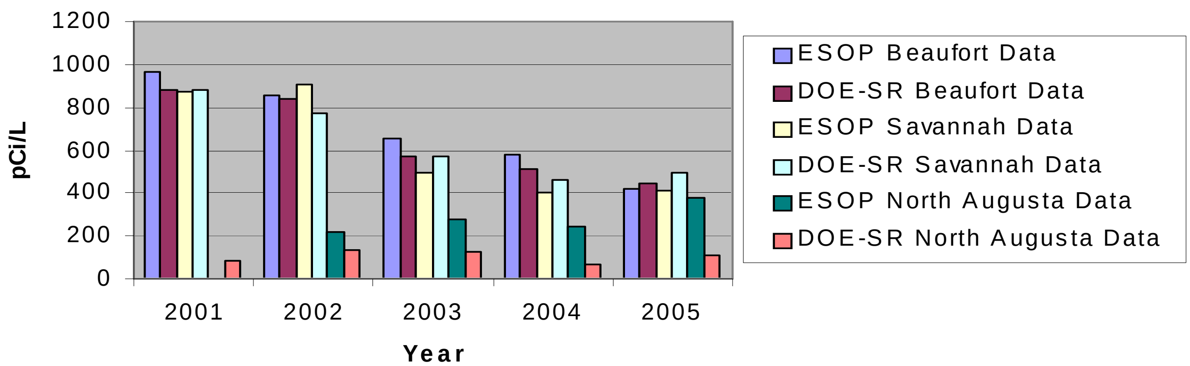


Figure 3. ESOP/DOE-SR Comparison of Yearly Averages of Tritium in Surface Water



2.2.4 Data

(Return to TOC)

Drinking Water Quality Monitoring Data

Drinking Water Quality Monitoring
Community Drinking Water Systems

(Return to TOC)

System Number:			DW0210001		DW0210002	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	3.42	<1.45	5.65	26.4
	±2	(sigma)	1.65		1.67	3.11
	N-V Beta	(pCi/L)	<3.18	<2.59	<2.19	5.64
	±2	(sigma)				1.79
	Tritium	(pCi/L)	<177	<199	293	300
	±2	(sigma)			87	96
	Cesium-137	(pCi/L)	<2.106	<1.926	NS	<3.576
	±2	(sigma)				

System Number:			DW0210003		DW0210007	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	NS	<1.33	<1.83	<1.47
	±2	(sigma)				
	N-V Beta	(pCi/L)	NS	2.49	<3.15	<2.59
	±2	(sigma)		1.37		
	Tritium	(pCi/L)	NS	<201	220	<199
	±2	(sigma)			85	
	Cesium-137	(pCi/L)	NS	<3.642	<3.693	<1.871
	±2	(sigma)				

System Number:			DW0220001		DW0220002	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<1.31	<1.14	<1.91	4.9
	±2	(sigma)				1.6
	N-V Beta	(pCi/L)	3.75	<2.31	<3.15	<2.59
	±2	(sigma)	1.4			
	Tritium	(pCi/L)	<175	<201	179	342
	±2	(sigma)			83	98
	Cesium-137	(pCi/L)	<1.858	<3.712	<3.511	<2.171
	±2	(sigma)				

System Number:			DW0220003		DW0220004	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<1.53	<1.40	<1.42	<1.44
	±2	(sigma)				
	N-V Beta	(pCi/L)	3.02	<2.34	3.17	<2.34
	±2	(sigma)	1.35		1.35	
	Tritium	(pCi/L)	<175	<201	<175	<201
	±2	(sigma)				
	Cesium-137	(pCi/L)	<1.974	<3.617	<2.045	<3.440
	±2	(sigma)				

Drinking Water Quality Monitoring
Community Drinking Water Systems

(Return to TOC)

System Number:			DW0220005		DW0220006	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<2.09	<1.35	<1.98	2.4
	±2	(sigma)				1.17
	N-V Beta	(pCi/L)	<3.16	<2.58	<3.16	<2.58
	±2	(sigma)				
	Tritium	(pCi/L)	200	<199	<177	<199
	±2	(sigma)	84			
	Cesium-137	(pCi/L)	<3.450	<2.079	<3.378	<2.232
	±2	(sigma)				

System Number:			DW0220008		DW0220012	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<2.09	2.79	<2.34	<2.22
	±2	(sigma)		1.22		
	N-V Beta	(pCi/L)	<3.02	<2.33	<2.24	<2.39
	±2	(sigma)				
	Tritium	(pCi/L)	<175	<201	179	<201
	±2	(sigma)			82	
	Cesium-137	(pCi/L)	<1.985	<3.686	<2.051	<3.551
	±2	(sigma)				

System Number:			DW0310001		DW0610001	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<2.80	<2.36	<1.77	<1.47
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.26	<2.40	<2.20	<2.34
	±2	(sigma)				
	Tritium	(pCi/L)	<175	<201	<175	<201
	±2	(sigma)				
	Cesium-137	(pCi/L)	<2.242	<3.640	<2.058	<3.598
	±2	(sigma)				

System Number:			DW0610002		DW0610003	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<4.47	<1.59	<4.28	<2.54
	±2	(sigma)				
	N-V Beta	(pCi/L)	<3.12	2.62	<3.11	<2.41
	±2	(sigma)		1.39		
	Tritium	(pCi/L)	<175	<201	<175	<201
	±2	(sigma)				
	Cesium-137	(pCi/L)	<2.160	<3.422	<2.017	<3.510
	±2	(sigma)				

Drinking Water Quality Monitoring
Community Drinking Water Systems

(Return to TOC)

System Number:			DW0610004		DW0610005	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<1.73	<1.58	<2.76	<1.70
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.20	<2.35	<3.05	<2.36
	±2	(sigma)				
	Tritium	(pCi/L)	<175	<201	<175	<201
	±2	(sigma)				
	Cesium-137	(pCi/L)	<2.017	<3.655	<1.837	<3.528
	±2	(sigma)				

System Number:			DWDUP01		DWDUP02	
Date:			June-05	Dec.-05	June-05	Dec.-05
Radionuclides	Gross Alpha	(pCi/L)	<1.99	1.47	4	<1.48
	±2	(sigma)		1.03	1.55	
	N-V Beta	(pCi/L)	<2.22	<2.34	<3.16	<2.59
	±2	(sigma)				
	Tritium	(pCi/L)	NS	<201	<177	214
	±2	(sigma)				93
	Cesium-137	(pCi/L)	<1.917	<3.557	<3.593	<2.039
	±2	(sigma)				

Drinking Water Quality Monitoring
Surface Water

(Return to TOC)

Sample Number:	0210003R					
Date:			January-05	February-05	March-05	April-05
Radionuclides	Gross Alpha	(pCi/L)	<2.05	<2.04	<2.06	<2.05
	±2	(sigma)				
	N-V Beta	(pCi/L)	<3.16	<3.16	<3.16	<3.16
	±2	(sigma)				
	Tritium	(pCi/L)	<177	<177	<177	<177
	±2	(sigma)				
	Cesium-137	(pCi/L)	<3.369	<3.51	<3.550	<3.519
	±2	(sigma)				
Sample Number:	0210003R					
Date:			May-05	June-05	July-05	August-05
Radionuclides	Gross Alpha	(pCi/L)	<2.03	NS	<1.36	<1.38
	±2	(sigma)				
	N-V Beta	(pCi/L)	<3.16	NS	<2.17	3.08
	±2	(sigma)				1.34
	Tritium	(pCi/L)	<177	NS	<197	199
	±2	(sigma)				91
	Cesium-137	(pCi/L)	<3.234	NS	<3.830	<3.308
	±2	(sigma)				
Sample Number:	0210003R					
Date:			September-05	October-05	November-05	December-05
Radionuclides	Gross Alpha	(pCi/L)	<1.38	<0.866	<1.28	<.853
	±2	(sigma)				
	N-V Beta	(pCi/L)	3.29	<2.35	<2.58	<2.65
	±2	(sigma)	1.35			
	Tritium	(pCi/L)	<197	NS	549	<196
	±2	(sigma)			106	
	Cesium-137	(pCi/L)	<3.439	<3.574	<2.156	<3.618
	±2	(sigma)				

Drinking Water Quality Monitoring
Surface Water

(Return to TOC)

Sample Number:	0720003R					
Date:			January-05	February-05	March-05	April-05
Radionuclides	Gross Alpha	(pCi/L)	<2.15	NS	<2.45	<2.82
	±2	(sigma)				
	N-V Beta	(pCi/L)	<3.17	NS	<3.19	<2.49
	±2	(sigma)				
	Tritium	(pCi/L)	483	NS	678	569
	±2	(sigma)	96		103	101
	Cesium-137	(pCi/L)	<3.791	NS	<3.858	<3.986
	±2	(sigma)				

Sample Number:	0720003R					
Date:			May-05	June-05	July-05	August-05
Radionuclides	Gross Alpha	(pCi/L)	1.04	<1.03	1.03	1.28
	±2	(sigma)	0.812		0.804	0.916
	N-V Beta	(pCi/L)	<2.36	<2.37	3.41	<2.37
	±2	(sigma)			1.45	
	Tritium	(pCi/L)	253	<199	256	<199
	±2	(sigma)	94		95	
	Cesium-137	(pCi/L)	<3.655	<3.754	<3.671	<3.765
	±2	(sigma)				

Sample Number:	0720003R					
Date:			September-05	October-05	November-05	December-05
Radionuclides	Gross Alpha	(pCi/L)	2.04	1.33	<1.52	2.13
	±2	(sigma)	1.12	0.953		1.07
	N-V Beta	(pCi/L)	2.61	<2.37	<2.60	3.89
	±2	(sigma)	1.41			1.59
	Tritium	(pCi/L)	294	409	<199	389
	±2	(sigma)	97	101		99
	Cesium-137	(pCi/L)	<3.354	<3.693	<2.019	<3.841
	±2	(sigma)				

Drinking Water Quality Monitoring
Surface Water

(Return to TOC)

Sample Number: SAVR						
Date:			January-05	February-05	March-05	April-05
Radionuclides	Gross Alpha	(pCi/L)	<2.33	<2.30	<2.30	<2.26
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.47	<2.47	<2.47	<2.46
	±2	(sigma)				
	Tritium	(pCi/L)	NS	NS	NS	NS
	±2	(sigma)				
	Cesium-137	(pCi/L)	<3.964	<3.999	<3.998	<3.999
	±2	(sigma)				
Sample Number: SAVR						
Date:			May-05	June-05	July-05	August-05
Radionuclides	Gross Alpha	(pCi/L)	NS	<2.27	<1.56	<1.52
	±2	(sigma)				
	N-V Beta	(pCi/L)	NS	<3.18	<2.19	<2.19
	±2	(sigma)				
	Tritium	(pCi/L)	NS	538	266	253
	±2	(sigma)		99	94	94
	Cesium-137	(pCi/L)	NS	<3.404	<3.460	<3.405
	±2	(sigma)				
Sample Number: SAVR						
Date:			September-05	October-05	November-05	December-05
Radionuclides	Gross Alpha	(pCi/L)	<1.63	<1.44	<.940	<.963
	±2	(sigma)				
	N-V Beta	(pCi/L)	<2.19	<2.59	<2.66	<2.66
	±2	(sigma)				
	Tritium	(pCi/L)	596	<199	389	411
	±2	(sigma)	106		98	99
	Cesium-137	(pCi/L)	<3.583	<2.132	<3.295	<3.552
	±2	(sigma)				

Drinking Water Quality Monitoring Tritium Data

(Return to TOC)

DW0210003R- North Augusta					
	Tritium	±2	Approximate	Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-05	<177	0	7.78E+11	<LLD	0
February-05	<177	0	7.74E+11	<LLD	0
March-05	<177	0	1.14E+12	<LLD	0
April-05	<177	0	1.66E+12	<LLD	0
May-05	<177	0	7.83E+11	<LLD	0
June-05	NS	NS	1.32E+12	<LLD	NS
July-05	<197	0	1.19E+12	<LLD	0
August-05	199	91	1.22E+12	2.43E+02	1.11E+02
September-05	<197	0	5.93E+11	<LLD	0
October-05	NS	NS	6.34E+11	<LLD	NS
November-05	549	106	5.49E+11	3.01E+02	5.82E+01
December-05	<196	0	6.31E+11	<LLD	0
Mean	374.00		9.39E+11	2.72E+02	Ci/month
Estimated Annual				3.27E+03	Ci/year
DW0720003R- Beafort-Jasper					
	Tritium	±2		Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-05	483	96	7.78E+11	3.76E+02	7.47E+01
February-05	NS	NS	7.74E+11	NS	NS
March-05	678	103	1.14E+12	7.73E+02	1.17E+02
April-05	569	101	1.66E+12	9.45E+02	1.68E+02
May-05	253	94	7.83E+11	1.98E+02	7.36E+01
June-05	<199	0	1.32E+12	<LLD	0
July-05	256	95	1.19E+12	3.05E+02	1.13E+02
August-05	<199	0	1.22E+12	<LLD	0
September-05	294	97	5.93E+11	1.74E+02	5.75E+01
October-05	409	101	6.34E+11	2.59E+02	6.40E+01
November-05	<199	0	5.49E+11	<LLD	0
December-05	389	99	6.31E+11	2.45E+02	6.25E+01
Mean	416.38		9.39E+11	4.33E+02	Ci/month
Estimated Annual				5.19E+03	Ci/year
SAVR- City of Savannah					
	Tritium	±2	Approximate	Tritium	±2
Month	(pCi/L)	(sigma)	Q (L/mon)	Total Ci/mon	(sigma)
January-05	NS	NS	7.78E+11	NS	NS
February-05	NS	NS	7.74E+11	NS	NS
March-05	NS	NS	1.14E+12	NS	NS
April-05	NS	NS	1.66E+12	NS	NS
May-05	NS	NS	7.83E+11	NS	NS
June-05	538	99	1.32E+12	7.10E+02	1.31E+02
July-05	266	94	1.19E+12	3.17E+02	1.12E+02
August-05	253	94	1.22E+12	3.09E+02	1.15E+02
September-05	596	106	5.93E+11	3.53E+02	6.29E+01
October-05	<199	0	6.34E+11	<LLD	0
November-05	389	98	5.49E+11	2.14E+02	5.38E+01
December-05	411	99	6.31E+11	2.59E+02	6.25E+01
Mean	402.00		9.39E+11	5.13E+02	Ci/month
Estimated Annual				6.16E+03	Ci/year

2.2.5 Summary Statistics
Drinking Water Quality Monitoring
Ground Water

(Return to TOC)

Radionuclide:		Gross Alpha (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210001**	3.42	3.42	0	3.42	3.42	1	0
	DW0210002	16.03	16.03	14.67	26.40	5.65	2	0
	DW0220002	4.90	4.90	0.00	4.90	4.90	1	0
	DW0220006	2.40	2.4	0	2.40	2.40	1	0
	DW0220008	2.79	2.79	0	2.79	2.79	1	0
yearly average of detectable gross alpha			5.91					
standard deviation			5.74					

Radionuclide:		Gross N-V Beta (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210002**	5.64	5.64	0	5.64	5.64	0	0
	DW0210003	2.49	2.49	0	2.49	2.49	1	0
	DW0220001	3.75	3.75	0	3.75	3.75	1	0
	DW0220004	3.17	3.17	0	3.17	3.17	1	0
	DW0610002	2.62	2.62	0	2.62	2.62	1	0
yearly average of detectable tritium			3.53					
standard deviation			1.28					

Radionuclide:		Tritium (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210002**	296.5	296.5	4.95	300	293.00	0	0
	DW0210007	220	220	0	220	220	1	0
	DW0220002	260.5	260.5	115.26	342	179	2	0
	DW0220005	200	200	0	200	200	1	0
	DW0220012	179	179	0	179	179	1	0
yearly average of detectable tritium			231.20					
standard deviation			47.29					

Summary Statistics
Drinking Water Quality Monitoring
Surface Water

(Return to TOC)

Radionuclide:		Gross Alpha (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210003R**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	DW0720003R	1.305	1.475	0.489	2.13	1.03	6	0.721
	DWSAVR	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
yearly mean of detectable gross alpha			1.475					
standard deviation			0					

Radionuclide:		Gross N-V Beta (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210003R**	3.185	3.185	0.148	3.29	3.08	2	0
	DW0720003R	3.41	3.303	0.647	3.89	2.61	3	-0.72211
	DWSAVR	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
yearly mean of detectable gross alpha			3.244					
standard deviation			0.084					

Radionuclide:		Tritium (pCi/L)						
Statistical Analysis:		**Median**	**Avg.**	**St. Dev.**	**Max**	**Min**	**Num**	**Skew**
System Number:	**DW0210003R**	374	374.00	247.49	549	199	2	0
	DW0720003R	399	416.38	153.24	678	253	8	0.604
	DWSAVR	400	408.83	139.14	596	253	6	0.223
yearly mean of detectable tritium			399.74					
standard deviation			22.60					

2.3 Radiological Monitoring of Surface Water

(Return to TOC)

2.3.1 Summary

Surface water bodies on and adjacent to the Savannah River Site (SRS) continue to be the focus for monitoring and surveillance activities of the Environmental Surveillance and Oversight Program (ESOP), Radiological Monitoring of Surface Water and Sediment (SW&S) Project. Accordingly, surface water and sediment samples were collected and analyzed for radionuclides, the results from which were compared to SRS data. In addition, project databases were expanded, and trends of radionuclides in streams and sediments were characterized. These activities will allow the project to generate independent data that can be shared with the public.

The SW&S Project continued to collect surface water samples from 14 specific locations within and external to the perimeter of the SRS as part of an "ambient" sampling network (Map 5, section 2.3.2). At some locations, samples are collected three days per week as part of an "enhanced" sampling protocol. Samples are analyzed, depending on location and frequency, for tritium, gross alpha, gross beta and gamma-emitting radionuclides.

The enhanced surface water monitoring program is intended to provide downstream drinking water customers with advance notice of the potential for increased tritium levels in the Savannah River as the result of a SRS release. This early detection facet is possible because of the continuous monitoring of six SRS streams that flow to the Savannah River. Samples were analyzed for tritium on the day of collection and results from the tritium analysis were used to project tritium activity in the Savannah River. There were no releases via SRS streams above expected activities, and tritium at Hwy. 301 (SV-118) did not exceed the Environmental Protection Agency's Maximum Contaminant Level for drinking water.

The SW&S Project will continue to collect and analyze surface water and sediment on and adjacent to the SRS. This monitoring effort will provide an improved understanding of radionuclide levels in the SRS surface waters and sediments and provide valuable information relative to human health exposure pathways.

RESULTS AND DISCUSSION

Surface Water

A summary of surface water data for each location is located in section 2.3.4.

<u>Tritium</u>

Samples from SRS streams and the Savannah River were analyzed for tritium activity. Four Mile Creek receives effluent from F-Area, H-Area, and the Central Sanitary Wastewater Treatment Facility (CSWTF); stormwater runoff from E-Area, C-Area, F-Area, and H-Area; and leachate from seepage basins and the Old Radioactive Waste Burial Ground (ORWBG) (WSRC, 2001a). Pen Branch receives discharges and stormwater runoff from K-Area. Most of the tritium in Pen Branch is attributed to groundwater seepage from K-Area. Upper Three Runs receives discharges from the Effluent Treatment Facility (ETF), which has treated low-level radioactive wastewater since 1994. Stormwater runoff from F-Area, H-Area, S-Area, and Z-Area also impact Upper Three Runs by transferring contamination to waterways of the state (WSRC 2001a). In addition, groundwater that has migrated from E-Area outcrops into Upper Three Runs (ORWBG FG 2001).

Tritium activities in the Savannah River at the confluences of the five SRS streams were scheduled for monitoring on a quarterly basis. (Section 2.3.4, Boat Run Data) The average values for the streams sampled were Upper Three Runs (2,355 pCi/L), Beaver Dam Creek (280 pCi/L), Steel Creek (6,420 pCi/L), and Lower Three Runs (1,940 pCi/L). Three samples were collected each time at Four Mile Creek, one from the creek mouth (67,365 pCi/L), one from 30 feet downstream of the creek mouth (26,289 pCi/L), and one from 150 feet downstream of the creek mouth (26,840 pCi/L). Samples were taken at these three intervals in order to show the effect of the mixing zone created by the Savannah River flow.

The average tritium activity at all five colocated sampling sites (section 2.3.3, Table 1) were reported without subtracting background values. 1) Upper Three Runs: 1,844 (±994.62) pCi/L [DOE-SR 2010 (±89.5) pCi/L]; 2) Four Mile Creek: 91,010 (±43,254.57 pCi/L [DOE-SR 103,000 (±323.0) pCi/L]; 3) Steel Creek: 2,982 (±637.8) pCi/L [DOE-SR 2970 (±96.4) pCi/L; 4) Lower Three Runs: 470 (±142.4) pCi/L [DOE-SR 639 (±80.7) pCi/L]; 5) Highway 301 Bridge: 509 (±211.9) pCi/L [DOE-SR 546 (±9.96) pCi/L]. All ESOP results were within one standard deviation (SD) of those reported by DOE-SR with the exception of Lower Three Runs that was within two SDs.

Cesium

Cesium (Cs-137) was detected in two surface water samples collected from Four Mile Creek in 2005. These values were 10.72 pCi/L at location SV-2045 and 3.16 pCi/L at SV-2039 (section 2.3.3, Table 2). Cesium-137 was only detected in two other samples at SV-2039 in the previous six years, 3.68 pCi/L (1999) and 8.22 pCi/l (2003).

Gross Alpha

Alpha-emitting radionuclide activity was detected at all nine locations where monthly composite samples were collected. Activity ranged from 1.14 pCi/L to 4.77 pCi/L, with the highest value at Upper Three Runs (SV-325). At colocated sampling points (section 2.3.3, Table 3), ESOP results were within one SD of DOE-SR results at Upper Three Runs, Four Mile Creek and Pen Branch, within two SDs at Highway 301 Bridge, and five SDs at Steel Creek. The position of the sampler sieve within the creek channel in Steel Creek may account for this variation due to reduced stream flow at the collection point of the ESOP sieve as opposed to the DOE-SR sieve location.

A review of the average annual gross alpha data of the preceding four-year period revealed variability with no apparent upward or downward trending (section 2.3.3, Figure 1). The results ranged from <LLD to 4.77 pCi/L, without subtracting background (Jackson Landing) activity values. All analytical results were below the EPA MCL of 15 pCi/L for drinking water (USEPA, 2002b).

Gross Beta

Beta-emitting radionuclide activity was detected in eight out of nine locations where monthly composite samples were collected in 2005. The activity ranged from 2.42 pCi/L to 4.60 pCi/L, with Four Mile Creek recording the highest activity. At colocated sampling points (section 2.3.3, table 4), ESOP results were within one SD of DOE-SR results at Lower Three Runs, within three SD at Four Mile Creek, and within six SD at Steel Creek. The sieve location within the Steel Creek channel may account for this variation.

Upward or downward trends are not readily apparent for the annual average gross beta data for 2001-2005 (section 2.3.3, figure 2). Activity levels were reported ranging from <LLD to 6.44 pCi/L, without subtracting background (Jackson Landing) activity. All analytical results were below the EPA MCL of 8 pCi/L for drinking water (USEPA, 2002b).

Sediment

Cesium-137 activity was detected in 12 of the 18 sediment samples collected (section 2.3.3, table 5). The activity ranged from 0.04 picocuries per gram (pCi/g) (SV-2019) to 1.85 pCi/g (SV-2018). The results from samples collected at Jackson Landing, Beaver Dam Creek and creek mouth, Pen Branch, and Upper Three Runs creek mouth were below the SCDHEC Minimum Detectable Activity (MDA).

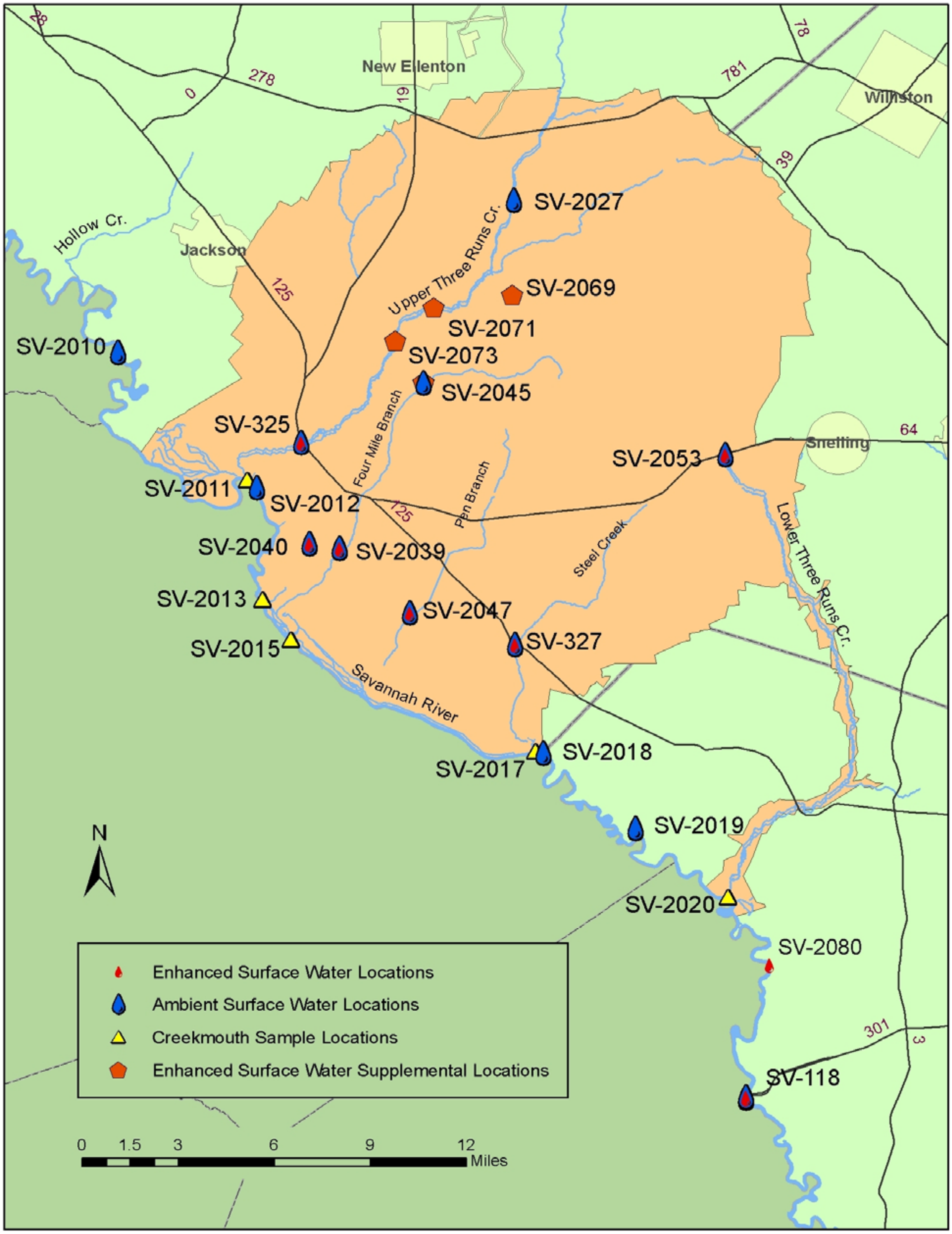
CONCLUSIONS AND RECOMMENDATIONS

All results for the public access locations downstream from SRS were below the EPA tritium MCL of 20,000 pCi/L for drinking water. However, data generated from samples collected at the mouth of Four Mile Creek indicate that the public could come into contact with tritium activity greater than the MCL at that location.

Analytical results for tritium activity in surface water collected at sampling sites colocated with DOE-SR were within one or two SDs. Also, a comparison of gross alpha and beta data identified results within one to five SDs and one to six SDs, respectively. The sampling location with the greatest variability, Steel Creek (SV-327), will be evaluated and the sampler sieve repositioned so as to be more representative of the collection point utilized by DOE-SR.

ESOP will continue independent monitoring of surface water and sediment and will periodically evaluate modification of the monitoring activities to better accomplish project’s goals and objectives. Monitoring will continue as long as there are activities at the SRS that create the potential for contamination entering the environment. Continued monitoring will provide an improved understanding of radionuclide activity in SRS surface waters and the Savannah River, and impart valuable information to human health exposure pathways. The comparison of data results allows for independent data verification of DOE-SR monitoring activities. Cooperation between DOE-SR and ESOP is a averages of providing credibility and confidence in the information being provided to the public.

2.3.2 (Return to TOC)
Map 5. Radiological Surface Water and Sediment Sampling Locations



2.3.3 Tables and Figures

(Return to TOC)

Radiological Monitoring of Surface Water and Sediments

Table 1. Surface Water Tritium Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Ave. Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	186	439	270	50	4
Upper Three Runs (SV-2027)	185	387	282	50	39
Upper Three Runs (SV-325)	611	5220	1844	50	50
U3R-4 at Road A*	497	4000	2010	12	NR
Upper Three Runs (SV-2011) Creek Mouth	569	5731	2355	4	3
TNX Boat Landing (SV-2012)	182	641	275	50	24
Beaver Dam Creek (SV-2040)	177	494	349	50	47
Beaver Dam Creek (SV-2013) Creek Mouth	206	320	280	4	3
Four Mile Creek (SV-2039)	47128	196929	91010	50	50
FM-6 Road A-12.2*	47000	195000	103000	12	NR
Four Mile Creek (SV-2045)	61556	610881	214019	50	50
Four Mile Creek (SV-2015) Creek Mouth	47895	96823	67365	4	3
Four Mile Creek (SV-2015) 30' downstream from creek mouth	3925	69911	26289	4	3
Four Mile Creek (SV-2015) 150' downstream from creek mouth	10341	40126	26840	4	3
Pen Branch (SV-2047)	19267	64,794	44650	50	50
PB-3 at Road 13.2*	35400	64900	48700	12	NR
Steel Creek (SV-327)	1636	4149	2982	50	50
SC-4 Steel Creek at Road A*	1740	4030	2970	12	NR
Steel Creek (SV-2017) Creek Mouth	1325	15866	6420	4	4
Steel Creek Boat Landing (SV-2018)	221	9903	2043	50	49
Steel Creek Boat Ramp River Mile 141.5	106	1300	599	53	NR
Lower Three Runs (SV-2053)	268	1034	470	50	50
L3R-1A at Road B*	219	1010	639	12	NR
Lower Three Runs (SV-2020) Creek Mouth	913	3900	1940	4	3
Little Hell Landing (SV-2019)	226	5275	901	50	47
Highway 301 Bridge (SV-118)	184	1137	509	50	48
River Mile 118.8*	139	1380	546	53	NR

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2005
(2) Bold and italicized entries represent colocated sampling stations.
(3) NR: Not Reported
(4) Conc. = Concentration

Tables and Figures
Radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Table 2. Surface Water Cs-137 Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Ave. Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	ND	ND	ND	12	0
Upper Three Runs (SV-325)	ND	ND	ND	12	0
U3R-4 at Road A*	-3.49	1.06	-0.94	12	NR
Beaver Dam Creek (SV-2040)	ND	ND	ND	12	0
Four Mile Creek (SV-2039)	3.16	3.16	3.16	12	1
FM-6 Road A-12.2*	-1.36	6.92	3.35	12	NR
Pen Branch (SV-2047)	ND	ND	ND	12	0
PB-3 at Road A-13.2*	-3.86	3.57	1.03	12	NR
Steel Creek (SV-327)	ND	ND	ND	12	0
SC-4 Steel Creek at Road A*	-3.95	4.84	0.14	12	NR
Steel Creek Boat Landing (SV-2018)	ND	ND	ND	12	0
Lower Three Runs (SV-2053)	ND	ND	ND	12	0
L3R-1A at Road B*	-2.09	4.76	1.26	12	NR
Highway 301 Bridge (SV-118)	ND	ND	ND	12	0
River Mile 118.8*	-0.76	0.91	0.08	12	NR
Four Mile Creek (SV-2045)	10.72	10.72	10.72	1	1
McQueen Branch (SV-2069)	NS	NS	NS	0	0
Upper Three Runs (SV-2071)	ND	ND	ND	1	0
Upper Three Runs (SV-2073)	NS	NS	NS	0	0

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2005
(2) Bold and italicized entries represent colocated sampling stations for both organizations
(3) NR = Sample results not reported.
(4) ND = None Detected.
(5) NS = No sample.

Tables and Figures
(Return to TOC)
Radiological Monitoring of Surface Water and Sediments

Table 3. Surface Water Gross Alpha Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Ave. Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	0.86	5.41	3.14	12	2
Upper Three Runs (SV-325)	1.71	9.39	4.77	12	10
U3R-4 at Road A*	1.05	6.27	2.74	12	NR
Beaver Dam Creek (SV-2040)	2.20	2.84	2.52	12	2
Four Mile Creek (SV-2039)	1.11	1.65	1.38	12	2
FM-6 Road A-12.2*	-0.45	4.43	1.18	12	NR
Pen Branch (SV-2047)	0.90	2.26	1.72	12	3
PB-3 at Road 13.2*	-0.11	3.54	1.39	12	NR
Steel Creek (SV-327)	2.17	3.82	2.94	12	4
SC-4 Steel Creek at Road A*	0.66	13.00	6.50	12	NR
Steel Creek Boat Landing (SV-2018)	2.37	3.11	2.74	12	2
Lower Three Runs (SV-2053)	1.14	1.14	1.14	12	1
L3R-1A at Road B*	-0.43	2.81	0.54	12	NR
Highway 301 Bridge (SV-118)	0.88	1.55	1.22	12	2
River Mile 118.8*	-1.06	1.82	0.36	12	NR
Four Mile Creek (SV-2045)	1.85	1.85	1.85	1	1
McQueen Branch (SV-2069)	NS	NS	NS	0	0
Upper Three Runs (SV-2071)	2.19	2.19	2.19	1	1
Upper Three Runs (SV-2073)	1.94	1.94	1.94	1	1

Tables and Figures
(Return to TOC)
Radiological Monitoring of Surface Water and Sediments

Table 4. Surface Water Gross Beta Detection Data

Sample Location	Min. Conc. (pCi/L)	Max. Conc. (pCi/L)	Mean Conc. (pCi/L)	# of Samples	# of Detects
Jackson Landing (SV-2010)	3.14	3.14	3.14	12	1
Upper Three Runs (SV-325)	3.16	3.16	3.16	12	1
U3R-4 at Road A*	0.70	3.30	1.71	12	NR
Beaver Dam Creek (SV-2040)	3.18	6.55	4.56	12	4
Four Mile Creek (SV-2039)	3.58	8.52	6.01	12	10
FM-6 Road A-12.2*	3.70	19.20	9.44	12	NR
Pen Branch (SV-2047)	4.60	4.60	4.60	12	1
PB-3 at Road 13.2*	0.84	3.78	1.75	12	NR
Steel Creek (SV-327)	2.75	3.44	3.06	12	3
SC-4 Steel Creek at Road A*	0.85	7.73	4.94	12	NR
Steel Creek Boat Landing (SV-2018)	2.42	2.42	2.42	12	1
Lower Three Runs (SV-2053)	2.72	4.14	3.22	12	4
L3R-1A at Road B*	1.01	6.19	3.19	12	NR
Highway 301 Bridge (SV-118)	ND	ND	ND	12	0
River Mile 118.8*	-0.71	4.51	2.12	12	NR
Four Mile Creek (SV-2045)	13.80	13.80	13.80	1	1
McQueen Branch (SV-2069)	NS	NS	NS	0	0
Upper Three Runs (SV-2071)	ND	ND	ND	1	0
Upper Three Runs (SV-2073)	ND	ND	ND	1	0

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2005.
(2) Bold and italicized entries represent colocated sampling stations for both organizations.
(3) NR = Sample results not reported. (4) NS = No sample. (5) ND = None Detected. (6) Conc. = Concentration.

Tables and Figures
(Return to TOC)
Radiological Monitoring of Surface Water and Sediments

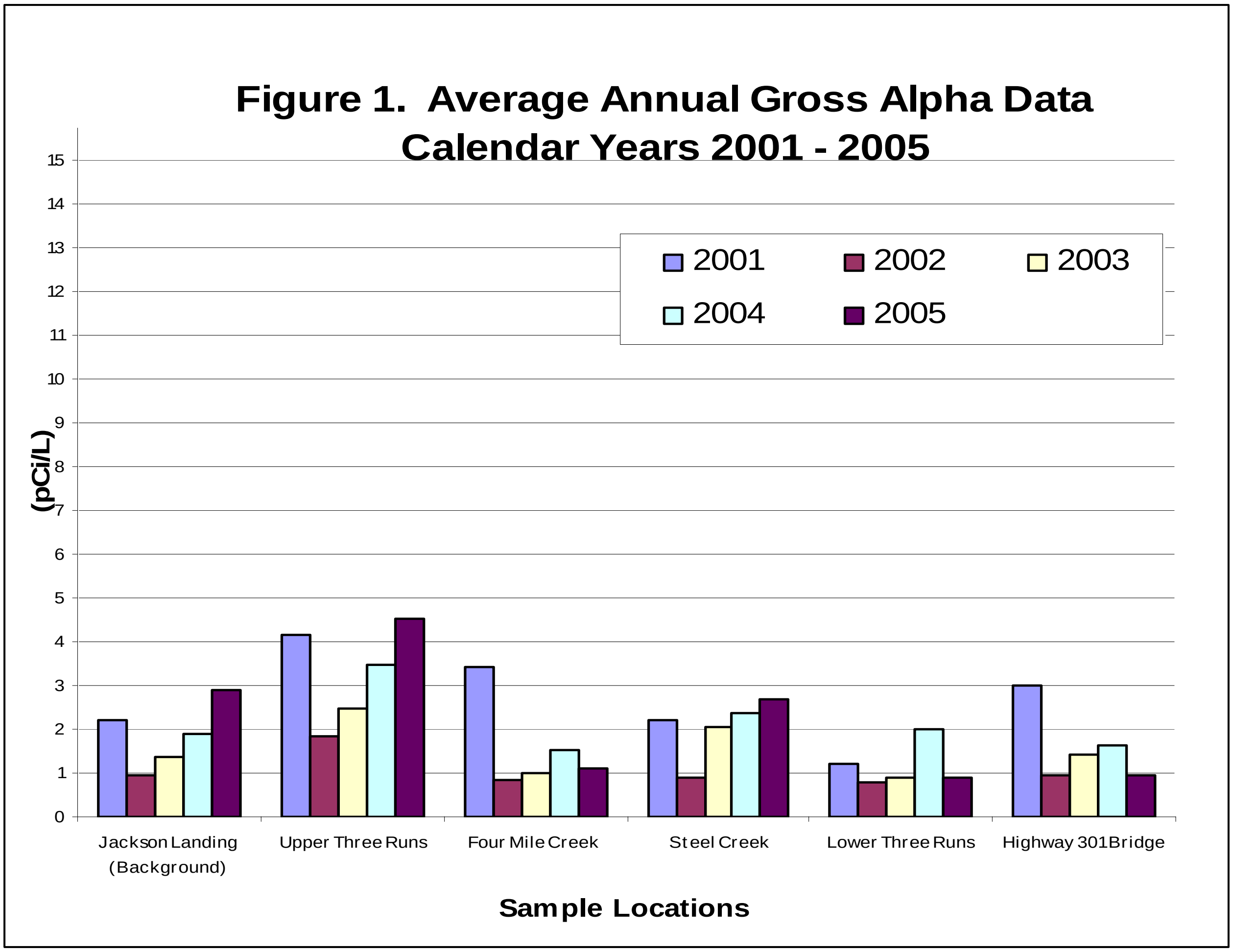
Table 5. Sediment Detection Data

Sample Location	Cs-137 (pCi/g)
Jackson Landing (SV-2010)	ND
Four Mile Creek (SV-2045)	0.73
Upper Three Runs (SV-325)	ND
Upper Three Runs (SV-2027)	ND
TNX Boat Landing (SV-2012)	ND
Beaver Dam Creek (SV-2040)	0.05
Four Mile Creek (SV-2039)	0.30
Pen Branch (SV-2047)	ND
Steel Creek (SV-327)	0.30
SC-4 Steel Creek at Road A*	10.20
Steel Creek Boat Landing (SV-2018)	1.85
Lower Three Runs (SV-2053)	0.22
L3R-1A at Road B*	0.43
Highway 301 Bridge (SV-118)	0.31
River Mile 118.8*	0.03
Little Hell Landing (SV-2019)	0.04
Lower Three Runs (SV-2020)	0.38
Lower 3 Runs Mouth*	0.24
Upper Three Runs (SV-2011)	0.35
Upper 3 Runs Creek Mouth*	0.03
Beaver Dam Creek (SV-2013)	ND
Beaver Dam Creek Mouth*	-0.01
Four Mile Creek (SV-2015)	0.47
Steel Creek (SV-2017)	0.56

Notes:
(1) *WSRC data from the SRS Environmental Data Report for 2005
(2) Bold and italicized entries represent colocated sampling stations for both organizations
(3) ND: Not Detected

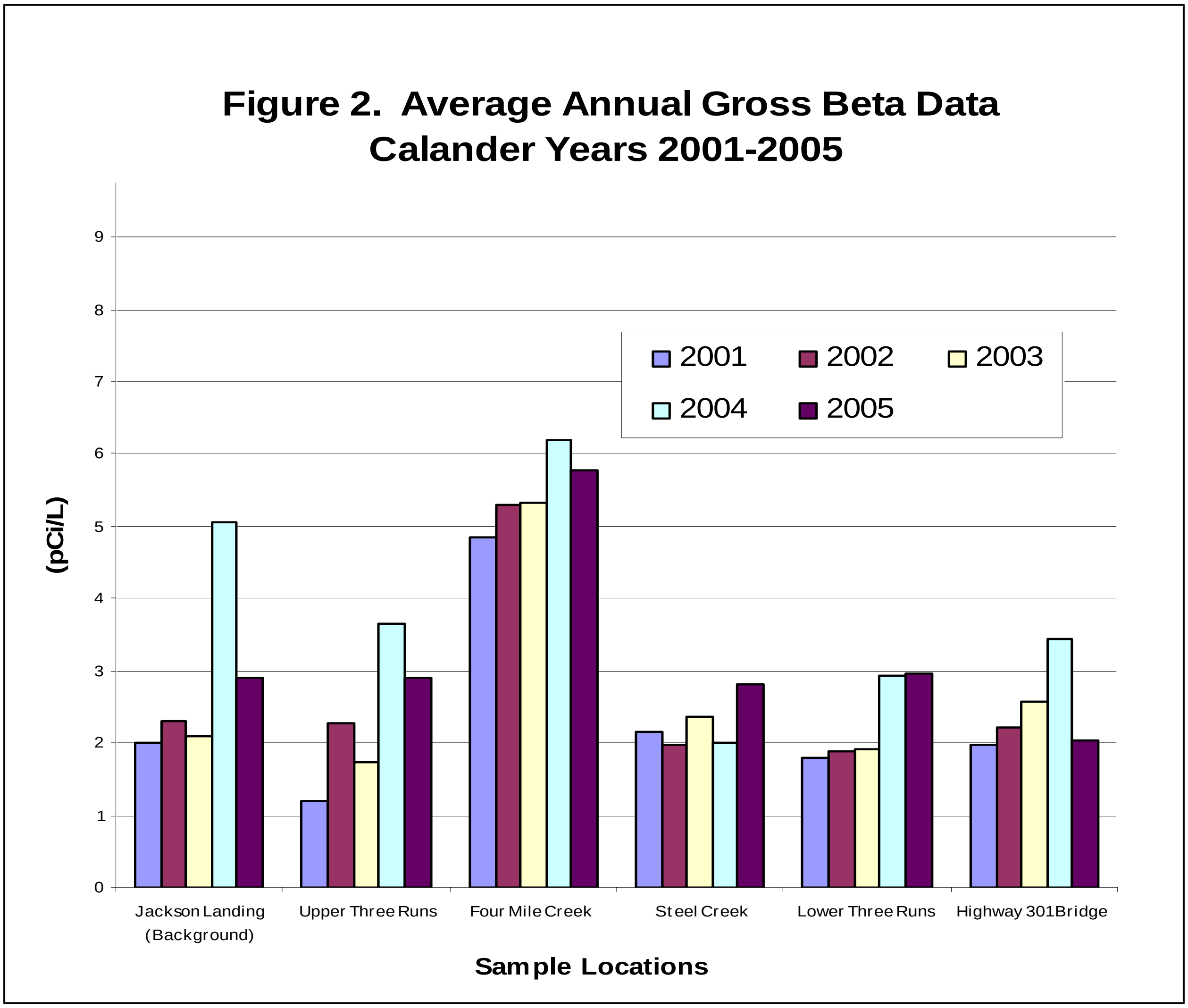
Tables and Figures
(Return to TOC)

Radiological Monitoring of Surface Water and Sediments



Note: 1. Reported activity does not exclude background data.
2. EPA MCL is 15 pCi/L

Tables and Figures (Return to TOC)
Radiological Monitoring of Surface Water and Sediments



Note: 1. EPA MCL is 8 pCi/L

2.3.4 Data

(Return to TOC)

Radiological Monitoring of Surface Water and Sediments

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Jackson Boat Landing (SV-2010)

Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.16	<LLD		2.67	<MDA		2.08
01/05/05	<196										
01/12/05	<201										
01/19/05	<188										
01/26/05	<183		5.41	1.86	2.22	<LLD		2.73	<MDA		3.12
02/02/05	<194										
02/09/05	<186										
02/16/05	<191										
02/23/05	<200		<LLD		1.83	<LLD		2.53	<MDA		2.13
03/02/05	<191										
03/09/05	<191										
03/16/05	<196										
03/23/05	<194										
03/30/05	<183		<LLD		1.69	3.14	1.36	2.27	<MDA		3.26
04/06/05	439	98									
04/13/05	<180										
04/20/05	<187										
04/27/05	<178		0.862	0.753	0.804	<LLD		2.35	<MDA		3.55
05/04/05	<183										
05/11/05	<181										
05/18/05	<186										
05/25/05	<183										
06/01/05	<177		<LLD		2.29	<LLD		2.47	<MDA		3.40
06/08/05	<175										
06/15/05	257	88									
06/22/05	<177										
06/29/05	<177		<LLD		2.47	<LLD		3.11	<MDA		4.00
07/06/05	<175										
07/13/05	186	83									
07/20/05	<181										
07/27/05	<185		<LLD		2.47	<LLD		3.11	<MDA		1.92
08/03/05	<186										
08/10/05	<183										
08/17/05	<180										
08/24/05	<175										
08/31/05	<180		<LLD		0.94	<LLD		2.36	<MDA		3.38
09/07/05	<177										
09/14/05	<190										
09/21/05	NS	NS									
09/28/05	<195		<LLD		1.86	<LLD		2.78	<MDA		2.00
10/05/05	187	82									
10/12/05	<185										
10/19/05	<183										
10/26/05	262*	83	<LLD		1.83	<LLD		2.77	<MDA		3.57
11/02/05	281	85									
11/09/05	<172										
11/16/05	<184										
11/23/05	<176										
11/30/05	<191		<LLD		2.01	<LLD		2.62	<MDA		2.11
12/07/05	<183										
12/14/05	<203										
12/21/05	<198										
12/28/05	<196										
N =	5		2			1			0		
Max. =	439		5.41			3.14			N/A		
Min. =	186		0.862			3.14			N/A		
Ave. =	270		3.136			3.14			N/A		
Median =	257		3.136			3.14			N/A		
Std. Dev.=	103.44		3.22			N/A			N/A		

*Data cannot be validated and verified.
NS= No sample result.

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Fourmile Branch @ Road C-4 (SV-2045)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/05/05	149232	1078
01/12/05	141760	1052
01/19/05	153547	1089
01/26/05	157124	1103
02/02/05	147052	1199
02/09/05	144384	1187
02/16/05	144995	1189
02/23/05	126497	1114
03/02/05	120840	1087
03/09/05	141568	1175
03/16/05	86001	921
03/23/05	138728	1046
03/30/05	61556	697
04/06/05	100733	992
04/13/05	111920	1048
04/20/05	117033	1072
04/27/05	117569	1076
05/04/05	109519	931
05/11/05	110626	933
05/18/05	114633	953
05/25/05	104260	906
06/01/05	87782	832
06/08/05	118463	971
06/15/05	105571	917
06/22/05	88800	835
06/29/05	80733	798
07/06/05	99650	884
07/13/05	91542	851
07/20/05	105397	913
07/27/05	97779	894
08/03/05	64689	718
08/10/05	68593	742
08/17/05	100727	897
08/24/05*	317008	1590
08/31/05	200177	1258
09/07/05	237676	1371
09/14/05	511080	2000
09/21/05	NS	NS
09/28/05	591921	2169
10/05/05	610881	2191
10/12/05	431034	1841
10/19/05	468073	1906
10/26/05	431240**	1821
11/02/05	446335	2243
11/09/05	493972	2983
11/16/05	462060	1894
11/23/05	237464	1356
11/30/05	453675	1861
12/07/05	384404	1718
12/14/05	439146	1827
12/21/05	345876	1628
12/28/05	360877	1671

N =	50
Max. =	610881
Min. =	61556
Ave. =	214019
Median =	140148
Std. Dev.=	159388.19

Sample Location: SRS TNX Boat Landing (SV-2012)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/05/05	333	97
01/12/05	252	95
01/19/05	303	92
01/26/05	255	89
02/02/05	214	97
02/09/05	228	94
02/16/05	<191	
02/23/05	<200	
03/02/05	274	99
03/09/05	400	104
03/16/05	315	102
03/23/05	261	93
03/30/05	<183	
04/06/05	247	89
04/13/05	194	90
04/20/05	205	94
04/27/05	336	96
05/04/05	<183	
05/11/05	391	94
05/18/05	<186	
05/25/05	<183	
06/01/05	<177	
06/08/05	190	83
06/15/05	208	85
06/22/05	376	92
06/29/05	191	84
07/06/05	<175	
07/13/05	239	85
07/20/05	<181	
07/27/05	<185	
08/03/05	<186	
08/10/05	<183	
08/17/05	184	84
08/24/05	<175	
08/31/05	<180	
09/07/05	<177	
09/14/05	641	106
09/21/05	NS	NS
09/28/05	<195	
10/05/05	<175	
10/12/05	<185	
10/19/05	<183	
10/26/05	281*	84
11/02/05	182	81
11/09/05	<172	
11/16/05	190	86
11/23/05	<176	
11/30/05	<191	
12/07/05	<183	
12/14/05	<203	
12/21/05	<198	
12/28/05	<196	

N =	24
Max. =	641
Min. =	182
Ave. =	275
Median =	249.5
Std. Dev.=	103.47

*Temporary discharge of phytoremediation pond (F Area) into Four Mile Creek commenced 08/19/05 @ 1545hrs.
**Data cannot be validated and verified.
NS = No sample result.

Radiological Monitoring of Surface Water and Sediments Radiological Surface Water Data

(Return to TOC)

Sample Location: Upper Three RuNR @ SC 125 (SV-325)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			2.94	1.47	1.91	<LLD		2.65	<MDA		1.95
01/05/05	1531	137									
01/12/05	5220	219									
01/19/05	2517	162									
01/26/05	3702	186	3.28	1.49	2.01	<LLD		2.72	<MDA		3.32
02/02/05	1486	145									
02/09/05	1690	149									
02/16/05	2329	169									
02/23/05	1754	155	1.71	1.18	1.62	<LLD		2.52	<MDA		2.06
03/02/05	2616	178									
03/09/05	3383	196									
03/16/05	3215	192									
03/23/05	4289	201									
03/30/05	2553	163	3.72	1.42	1.57	<LLD		2.26	<MDA		3.13
04/06/05	2638	174									
04/13/05	2973	184									
04/20/05	1851	155									
04/27/05	1861	153	8.67	1.98	.749	<LLD		2.34	<MDA		3.64
05/04/05	2028	147									
05/11/05	2919	169									
05/18/05	2313	155									
05/25/05	2704	164									
06/01/05	963	114	9.39	2.09	1.90	3.16	1.55	2.44	<MDA		3.68
06/08/05	1274	126									
06/15/05	1005	118									
06/22/05	1686	136									
06/29/05	1970	144	7.18	2.04	2.41	<LLD		3.11	<MDA		4.00
07/06/05	1137	120									
07/13/05	2067	147									
07/20/05	1107	121									
07/27/05	959	117	2.84	1.51	2.25	<LLD		3.10	<MDA		1.88
08/03/05	1100	122									
08/10/05	611	104									
08/17/05	732	108									
08/24/05	1096	118									
08/31/05	682	105	4.63	1.36	0.87	<LLD		2.35	<MDA		3.67
09/07/05	806	108									
09/14/05	1703	140									
09/21/05	NR	NR									
09/28/05	1870	146	3.35	1.38	1.65	<LLD		2.76	<MDA		1.86
10/05/05	2448	156									
10/12/05	2247	154									
10/19/05	1803	143									
10/26/05	1383*	125	<LLD		1.59	<LLD		2.75	<MDA		3.20
11/02/05	1449	128									
11/09/05	1207	138									
11/16/05	1024	118									
11/23/05	1595	133									
11/30/05	809	112	<LLD		1.78	<LLD		2.61	<MDA		1.86
12/07/05	1143	121									
12/14/05	629	110									
12/21/05	696	111									
12/28/05	806	114									
N =	50		10			1			0		
Max. =	5220		9.39			3.16			N/A		
Min. =	611		1.71			3.16			N/A		
Ave. =	1844		4.77			3.16			N/A		
Median =	1697		3.54			3.16			N/A		
Std. Dev.=	994.62		2.67			N/A			N/A		

*Data cannot be validated and verified.

NR= No sample result.

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Beaver Dam Creek (SV-2040)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.18	<LLD		2.67	<MDA		2.09
01/05/05	332	96									
01/12/05	382	101									
01/19/05	339	94									
01/26/05	439	96	<LLD		2.35	<LLD		2.72	<MDA		3.32
02/02/05	348	103									
02/09/05	459	105									
02/16/05	328	101									
02/23/05	<200		<LLD		1.86	<LLD		2.54	<MDA		2.28
03/02/05	361	103									
03/09/05	272	98									
03/16/05	441	108									
03/23/05	266	93									
03/30/05	342	92	<LLD		1.82	3.18	1.37	2.27	<MDA		3.29
04/06/05	387	96									
04/13/05	332	97									
04/20/05	396	102									
04/27/05	255	92	2.84	1.24	0.83	6.55	1.63	2.35	<MDA		3.59
05/04/05	331	92									
05/11/05	340	92									
05/18/05	388	95									
05/25/05	302	91									
06/01/05	376	92	<LLD		2.31	<LLD		2.47	<MDA		3.52
06/08/05	494	96									
06/15/05	450	96									
06/22/05	448	94									
06/29/05	440	94	<LLD		2.60	<LLD		3.12	<MDA		4.00
07/06/05	428	93									
07/13/05	408	92									
07/20/05	464	97									
07/27/05	365	94	<LLD		2.51	<LLD		3.11	<MDA		2.09
08/03/05	343	94									
08/10/05	293	90									
08/17/05	271	88									
08/24/05	365	90									
08/31/05	354	92	2.20	1.06	0.97	5.11	1.57	2.36	<MDA		3.66
09/07/05	373	91									
09/14/05	307	93									
09/21/05	NR	NR									
09/28/05	225	92	<LLD		1.89	<LLD		2.78	<MDA		1.88
10/05/05	467	94									
10/12/05	446	98									
10/19/05	419	96									
10/26/05	426*	90	<LLD		1.84	<LLD		2.77	<MDA		3.36
11/02/05	243	84									
11/09/05	177	91									
11/16/05	230	88									
11/23/05	183	82									
11/30/05	<191		<LLD		2.17	3.4	1.54	2.63	<MDA		1.88
12/07/05	342	92									
12/14/05	<203										
12/21/05	243	94									
12/28/05	223	92									
N =	47		2			4			0		
Max. =	494		2.84			6.55			N/A		
Min. =	177		2.20			3.18			N/A		
Ave. =	349		2.52			4.56			N/A		
Median =	348		2.52			4.26			N/A		
Std. Dev.=	80.61		0.45			1.58			N/A		

*Data cannot be validated and verified.
NR= No sample result.

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Four Mile Creek @ Road A-13 (SV-2039)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.02	5.38	1.66	2.66	<MDA		1.83
01/05/05	82322	800									
01/12/05	84754	815									
01/19/05	71746	1269									
01/26/05	81657	798	<LLD		2.13	6.65	1.74	2.73	<MDA		3.27
02/02/05	80693	884									
02/09/05	79930	879									
02/16/05	77844	868									
02/23/05	75966	859	<LLD		1.69	6.21	1.66	2.52	<MDA		2.09
03/02/05	72776	841									
03/09/05	69439	818									
03/16/05	75250	855									
03/23/05	70686	746									
03/30/05	58483	681	<LLD		1.66	7.66	1.62	2.26	<MDA		3.57
04/06/05	56119	737									
04/13/05	59296	759									
04/20/05	63446	784									
04/27/05	63792	786	1.65	0.942	0.768	5.01	1.53	2.34	<MDA		3.98
05/04/05	64391	713									
05/11/05	61427	693									
05/18/05	60572	692									
05/25/05	58212	679									
06/01/05	54137	653	<LLD		2.04	4.95	1.58	2.45	<MDA		3.84
06/08/05	47128	613									
06/15/05	53474	653									
06/22/05	59327	682									
06/29/05	54700	656	<LLD		2.34	3.58	1.76	3.10	<MDA		4.00
07/06/05	51131	632									
07/13/05	49565	627									
07/20/05	50683	634									
07/27/05	50390	631	<LLD		2.33	5.86	1.88	3.10	<MDA		1.98
08/03/05	51296	639									
08/10/05	51754	641									
08/17/05	49964	632									
08/24/05*	85802	819									
08/31/05	119103	965	1.11	0.79	0.92	6.31	1.63	2.35	<MDA		3.63
09/07/05	99285	880									
09/14/05	137147	1032									
09/21/05	NR	NR									
09/28/05	196929	1240	<LLD		1.72	<LLD		2.76	<MDA		2.48
10/05/05	186521	1202									
10/12/05	129525	1008									
10/19/05	159146	1115									
10/26/05	168323*	1139	<LLD		1.72	<LLD		2.76	<MDA		3.89
11/02/05	165812	1136									
11/09/05	166303	1413									
11/16/05	176547	1171									
11/23/05	136871	1014									
11/30/05	134740	1015	<LLD		1.94	8.52	1.81	2.62	3.16	1.57	1.74
12/07/05	148783	1068									
12/14/05	136696	1022									
12/21/05	144201	1054									
12/28/05	134748	1023									
N =	50		2			10			1		
Max. =	196929		1.65			8.52			3.16		
Min. =	47128		1.11			3.58			3.16		
Ave. =	91010		1.38			6.01			3.16		
Median =	74013		1.38			6.04			3.16		
Std. Dev.=	43254.57		0.38			1.41			N/A		

*Temporary discharge of phytoremediation pond (F Area) into Four Mile Creek commenced 08/19/05 @ 1545hrs.
*Data cannot be validated and verified.
NR= No sample result.

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Pen Branch @ Road A-13 (SV-2047)												
Date	Tritium		Gross Alpha			Gross Beta			Cs-137			
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.42	<LLD		2.69	<MDA		2.12
01/05/05	58012	674									
01/12/05	63404	707									
01/19/05	50070	632									
01/26/05	61100	693	<LLD		2.36	<LLD		2.74	<MDA		3.39
02/02/05	49453	695									
02/09/05	50193	698									
02/16/05	46734	675									
02/23/05	48493	688	<LLD		1.99	<LLD		2.55	<MDA		1.96
03/02/05	32596	566									
03/09/05	41966	639									
03/16/05	46311	672									
03/23/05	37067	547									
03/30/05	25605	461	2.26	1.36	1.84	4.60	1.46	2.27	<MDA		3.29
04/06/05	25572	503									
04/13/05	34094	579									
04/20/05	43434	652									
04/27/05	50215	698	0.902	0.79	0.84	<LLD		2.35	<MDA		3.74
05/04/05	51759	641									
05/11/05	56380	667									
05/18/05	54573	656									
05/25/05	55516	664									
06/01/05	54542	655	<LLD		2.33	<LLD		2.47	<MDA		3.8
06/08/05	22664	434									
06/15/05	19267	406									
06/22/05	40489	570									
06/29/05	44728	595	<LLD		3.04	<LLD		3.14	<MDA		3.98
07/06/05	38215	551									
07/13/05	36413	544									
07/20/05	26240	467									
07/27/05	37863	553	<LLD		2.91	<LLD		3.13	<MDA		1.86
08/03/05	37963	554									
08/10/05	36433	542									
08/17/05	30100	493									
08/24/05	35165	530									
08/31/05	29920	490	2.01	1.05	1.02	<LLD		2.37	<MDA		3.51
09/07/05	39796	560									
09/14/05	49414	624									
09/21/05	NR	NR									
09/28/05	61157	694	<LLD		2.10	<LLD		2.79	<MDA		2.02
10/05/05	61363	693									
10/12/05	44743	597									
10/19/05	52689	662									
10/26/05	58987*	677	<LLD		1.88	<LLD		2.78	<MDA		3.44
11/02/05	64794	711									
11/09/05	62503	853									
11/16/05	63347	707									
11/23/05	47362	604									
11/30/05	48574	613	<LLD		2.10	<LLD		2.63	<MDA		1.8
12/07/05	43626	584									
12/14/05	41248	567									
12/21/05	40081	561									
12/28/05	39267	557									
N =	50		3			1			0		
Max. =	64794		2.26			4.60			N/A		
Min. =	19267		0.90			4.60			N/A		
Ave. =	44650		1.72			4.60			N/A		
Median =	44736		2.01			4.60			N/A		
Std. Dev.=	11589.16		0.72			N/A			N/A		

*Data cannot be validated and verified.
NR= No sample result.

Radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Radiological Surface Water Data

Sample Location: Steel Creek @ SC 125 (SV-327)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.32	<LLD		2.68	<MDA		2.1
01/05/05	3410	182									
01/12/05	3479	185									
01/19/05	2808	168									
01/26/05	3524	182	<LLD		2.46	2.98	1.56	2.74	<MDA		3.54
02/02/05	2825	183									
02/09/05	3175	189									
02/16/05	2601	176									
02/23/05	2740	182	3.16	1.66	2.06	<LLD		2.55	<MDA		2.11
03/02/05	1738	152									
03/09/05	2167	164									
03/16/05	2362	171									
03/23/05	1954	148									
03/30/05	1636	138	2.62	1.43	1.87	2.75	1.35	2.28	<MDA		3.26
04/06/05	1991	155									
04/13/05	2441	170									
04/20/05	3037	187									
04/27/05	3208	189	3.82	1.62	1.05	3.44	1.46	2.38	<MDA		3.74
05/04/05	3029	172									
05/11/05	3669	185									
05/18/05	3859	190									
05/25/05	3444	182									
06/01/05	3748	186	<LLD		2.49	<LLD		2.48	<MDA		3.74
06/08/05	1920	145									
06/15/05	2405	158									
06/22/05	4149	195									
06/29/05	3834	188	<LLD		2.76	<LLD		3.12	<MDA		4.00
07/06/05	2748	164									
07/13/05	2798	166									
07/20/05	2293	156									
07/27/05	2721	166	<LLD		2.76	<LLD		3.12	<MDA		2.06
08/03/05	2607	163									
08/10/05	2397	157									
08/17/05	3104	174									
08/24/05	2849	166									
08/31/05	2785	166	2.17	1.04	0.96	<LLD		2.36	<MDA		3.54
09/07/05	3505	181									
09/14/05	4097	195									
09/21/05	NR	NR									
09/28/05	3878	192	<LLD		2.08	<LLD		2.79	<MDA		2.36
10/05/05	3782	186									
10/12/05	2705	165									
10/19/05	3386	182									
10/26/05	3648*	181	<LLD		1.82	<LLD		2.77	<MDA		3.71
11/02/05	3863	187									
11/09/05	3701	213									
11/16/05	3722	187									
11/23/05	2689	161									
11/30/05	2897	169	<LLD		2.09	<LLD		2.63	<MDA		1.86
12/07/05	3040	171									
12/14/05	2566	163									
12/21/05	2803	169									
12/28/05	3005	173									
N =	50		4			3			0		
Max. =	4149		3.82			3.44			N/A		
Min. =	1636		2.17			2.75			N/A		
Ave. =	2982		2.94			3.06			N/A		
Median =	2873		2.89			2.98			N/A		
Std. Dev.=	637.81		0.71			0.35			N/A		

*Data cannot be validated and verified.
NR= No sample result.

Radiological Monitoring of Surface Water and Sediments Radiological Surface Water Data

(Return to TOC)

Sample Location: Steel Creek Landing @ RM 141 (SV-2018)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			3.11	1.68	2.26	<LLD		2.67	<MDA		2.19
01/05/05	938	119									
01/12/05	885	118									
01/19/05	1371	130									
01/26/05	2494	159	<LLD		2.27	<LLD		2.73	<MDA		3.27
02/02/05	1318	140									
02/09/05	1317	137									
02/16/05	1986	159									
02/23/05	1567	149	<LLD		1.86	<LLD		2.54	<MDA		2.10
03/02/05	1492	145									
03/09/05	1438	143									
03/16/05	1250	138									
03/23/05	1928	149									
03/30/05	957	119	<LLD		1.78	<LLD		2.27	<MDA		3.33
04/06/05	4185	214									
04/13/05	9903	319									
04/20/05	1424	142									
04/27/05	273	93	2.37	1.12	0.788	<LLD		2.34	<MDA		3.66
05/04/05	<183										
05/11/05	536	100									
05/18/05	230	89									
05/25/05	253	89									
06/01/05	908	112	<LLD		2.21	<LLD		2.46	<MDA		3.75
06/08/05	8363	274									
06/15/05	7366	261									
06/22/05	8060	269									
06/29/05	559	99	<LLD		2.56	<LLD		3.11	<MDA		3.99
07/06/05	5859	231									
07/13/05	5059	218									
07/20/05	221	87									
07/27/05	5878	235	<LLD		2.60	<LLD		3.12	<MDA		2.14
08/03/05	4005	201									
08/10/05	1787	142									
08/17/05	6951	251									
08/24/05	513	97									
08/31/05	1177	122	<LLD		0.96	2.42	1.38	2.36	<MDA		3.46
09/07/05	412	93									
09/14/05	454	99									
09/21/05	NR	NR									
09/28/05	268	94	<LLD		1.85	<LLD		2.77	<MDA		2.16
10/05/05	478	95									
10/12/05	618	105									
10/19/05	511	99									
10/26/05	371*	88	<LLD		1.84	<LLD		2.77	<MDA		3.63
11/02/05	482	94									
11/09/05	457	106									
11/16/05	533	101									
11/23/05	456	94									
11/30/05	925	116	<LLD		2.1	<LLD		2.63	<MDA		2.24
12/07/05	573	101									
12/14/05	511	105									
12/21/05	402	100									
12/28/05	596	107									
N =	49		2			1			0		
Max. =	9903		3.11			2.42			N/A		
Min. =	221		2.37			2.42			N/A		
Ave. =	2043		2.74			2.42			N/A		
Median =	938		2.74			2.42			N/A		
Std. Dev.=	2507.68		0.52			N/A			N/A		

*Data cannot be validated and verified.

NR= No sample result.

Radiological Monitoring of Surface Water and Sediments (Return to TOC)
Radiological Surface Water Data

Sample Location: Little Hell Boat Landing (SV-2019)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/05/05	345	97
01/12/05	587	108
01/19/05	335	94
01/26/05	308	91
02/02/05	441	107
02/09/05	382	102
02/16/05	226	97
02/23/05	325	105
03/02/05	1307	139
03/09/05	354	102
03/16/05	303	102
03/23/05	788	114
03/30/05	774	110
04/06/05	4276	216
04/13/05	4292	217
04/20/05	242	96
04/27/05	260	93
05/04/05	<183	
05/11/05	333	92
05/18/05	367	95
05/25/05	<183	
06/01/05	431	94
06/08/05	1222	123
06/15/05	4485	207
06/22/05	3668	188
06/29/05	389	92
07/06/05	492	96
07/13/05	5275	222
07/20/05	920	114
07/27/05	258	90
08/03/05	238	90
08/10/05	313	92
08/17/05	678	106
08/24/05	437	94
08/31/05	292	90
09/07/05	650	103
09/14/05	312	94
09/21/05	NS	NS
09/28/05	539	105
10/05/05	1198	121
10/12/05	437	97
10/19/05	359	93
10/26/05	501*	93
11/02/05	337	88
11/09/05	477	107
11/16/05	482	98
11/23/05	400	93
11/30/05	383	97
12/07/05	247	88
12/14/05	539	106
12/21/05	<198	
12/28/05	630	109
N =	47	
Max. =	5275	
Min. =	226	
Ave. =	901	
Median =	431	
Std. Dev.=	1257.38	

*Data cannot be validated and verified.
NS = No sample result.

Sample Location: Upper Three Runs @ Road 2-1 (SV-2027)		
Date	Tritium	
	pCi/L	+/-2 Sigma
01/05/05	304	96
01/12/05	295	97
01/19/05	305	92
01/26/05	337	92
02/02/05	357	103
02/09/05	298	97
02/16/05	284	99
02/23/05	334	105
03/02/05	247	98
03/09/05	289	99
03/16/05	239	99
03/23/05	215	91
03/30/05	<183	
04/06/05	<172	
04/13/05	252	93
04/20/05	259	96
04/27/05	377	98
05/04/05	<183	
05/11/05	280	89
05/18/05	250	90
05/25/05	239	89
06/01/05	253	87
06/08/05	315	89
06/15/05	<179	
06/22/05	258	87
06/29/05	273	87
07/06/05	300	88
07/13/05	257	86
07/20/05	274	90
07/27/05	<185	
08/03/05	<186	
08/10/05	185	86
08/17/05	193	85
08/24/05	285	87
08/31/05	246	87
09/07/05	277	87
09/14/05	365	96
09/21/05	NS	NS
09/28/05	<195	
10/05/05	365	90
10/12/05	387	95
10/19/05	252	89
10/26/05	263*	82
11/02/05	343	88
11/09/05	240	95
11/16/05	<184	
11/23/05	200	84
11/30/05	<191	
12/07/05	288	90
12/14/05	<203	
12/21/05	<198	
12/28/05	278	95
N =	39	
Max.=	387	
Min.=	185	
Ave.=	282	
Median =	278	
Std. Dev.=	49.73	

Radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Radiological Surface Water Data

Sample Location: US-301 Bridge (SV-118)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		2.28	<LLD		2.68	<MDA		2.03
01/05/05	401	99									
01/12/05	764	114									
01/19/05	1137	122									
01/26/05	567	102	<LLD		2.34	<LLD		2.74	<MDA		3.47
02/02/05	531	111									
02/09/05	699	115									
02/16/05	438	106									
02/23/05	325	104	<LLD		1.91	<LLD		2.54	<MDA		2.16
03/02/05	685	116									
03/09/05	715	117									
03/16/05	586	114									
03/23/05	951	119									
03/30/05	334	92	<LLD		1.84	<LLD		2.27	<MDA		3.15
04/06/05	378	96									
04/13/05	282	95									
04/20/05	<187										
04/27/05	290	94	0.88	0.771	0.82	<LLD		2.35	<MDA		3.98
05/04/05	300	90									
05/11/05	289	90									
05/18/05	443	98									
05/25/05	295	91									
06/01/05	411	93	<LLD		2.20	<LLD		2.46	<MDA		3.88
06/08/05	463	95									
06/15/05	825	110									
06/22/05	494	97									
06/29/05	303	89	<LLD		2.78	<LLD		3.13	<MDA		3.99
07/06/05	298	88									
07/13/05	263	86									
07/20/05	521	99									
07/27/05	<185		<LLD		2.49	<LLD		3.11	<MDA		2.10
08/03/05	251	90									
08/10/05	184	86									
08/17/05	394	93									
08/24/05	341	89									
08/31/05	319	90	1.55	0.96	1.02	<LLD		2.37	<MDA		3.70
09/07/05	765	107									
09/14/05	574	104									
09/21/05	NR	NR									
09/28/05	808	114	<LLD		1.88	<LLD		2.78	<MDA		1.80
10/05/05	790	107									
10/12/05	684	106									
10/19/05	587	102									
10/26/05	468*	91	<LLD		1.84	<LLD		2.77	<MDA		3.77
11/02/05	557	97									
11/09/05	381	102									
11/16/05	365	94									
11/23/05	591	101									
11/30/05	359	95	<LLD		2.16	<LLD		2.63	<MDA		2.20
12/07/05	412	95									
12/14/05	673	111									
12/21/05	552	106									
12/28/05	833	115									
N =	48		2			0			0		
Max. =	1137		1.55			N/A			N/A		
Min. =	184		0.88			N/A			N/A		
Ave. =	509		1.22			N/A			N/A		
Median =	453		1.22			N/A			N/A		
Std. Dev.=	211.88		0.47			N/A			N/A		

*Data cannot be validated and verified.

NR= No sample result.

Radiological Monitoring of Surface Water and Sediments
Radiological Surface Water Data

(Return to TOC)

Sample Location: Lower Three RuNR @ Road B (SV-2053)											
Date	Tritium		Gross Alpha			Gross Beta			Cs-137		
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	LLD	pCi/L	+/-2 Sigma	MDA
12/29/04			<LLD		1.91	2.72	1.51	2.65	<MDA		2.34
01/05/05	363	98									
01/12/05	496	105									
01/19/05	453	98									
01/26/05	624	104	<LLD		2.06	<LLD		2.72	<MDA		3.60
02/02/05	503	109									
02/09/05	487	106									
02/16/05	384	103									
02/23/05	398	107	<LLD		1.70	<LLD		2.52	<MDA		2.17
03/02/05	624	113									
03/09/05	443	105									
03/16/05	489	109									
03/23/05	330	96									
03/30/05	380	94	<LLD		1.62	4.14	1.42	2.26	<MDA		3.57
04/06/05	419	98									
04/13/05	377	99									
04/20/05	493	106									
04/27/05	505	104	<LLD		0.75	<LLD		2.34	<MDA		3.88
05/04/05	372	93									
05/11/05	575	101									
05/18/05	522	101									
05/25/05	487	98									
06/01/05	426	94	<LLD		1.92	3.30	1.47	2.44	<MDA		3.90
06/08/05	524	97									
06/15/05	410	94									
06/22/05	541	98									
06/29/05	572	99	<LLD		2.28	<LLD		3.10	<MDA		3.49
07/06/05	472	94									
07/13/05	487	95									
07/20/05	417	95									
07/27/05	277	90	<LLD		2.30	<LLD		3.10	<MDA		0.80
08/03/05	268	90									
08/10/05	349	92									
08/17/05	433	95									
08/24/05	423	93									
08/31/05	312	90	1.14	0.81	0.94	<LLD		2.36	<MDA		3.52
09/07/05	322	89									
09/14/05	506	101									
09/21/05	NR	NR									
09/28/05	975	119	<LLD		1.75	<LLD		2.77	<MDA		2.28
10/05/05	1034	115									
10/12/05	549	101									
10/19/05	453	97									
10/26/05	492*	92	<LLD		1.73	<LLD		2.76	<MDA		3.98
11/02/05	600	99									
11/09/05	602	113									
11/16/05	479	98									
11/23/05	466	96									
11/30/05	352	95	<LLD		1.85	2.73	1.49	2.61	<MDA		2.00
12/07/05	460	97									
12/14/05	327	98									
12/21/05	284	95									
12/28/05	474	102									
N =	50		1			4			0		
Max. =	1034		1.14			4.14			N/A		
Min. =	268		1.14			2.72			N/A		
Ave. =	470		1.14			3.22			N/A		
Median =	463		1.14			3.02			N/A		
Std. Dev.=	142.41		N/A			0.67			N/A		

*Data cannot be validated and verified.

NR= No sample result.

Radiological Monitoring of Surface Water and Sediments Boat Run Data

(Return to TOC)

Sample Location: Upper Three Runs @ RM 157.4 (SV-2011)		
Date	Tritium	
	pCi/L	+/-2 Sigma
02/14/05	5731	225
05/09/05	764	110
08/12/05*	<189	
10/10/05	569	102
N =	3	
Max. =	5731	
Min. =	569	
Average =	2355	
Median =	764	
Std. Dev. =	2925.6	

Sample Location: Beaver Dam Creek Mouth @ RM 152.3 (SV-2013)		
Date	Tritium	
	pCi/L	+/-2 Sigma
02/14/05	314	93
05/09/05	320	92
08/12/05*	<189	
10/10/05	206	85
N =	3	
Max. =	320	
Min. =	206	
Average =	280	
Median =	314	
Std. Dev. =	64.2	

Sample Location: Four Mile Creek @ RM 150.6 (SV-2015)						
Date	Tritium (at Creek Mouth (CM))		Tritium (30 Feet from CM)		Tritium (150 Feet from CM)	
	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma	pCi/L	+/-2 Sigma
02/14/05	57376	670	5032	213	30053	489
05/09/05	47895	618	3925	191	10341	294
08/12/05*	<189		<189		<189	
10/10/05	96823	871	69911	740	40126	563
N =	3		3		3	
Max. =	96823		69911		40126	
Min. =	47895		3925		10341	
Average =	67365		26289		26840	
Median =	57376		5032		30053	
Std. Dev. =	25948.4		37781.5		15150.2	

Sample Location: Steel Creek Mouth @ RM 141.8 (SV-2017)		
Date	Tritium	
	pCi/L	+/-2 Sigma
02/14/05	15866	362
05/09/05	5500	223
08/12/05*	1325	126
10/10/05	2987	170
N =	4	
Max. =	15866	
Min. =	1325	
Average =	6420	
Median =	4244	
Std. Dev. =	6527.3	

Sample Location: Lower Three Runs Mouth @ RM 129 (SV-2020)		
Date	Tritium	
	pCi/L	+/-2 Sigma
02/14/05	3900	191
05/09/05	1006	118
08/12/05*	<189	
10/10/05	913	113
N =	3	
Max. =	3900	
Min. =	913	
Average =	1940	
Median =	1006	
Std. Dev. =	1698.3	

Notes: *River level elevated.

Radiological Monitoring of Surface Water and Sediments Radiological Sediment Monitoring

(Return to TOC)

2005 Radiological Sediment Data (pCi/g)													
Location:	**Cs-137**	**Co-58**	**Co-60**	**Ac-228**	**Am-241**	**K-40**	**Location:**	**Cs-137**	**Co-58**	**Co-60**	**Ac-228**	**Am-241**	**K-40**
SV-2010	<MDA	<MDA	<MDA	1.61	<MDA	10.97	**SV-2011**	0.35	<MDA	<MDA	1.98	<MDA	10.16
+/-2 Sigma				0.11		0.82	+/-2 Sigma	0.06			0.17		0.98
MDA	0.03	0.07	0.02	0.08	0.04	0.19	MDA	0.04	0.12	0.04	0.16	0.09	0.41
SV-2045	0.73	<MDA	<MDA	<MDA	<MDA.	<MDA	**SV-2013**	<MDA	<MDA	<MDA	0.80	<MDA	12.05
+/-2 Sigma	0.08						+/-2 Sigma				0.07		0.86
MDA	0.01	0.04	0.01	0.09	0.03	0.10	MDA	0.02	0.06	0.02	0.08	0.04	0.17
SV-325	<MDA	<MDA	<MDA	1.36	<MDA	<MDA	**SV-2015**	0.47	<MDA	<MDA	1.48	<MDA	14.41
+/-2 Sigma				0.09			+/-2 Sigma	0.06			0.12		1.10
MDA	0.02	0.06	0.02	0.07	0.04	0.37	MDA	0.03	0.09	0.03	0.12	0.07	0.26
SV-2012	<MDA	<MDA	<MDA	1.42	<MDA	15.75	**SV-2017**	0.56	<MDA	<MDA	1.32	<MDA	10.49
+/-2 Sigma				0.13		1.18	+/-2 Sigma	0.07			0.11		0.83
MDA	0.03	0.10	0.03	0.12	0.06	0.26	MDA	0.03	0.07	0.31	0.10	0.06	0.24
SV-2040	0.05	<MDA	<MDA	1.18	<MDA	9.01	**SV-2020**	0.38	<MDA	<MDA	1.18	<MDA	17.04
+/-2 Sigma	0.02			0.10		0.74	+/-2 Sigma	0.06			0.10		1.22
MDA	0.03	0.08	0.03	0.10	0.04	0.22	MDA	0.03	0.09	0.37	0.10	0.07	0.26
SV-2039	0.30	<MDA	<MDA	<MDA	<MDA	<MDA.	N =	12	0	0	15	0	12
+/-2 Sigma	0.03						Ave. =	0.46	N/A	N/A	1.35	N/A	10.70
MDA	0.01	0.04	0.01	0.08	0.02	0.31	Median =	0.33	N/A	N/A	1.32	N/A	11.51
SV-2047	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	Std. Dev. =	0.48	N/A	N/A	0.67	N/A	5.20
+/-2 Sigma													
MDA	0.01	0.04	0.01	0.07	0.02	0.29							
SV-327	0.30	<MDA	<MDA	0.41	<MDA	0.51							
+/-2 Sigma	0.03			0.04		0.19							
MDA	0.02	0.04	0.01	0.02	0.03	0.11							
SV-2018	1.85	<MDA	<MDA	1.16	<MDA	13.85							
+/-2 Sigma	0.14			0.12		1.10							
MDA	0.03	0.10	0.04	0.12	0.06	0.29							
SV-2019	0.04	<MDA	<MDA	0.49	<MDA	1.02							
+/-2 Sigma	0.01			0.05		0.22							
MDA	0.01	0.05	0.01	0.05	0.03	0.12							
SV-118	0.31	<MDA	<MDA	1.07	<MDA	13.10							
+/-2 Sigma	0.04			0.10		0.99							
MDA	0.03	0.10	0.03	0.11	0.05	0.24							
SV-2053	0.22	<MDA	<MDA	3.27	<MDA	<MDA							
+/-2 Sigma	0.04			0.16									
MDA	0.03	0.08	0.02	0.08	0.06	0.22							
SV-2027	<MDA	<MDA	<MDA	1.51	<MDA	<MDA							
+/-2 Sigma				0.11									
MDA	0.02	0.09	0.03	0.10	0.05	0.25							

(Return to TOC)

2.4 Non-Radiological Monitoring of Surface Water and Sediment

2.4.1 Summary

The streams located on the Savannah River Site (SRS) receive treated wastewater and nonpoint source runoff from on-site facilities. Recent and historical data from SRS Environmental Reports indicate that the SRS surface waters are in accordance with Freshwaters Standard guidelines stated in the South Carolina Department of Health and Environmental Control (SCDHEC) Water Classifications and Standards (Regulation 61-68), 2005.

In 2005, the Environmental Surveillance Oversight Program (ESOP) assessed the sediment and surface water quality for nonradiological parameters on SRS by sampling the on-site streams for inorganic and organic contaminants. Specific parameters were analyzed monthly, biannually, and annually. Sampling locations were strategically chosen to monitor ambient sediment and surface water conditions to detect the nonradiological impact from the Department of Energy – Savannah River (DOE-SR) operations (Map 6, section 2.4.2).

Metals were detected in many of the sediment samples. Chromium, lead, nickel and zinc were detected at levels above their associated South Carolina state averages. The detected metals can be traced to on-site facilities, effluents and processes. Sediment data from this study, as well as 2005 DOE-SR sediment data, indicate no measurable impacts from DOE-SR operations. However, a comparison of SRS and ESOP sediment data could not be completed because of different methods used for analyzing sediments.

The overall water quality on the SRS for nonradiological parameters meets the Freshwaters Standard for South Carolina streams. As in previous years, all but two of the surface water parameters, nitrate and pH, continued to be within expected ranges for South Carolina streams. Nitrate concentrations from the Four Mile Creek (SV-326) sample location were higher than comparable South Carolina streams. These elevated nitrate concentrations possibly result from groundwater from beneath F- and H-area seepage basins outcropping into Four Mile Creek. Also, surface water pH from one of the Upper Three Runs (SV-2027) sample locations continues to be lower than comparable South Carolina streams. This trend is typical for black water streams, such as Upper Three Runs. Data from ESOP surface water locations were compared to DOE-SR data where sample points were colocated. There were no notable differences between the ESOP and SRS surface water data.

ESOP will continue the nonradiological independent monitoring and surveillance of SRS surface water to verify and validate SRS surface water quality. Continued monitoring is required because of increased land disturbance from accelerated clean-up, logging, and the potential for new emissions. The future locations, number of samples, sample frequencies and monitoring parameters may change to maximize available resources and to address critical issues.

RESULTS AND DISCUSSION

<u>Sediments</u>

All ESOP sediment data can be found in section 2.4.4.

Metals were detected in many of the sediment samples. Chromium was detected above the South Carolina state average of 13.39 mg/kg, at SV-175, at a level of 40 mg/kg. Nickel was detected above the state average of 3.92 mg/kg, at SV-325, at a level of 5 mg/kg, and SV-175 at a level of 10 mg/kg. Lead was detected above the state average of 13.62 mg/kg, at SV-175, at a level of 37 mg/kg. Zinc was also detected above the state average of 21.61 mg/kg, at SV-175, at a level of 50 mg/kg. The detected metals can be traced to on-site facilities, effluents and processes.

Acetone was detected in sediment samples collected at SV-2047 and SV-327. Information regarding acetone contamination on SRS was not available. Further investigation into the matter may be warranted. However, acetone is used in sediment sample analysis, therefore, the detected Acetone may be due to lab contamination.

Total Kjeldahl Nitrogen (TKN) has been consistently detected above the state average, over the last six years, at the Lower Three Runs sample site SV-175. It peaked from 2000 to 2002, and then descended to below the state average in 2005. This is shown in Figure 1, section 2.4.3. Detected TKN is most likely due to agricultural runoff.

Over the past seven years there have been sporadic detections of metals and nutrients above the South Carolina state averages in the SRS streams. These detections have not been consistently seen in every year.

Note that South Carolina state averages are from the Summary of Selected Water Quality Parameter Concentrations in South Carolina Water and Sediments (SCDHEC, 1998).

<u>Surface Water</u>

All surface water data can be found in section 2.4.4.

ESOP field personnel recorded pH at each sample location during each sampling event. . The freshwaters pH standard for South Carolina is between 6.0 and 8.5 (SCDHEC, 1998). Measurements below the standard range for pH were observed in eight of nine months of data collected at Upper Three Runs (SV-2027), which is the background location not typically affected by SRS operations. These measurements ranged from 4.24 to 5.97. The pH did reach the standard range in February, when it was observed at 6.00. Low pH is typical for black water streams such as Upper Three Runs (USGS 2000). The pH was also low at the other Upper Three Runs location (SV-325) where it ranged from 4.60 to 6.41 with an average 5.73 ± 0.74. The pH was low in several other locations as well. At Tims Branch (SV-324) the pH averaged 5.94 ± 0.46 for the year and ranged from 5.27 to 6.67. At Four Mile Creek (SV-326), the pH only dropped below 6.00 in June. The pH was low at the Pen Branch location (SV-2047) in January, February, and December and ranging from 5.31 to 6.99, with an average of 6.13 ± 0.40. The Steel Creek location (SV-327) also had low pH in January and February at 5.51 and 5.91 respectively. The two Lower Three Runs locations (SV-175 and SV-328) had low pHs in January only at 5.64 and 5.88 respectively.

Nitrate/nitrite concentrations above the state average of 0.639 mg/L were observed from monthly samples collected at Four Mile Creek (SV-326) location (Figure 2, section 2.4.3). The average nitrate/nitrite concentration at the Four Mile Creek location (SV-326) was 1.43 ± 0.064 mg/L, which increased from the 2004 average of 1.29 ± 0.37 mg/L (SCDHEC, 2005a). The elevated nitrate/nitrite level may be explained by groundwater beneath F-Area and H-Area seepage basins outcropping into Four Mile Creek (RAC, 1999). However, the observed levels of nitrate/nitrite are still below the 10 mg/L Maximum Contaminant Level (MCL) (USEPA, 1996). If nitrate/nitrite levels continue to increase, additional sampling may be required.

The DOE-SR surface water sample location FM-6 on Four Mile Creek is located approximately four miles downstream from the ESOP surface water sample location (SV-326). The DOE-SR average nitrate/nitrite concentration for this location in 2005 was 0.785 ± 0.22 mg/L. As shown in Figure 2, section 2.4.3, DOE-SR nitrate/nitrite levels for Four Mile Creek have been consistently below ESOP nitrate/nitrite levels.

ESOP field personnel collected surface water samples for fecal coliform analysis at each location during each sampling event. The freshwaters fecal coliform standard for South Carolina is: five consecutive samples during any 30 day period shall not exceed a geometric mean of 200 colonies/100 mL membrane fecal coliform (MFC); nor shall more than ten percent of the total samples during any 30 day period exceed 400 colonies/100mL MFC (SCDHEC, 2005b). Of the 108 fecal coliform samples taken in 2005, eight were greater than 400 colonies/100mL MFC.

Samples analyzed for other parameters (including but not limited to alkalinity, metals, total organic carbon, volatile organic compounds, pesticides and polychlorinated biphenyl) indicated that the SRS streams met the established freshwater standards during this study (SCDHEC, 2005b). Surface water statistical analysis can be found in section 2.4.5.

ESOP and DOE-SR (WSRC, 2006) data comparison for the four colocated sample locations for 2005 are found in section 2.4.4. The data comparison includes yearly averages, yearly observed maximums, yearly minimums, and yearly standard deviations. At ESOP site SV-2027, which is located on the Upper Three Runs, dissolved oxygen (8.2 ± 1.55), water temperature (17.3 ±4.6), total phosphorus (0.031 ± 0.007), and nitrate/nitrite/nitrite levels (0.126 ± 0.058) were all within one standard deviation of DOE-SR site U3R-1A. Total suspended solids (2.48 ± 1.48) and pH (5.42 ± 0.60) were within two standard deviations. Iron (0.52 ± 0.46) was within three standard deviations, total organic carbon (7.8 ± 1.8) was within seven, manganese (0.021 ± 0.001) was within ten, and zinc (0.067 ± 0.075) was within 15. These large differences in detection of iron, total organic carbon, manganese, and zinc may be due to the sample locations being approximately one and a half miles apart.

At DOE-SR site TB-5, which is located on Tims Branch, pH (6.47 ± 1.07), dissolved oxygen (9.0 ± 1.39), water temperature (17.34 ± 5.73), nitrate/nitrite/nitrite levels (0.087 ± 0.030), iron (2.380 ± 0.713), manganese (0.081 ± 0.040), and total organic carbon (5.433 ± 1.592) were within one standard deviation of ESOP site SV-324. Total suspended solids (6.75 ± 2.60) were within two, and total phosphorus (0.133 ± 0.070) was within three standard deviations.

At ESOP site SV-325, which is located on Upper Three Runs, dissolved oxygen (8.97 ± 4.52), water temperature (17.02 ± 6.06), total suspended solids (0.039 ± 0.012), iron (0618 ± 0.165), manganese (0.030 ± 0.023), and total organic carbon (6.550 ± 5.838) were within one standard deviation of DOE-SR site U3R-4. Nitrate/nitrite levels (0.292 ± 0.097) and pH (5.73 ± 0.74) and were within two and total phosphorus (0.039 ± 0.012) was within three standard deviations.

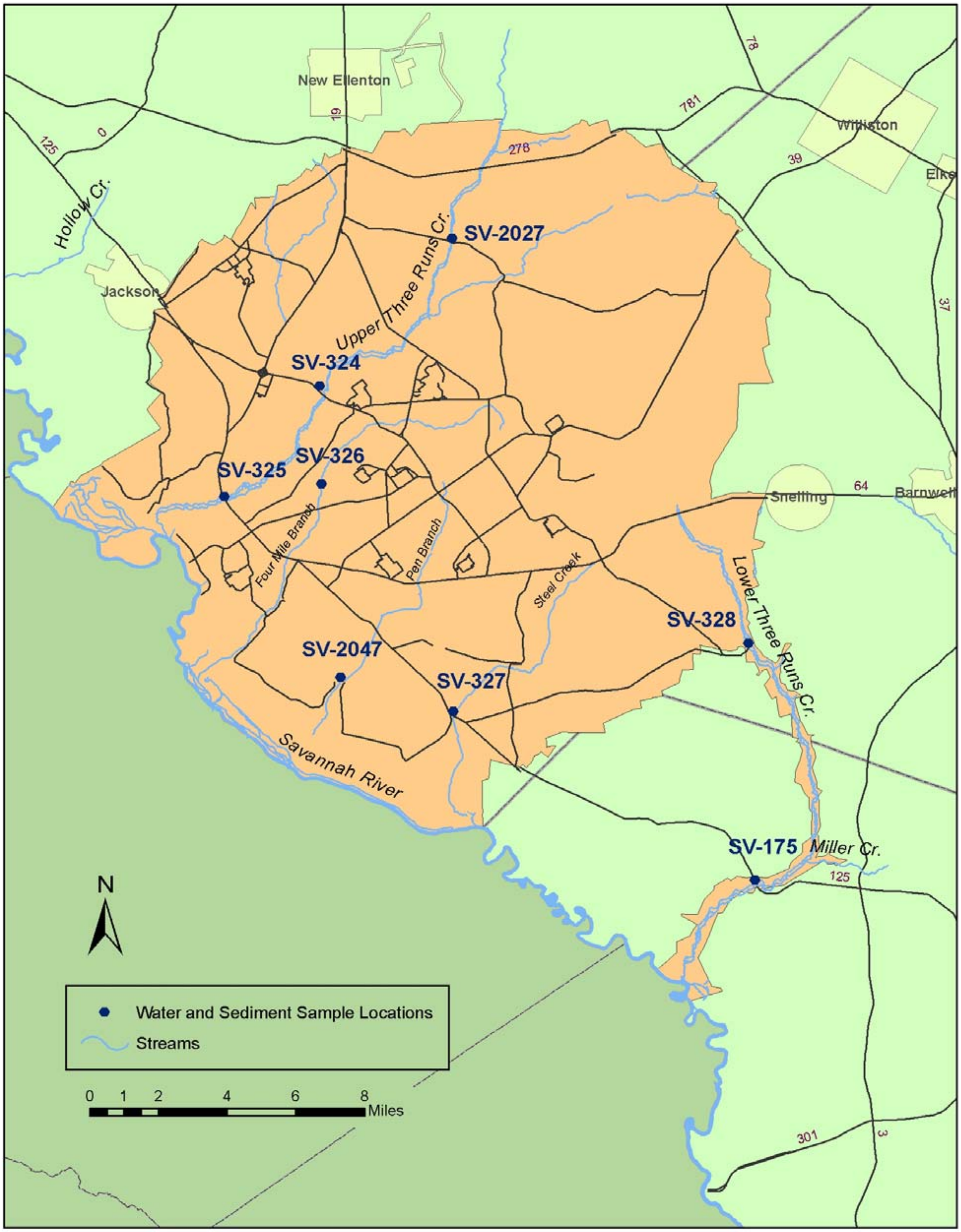
At DOE-SR site SC-4, which is located on Steel Creek, pH (6.88 ± 0.47), dissolved oxygen (9.30 ± 1.35), water temperature (18.89 ± 5.94), nitrate/nitrite levels (0.075 ± 0.020), total phosphorus (0.049 ± 0.039), iron (0.537 ±0.211), manganese (0.049 ± 0.016), zinc (0.017 ± 0.014), and total organic carbon (6.500 ± 2.627), were within one standard deviation of ESOP site SV-327. Total suspended solids (2.75 ± 1.91) were within two standard deviations.

Note that South Carolina state averages are from the Summary of Selected Water Quality Parameter Concentrations in South Carolina Water and Sediments (SCDHEC, 1998).

2.4.2

(Return to TOC)

Map 6. Non-radiological Surface Water and Sediments Sampling Locations



2.4.3 Tables and Figures
(Return to TOC)

Non-radiological Monitoring of Surface Water and Sediments

Figure 1. Trending Data for TKN at SV-175

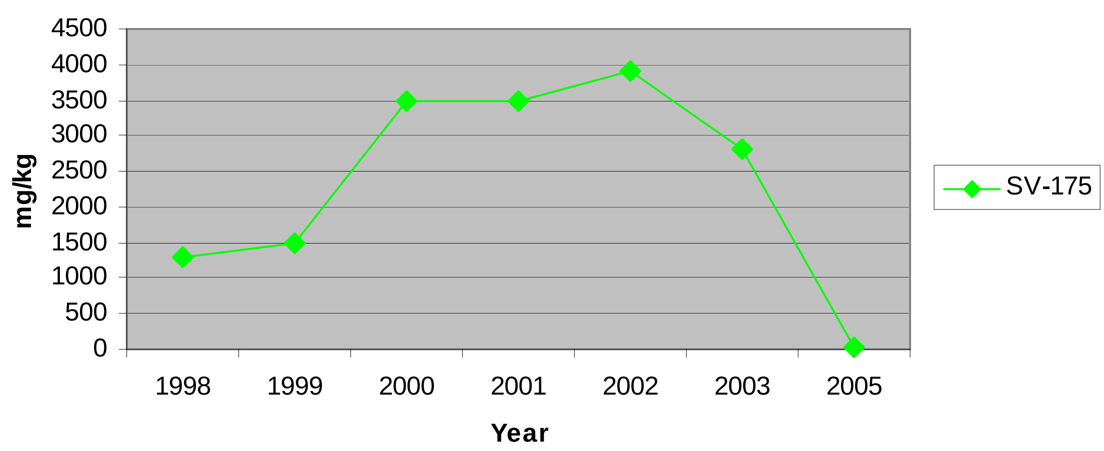
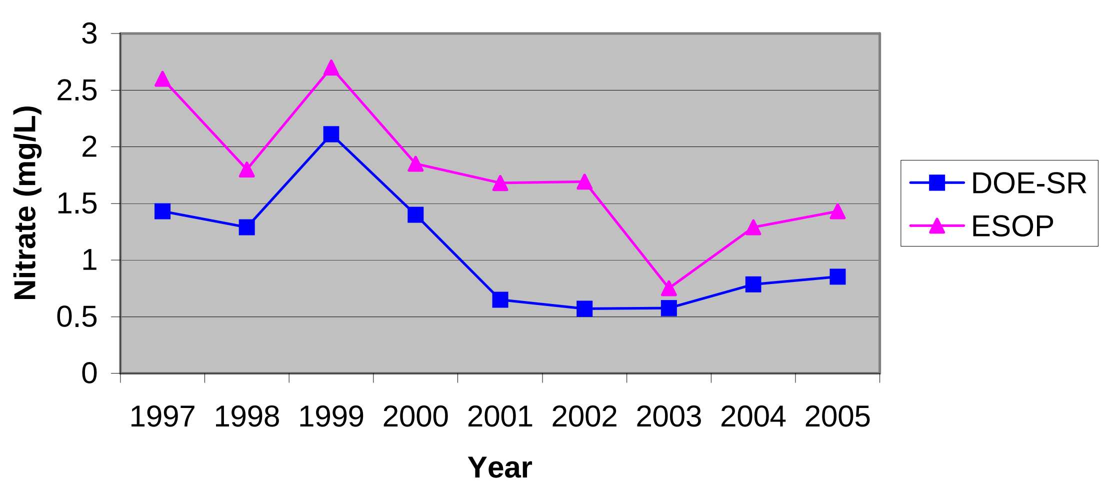


Figure 2. DOE-SR and ESOP Average Nitrate/Nitrite Levels in Four Mile Creek



2.4.4 Data

(Return to TOC)

Non-radiological Monitoring of Surface Water and Sediments

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-2027							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	5.09	6.00	AP	AP	4.55	5.04
	DO	**mg/L**	9.10	9.76	AP	AP	AP	8.00
	Water Temperature	**celsius**	11.1	15.5	AP	AP	19.5	21.8
	Alkalinity	**mg/L**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Turbidity	**NTU**	1.4	2.1	3.0	1.2	1.6	2.2
	BOD	**mg/L**	<2.0	<2.0	2.2	<2.0	<2.0	<2.0
	TSS	**mg/L**	2.10	2.30	2.20	0.60	<0.50	3.90
	Fecal Coliform (MFC)	**FC/100mL**	130	120	240	110	62	82
	NH3 NH4	**mg/L**	0.092	0.150	0.140	0.059	0.110	<0.050
	NO3 NO2	**mg/L**	0.360	0.260	0.180	0.210	0.220	0.200
	TKN	**mg/L**	0.20	0.15	0.25	0.24	0.36	0.10
	Total Phosphorus	**mg/L**	<0.020	<0.020	<0.020	0.033	<0.020	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	0.40	0.19	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.021	<0.010	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	0.120	<0.010	NS	NS
	TOC	**mg/L**	NS	NS	6.5	<2.0	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	4.87	5.40	5.35	4.24	5.97	5.85
	DO	**mg/L**	AP	7.71	5.40	6.75	9.05	9.82
	Water Temperature	**celsius**	23.1	22.2	19.9	14.9	14.8	10.2
	Alkalinity	**mg/L**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Turbidity	**NTU**	17.0	5.6	1.3	1.1	1.0	1.5
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	4.30	2.70	5.90	3.30	1.20	2.70
	Fecal Coliform (MFC)	**FC/100mL**	600	600	110	240	86	200
	NH3 NH4	**mg/L**	0.077	0.100	0.130	0.270	0.130	AP
	NO3 NO2	**mg/L**	0.180	0.260	0.220	0.210	0.230	0.240
	TKN	**mg/L**	0.41	0.36	0.20	0.41	0.28	0.11
	Total Phosphorus	**mg/L**	0.039	0.033	<0.020	0.028	0.020	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	1.20	NS	NS	0.28	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.019	NS	NS	0.019	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	0.014	NS	NS	<0.010	NS	NS
	TOC	**mg/L**	9.0	NS	NS	<2.0	NS	NS

Notes:

1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-324							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	5.27	6.67	AP	AP	5.33	5.66
	DO	**mg/L**	10.01	9.58	AP	AP	AP	7.68
	Water Temperature	**celsius**	9.4	14.3	AP	AP	19.8	22.8
	Alkalinity	**mg/L**	3.5	4.5	3.9	6.4	9.5	7.0
	Turbidity	**NTU**	2.3	3.8	5.7	3.5	5.0	7.1
	BOD	**mg/L**	<2.0	<2.0	2.5	<2.0	<2.0	<2.0
	TSS	**mg/L**	2.50	2.90	1.80	2.30	3.20	7.80
	Fecal Coliform (MFC)	**FC/100mL**	15	30	70	70	70	140
	NH3 NH4	**mg/L**	0.150	0.220	0.120	0.061	0.120	0.050
	NO3 NO2	**mg/L**	0.220	0.110	0.098	0.075	0.075	0.069
	TKN	**mg/L**	0.30	0.22	0.32	0.28	0.58	0.51
	Total Phosphorus	**mg/L**	0.025	0.027	0.048	0.035	0.049	0.058
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	1.50	1.50	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.560	0.033	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	TOC	**mg/L**	NS	NS	5.4	4.0	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	5.71	6.25	5.85	6.02	6.42	6.20
	DO	**mg/L**	Ap	7.92	6.40	6.86	9.46	10.92
	Water Temperature	**celsius**	23.9	22.9	20.8	14.7	13.5	7.2
	Alkalinity	**mg/L**	8.2	7.6	5.9	6.4	5.1	4.3
	Turbidity	**NTU**	4.5	6.5	4.5	3.2	1.6	2.9
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	7.00	4.60	3.50	3.30	1.60	2.70
	Fecal Coliform (MFC)	**FC/100mL**	220	150	310	100	67	20
	NH3 NH4	**mg/L**	0.100	0.092	0.089	0.320	0.180	AP
	NO3 NO2	**mg/L**	0.033	0.040	0.039	0.047	0.070	0.120
	TKN	**mg/L**	0.36	0.18	0.28	0.46	0.29	0.13
	Total Phosphorus	**mg/L**	0.067	0.052	0.033	0.045	0.025	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	2.90	NS	NS	0.36	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.084	NS	NS	0.011	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	TOC	**mg/L**	9.3	NS	NS	3.7	NS	NS

Notes:

1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-326							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	6.92	6.96	AP	AP	6.06	5.91
	DO	**mg/L**	10.71	9.88	AP	AP	7.91	6.68
	Water Temperature	**celsius**	8.8	13.9	AP	AP	21.8	25.1
	Alkalinity	**mg/L**	14.0	13.0	8.0	16.0	26.0	14.0
	Turbidity	**NTU**	4.2	2.6	8.9	3.1	4.3	5.5
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	4.00	1.50	2.40	0.60	0.50	4.90
	Fecal Coliform (MFC)	**FC/100mL**	65	40	200	120	100	140
	NH3 NH4	**mg/L**	0.150	0.190	0.170	0.083	0.120	0.065
	NO3 NO2	**mg/L**	2.700	1.400	0.620	1.100	1.300	0.440
	TKN	**mg/L**	0.37	0.19	0.27	0.43	0.54	0.38
	Total Phosphorus	**mg/L**	0.140	0.097	0.077	0.100	0.240	0.084
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	1.00	0.88	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.090	0.054	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	0.028	0.012	NS	NS
	TOC	**mg/L**	NS	NS	5.2	4.3	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	6.31	6.58	6.06	6.24	6.73	7.15
	DO	**mg/L**	AP	6.42	5.90	6.60	8.39	10.46
	Water Temperature	**celsius**	25.3	24.2	21.9	15.0	13.2	6.2
	Alkalinity	**mg/L**	20.0	24.0	29.0	15.0	13.0	12.0
	Turbidity	**NTU**	3.9	6.4	4.2	2.8	2.8	3.6
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	1.40	1.00	30.00	1.60	0.90	3.80
	Fecal Coliform (MFC)	**FC/100mL**	50	100	600	150	87	55
	NH3 NH4	**mg/L**	0.061	0.100	0.140	0.260	0.240	0.150
	NO3 NO2	**mg/L**	1.000	2.200	1.700	1.100	1.600	2.000
	TKN	**mg/L**	0.23	0.35	0.48	0.60	0.30	0.38
	Total Phosphorus	**mg/L**	0.170	0.270	0.290	0.150	0.092	0.140
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	1.00	NS	NS	1.80	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.062	NS	NS	0.040	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	0.015	NS	NS	<0.010	NS	NS
	TOC	**mg/L**	4.9	NS	NS	5.5	NS	NS

Notes:
1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-325							
Sample Date:		units	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05
Monthly Parameters	pH	su	4.66	4.60	AP	AP	5.04	5.36
	DO	mg/L	11.17	9.36	AP	AP	8.50	7.90
	Water Temperature	celsius	7.6	13.4	AP	AP	20.6	22.8
	Alkalinity	mg/L	2.9	2.7	<1.0	3.2	4.0	3.0
	Turbidity	NTU	3.2	3.9	5.8	2.6	2.5	7.2
	BOD	mg/L	<2.0	2.6	<2.0	<2.0	<2.0	<2.0
	TSS	mg/L	2.80	4.20	1.40	2.00	<0.50	7.50
	Fecal Coliform (MFC)	FC/100mL	80	60	540	120	160	130
	NH3 NH4	mg/L	0.067	0.099	0.230	0.061	0.100	<0.050
	NO3 NO2	mg/L	0.190	0.170	0.027	0.120	0.150	0.110
	TKN	mg/L	0.32	0.15	0.42	0.26	0.44	0.37
	Total Phosphorus	mg/L	<0.020	0.022	0.038	0.029	0.045	0.049
Quarterly Metals and TOC	Cadmium	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Chromium	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Copper	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Iron	mg/L	NS	NS	0.56	0.41	NS	NS
	Mercury	mg/L	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	mg/L	NS	NS	0.064	0.019	NS	NS
	Nickel	mg/L	NS	NS	<0.020	<0.020	NS	NS
	Lead	mg/L	NS	NS	<0.050	<0.050	NS	NS
	Zinc	mg/L	NS	NS	<0.010	<0.010	NS	NS
	TOC	mg/L	NS	NS	15.0	2.6	NS	NS
Sample Date:		units	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
Monthly Parameters	pH	su	6.06	6.20	6.19	6.37	6.41	6.41
	DO	mg/L	AP	7.90	6.20	10.42	9.30	9.98
	Water Temperature	celsius	23.9	23.0	21.1	15.6	13.5	8.7
	Alkalinity	mg/L	2.4	4.2	3.2	3.2	2.5	2.4
	Turbidity	NTU	3.0	3.3	1.6	1.8	1.4	1.7
	BOD	mg/L	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	mg/L	2.40	1.00	1.20	4.80	<0.50	2.20
	Fecal Coliform (MFC)	FC/100mL	180	280	200	210	87	45
	NH3 NH4	mg/L	0.073	0.130	0.120	0.260	0.170	0.150
	NO3 NO2	mg/L	0.110	0.110	0.160	0.120	0.120	0.120
	TKN	mg/L	0.26	0.18	0.28	0.38	0.27	0.17
	Total Phosphorus	mg/L	0.052	0.048	0.024	0.047	<0.020	<0.020
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	0.75	NS	NS	0.75	NS	NS
	Mercury	mg/L	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	mg/L	0.021	NS	NS	0.016	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	TOC	mg/L	5.9	NS	NS	2.7	NS	NS

Notes:
1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-2047							
Sample Date:		units	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05
Monthly Parameters	pH	su	5.31	5.41	AP	AP	6.55	6.09
	DO	mg/L	11.20	9.47	AP	AP	9.26	7.67
	Water Temperature	celsius	6.2	12.8	AP	AP	21.1	24.3
	Alkalinity	mg/L	18.0	16.0	6.0	21.0	24.0	28.0
	Turbidity	NTU	2.8	4.8	8.9	3.3	3.5	7.5
	BOD	mg/L	<2.0	<2.0	2.6	<2.0	<2.0	<2.0
	TSS	mg/L	1.90	6.60	2.80	0.70	<0.50	6.10
	Fecal Coliform (MFC)	FC/100mL	180	150	180	100	73	160
	NH3 NH4	mg/L	<0.050	0.210	0.290	0.120	0.083	<0.050
	NO3 NO2	mg/L	0.210	0.200	0.250	0.130	0.140	0.100
	TKN	mg/L	0.32	0.26	0.42	0.53	0.44	0.30
	Total Phosphorus	mg/L	<0.020	0.026	0.043	0.041	0.035	0.035
Quarterly Metals and TOC	Cadmium	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Chromium	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Copper	mg/L	NS	NS	<0.010	<0.010	NS	NS
	Iron	mg/L	NS	NS	0.94	0.72	NS	NS
	Mercury	mg/L	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	mg/L	NS	NS	0.110	0.057	NS	NS
	Nickel	mg/L	NS	NS	<0.020	<0.020	NS	NS
	Lead	mg/L	NS	NS	<0.050	<0.050	NS	NS
	Zinc	mg/L	NS	NS	<0.010	<0.010	NS	NS
	TOC	mg/L	NS	NS	13.0	4.5	NS	NS
Sample Date:		units	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
Monthly Parameters	pH	su	6.37	6.22	6.18	6.32	6.99	5.88
	DO	mg/L	7.78	7.60	5.89	7.96	8.70	12.87
	Water Temperature	celsius	25.2	25.1	23.4	11.6	16.6	6.9
	Alkalinity	mg/L	22.0	19.0	23.0	22.0	18.0	16.0
	Turbidity	NTU	3.7	4.0	2.2	2.3	2.0	2.6
	BOD	mg/L	<2.0	<2.0	3.9	<2.0	<2.0	<2.0
	TSS	mg/L	1.90	3.80	0.50	3.50	1.30	4.20
	Fecal Coliform (MFC)	FC/100mL	42	320	600	160	45	48
	NH3 NH4	mg/L	0.056	0.099	0.064	0.110	0.140	AP
	NO3 NO2	mg/L	0.130	0.099	0.120	<0.020	0.110	0.120
	TKN	mg/L	0.37	0.34	0.32	0.34	0.26	0.11
	Total Phosphorus	mg/L	0.045	0.036	0.032	0.029	0.023	0.031
Quarterly Metals and TOC	Cadmium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Chromium	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Copper	mg/L	<0.010	NS	NS	<0.010	NS	NS
	Iron	mg/L	1.20	NS	NS	0.59	NS	NS
	Mercury	mg/L	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	mg/L	0.082	NS	NS	0.051	NS	NS
	Nickel	mg/L	<0.020	NS	NS	<0.020	NS	NS
	Lead	mg/L	<0.050	NS	NS	<0.050	NS	NS
	Zinc	mg/L	<0.010	NS	NS	<0.010	NS	NS
	TOC	mg/L	7.6	NS	NS	2.8	NS	NS

Notes:

1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-327							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	5.51	5.91	AP	AP	6.55	6.30
	DO	**mg/L**	10.20	9.52	AP	AP	9.15	7.58
	Water Temperature	**celsius**	6.6	12.6	AP	AP	20.7	24.2
	Alkalinity	**mg/L**	22.0	21.0	AP	22.0	25.0	21.0
	Turbidity	**NTU**	1.9	17.0	3.5	2.5	2.2	4.4
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	1.00	37.00	1.40	0.60	<0.50	6.50
	Fecal Coliform (MFC)	**FC/100mL**	240	180	150	90	60	35
	NH3 NH4	**mg/L**	0.098	0.100	0.180	0.089	0.084	0.060
	NO3 NO2	**mg/L**	0.110	0.071	0.075	0.073	0.100	0.110
	TKN	**mg/L**	0.36	0.25	0.42	0.41	0.52	0.28
	Total Phosphorus	**mg/L**	<0.020	0.034	0.023	0.036	0.033	0.039
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	0.75	0.57	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.072	0.051	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	TOC	**mg/L**	NS	NS	10.0	4.1	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	6.39	6.62	6.38	6.73	6.91	7.02
	DO	**mg/L**	7.49	7.15	6.02	8.20	8.20	12.20
	Water Temperature	**celsius**	24.8	24.9	23.6	12.4	16.6	7.0
	Alkalinity	**mg/L**	20.0	20.0	24.0	23.0	22.0	20.0
	Turbidity	**NTU**	2.1	2.5	4.1	1.5	1.6	1.5
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	0.80	1.40	2.20	1.10	0.60	8.80
	Fecal Coliform (MFC)	**FC/100mL**	30	200	600	55	50	55
	NH3 NH4	**mg/L**	0.071	0.087	0.090	0.250	0.140	0.120
	NO3 NO2	**mg/L**	0.110	0.055	0.074	0.056	0.030	0.064
	TKN	**mg/L**	0.26	0.36	0.32	0.41	0.23	0.12
	Total Phosphorus	**mg/L**	0.021	0.032	0.037	0.020	<0.020	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	0.65	NS	NS	0.33	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.053	NS	NS	0.035	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	0.012	NS	NS	0.023	NS	NS
	TOC	**mg/L**	6.7	NS	NS	2.8	NS	NS

Notes:

1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-175							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	5.64	6.13	AP	AP	6.83	6.48
	DO	**mg/L**	11.29	8.36	AP	AP	8.66	7.28
	Water Temperature	**celsius**	5.9	16.0	AP	AP	21.0	25.1
	Alkalinity	**mg/L**	37.0	26.0	AP	35.0	38.0	30.0
	Turbidity	**NTU**	2.1	4.0	3.6	2.5	2.5	27.0
	BOD	**mg/L**	<2.0	3.8	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	1.20	1.20	1.00	0.90	<0.50	48.00
	Fecal Coliform (MFC)	**FC/100mL**	140	410	340	35	100	100
	NH3 NH4	**mg/L**	0.054	0.160	0.200	0.100	0.086	<0.050
	NO3 NO2	**mg/L**	0.089	0.050	0.044	0.110	0.150	0.110
	TKN	**mg/L**	0.38	0.65	0.40	0.50	0.52	0.34
	Total Phosphorus	**mg/L**	0.020	0.048	0.036	0.054	0.056	0.120
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	0.56	0.53	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.023	0.051	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	TOC	**mg/L**	NS	NS	10.0	4.4	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	6.46	6.84	6.69	7.02	7.22	7.02
	DO	**mg/L**	6.97	6.73	5.94	6.82	7.44	11.98
	Water Temperature	**celsius**	25.5	25.6	23.0	13.0	17.2	6.8
	Alkalinity	**mg/L**	32.0	31.0	50.0	45.0	40.0	37.0
	Turbidity	**NTU**	2.2	3.1	1.9	1.6	<1.0	1.6
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	0.50	0.80	<0.50	2.40	<0.50	0.80
	Fecal Coliform (MFC)	**FC/100mL**	120	250	120	240	140	160
	NH3 NH4	**mg/L**	0.060	0.064	0.070	<0.050	0.150	0.092
	NO3 NO2	**mg/L**	0.110	0.120	0.100	0.067	0.031	0.054
	TKN	**mg/L**	0.50	0.32	0.21	0.36	0.25	0.18
	Total Phosphorus	**mg/L**	0.049	0.071	0.046	0.088	0.044	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	0.77	NS	NS	0.39	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.066	NS	NS	0.057	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	TOC	**mg/L**	8.2	NS	NS	3.8	NS	NS

Notes:
1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Surface Water Data

Sample Location:	SV-328							
Sample Date:		**units**	**Jan-05**	**Feb-05**	**Mar-05**	**Apr-05**	**May-05**	**Jun-05**
Monthly Parameters	**pH**	**su**	5.88	6.81	AP	AP	6.79	6.43
	DO	**mg/L**	9.92	9.20	AP	AP	8.63	7.22
	Water Temperature	**celsius**	8.2	13.1	AP	AP	21.0	25.8
	Alkalinity	**mg/L**	39.0	33.0	AP	33.0	37.0	26.0
	Turbidity	**NTU**	1.7	2.9	1.9	1.6	2.0	2.6
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	1.60	1.80	0.60	0.60	<0.50	5.10
	Fecal Coliform (MFC)	**FC/100mL**	280	200	290	110	130	60
	NH3 NH4	**mg/L**	<0.050	0.130	0.180	0.099	0.084	0.076
	NO3 NO2	**mg/L**	0.120	0.076	0.029	0.084	0.100	0.071
	TKN	**mg/L**	0.42	0.25	0.25	0.37	0.78	0.29
	Total Phosphorus	**mg/L**	<0.020	0.048	0.024	0.035	0.076	0.031
Quarterly Metals and TOC	**Cadmium**	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Chromium	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Copper	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	Iron	**mg/L**	NS	NS	0.25	0.30	NS	NS
	Mercury	**mg/L**	NS	NS	<0.0020	<0.0020	NS	NS
	Manganese	**mg/L**	NS	NS	0.022	0.052	NS	NS
	Nickel	**mg/L**	NS	NS	<0.020	<0.020	NS	NS
	Lead	**mg/L**	NS	NS	<0.050	<0.050	NS	NS
	Zinc	**mg/L**	NS	NS	<0.010	<0.010	NS	NS
	TOC	**mg/L**	NS	NS	6.1	3.8	NS	NS
Sample Date:		**units**	**Jul-05**	**Aug-05**	**Sep-05**	**Oct-05**	**Nov-05**	**Dec-05**
Monthly Parameters	**pH**	**su**	6.96	6.96	6.70	7.31	7.21	7.44
	DO	**mg/L**	6.46	7.12	5.84	7.29	7.53	11.39
	Water Temperature	**celsius**	26.0	25.8	22.8	13.1	17.2	8.4
	Alkalinity	**mg/L**	28.0	34.0	57.0	44.0	40.0	38.0
	Turbidity	**NTU**	1.3	1.2	1.2	1.1	1.0	<1.0
	BOD	**mg/L**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	TSS	**mg/L**	<0.50	0.60	<0.50	1.10	<0.50	1.10
	Fecal Coliform (MFC)	**FC/100mL**	100	300	600	100	100	270
	NH3 NH4	**mg/L**	<0.050	0.054	0.078	0.120	0.150	0.083
	NO3 NO2	**mg/L**	0.088	0.073	0.100	0.072	0.043	0.069
	TKN	**mg/L**	0.35	0.25	0.20	0.32	0.16	0.21
	Total Phosphorus	**mg/L**	0.039	0.033	0.030	0.040	0.027	<0.020
Quarterly Metals and TOC	**Cadmium**	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Chromium	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Copper	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	Iron	**mg/L**	0.47	NS	NS	0.29	NS	NS
	Mercury	**mg/L**	<0.0020	NS	NS	<0.0020	NS	NS
	Manganese	**mg/L**	0.052	NS	NS	0.05	NS	NS
	Nickel	**mg/L**	<0.020	NS	NS	<0.020	NS	NS
	Lead	**mg/L**	<0.050	NS	NS	<0.050	NS	NS
	Zinc	**mg/L**	<0.010	NS	NS	<0.010	NS	NS
	TOC	**mg/L**	4.5	NS	NS	2.6	NS	NS

Notes:
1. "AP" is "Analytical Problem"
2. "NS" is "No Sample"

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Sediment Data

Sample Location:			SV-2027	SV-324	SV-325	SV-2047
Sample Date:			12/1/2005	12/1/2005	12/1/2005	12/1/2005
	Percent Volatile Solids	%	1.6	<1.0	3.9	<1.0
Metals and TOC	Aluminum	mg/kg	1300	220	3400	1200
	Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0
	Chromium	mg/kg	2.6	1.1	4.5	2.1
	Copper	mg/kg	<1.0	<1.0	1.6	<1.0
	Iron	mg/kg	620	350	1300	1000
	Mercury	mg/kg	<0.10	<0.10	<0.10	<0.10
	Manganese	mg/kg	5.8	28	27	35
	Nickel	mg/kg	<2.0	<2.0	5	<2.0
	Lead	mg/kg	<5.0	<5.0	7.6	<5.0
	Zinc	mg/kg	2.6	<1.0	12	3.4
VOC's	1,1,1-Trichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1,2,2-Tetrachloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1,2-Trichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1-Dichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1-Dichloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,2-Dichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,2-Dichloropropane	mg/kg	<0.020	<0.020	<0.020	<0.020
	2-Butanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	2-Hexanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	4-Methyl-2-Pentanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	Acetone	mg/kg	<0.050	<0.050	<0.050	23.6
	Benzene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromodichloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromoform	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromomethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Carbon Disulfide	mg/kg	<0.020	<0.020	<0.020	<0.020
	Carbon tetrachloride	mg/kg	<0.020	<0.020	<0.020	<0.020
	cis-1,2Dichloroethylene	mg/kg	<0.020	<0.020	<0.020	<0.020
	cis-1,3-Dichloropropene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Dibromochloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Dichloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Ethyl benzene	mg/kg	<0.020	<0.020	<0.020	<0.020
	m,p-xylenes	mg/kg	<0.040	<0.040	<0.040	<0.040
	o-Xylene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Styrene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Tetrachloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Toluene	mg/kg	<0.020	<0.020	<0.020	<0.020
	trans-1,2-Dichloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	trans-1,3-Dichloropropene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Trichlorethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Vinyl chloride	mg/kg	<0.020	<0.020	<0.020	<0.020

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Sediment Data

Sample Location:			**SV-2027**	**SV-324**	**SV-325**	**SV-2047**
Sample Date:			**12/1/2005**	**12/1/2005**	**12/1/2005**	**12/1/2005**
Pesticides/PCB	**Aldrin**	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	alpha-BHC	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	beta-BHC	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Chlordane	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	delta-BHC	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Dieldrin	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan I	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan II	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan Sulfate	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Endrin	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Endrin aldehyde	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Heptachlor	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Heptachlor epoxide	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	Lindane	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	p,p'-DDD	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	p,p'-DDE	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	p,p'-DDT	**mg/kg**	<0.0020	<0.0020	<0.0020	<0.0020
	PCB 1016	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	PCB 1221	**mg/kg**	<0.030	<0.030	<0.030	<0.030
	PCB 1232	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	PCB 1242	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	PCB 1248	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	PCB 1254	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	PCB 1260	**mg/kg**	<0.015	<0.015	<0.015	<0.015
	Toxaphene	**mg/kg**	<0.070	<0.070	<0.070	<0.070

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Sediment Data

Sample Location:			SV-327	SV-175	SV-328	Duplicate
Sample Date:			12/1/2005	12/1/2005	12/1/2005	12/1/2005
	Percent Volatile Solids	%	<1.0	29	<1.0	<1.0
Metals and TOC	Aluminum	mg/kg	580	21000	410	310
	Cadmium	mg/kg	<1.0	<1.0	<1.0	<1.0
	Chromium	mg/kg	<1.0	40	1.7	<1.0
	Copper	mg/kg	<1.0	7.4	<1.0	<1.0
	Iron	mg/kg	1300	10000	470	250
	Mercury	mg/kg	<0.10	0.13	<0.10	<0.10
	Manganese	mg/kg	18	470	16	26
	Nickel	mg/kg	<2.0	10	<2.0	<2.0
	Lead	mg/kg	<5.0	37	<5.0	<5.0
	Zinc	mg/kg	1.1	50	1.1	<1.0
VOC's	1,1,1-Trichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1,2,2-Tetrachloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1,2-Trichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1-Dichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,1-Dichloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,2-Dichloroethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	1,2-Dichloropropane	mg/kg	<0.020	<0.020	<0.020	<0.020
	2-Butanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	2-Hexanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	4-Methyl-2-Pentanone	mg/kg	<0.020	<0.020	<0.020	<0.020
	Acetone	mg/kg	0.102	<0.050	<0.050	<0.050
	Benzene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromodichloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromoform	mg/kg	<0.020	<0.020	<0.020	<0.020
	Bromomethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Carbon Disulfide	mg/kg	<0.020	<0.020	<0.020	<0.020
	Carbon tetrachloride	mg/kg	<0.020	<0.020	<0.020	<0.020
	cis-1,2Dichloroethylene	mg/kg	<0.020	<0.020	<0.020	<0.020
	cis-1,3-Dichloropropene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Dibromochloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Dichloromethane	mg/kg	<0.020	<0.020	<0.020	<0.020
	Ethyl benzene	mg/kg	<0.020	<0.020	<0.020	<0.020
	m,p-xylenes	mg/kg	<0.040	<0.040	<0.040	<0.040
	o-Xylene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Styrene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Tetrachloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Toluene	mg/kg	<0.020	<0.020	<0.020	<0.020
	trans-1,2-Dichloroethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	trans-1,3-Dichloropropene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Trichlorethene	mg/kg	<0.020	<0.020	<0.020	<0.020
	Vinyl chloride	mg/kg	<0.020	<0.020	<0.020	<0.020

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
Non-radiological Sediment Data

Sample Location:			SV-327	SV-175	SV-328	Duplicate
Sample Date:			12/1/2005	12/1/2005	12/1/2005	12/1/2005
Pesticides/PCB	Aldrin	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	alpha-BHC	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	beta-BHC	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Chlordane	mg/kg	<0.015	<0.015	<0.015	<0.015
	delta-BHC	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Dieldrin	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan I	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan II	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Endosulfan Sulfate	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Endrin	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Endrin aldehyde	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Heptachlor	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Heptachlor epoxide	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	Lindane	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	p,p'-DDD	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020
	p,p'-DDE	mg/kg	<0.0020	0.008	<0.0020	<0.0020
	p,p'-DDT	mg/kg	<0.0020	0.0033	<0.0020	<0.0020
	PCB 1016	mg/kg	<0.015	<0.015	<0.015	<0.015
	PCB 1221	mg/kg	<0.030	<0.030	<0.030	<0.030
	PCB 1232	mg/kg	<0.015	<0.015	<0.015	<0.015
	PCB 1242	mg/kg	<0.015	<0.015	<0.015	<0.015
	PCB 1248	mg/kg	<0.015	<0.015	<0.015	<0.015
	PCB 1254	mg/kg	<0.015	<0.015	<0.015	<0.015
	PCB 1260	mg/kg	<0.015	<0.015	<0.015	<0.015
	Toxaphene	mg/kg	<0.070	<0.070	<0.070	<0.070

Non-radiological Monitoring of Surface Water and Sediments ESOP and DOE-SR Data Comparison

(Return to TOC)

ESOP Sample Location:	SV-2027				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.24	0.60	6	4.24
DO	mg/L	8.20	1.55	9.82	5.4
Water Temperature	celsius	17.3	4.6	23.1	10.23
TSS	mg/L	2.84	1.48	5.9	0.6
Total Phosphorus	mg/L	0.031	0.007	0.039	0.02
NO3 NO2	mg/L	0.231	0.048	0.36	0.18
Mercury	mg/L	ND	ND	ND	ND
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	0.52	0.46	1.2	0.19
Lead	mg/L	ND	ND	ND	ND
Manganese	mg/L	0.020	0.001	0.021	0.019
Nickel	mg/L	ND	ND	ND	ND
Zinc	mg/L	0.067	0.075	0.12	0.014
TOC	mg/L	7.8	1.8	9	6.5

DOE-SR Sample Location:	U3R-1A				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.05	0.80	6.80	4.60
DO	mg/L	8.90	0.99	11.47	7.49
Water Temperature	celsius	17.64	4.33	22.00	10.00
TSS	mg/L	3.69	1.29	6.00	2.00
Total Phosphorus	mg/L	0.054	0.030	0.120	0.012
NO3 NO2	mg/L	0.219	0.025	0.260	0.170
Mercury	mg/L	0.049	0.047	0.098	0.007
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	ND	ND	ND	ND
Copper	mg/L	0.002	0.001	0.003	0.001
Iron	mg/L	0.343	0.076	0.464	0.208
Lead	mg/L	0.002	0.000	0.002	0.002
Manganese	mg/L	0.009	0.001	0.012	0.007
Nickel	mg/L	0.002	0.001	0.003	0.001
Zinc	mg/L	0.009	0.004	0.013	0.005
TOC	mg/L	2.592	0.742	3.600	1.500

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
ESOP and DOE-SR Data Comparison

ESOP Sample Location:		SV-324			
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.94	0.46	6.67	5.27
DO	mg/L	8.60	1.61	10.92	6.4
Water Temperature	celsius	16.9	5.9	23.9	7.24
TSS	mg/L	3.60	1.95	7.8	1.6
Total Phosphorus	mg/L	0.042	0.014	0.067	0.025
NO3 NO2	mg/L	0.083	0.051	0.22	0.033
Mercury	mg/L	ND	ND	ND	ND
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	1.57	1.04	2.9	0.36
Lead	mg/L	ND	ND	ND	ND
Manganese	mg/L	0.172	0.260	0.56	0.011
Nickel	mg/L	ND	ND	ND	ND
Zinc	mg/L	ND	ND	ND	ND
TOC	mg/L	5.6	2.6	9.3	3.7

DOE-SR Sample Location:		TB-5			
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.47	1.07	12.00	3.60
DO	mg/L	9.00	1.39	12.00	7.08
Water Temperature	celsius	17.34	5.73	23.00	8.00
TSS	mg/L	6.75	2.60	12.00	3.00
Total Phosphorus	mg/L	0.113	0.070	12.000	0.030
NO3 NO2	mg/L	0.087	0.030	12.000	0.052
Mercury	mg/L	0.059	0.040	3.000	0.021
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	0.005	0.000	1.000	0.005
Copper	mg/L	0.005	0.003	3.000	0.002
Iron	mg/L	2.380	0.713	12.000	1.173
Lead	mg/L	0.003	0.001	3.000	0.002
Manganese	mg/L	0.081	0.040	12.000	0.015
Nickel	mg/L	0.012	0.007	11.000	0.003
Zinc	mg/L	0.021	0.015	4.000	0.008
TOC	mg/L	5.433	1.592	12.000	3.100

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation

Non-radiological Monitoring of Surface Water and Sediments (Return to TOC)
ESOP and DOE-SR Data Comparison

ESOP Sample Location:	SV-325				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	5.73	0.74	6.41	4.60
DO	mg/L	8.97	1.52	11.17	6.20
Water Temperature	celsius	17.02	6.06	23.90	7.60
TSS	mg/L	2.95	2.02	7.50	1.00
Total Phosphorus	mg/L	0.039	0.012	0.052	0.022
NO3 NO2	mg/L	0.292	0.097	0.440	0.150
Mercury	mg/L	ND	ND	ND	ND
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	0.618	0.165	0.750	0.410
Lead	mg/L	ND	ND	ND	ND
Manganese	mg/L	0.030	0.023	0.064	0.016
Nickel	mg/L	ND	ND	ND	ND
Zinc	mg/L	ND	ND	ND	ND
TOC	mg/L	6.550	5.838	15.000	2.600

DOE-SR Sample Location:	U3R-4				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.78	0.46	7.40	5.90
DO	mg/L	8.92	0.98	10.36	7.23
Water Temperature	celsius	18.41	5.53	25.00	9.00
TSS	mg/L	4.00	2.13	8.00	1.00
Total Phosphorus	mg/L	0.067	0.029	0.110	0.024
NO3 NO2	mg/L	0.123	0.027	0.160	0.080
Mercury	mg/L	0.102	0.056	0.144	0.038
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	0.001	0.000	0.001	0.001
Copper	mg/L	0.003	0.002	0.006	0.001
Iron	mg/L	0.480	0.183	0.962	0.291
Lead	mg/L	0.003	0.001	0.004	0.003
Manganese	mg/L	0.020	0.006	0.034	0.013
Nickel	mg/L	0.008	0.016	0.045	0.001
Zinc	mg/L	0.115	0.201	0.416	0.006
TOC	mg/L	4.233	1.388	6.900	2.700

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation

Non-radiological Monitoring of Surface Water and Sediments ESOP and DOE-SR Data Comparison

(Return to TOC)

ESOP Sample Location:	SV-327				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.43	0.45	7.02	5.51
DO	mg/L	8.57	1.76	12.20	6.02
Water Temperature	celsius	17.34	7.30	24.90	6.60
TSS	mg/L	5.58	10.76	37.00	0.60
Total Phosphorus	mg/L	0.031	0.007	0.039	0.020
NO3 NO2	mg/L	0.077	0.026	0.110	0.030
Mercury	mg/L	ND	ND	ND	ND
Cadmium	mg/L	ND	ND	ND	ND
Chromium	mg/L	ND	ND	ND	ND
Copper	mg/L	ND	ND	ND	ND
Iron	mg/L	0.575	0.179	0.750	0.330
Lead	mg/L	ND	ND	ND	ND
Manganese	mg/L	0.053	0.015	0.072	0.035
Nickel	mg/L	ND	ND	ND	ND
Zinc	mg/L	0.018	0.008	0.023	0.012
TOC	mg/L	5.900	3.178	10.000	2.800

DOE-SR Sample Location:	SC-4				
	units	Average	St. Dev.	Maximum	Minimum
pH	su	6.88	0.47	7.50	5.80
DO	mg/L	9.30	1.35	11.44	7.15
Water Temperature	celsius	18.89	5.94	26.00	9.00
TSS	mg/L	2.75	1.91	7.00	1.00
Total Phosphorus	mg/L	0.049	0.039	0.150	0.020
NO3 NO2	mg/L	0.075	0.020	0.100	0.042
Mercury	mg/L	0.061	0.050	0.119	0.030
Cadmium	mg/L	0.002	0.000	0.002	0.002
Chromium	mg/L	0.001	0.000	0.001	0.001
Copper	mg/L	0.004	0.002	0.006	0.003
Iron	mg/L	0.537	0.211	1.029	0.299
Lead	mg/L	0.002	0.000	0.002	0.002
Manganese	mg/L	0.049	0.016	0.078	0.031
Nickel	mg/L	0.002	0.001	0.002	0.001
Zinc	mg/L	0.017	0.014	0.033	0.009
TOC	mg/L	6.500	2.627	12.000	3.500

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation

2.4.5 Summary Statistics
(Return to TOC)

Non-radiological Monitoring of Surface Water and Sediments

Sample Location:	SV-2027								
Sample Date:		**units**	**Avg.**	**St. Dev.**	**Median**	**Max**	**Min**	**Num**	**Skew**
Monthly Parameters	**pH**	**su**	5.24	0.60	5.22	6.00	4.24	10	-0.19
	DO	**mg/L**	8.20	1.55	8.53	9.82	5.40	8	-0.80
	Water Temperature	**celsius**	17.3	4.6	17.5	23.1	10.2	10	-0.3
	Alkalinity	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Turbidity	**NTU**	3.3	4.5	1.6	17.0	1.0	12	3.0
	BOD	**mg/L**	2.2	0.0	2.2	2.2	2.2	1	0.0
	TSS	**mg/L**	2.84	1.48	2.70	5.90	0.60	11	0.64
	Fecal Coliform (MFC)	**FC/100mL**	215	189	125	600	62	12	2
	NH3 NH4	**mg/L**	0.126	0.058	0.120	0.270	0.059	10	1.788
	NO3 NO2	**mg/L**	0.231	0.048	0.220	0.360	0.180	12	1.829
	TKN	**mg/L**	0.26	0.11	0.25	0.41	0.10	12	0.10
	Total Phosphorus	**mg/L**	0.031	0.007	0.033	0.039	0.020	5	-0.687
Quarterly Metals and TOC	**Cadmium**	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Chromium	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Copper	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Iron	**mg/L**	0.52	0.46	0.34	1.20	0.19	4	1.80
	Mercury	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Manganese	**mg/L**	0.020	0.001	0.019	0.021	0.019	3	1.732
	Nickel	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Lead	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Zinc	**mg/L**	0.067	0.075	0.067	0.120	0.014	2	0.000
	TOC	**mg/L**	7.8	1.8	7.8	9.0	6.5	2	0.0

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
Non-radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Sample Location:	SV-324								
Sample Date:		**units**	**Avg.**	**St. Dev.**	**Median**	**Max**	**Min**	**Num**	**Skew**
Monthly Parameters	**pH**	**su**	5.94	0.46	5.94	6.67	5.27	10	-0.01
	DO	**mg/L**	8.60	1.61	8.69	10.92	6.40	8	-0.02
	Water Temperature	**celsius**	16.9	5.9	17.3	23.9	7.2	10	-0.4
	Alkalinity	**mg/L**	6.0	1.8	6.2	9.5	3.5	12	0.4
	Turbidity	**NTU**	4.2	1.7	4.2	7.1	1.6	12	0.3
	BOD	**mg/L**	2.5	0.0	2.5	2.5	2.5	1	0.0
	TSS	**mg/L**	3.60	1.95	3.05	7.80	1.60	12	1.41
	Fecal Coliform (MFC)	**FC/100mL**	105	88	70	310	15	12	1
	NH3 NH4	**mg/L**	0.137	0.079	0.120	0.320	0.050	11	1.378
	NO3 NO2	**mg/L**	0.083	0.051	0.073	0.220	0.033	12	1.840
	TKN	**mg/L**	0.33	0.13	0.30	0.58	0.13	12	0.61
	Total Phosphorus	**mg/L**	0.042	0.014	0.045	0.067	0.025	11	0.255
Quarterly Metals and TOC	**Cadmium**	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Chromium	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Copper	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Iron	**mg/L**	1.57	1.04	1.50	2.90	0.36	4	0.37
	Mercury	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Manganese	**mg/L**	0.172	0.260	0.059	0.560	0.011	4	1.919
	Nickel	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Lead	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	Zinc	**mg/L**	ND	ND	ND	ND	ND	ND	ND
	TOC	**mg/L**	5.6	2.6	4.7	9.3	3.7	4	1.5

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
Non-radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Sample Location:	SV-326								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	6.49	0.44	6.45	7.15	5.91	10	0.17
	DO	mg/L	8.11	1.86	7.91	10.71	5.90	9	0.36
	Water Temperature	celsius	17.5	7.0	18.4	25.3	6.2	10	-0.4
	Alkalinity	mg/L	17.0	6.4	14.5	29.0	8.0	12	0.8
	Turbidity	NTU	4.4	1.8	4.1	8.9	2.6	12	1.6
	BOD	mg/L	ND	ND	ND	ND	ND	ND	ND
	TSS	mg/L	4.38	8.20	1.55	30.00	0.50	12	3.28
	Fecal Coliform (MFC)	FC/100mL	142	152	100	600	40	12	3
	NH3 NH4	mg/L	0.144	0.064	0.145	0.260	0.061	12	0.485
	NO3 NO2	mg/L	1.430	0.653	1.350	2.700	0.440	12	0.415
	TKN	mg/L	0.38	0.12	0.38	0.60	0.19	12	0.32
	Total Phosphorus	mg/L	0.154	0.074	0.140	0.290	0.077	12	0.875
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	1.17	0.42	1.00	1.80	0.88	4	1.89
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.062	0.021	0.058	0.090	0.040	4	0.912
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	0.018	0.009	0.015	0.028	0.012	3	1.493
	TOC	mg/L	5.0	0.5	5.1	5.5	4.3	4	-0.8

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
Non-radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Sample Location:	SV-325								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	5.73	0.74	6.13	6.41	4.60	10	-0.66
	DO	mg/L	8.97	1.52	9.30	11.17	6.20	9	-0.41
	Water Temperature	celsius	17.0	6.1	18.1	23.9	7.6	10	-0.4
	Alkalinity	mg/L	3.1	0.6	3.0	4.2	2.4	11	0.8
	Turbidity	NTU	3.2	1.8	2.8	7.2	1.4	12	1.4
	BOD	mg/L	2.6	0.0	2.6	2.6	2.6	1	0.0
	TSS	mg/L	2.95	2.02	2.30	7.50	1.00	10	1.42
	Fecal Coliform (MFC)	FC/100mL	174	134	145	540	45	12	2
	NH3 NH4	mg/L	0.133	0.065	0.120	0.260	0.061	11	0.917
	NO3 NO2	mg/L	0.126	0.041	0.120	0.190	0.027	12	-0.887
	TKN	mg/L	0.29	0.10	0.28	0.44	0.15	12	0.06
	Total Phosphorus	mg/L	0.039	0.012	0.045	0.052	0.022	9	-0.597
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	0.62	0.16	0.66	0.75	0.41	4	-0.67
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.03	0.02276	0.02	0.064	0.016	4	1.95089
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	ND	ND	ND	ND	ND	ND	ND
	TOC	mg/L	6.6	5.8	4.3	15.0	2.6	4	1.6

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
Non-radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Sample Location:	SV-2047								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	6.13	0.50	6.20	6.99	5.31	10.00	-0.24
	DO	mg/L	8.84	2.00	8.33	12.87	5.89	10.00	0.83
	Water Temperature	celsius	17.3	7.5	18.9	25.2	6.2	10.0	-0.4
	Alkalinity	mg/L	19.4	5.5	20.0	28.0	6.0	12.0	-1.1
	Turbidity	NTU	4.0	2.2	3.4	8.9	2.0	12.0	1.5
	BOD	mg/L	3.3	0.9	3.3	3.9	2.6	2.0	0.0
	TSS	mg/L	3.03	2.04	2.80	6.60	0.50	11.00	0.57
	Fecal Coliform (MFC)	FC/100mL	172	156	155	600	42	12	2
	NH3 NH4	mg/L	0.130	0.075	0.110	0.290	0.056	9.000	1.398
	NO3 NO2	mg/L	0.146	0.050	0.130	0.250	0.099	11.000	1.180
	TKN	mg/L	0.33	0.10	0.33	0.53	0.11	12.00	-0.26
	Total Phosphorus	mg/L	0.034	0.007	0.035	0.045	0.023	11.000	0.055
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	0.86	0.27	0.83	1.20	0.59	4.00	0.55
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.075	0.027	0.070	0.110	0.051	4.000	0.805
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	ND	ND	ND	ND	ND	ND	ND
	TOC	mg/L	7.0	4.5	6.1	13.0	2.8	4.0	1.0

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
(Return to TOC)
Non-radiological Monitoring of Surface Water and Sediments

Sample Location:	SV-327								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	6.43	0.45	6.47	7.02	5.51	10	-0.86
	DO	mg/L	8.57	1.76	8.20	12.20	6.02	10	0.79
	Water Temperature	celsius	17.3	7.3	18.6	24.9	6.6	10	-0.40
	Alkalinity	mg/L	21.8	1.7	22.0	25.0	20.0	11	0.67
	Turbidity	NTU	3.7	4.3	2.4	17.0	1.5	12	3.15
	BOD	mg/L	ND	ND	ND	ND	ND	ND	ND
	TSS	mg/L	5.58	10.76	1.40	37.00	0.60	11	2.97
	Fecal Coliform (MFC)	FC/100mL	145	160	75	600	30	12	2.38
	NH3 NH4	mg/L	0.114	0.054	0.094	0.250	0.060	12	1.77
	NO3 NO2	mg/L	0.077	0.026	0.074	0.110	0.030	12	-0.09
	TKN	mg/L	0.33	0.11	0.34	0.52	0.12	12	-0.17
	Total Phosphorus	mg/L	0.031	0.007	0.033	0.039	0.020	9	-0.58
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	0.58	0.18	0.61	0.75	0.33	4	-1.03
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.053	0.015	0.052	0.072	0.035	4	0.29
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	0.018	0.008	0.018	0.023	0.012	2	0.00
	TOC	mg/L	5.9	3.2	5.4	10.0	2.8	4	0.70

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
(Return to TOC)

Non-radiological Monitoring of Surface Water and Sediments

Sample Location:	SV-175								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	6.63	0.47	6.76	7.22	5.64	10	-1.02
	DO	mg/L	8.15	2.00	7.36	11.98	5.94	10	1.19
	Water Temperature	celsius	17.9	7.4	19.1	25.6	5.9	10	-0.6
	Alkalinity	mg/L	36.5	6.9	37.0	50.0	26.0	11	0.6
	Turbidity	NTU	4.7	7.4	2.5	27.0	1.6	11	3.3
	BOD	mg/L	3.8	0.0	3.8	3.8	3.8	1	0.0
	TSS	mg/L	6.31	15.64	1.00	48.00	0.50	9	2.99
	Fecal Coliform (MFC)	FC/100mL	180	109	140	410	35	12	1
	NH3 NH4	mg/L	0.104	0.050	0.089	0.200	0.054	10	0.982
	NO3 NO2	mg/L	0.086	0.036	0.095	0.150	0.031	12	0.018
	TKN	mg/L	0.38	0.14	0.37	0.65	0.18	12	0.32
	Total Phosphorus	mg/L	0.057	0.027	0.049	0.120	0.020	11	1.267
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	0.56	0.16	0.55	0.77	0.39	4	0.65
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.049	0.019	0.054	0.066	0.023	4	-1.348
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	ND	ND	ND	ND	ND	ND	ND
	TOC	mg/L	6.6	3.0	6.3	10.0	3.8	4	0.3

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

Summary Statistics
Non-radiological Monitoring of Surface Water and Sediments

(Return to TOC)

Sample Location:	SV-328								
Sample Date:		units	Avg.	St. Dev.	Median	Max	Min	Num	Skew
Monthly Parameters	pH	su	6.85	0.45	6.89	7.44	5.88	10.00	-0.94
	DO	mg/L	8.06	1.70	7.41	11.39	5.84	10.00	0.79
	Water Temperature	celsius	18.1	7.1	19.1	26.0	8.2	10.0	-0.3
	Alkalinity	mg/L	37.2	8.4	37.0	57.0	26.0	11.0	1.2
	Turbidity	NTU	1.7	0.6	1.6	2.9	1.0	11.0	0.9
	BOD	mg/L	ND	ND	ND	ND	ND	ND	ND
	TSS	mg/L	1.56	1.50	1.10	5.10	0.60	8.00	2.33
	Fecal Coliform (MFC)	FC/100mL	212	151	165	600	60	12	2
	NH3 NH4	mg/L	0.105	0.039	0.092	0.180	0.054	10.000	0.751
	NO3 NO2	mg/L	0.077	0.025	0.075	0.120	0.029	12.000	-0.342
	TKN	mg/L	0.32	0.16	0.27	0.78	0.16	12.00	2.25
	Total Phosphorus	mg/L	0.038	0.015	0.034	0.076	0.024	10.000	2.035
Quarterly Metals and TOC	Cadmium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Chromium	mg/L	ND	ND	ND	ND	ND	ND	ND
	Copper	mg/L	ND	ND	ND	ND	ND	ND	ND
	Iron	mg/L	0.33	0.10	0.30	0.47	0.25	4.00	1.70
	Mercury	mg/L	ND	ND	ND	ND	ND	ND	ND
	Manganese	mg/L	0.044	0.015	0.051	0.052	0.022	4.000	-1.976
	Nickel	mg/L	ND	ND	ND	ND	ND	ND	ND
	Lead	mg/L	ND	ND	ND	ND	ND	ND	ND
	Zinc	mg/L	ND	ND	ND	ND	ND	ND	ND
	TOC	mg/L	4.3	1.5	4.2	6.1	2.6	4.0	0.4

Notes:
1. "SU" is Standard Units
2. "mg/L" is milligrams per Liter
3. "ND" is No Detect
4. "St. Dev." is Standard Deviation
5. "FC" is Fecal Coliform
6. "NTU" is Nephelometric Turbidity Units

3.1 Surface Soil Monitoring

(Return to TOC)

3.1.1 Summary

The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) provides independent nonregulatory evaluation of Department of Energy – Savannah River (DOE-SR) environmental monitoring programs. ESOP personnel independently evaluated surface soils for select gamma-emitting radionuclides, a specified Target Analyte List (TAL) of metals, and specific radionuclides. These soil samples were collected to determine if Savannah River Site (SRS) activities might have impacted areas outside of the site boundaries.

The ESOP surface soil monitoring project changed in 2004 to include more random coverage of perimeter soils (those within 50 miles of SRS) and background soils (those greater than 50 miles). This sampling program was implemented to allow future probabilistic comparisons of the SRS perimeter and South Carolina (SC) background contaminant levels in soils. ESOP collected samples in 2005 from 12 perimeter sites within the 50-mile radius of SRS and 12 background sites outside of the 50-mile radius. Soil sampling locations are located on Map 1, page ix.

ESOP initiated the random sampling regime to determine if elevated levels of contaminants were attributed to SRS activities. Averages for background samples were subtracted from perimeter samples to determine SRS off-site 50-mile perimeter random environmental concentrations above SC background. Statistical analyses were conducted to determine if the perimeter (E) and background (B) radionuclide populations are significantly different. These perimeter minus background (E-B) averages were used to determine if data collected by ESOP were comparable to DOE-SR data.

Cesium –137 (Cs-137) was the only radionuclide for which ESOP and DOE-SR shared analysis results. The hypothesis considered is that the SRS perimeter random soil population for Cs-137 is not more contaminated than the South Carolina background random Cs-137 population. Statistical evidence did not reject this hypothesis. DOE-SR does not collect samples for metals, so no comparison between DOE-SR and ESOP was made. All E-B averages for metals in ESOP samples were below the Environmental Protection Agency's Region 9 Preliminary Remediation Goals for residential soils.

RESULTS AND DISCUSSION

<u>Gamma</u>

Potassium-40 (K-40), Cesium-137 (Cs-137), Europium-155 (Eu-155), Lead-212 and -214 (Pb-212, Pb-214), Radium-226 (Ra-226), and Actinium-228 (Ac-228) were the only gamma-emitting radionuclides detected among perimeter and background samples. All other gamma-emitting radionuclides were below the Minimum Detectable Activity (MDA). Gamma-emitting radionuclides where at least one detect was recorded for either the background or perimeter location is given in Table 1, section 3.1.2. This data represents all random data collected from every sampling location and can be considered to be a grand average for each radionuclide. All gamma data is given in section 3.1.3.

Uranium

Samples collected during the second quarter were analyzed for uranium, with detections in both perimeter and background samples. The highest detection for U-234 (0.3911 pCi/g, ± 0.1264 pCi/g) was collected in a background sample in Beaufort county. Additionally, the highest detection for U-238 (0.4682 pCi/g, ± 0.1425 pCi/g) was in the same sample. A sample collected from Orangeburg county had a detection for U-235 of 0.0696 pCi/g (± 0.0354 pCi/g). All uranium data is given in section 3.1.3.

Metals

Fourteen of the 24 metals from the TAL were detected either in a perimeter or background sample. Metals where at least one detect was recorded for either the background or perimeter location is given in Table 2 in section 3.1.2. All metals data is given in section 3.1.3.

Statistical Summary

Summary statistics are given in section 3.1.4.

Background (B) sample averages were subtracted from perimeter (E) sample averages in order to determine the SRS random environmental concentrations above background. If this number was greater than zero and the radionuclide was associated with SRS, then further statistical analysis was conducted. Statistical analysis of data between ESOP and DOE-SR cannot be done since DOE-SR does not do random sampling. However, since ESOP collects random samples, a statistical comparison can be done between SRS perimeter and SC background samples. This comparison can be used to determine the statistical significance of any differences encountered between perimeter and background samples collected by ESOP. ESOP data can be compared to DOE-SR data using standard deviation.

When the random and non-random samples were averaged, only five radionuclides had a perimeter minus background (E-B) average greater than zero (Cs-137, Eu-155, Pb-214, Ra-226, and Ac-228, Table 1). These averages were calculated to provide a more accurate characterization of the contaminant concentrations throughout the sampling area. DOE-SR did not conduct analysis of Pb-212, Pb-214, Ra-226, and Ac-228. These are Naturally Occurring Radioactive Materials (NORM) and any detected levels may result from the decay of natural products. Cesium-137 and Europium-155 are fission products and any elevated levels could be related to man-made activities. Uranium-234, uranium-235, and uranium-238 are considered to be NORM. However, uranium is stored on SRS and could potentially contribute to elevated levels of these isotopes. Statistical analysis of Cs-137 was done using ESOP random sampling averages. The hypothesis that the SRS perimeter random soil population for Cs-137 is not more contaminated than the South Carolina background random Cs-137 population was not disproven by the application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level (Michigan, 2002; EPA, 2000a). There were not enough samples collected to perform a statistical analysis on the uranium and alpha/beta analyses results collected by ESOP. The ESOP random “E-B”

average for Cs-137 was 0.035 pCi/g (± 0.040). The DOE-SR Cs-137 average was 0.279 pCi/g (± 0.154 pCi/g) (WSRC, 2006). The ESOP average for Cs-137 falls within two standard deviations of the DOE-SR data. Therefore, the data reported by DOE-SR is comparable to the data reported by ESOP.

DOE-SR did not collect samples for metals analysis, so no comparison to ESOP metals data can be made. The ESOP data was used to calculate “E-B” averages from the “detects only” data for metals. Five metals had “E-B” averages greater than zero (Ba, Be, Co, Mn, and Ti, Table 2). All of these averages were well below the Region 9 Preliminary Remediation Goals for residential soil established by the Environmental Protection Agency (EPA) (USEPA, 2004b).

CONCLUSIONS AND RECOMMENDATIONS

ESOP incorporated a random sampling regime to conduct statistical tests to determine if differences in concentrations between perimeter samples and background samples were significant. The primary objective was to determine if the SRS 50-mile perimeter samples were significantly greater than the SC background.

The hypothesis that the SRS perimeter random soil population for Cs-137 had the same shape and location as the South Carolina background random Cs-137 population was not disproven by statistical analysis. The ESOP “E-B detects only” average was within one SD of the DOE-SR data. Cesium-137 within the 50-mile SRS perimeter is not significantly different than the SC background at the 0.05 significance level. Any observed elevated levels of contaminants may be due to fallout from past events or activities from other facilities. Additionally, differences in metal concentrations may be attributed to soil composition. Random sample collection from a variety of background locations may provide a better characterization of the soil types throughout the state.

ESOP will continue to conduct random sampling in addition to non-random sampling. Specifically, an enhanced regime of non-random sampling around the SRS perimeter and the SC background will be implemented. The random sampling will allow more probabilistic tests on SRS perimeter and SC background samples. The possibility of comparing elevated maximums across SC with nuclear fallout radioactive deposition tracks may be achieved at some time in the future.

3.1.2 Tables and Figures

(Return to TOC)

Surface Soil Monitoring

Table 1. Random SRS perimeter minus SC background averages for gamma results.

		Perimeter Samples (<50 miles)			Background Samples (>50 Miles)			E-B	E-B
		AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	MEDIAN
K-40	D ONLY	3.607	5.068	1.194	8.786	9.223	5.306	-5.178	-4.112
	D + 0.5 MDA ND	3.026	4.781	0.991	6.624	8.784	4.365	-3.599	-3.374
Cs-137	D ONLY	0.202	0.119	0.178	0.166	0.086	0.138	0.035	0.040
	D + 0.5 MDA ND	0.171	0.130	0.173	0.141	0.098	0.123	0.029	0.050
Eu-155	D ONLY	0.553	0.365	0.359	0.375	0.398	0.375	0.179	-0.016
	D + 0.5 MDA ND	0.169	0.281	0.036	0.086	0.181	0.029	0.083	0.007
Pb-212	D ONLY	1.176	1.093	0.804	1.405	1.245	0.887	-0.228	-0.083
	D + 0.5 MDA ND	0.788	1.044	0.475	0.592	1.039	0.013	0.197	0.462
Pb-214	D ONLY	1.062	0.710	0.870	0.685	0.284	0.607	0.377	0.263
	D + 0.5 MDA ND	NA	NA	NA	NA	NA	NA	NA	NA
Ra-226	D ONLY	2.295	1.451	1.856	1.632	0.658	1.505	0.664	0.352
	D + 0.5 MDA ND	NA	NA	NA	NA	NA	NA	NA	NA
Ac-228	D ONLY	1.111	0.761	0.944	0.982	0.712	0.827	0.129	0.117
	D + 0.5 MDA ND	1.027	0.781	0.852	0.833	0.732	0.796	0.194	0.056

Table 2. Random SRS perimeter minus SC background averages for metals results

	Perimeter Samples (<50 Miles)			Background Samples (>50 Miles)			E-B	E-B
	AVERAGE	ST DEV	MEDIAN	AVERAGE	ST DEV	MEDIAN	AVERAGE	MEDIAN
Aluminum	8215.00	6302.42	7400.00	12033.33	7919.52	9100.00	-3818.33	-1700.00
Barium	51.15	48.32	28.00	47.17	34.45	35.00	3.99	-7.00
Beryllium	0.56	0.03	0.57	0.54	0.19	0.49	0.02	0.08
Chromium	8.71	5.73	9.60	14.44	11.93	12.00	-5.73	-2.40
Cobalt	8.22	4.83	9.80	7.96	3.27	6.20	0.26	3.60
Copper	8.57	5.19	9.60	9.47	8.19	7.60	-0.90	2.00
Iron	6580.00	7546.42	3300.00	12416.67	10819.24	8300.00	-5836.67	-5000.00
Lead	20.93	9.39	20.50	24.92	9.97	24.50	-3.99	-4.00
Magnesium	524.42	736.11	140.00	944.25	1074.05	555.00	-419.83	-415.00
Manganese	320.52	515.01	52.50	130.92	180.83	45.50	189.60	7.00
Nickel	5.33	2.90	5.05	9.01	10.61	5.20	-3.68	-0.15
Titanium	180.56	177.02	120.00	166.43	158.68	96.00	14.13	24.00
Vanadium	13.09	9.29	9.75	21.49	14.81	19.00	-8.40	-9.25
Zinc	11.83	12.85	5.60	17.08	15.63	9.10	-5.25	-3.50

3.1.3 Data

(Return to TOC)

Surface Soil Monitoring

Surface Soil Monitoring
Gamma Data Perimeter Samples < 50 Miles from SRS

(Return to TOC)

Sample ID:	E13012705	E14012805	E15012505	E16030605
County:	ORANGEBURG	AIKEN	McCORMICK	BAMBERG
Collection Date	27 JAN 05	28 JAN 05	25 JAN 05	03 JUN 05
Analysis Date	10 JUN 05	13 JUN 05	09 JUN 05	26 AUG 05
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<1.627E+00	<1.138E+00	<1.365E+00	<4.771E-01
Na-22	<3.415E-02	<2.847E-02	<4.549E-02	<2.154E-02
K-40	<3.122E-01	**0.797**	**16.330**	**0.534**
plus or minus 2 SD		**0.349**	**1.273**	**0.249**
MDA		**0.219**	**0.303**	**0.183**
Mn-54	<4.886E-02	<3.304E-02	<4.668E-02	<2.430E-02
Co-58	<1.161E-01	<8.414E-02	<1.101E-01	<4.261E-02
Co-60	<3.343E-02	<2.596E-02	<3.702E-02	<2.200E-02
Zn-65	<1.083E-01	<7.868E-02	<1.267E-01	<6.433E-02
Y-88	<6.669E-02	<6.016E-02	<6.166E-02	<3.183E-02
Zr-95	<2.715E-01	<1.999E-01	<2.428E-01	<9.295E-02
Ru-103	<3.423E-01	<2.477E-01	<2.996E-01	<7.803E-02
Sb-125	<1.094E-01	<7.277E-02	<8.930E-02	<5.591E-02
I-131	< 8 HLE	< 8 HLE	< 8 HLE	8 HLE
Cs-134	<4.062E-02	<2.673E-02	<3.553E-02	<2.593E-02
Cs-137	**0.429**	**0.179**	<3.769E-02	**0.080**
plus or minus 2 SD	**0.061**	**0.031**		**0.025**
MDA	**0.038**	**0.028**		**0.021**
Ce-144	<3.194E-01	<2.040E-01	<2.317E-01	<1.372E-01
Eu-152	<8.537E-02	<5.141E-02	<6.021E-02	<3.983E-02
Eu-154	<6.132E-02	<3.760E-02	<4.291E-02	<2.843E-02
Eu-155	**0.974**	**0.359**	**0.327**	<3.918E-02
plus or minus 2 SD	**0.112**	**0.055**	**0.063**	
MDA	**0.094**	**0.048**	**0.059**	
Pb-212	**3.548**	**1.739**	**1.405**	**0.967**
plus or minus 2 SD	**0.299**	**0.153**	**0.647**	**0.091**
MDA	**0.044**	**0.024**	**0.029**	**0.022**
Pb-214	**2.755**	**0.942**	**1.277**	**0.797**
plus or minus 2 SD	**0.153**	**0.072**	**0.090**	**0.055**
MDA	**0.070**	**0.049**	**0.059**	**0.039**
Ra-226	**5.919**	**2.004**	**2.649**	**1.460**
plus or minus 2 SD	**8.098**	**0.530**	**0.601**	**0.488**
MDA	**0.753**	**0.507**	**0.597**	**0.386**
Ac-228	**3.108**	**1.698**	**1.422**	**0.960**
plus or minus 2 SD	**0.175**	**0.125**	**0.127**	**0.082**
MDA	**0.126**	**0.091**	**0.130**	**0.079**
Th-234	<5.320E-01	<2.760E-01	<3.359E-01	<2.266E-01
Am-241	<90210E-02	<5.070E-02	<5.793E-02	<4.433E-02

Notes:
1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring
(Return to TOC)
Gamma Data Perimeter Samples < 50 Miles from SRS

Sample ID:	E17060605	E18020605	SSE20	SSE21
County:	ORANGEBURG	ORANGEBURG	AIKEN	BAMBERG
Collection Date	06 JUN 05	02 JUN 05	30 NOV 05	23 AUG 05
Analysis Date	26 AUG 05	25 AUG 05	20 JAN 06	16 SEP 05
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<3.779E-01	<4.199E-01	<3.687E-01	<2.349E-01
Na-22	<1.864E-02	<2.344E-02	<2.968E-02	<2.540E-02
K-40	<1.558E-01	**0.538**	**1.365**	**0.861**
plus or minus 2 SD		**0.252**	**0.305**	**0.389**
MDA		**0.192**	**0.216**	**0.247**
Mn-54	<2.357E-02	<2.580E-02	<2.993E-02	<2.487E-02
Co-58	<3.530E-02	<4.007E-02	<3.725E-02	<2.454E-02
Co-60	<1.766E-02	<2.098E-02	<2.598E-02	<2.418E-02
Zn-65	<4.783E-02	<6.508E-02	<7.901E-02	<5.798E-02
Y-88	<2.888E-02	<3.294E-02	<0.03736	<2.386E-02
Zr-95	<7.886E-02	<9.157E-02	<7.083E-02	<5.241E-02
Ru-103	<6.430E-02	<7.824E-02	<5.415E-02	<3.096E-02
Sb-125	<4.824E-02	<5.190E-02	<6.885E-02	<6.549E-02
I-131	8 HLE	8 HLE	<1.841E+00	<1.610E-01
Cs-134	<2.113E-02	<2.439E-02	<3.186E-02	<2.363E-02
Cs-137	<1.922E-02	**0.062**	**0.170**	**0.216**
plus or minus 2 SD		**0.026**	**0.035**	**0.034**
MDA		**0.024**	**0.031**	**0.028**
Ce-144	<1.159E-01	<1.258E-01	<1.478E-01	<1.341E-01
Eu-152	<3.373E-02	<3.873E-02	<4.813E-02	<4.644E-02
Eu-154	<2.382E-02	<2.698E-02	<3.388E-02	<3.282E-02
Eu-155	<5.105E-02	<5.560E-02	<7.140E-02	0.279
plus or minus 2 SD				0.046
MDA				0.043
Pb-212	**0.640**	<1.976E-02	<2.610E-02	<2.147E-02
plus or minus 2 SD	**0.063**			
MDA	**0.017**			
Pb-214	**0.445**	**0.650**	**1.302**	**1.066**
plus or minus 2 SD	**0.040**	**0.052**	**0.088**	**0.067**
MDA	**0.031**	**0.037**	**0.046**	**0.044**
Ra-226	**0.798**	**1.309**	**3.613**	**2.430**
plus or minus 2 SD	**0.320**	**0.448**	**0.663**	**0.465**
MDA	**0.336**	**0.367**	**0.451**	**0.451**
Ac-228	**0.618**	**0.683**	**0.760**	**1.000**
plus or minus 2 SD	**0.067**	**0.078**	**0.092**	**0.086**
MDA	**0.066**	**0.074**	**0.094**	**0.082**
Th-234	<1.834E-01	<2.362E-01	<3.018E-01	<2.586E-01
Am-241	<3.585E-02	<4.030E-02	<5.886E-02	<4.346E-02

Notes:
1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring

(Return to TOC)

Gamma Data Perimeter Samples < 50 Miles from SRS

Sample ID:	SSE22	SSE24	SSE25	SSE26
County:	HAMPTON	BARNWELL	EDGEFIELD	McCORMICK
Collection Date	07 DEC 05	07 DEC 05	08 DEC 05	08 DEC 05
Analysis Date	24 JAN 06	25 JAN 06	26 JAN 06	27 JAN 06
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<2.557E-01	<4.239E-01	<3.899E-01	<4.047E-01
Na-22	<1.947E-02	<3.031E-02	<3.355E-02	<3.355E-02
K-40	**1.121**	**1.267**	**6.685**	**6.576**
plus or minus 2 SD	**0.244**	**0.340**	**0.703**	**0.701**
MDA	**0.144**	**0.274**	**0.265**	**0.266**
Mn-54	<1.975E-02	<3.412E-02	<3.218E-02	<3.477E-02
Co-58	<2.497E-02	<4.137E-02	<4.139E-02	<4.159E-02
Co-60	<1.848E-02	<3.124E-02	<3.116E-02	<3.193E-02
Zn-65	<4.500E-02	<9.233E-02	<8.141E-02	<8.132E-02
Y-88	<2.448E-02	<3.968E-02	<4.159E-02	<3.606E-02
Zr-95	<5.107E-02	<8.894E-02	<8.190E-02	<7.858E-02
Ru-103	<3.580E-02	<6.207E-02	<5.744E-02	<5.515E-02
Sb-125	<5.155E-02	<8.616E-02	<7.326E-02	<7.869E-02
I-131	<1.035E+00	<1.960E+00	<1.847E+00	<1.713E+00
Cs-134	<2.077E-02	<3.739E-02	<3.099E-02	<2.974E-02
Cs-137	**0.091**	**0.176**	**0.265**	**0.350**
plus or minus 2 SD	**0.023**	**0.046**	**0.050**	**0.053**
MDA	**0.020**	**0.035**	**0.030**	**0.029**
Ce-144	<1.044E-01	<1.755E-01	<1.533E-01	<1.558E-01
Eu-152	<3.286E-02	<5.506E-02	<4.805E-02	<5.009E-02
Eu-154	<2.307E-02	<3.989E-02	<3.443E-02	<3.540E-02
Eu-155	<4.762E-02	<5.421E-02	<7.170E-02	<7.159E-02
plus or minus 2 SD				
MDA				
Pb-212	**0.359**	<3.137E-02	**0.161**	**0.592**
plus or minus 2 SD	**0.046**		**0.027**	**0.074**
MDA	**0.018**		**0.025**	**0.025**
Pb-214	**0.391**	**2.032**	**0.522**	**0.561**
plus or minus 2 SD	**0.043**	**0.117**	**0.060**	**0.059**
MDA	**0.034**	**0.054**	**0.050**	**0.053**
Ra-226	**0.899**	**3.339**	**1.416**	**1.708**
plus or minus 2 SD	**0.365**	**0.707**	**0.488**	**0.561**
MDA	**0.307**	**0.537**	**0.476**	**0.469**
Ac-228	**0.388**	**0.944**	**0.640**	<2.130E-01
plus or minus 2 SD	**0.064**	**0.107**	**0.098**	
MDA	**0.078**	**0.114**	**0.108**	
Th-234	<1.943E-01	<3.154E-01	<4.047E-01	<2.832-01
Am-241	<3.693E-02	<6.707E-02	<5.450E-02	<5.691E-02

Notes:
1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring
Gamma Data Background Samples > 50 Miles from SRS

(Return to TOC)

Sample ID:	B13020205	B14260505	B15040505	B16250505
County:	YORK	LEXINGTON	BEAUFORT	OCONEE
Collection Date	02 FEB 05	26 MAY 05	04 MAY 05	25 MAY 05
Analysis Date	13 JUN 05	25 AUG 05	23 AUG 05	24 AUG 05
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<9.216E-01	<5.956E-01	<8.531E-01	<5.081E-01
Na-22	<3.209E-02	<3.240E-02	<3.130E-02	<2.751E-02
K-40	**5.756**	**9.937**	**5.306**	**4.676**
plus or minus 2 SD	**0.638**	**0.862**	**0.581**	**0.528**
MDA	**0.205**	**0.244**	**0.254**	**0.206**
Mn-54	<3.226E-02	<3.150E-02	<3.691E-02	<2.628E-02
Co-58	<8.150E-02	<5.450E-02	<7.419E-02	<4.674E-02
Co-60	<2.837E-02	<2.719E-02	<3.216E-02	<2.402E-02
Zn-65	<.8.854E-02	<8.382E-02	<9.944E-02	<6.827E-02
Y-88	<5.130E-02	<3.745E-02	<5.298E-02	<4.235E-02
Zr-95	<1.684E-01	<1.234E-01	<1.670E-01	<9.861E-02
Ru-103	<2.050E-01	<1.033E-01	<1.650E-01	<9.051E-02
Sb-125	<6.794E-02	<6.549E-02	<7.351E-02	<5.848E-02
I-131	8 HLE	8 HLE	8 HLE	8 HLE
Cs-134	<2.442E-02	<2.743E-02	<3.407E-02	<2.492E-02
Cs-137	**0.119**	**0.098**	**0.336**	**0.176**
plus or minus 2 SD	**0.030**	**0.031**	**0.049**	**0.034**
MDA	**0.028**	**0.028**	**0.032**	**0.024**
Ce-144	<1.691E-01	<1.504E-01	<1.885E-01	<1.290E-01
Eu-152	<4.531E-02	<4.537E-02	<5.222E-02	<3.876E-02
Eu-154	<3.270E-02	<3.156E-02	<3.745E-02	<2.748E-02
Eu-155	<5.872E-02	<4.634E-02	<5.477E-02	<5.588E-02
plus or minus 2 SD				
MDA				
Pb-212	<2.038E-02	<2.313E-02	**1.143**	<1.924E-02
plus or minus 2 SD			**0.109**	
MDA			**0.028**	
Pb-214	**0.374**	**0.556**	**1.168**	**0.373**
plus or minus 2 SD	**0.049**	**0.056**	**0.077**	**0.047**
MDA	**0.046**	**0.043**	**0.049**	**0.040**
Ra-226	**1.072**	**1.756**	**2.855**	**1.141**
plus or minus 2 SD	**0.421**	**0.513**	**0.589**	**0.435**
MDA	**0.446**	**0.415**	**0.496**	**0.360**
Ac-228	<1.810E-01	**0.838**	**1.161**	<1.679E-01
plus or minus 2 SD		**0.089**	**0.104**	
MDA		**0.088**	**0.104**	
Th-234	<3.114E-01	<2.673E-01	<3.134E-01	<2.367E-01
Am-241	<3.927E-02	<4.727E-02	<5.732E-02	<4.012E-02

Notes:
1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring

(Return to TOC)

Gamma Data Background Samples > 50 Miles from SRS

Sample ID:	B17250505	B18010605	SSB19	SSB20
County:	ANDERSON	DARLINGTON	WILLIAMSBURG	JASPER
Collection Date	25 MAY 05	01 JUN 05	04 AUG 05	09 AUG 05
Analysis Date	24 AUG 05	25 AUG 05	14 SEP 05	15 SEP 05
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<6.426E-01	<4.201E-01	<2.412E-01	<2.553E-01
Na-22	<3.728E-02	<2.087E-02	<2.143E-02	<2.181E-02
K-40	**14.390**	<1.835E-01	**1.257**	<4.980E-01
plus or minus 2 SD	**1.107**		**0.310**	
MDA	**0.250**		**0.187**	
Mn-54	<3.572E-02	<2.478E-02	<2.192E-02	<2.497E-02
Co-58	<6.815E-02	<3.913E-02	<2.858E-02	<2.825E-02
Co-60	<3.306E-02	<1.780E-02	<1.856E-02	<2.030E-02
Zn-65	<9.368E-02	<5.897E-02	<5.453E-02	<5.319E-02
Y-88	<4.083E-02	<3.242E-02	<2.508E-02	<2.600E-02
Zr-95	<1.412E-01	<8.759E-02	<5.412E-02	<5.867E-02
Ru-103	<1.116E-01	<7.629E-02	<3.617E-02	<3.437E-02
Sb-125	<7.336E-02	<5.100E-02	<5.528E-02	<5.769E-02
I-131	8 HLE	8 HLE	<6.203E-01	<4.553E-02
Cs-134	<2.886E-02	<2.234E-02	<2.112E-02	<2.100E-02
Cs-137	**0.290**	**0.106**	**0.070**	**0.128**
plus or minus 2 SD	**0.045**	**0.026**	**0.022**	**0.024**
MDA	**0.029**	**0.023**	**0.021**	**0.023**
Ce-144	<1.669E-01	<1.253E-01	<1.283E-01	<1.305E-01
Eu-152	<5.031E-02	<3.675E-02	<4.010E-02	<4.344E-02
Eu-154	<3.478E-02	<2.634E-02	<2.839E-02	<3.033E-02
Eu-155	<7.206E-02	**0.093**	<5.527E-02	<5.945E-02
plus or minus 2 SD		**0.043**		
MDA		**0.042**		
Pb-212	<2.368E-02	**0.635**	**0.753**	**0.887**
plus or minus 2 SD		**0.310**	**0.371**	**0.084**
MDA		**0.018**	**0.019**	**0.019**
Pb-214	**0.626**	**0.588**	**0.731**	**0.930**
plus or minus 2 SD	**0.060**	**0.052**	**0.053**	**0.065**
MDA	**0.048**	**0.036**	**0.037**	**0.039**
Ra-226	**1.417**	**1.504**	**1.505**	**1.901**
plus or minus 2 SD	**0.502**	**0.407**	**0.417**	**0.431**
MDA	**0.458**	**0.351**	**0.392**	**0.432**
Ac-228	**0.817**	**0.651**	**0.772**	**0.776**
plus or minus 2 SD	**0.104**	**0.072**	**0.077**	**0.079**
MDA	**0.109**	**0.072**	**0.080**	**0.075**
Th-234	<2.840E-01	<3.062E-01	<2.128E-01	<2.484E-01
Am-241	<5.236E-02	<3.862E-02	<3.915E-02	<4.175E-02

Notes:

1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring
Gamma Data Background Samples > 50 Miles from SRS

(Return to TOC)

Sample ID:	SSB21	SSB22	SSB23	SSB24
County:	SUMTER	FAIRFIELD	GEORGETOWN	SALUDA
Collection Date	10 AUG 05	29 DEC 05	17 NOV 05	17 OCT 05
Analysis Date	16 SEP 05	19 JAN 06	20 JAN 06	20 JAN 06
Analyte and Results	pCi/g	pCi/g	pCi/g	pCi/g
Be-7	<2.183E-01	<3.556E-01	<5.089E-01	<4.846E-01
Na-22	<1.993E-02	<4.188E-02	<3.165E-02	<2.132E-02
K-40	<1.540E-01	**31.000**	**4.054**	**2.697**
plus or minus 2 SD		**2.001**	**0.550**	**0.390**
MDA		**0.289**	**0.264**	**0.197**
Mn-54	<2.208E-02	<3.605E-02	<3.567E-02	<2.452E-02
Co-58	<2.417E-02	<4.156E-02	<4.855E-02	<4.157E-02
Co-60	<1.701E-02	<3.629E-02	<2.983E-02	<1.891E-02
Zn-65	<4.147E-02	<9.067E-02	<8.357E-02	<5.306E-02
Y-88	<2.206E-02	<3.264E-02	<4.257E-02	<2.992E-02
Zr-95	<5.036E-02	<8.267E-02	<1.033E-01	<8.720E-02
Ru-103	<3.044E-02	<4.474E-02	<7.503E-02	<8.297E-02
Sb-125	<5.096E-02	<8.994E-02	<7.520E-02	<4.774E-02
I-131	<3.935E-01	<1.999E-01	<5.821E+00	8 HLE
Cs-134	<1.924E-02	<3.620E-02	<3.571E-02	<2.015E-02
Cs-137	**0.148**	<3.998E-02	**0.195**	<2.171E-02
plus or minus 2 SD	**0.027**		**0.038**	
MDA	**0.020**		**0.031**	
Ce-144	<1.110E-01	<2.216E-01	<1.714E-01	<1.071E-01
Eu-152	<3.696E-02	<7.653E-02	<5.354E-02	<3.493E-02
Eu-154	<2.664E-02	<5.364E-02	<3.784E-02	<2.415E-02
Eu-155	<4.120E-02	**0.656**	<7.849E-02	<4.774E-02
plus or minus 2 SD		**0.101**		
MDA		**0.076**		
Pb-212	<1.729E-02	**3.606**	<2.970E-02	<1.850E-02
plus or minus 2 SD		**0.311**		
MDA		**0.039**		
Pb-214	**0.497**	**0.843**	**1.152**	**0.380**
plus or minus 2 SD	**0.046**	**0.087**	**0.085**	**0.043**
MDA	**0.034**	**0.067**	**0.051**	**0.033**
Ra-226	**0.866**	**2.500**	**2.302**	**0.763**
plus or minus 2 SD	**0.431**	**0.751**	**0.550**	**0.299**
MDA	**0.366**	**0.676**	**0.499**	**0.304**
Ac-228	**0.838**	**2.861**	**0.984**	**<1.260E-01**
plus or minus 2 SD	**0.071**	**0.171**	**0.115**	
MDA	**0.061**	**0.135**	**0.108**	
Th-234	<2.063E-01	<4.470E-01	<3.484E-01	<2.477E-01
Am-241	<3.612E-02	<8.365E-02	<6.284E-02	<3.654E-02

Notes:
1. Detects are in bold
2. "8 HLE" indicates 8 half lives have expired.
3. Shaded areas indicate no data collected.

Surface Soil Monitoring
Metals Data Perimeter Samples < 50 Miles from SRS

(Return to TOC)

Sample ID:	E13012705	E14012805	E15012505	E16030605
County:	ORANGEBURG	AIKEN	McCORMICK	BAMBERG
Collection Date	27 JAN 05	28 JAN 05	25 JAN 05	03 JUN 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**6300.00**	**13000.00**	**21000.00**	**2900.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**15.00**	**28.00**	**130.00**	**12.00**
Beryllium	<0.30	<0.30	**0.86**	<0.30
Boron	<10	<10	<10	ND
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	**4.90**	**13.00**	**17.00**	**3.00**
Cobalt	<2.0	<2.0	**9.80**	<2.0
Copper	<1.0	**3.10**	**14.00**	<1.0
Iron	**1600.00**	**7300.00**	**19000.00**	**1300.00**
Lead	**15.00**	**18.00**	**39.00**	**7.40**
Magnesium	**130.00**	**180.00**	**1600.00**	**64.00**
Manganese	**14.00**	**150.00**	**840.00**	**20.00**
Mercury	<0.10	<0.10	<0.10	<0.10
Molybdenum	<2.0	<2.0	<2.0	ND
Nickel	<2.0	**2.70**	**7.20**	<2.0
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	ND
Titanium	**190.00**	**120.00**	**620.00**	ND
Vanadium	**5.20**	**17.00**	**28.00**	**6.70**
Zinc	**3.10**	**6.00**	**36.00**	**2.50**

Notes:

1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Metals Data Perimeter Samples < 50 Miles from SRS

(Return to TOC)

Sample ID:	E17060605	E18020605	SSE20	SSE21
	ORANGEBURG	ORANGEBURG	AIKEN	BAMBERG
Collection Date	06 JUN 05	02 JUN 05	30 NOV 05	23 AUG 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**480.00**	**1900.00**	**4900.00**	**11000.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	<5.0	**8.70**	**19.00**	**54.00**
Beryllium	<0.30	<0.30	<0.30	**0.58**
Boron	ND	ND	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	<1.0	**2.00**	**4.40**	**9.60**
Cobalt	<2.0	<2.0	<2.0	**2.10**
Copper	<1.0	<1.0	**7.20**	<1.0
Iron	**400.00**	**360.00**	**3200.00**	**4400.00**
Lead	<5	<5	**17.00**	**23.00**
Magnesium	**19.00**	**45.00**	**130.00**	**320.00**
Manganese	**3.10**	**2.50**	**6.00**	**120.00**
Mercury	<0.10	<0.10	<0.10	0.14
Molybdenum	ND	ND	<2.0	<2.0
Nickel	<2.0	<2.0	<2.0	**2.90**
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	ND	ND	<50	<50
Titanium	ND	ND	**60.00**	**61.00**
Vanadium	<2.0	**2.00**	**5.50**	**11.00**
Zinc	**1.20**	**1.30**	**5.20**	**11.00**

Notes:
1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Metals Data Perimeter Samples < 50 Miles from SRS

(Return to TOC)

Sample ID:	SSE22	SSE24	SSE25	SSE26
	HAMPTON	BARNWELL	EDGEFIELD	McCORMICK
Collection Date	07 DEC 05	07 DEC 05	08 DEC 05	08 DEC 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**1600.00**	**8500.00**	**13000.00**	**14000.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**19.00**	**37.00**	**110.00**	**130.00**
Beryllium	<0.30	**0.51**	**0.55**	**0.58**
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	**1.90**	**10.00**	**16.00**	**14.00**
Cobalt	<2.0	**4.20**	**13.00**	**12.00**
Copper	<1.0	**2.10**	**13.00**	**12.00**
Iron	**1000.00**	**3400.00**	**19000.00**	**18000.00**
Lead	**9.90**	**27.00**	**27.00**	**26.00**
Magnesium	**55.00**	**150.00**	**1700.00**	**1900.00**
Manganese	**5.60**	**85.00**	**1400.00**	**1200.00**
Mercury	<0.10	<0.10	<0.10	<0.10
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	<2.0	**2.60**	**7.70**	**8.90**
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**75.00**	**79.00**	**240.00**	**180.00**
Vanadium	<2.0	**8.50**	**26.00**	**21.00**
Zinc	**3.60**	**11.00**	**30.00**	**31.00**

Notes:
1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Metals Data Background Samples > 50 Miles from SRS

(Return to TOC)

Sample ID:	B13020205	B14260505	B15040505	B16250505
County:	YORK	LEXINGTON	BEAUFORT	OCONEE
Collection Date	02 FEB 05	26 MAY 05	04 MAY 05	25 MAY 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**15000.00**	**2700.00**	**8200.00**	**21000.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**68.00**	**62.00**	**16.00**	**67.00**
Beryllium	**0.47**	**0.52**	<0.30	**0.49**
Boron	<10	ND	ND	ND
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	**19.00**	**34.00**	**12.00**	**14.00**
Cobalt	**12.00**	**5.20**	<2.0	**6.20**
Copper	**19.00**	**18.00**	**1.00**	**7.60**
Iron	**20000.00**	**36000.00**	**7700.00**	**16000.00**
Lead	**21.00**	**37.00**	**20.00**	**28.00**
Magnesium	**2400.00**	**880.00**	**440.00**	**970.00**
Manganese	**400.00**	**110.00**	**30.00**	**320.00**
Mercury	<0.10	<0.10	<0.10	<0.10
Molybdenum	<2.0	ND	ND	ND
Nickel	**5.70**	**12.00**	<2.0	**4.70**
Selenium	<10	<10	<10	<10
Silver	<3	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	<50	ND	ND	ND
Titanium	**500.00**	ND	ND	ND
Vanadium	**46.00**	**43.00**	**18.00**	**35.00**
Zinc	**25.00**	**28.00**	**6.80**	**22.00**

Notes:
1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Metals Data Background Samples > 50 Miles from SRS

(Return to TOC)

Sample ID:	B17250505	B18010605	SSB19	SSB20
	ANDERSON	DARLINGTON	WILLIAMSBURG	JASPER
Collection Date	25 MAY 05	01JUN 05	04 AUG 05	09 AUG 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**21000.00**	**5900.00**	**4600.00**	**5900.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**130.00**	**37.00**	**13.00**	**24.00**
Beryllium	**0.96**	**0.39**	<0.30	<0.30
Boron	ND	ND	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	**41.00**	**5.40**	**4.50**	**3.50**
Cobalt	**11.00**	<2.0	<2.0	<2.0
Copper	**12.00**	**2.60**	<1.0	<1.0
Iron	**23000.00**	**2200.00**	**1600.00**	**1200.00**
Lead	**32.00**	**20.00**	**12.00**	**30.00**
Magnesium	**1900.00**	**170.00**	**120.00**	**51.00**
Manganese	**530.00**	**24.00**	**4.20**	**2.90**
Mercury	<0.10	<0.10	<0.10	<0.10
Molybdenum	ND	ND	<2.0	<2.0
Nickel	**34.00**	**2.30**	<2.0	<2.0
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	ND	ND	<50	<50
Titanium	ND	ND	**110.00**	**96.00**
Vanadium	**34.00**	**6.20**	**5.50**	**5.50**
Zinc	**52.00**	**10.00**	**2.20**	**4.00**

Notes:
1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Metals Data Background Samples > 50 Miles from SRS

(Return to TOC)

Sample ID:	SSB21	SSB22	SSB23	SSB24
	SUMTER	FAIRFIELD	GEORGETOWN	SALUDA
Collection Date	10 AUG 05	29 DEC 05	17 NOV 05	17 OCT 05
Analyte and Results	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	**10000.00**	**27000.00**	**17000.00**	**6100.00**
Antimony	<5.0	<5.0	<5.0	<5.0
Arsenic	<10	<10	<10	<10
Barium	**12.00**	**33.00**	**73.00**	**31.00**
Beryllium	<0.30	**0.40**	**0.54**	<0.30
Boron	<10	<10	<10	<10
Cadmium	<1.0	<1.0	<1.0	<1.0
Chromium	**9.40**	**12.00**	**15.00**	**3.50**
Cobalt	<2.0	**5.40**	<2.0	<2.0
Copper	**2.00**	**21.00**	**2.00**	<1.0
Iron	**7000.00**	**21000.00**	**8900.00**	**4400.00**
Lead	**16.00**	**31.00**	**42.00**	**10.00**
Magnesium	**180.00**	**3400.00**	**670.00**	**150.00**
Manganese	**8.90**	**61.00**	**13.00**	**67.00**
Mercury	<0.10	<0.10	<0.10	<0.10
Molybdenum	<2.0	<2.0	<2.0	<2.0
Nickel	**2.70**	**7.90**	**2.80**	<2.0
Selenium	<10	<10	<10	<10
Silver	<3.0	<3.0	<3.0	<3.0
Thallium	<50	<50	<50	<50
Tin	<50	<50	<50	<50
Titanium	**78.00**	**240.00**	**67.00**	**74.00**
Vanadium	**16.00**	**20.00**	**22.00**	**6.70**
Zinc	**5.00**	**36.00**	**8.20**	**5.70**

Notes:
1. Detects in bold
2. mg/kg = milligrams of analyte per kilogram of soil (ppm)

Surface Soil Monitoring
Uranium Data

(Return to TOC)

Perimeter Samples

Sample Location:		E16030605	E17060605	E18020605
Sample Date:		03 JUN 05	06 JUN 05	02 JUN 05
U-234	(pCi/g)	**0.1563**	**0.1322**	**0.2839**
Uncertainty	(+/- 2 sig)	**0.0788**	**0.0490**	**0.0834**
MDA	(pCi/g)	**0.0722**	**0.0238**	**0.0221**
U-235	(pCi/g)	<MDA	<MDA	**0.0696**
Uncertainty	(+/- 2 sig)			**0.0354**
MDA	(pCi/g)	0.0586	0.0166	**0.0187**
U-238	(pCi/g)	**0.2510**	**0.1163**	**0.2143**
Uncertainty	(+/- 2 sig)	**0.1030**	**0.0458**	**0.0692**
MDA	(pCi/g)	**0.0767**	**0.0284**	**0.0187**

Background Samples

Sample Location:		B14260505	B15040505	B16250505	B17250505	B18010605
Collection Date:		26 MAY 05	04 MAY 05	25 MAY 05	25 MAY 05	01 JUN 05
U-234	(pCi/g)	**0.3398**	**0.3911**	**0.2419**	**0.2282**	**0.2573**
Uncertainty	(+/- 2 sig)	**0.0886**	**0.1264**	**0.0764**	**0.1023**	**0.0713**
MDA	(pCi/g)	**0.0207**	**0.0639**	**0.0382**	**0.0933**	**0.0207**
U-235	(pCi/g)	<MDA	<MDA	<MDA	<MDA	<MDA
Uncertainty	(+/- 2 sig)					
MDA	(pCi/g)	0.0161	0.0519	0.0273	0.0568	0.0171
U-238	(pCi/g)	**0.3701**	**0.4682**	**0.2005**	**0.3671**	**0.2234**
Uncertainty	(+/- 2 sig)	**0.0941**	**0.1425**	**0.0687**	**0.1317**	**0.0645**
MDA	(pCi/g)	**0.0161**	**0.0679**	**0.0459**	**0.0711**	**0.0082**

Notes:
1. "MDA" = minimum detectable activity
2. Detects in bold

3.1.4 Summary Statistics
Surface Soil Monitoring
Gamma Summary Statistics

(Return to TOC)

Summary Statistics (Detects Only)
2005 ESOP Random Soil Radiological Data
Perimeter Samples (<50 Miles)

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	3.607	5.068	1.194	0.534	16.330
Cs-137	0.202	0.119	0.178	0.062	0.429
Eu-155	0.553	0.365	0.359	0.327	0.974
Pb-212	1.176	1.093	0.804	0.161	3.548
Pb-214	1.062	0.710	0.870	0.391	2.755
Ra-226	2.295	1.451	1.856	0.798	5.919
Ac-228	1.111	0.761	0.944	0.388	3.108
U-234	0.191	0.156	0.082	0.132	0.284
U-235	0.0696	0.0696	NA	0.0696	0.0696
U-238	0.194	0.214	0.070	0.116	0.251
Alpha	15.382	2.704	10.077	11.090	20.500
Beta	9.714	3.561	10.000	4.140	13.500

Summary Statistics (Detects Only)
2005 ESOP Random Soil Radiological Data
Background Samples (>50 Miles)

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
K-40	8.786	9.223	5.306	1.257	31.000
Cs-137	0.166	0.086	0.138	0.070	0.336
Eu-155	0.375	0.398	0.375	0.093	0.656
Pb-212	1.405	1.245	0.887	0.635	3.606
Pb-214	0.685	0.284	0.607	0.373	1.168
Ra-226	1.632	0.658	1.505	0.763	2.855
Ac-228	0.982	0.712	0.827	0.126	2.861
U-234	0.292	0.257	0.071	0.228	0.391
U-235	ND	ND	ND	ND	ND
U-238	0.326	0.367	0.112	0.200	0.468
Alpha	7.647	0.565	4.106	7.130	8.250
Beta	8.893	3.511	6.202	4.880	11.400

1. Only one detect for U-235 in perimeter samples
2. "ND" is No Detect

Surface Soil Monitoring
Metals Summary Statistics

(Return to TOC)

Summary Statistics (Detects Only)
2005 ESOP Random Soil Metals Data
Perimeter Samples (<50 Miles)

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Aluminum	8215.00	6302.42	7400.00	480.00	21000.00
Barium	51.15	48.32	28.00	8.70	130.00
Beryllium	0.56	0.03	0.57	0.51	0.58
Chromium	8.71	5.73	9.60	1.90	17.00
Cobalt	8.22	4.83	9.80	2.10	13.00
Copper	8.57	5.19	9.60	2.10	14.00
Iron	6580.00	7546.42	3300.00	360.00	19000.00
Lead	20.93	9.39	20.50	7.40	39.00
Magnesium	524.42	736.11	140.00	19.00	1900.00
Manganese	320.52	515.01	52.50	2.50	1400.00
Nickel	5.33	2.90	5.05	2.60	8.90
Titanium	180.56	177.02	120.00	60.00	620.00
Vanadium	13.09	9.29	9.75	2.00	28.00
Zinc	11.83	12.85	5.60	1.20	36.00

Summary Statistics (Detects Only)
2005 ESOP Random Soil Metals Data
Background Samples (>50 Miles)

	AVERAGE	ST DEV	MEDIAN	MIN	MAX
Aluminum	12033.33	7919.52	9100.00	2700.00	27000.00
Barium	47.17	34.45	35.00	12.00	130.00
Beryllium	0.54	0.19	0.49	0.39	0.96
Chromium	14.44	11.93	12.00	3.50	41.00
Cobalt	7.96	3.27	6.20	5.20	12.00
Copper	9.47	8.19	7.60	1.00	21.00
Iron	12416.67	10819.24	8300.00	1200.00	36000.00
Lead	24.92	9.97	24.50	10.00	42.00
Magnesium	944.25	1074.05	555.00	51.00	3400.00
Manganese	130.92	180.83	45.50	2.90	530.00
Nickel	9.01	10.61	5.20	2.30	34.00
Titanium	166.43	158.68	96.00	67.00	500.00
Vanadium	21.49	14.81	19.00	5.50	46.00
Zinc	17.08	15.63	9.10	2.20	52.00

3.2 Radiological Monitoring of Terrestrial Vegetation (Return to TOC)

3.2.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) monitors for the presence of radionuclides in vegetation around the Savannah River Site (SRS) stemming from SRS operations. In 2005, ESOP conducted independent vegetation monitoring at 17 locations around the perimeter of the SRS; three former SRS monitoring locations 25 miles from the center of SRS; and 24 locations selected at random (Map 7, section 3.2.2). Sampling was performed quarterly in February, May, August, and November. Additional random and nonrandom sampling of fungi was performed to monitor the bioconcentration of select radioisotopes in the environment.

Samples from 16 vegetation stations were analyzed for tritium activity. All but one of the SRS perimeter stations exhibited tritium levels greater than the Lower Limit of Detection. Average activity levels were fairly uniform around SRS, with the highest activity located on the western side. Vegetation was collected for gamma analysis at selected eight perimeter stations where sampling had consistently shown detectable levels of cesium-137 (Cs-137) and one station added in 2005. Cesium-137 was detected at all of these locations, with the highest activities from stations on the northern and southeastern sides of the SRS.

ESOP added fungi sampling to the vegetation project in 2004. Evidence from European studies of the Chernobyl meltdown radioactive releases indicated that fungi are the greatest bioconcentrators of many heavy metals and radionuclides. Also, a DOE-SR survey of fungi noted that Cs-137 concentration fluctuation in deer may be related to the availability of fungi. Fungi were collected at 24 random and one non-random location. Four gamma-emitting radioisotopes were detected in 2005 within the 50-mile SRS perimeter at levels greater than the South Carolina background levels: Cs-137, potassium-40, lead-212, and lead-214.

RESULTS AND DISCUSSION

Results from all vegetation analyses, listed by station and date, are included in section 3.2.4. Results of gamma analysis of fungi are in section 3.2.4. Summary statistics for vegetation and fungi are presented in section 3.2.5.

<u>Tritium in Vegetation</u>

Quarterly sampling data is presented in section 3.2.4. Tritium was detected in vegetation from 15 of the 16 perimeter sites sampled in 2005. Five of the stations exhibited tritium levels greater than the LLD in all four sampling months. The highest tritium level in 2005, 2898 pCi/L, occurred in August on the west side of SRS at station BWL-009. This station also had the highest activity level in February, 2511 pCi/L. The highest level detected in May, 1519 pCi/L, came from BWL-004 on the southeast side of SRS. In November the highest level, 1707 pCi/L, came from BWL-001 on the northeast side of SRS.

Tritium was detected at two of the three 25-mile radius stations, three times at Langley, and once at the station in Springfield. One randomly selected station within 50 miles of SRS, in Aiken County, exhibited detectable tritium activity. No background sample exhibited tritium activity above the LLD.

The two highest tritium activities in 2005 were from a site on the western side of the SRS, in the vicinity of D-Area and Plant Vogtle. This is similar to results from 2000 through 2004 sampling (section 3.2.3, Figure 1; SCDHEC 2001, 2002, 2003, 2004, 2005b). The Heavy Water Facility in D-Area processed residual heavy water from past reactor operations and other DOE-SR sites' activities through 1998 (WSRC, 2000a). Residual tritium from releases at this facility may be partly responsible for higher tritium levels in the nearby vegetation. Tritium releases from the nearby Vogtle Electric Generating Plant in Georgia may also account for elevated tritium levels in this area of the SRS.

Two stations on the east side of SRS also exhibited highest tritium activities in two sampling months. Tritium levels over 2000 pCi/L were detected at BWL-001 in 2001 (Figure 1), and although tritium levels at BWL-004 do not average over 1000 pCi/L, tritium has been detected there every year since 2000. These results underscore the variability of tritium occurrence around SRS.

Tritium analysis results from ESOP and DOE-SR sampling are presented in section 3.2.3, Table 1. However, differences between the two programs in sampling dates, the vegetation sampled, and analysis methods should be considered during comparison. The DOE-SR program did not detect tritium from any perimeter station in 2005; tritium was detected at similar times in samples from five comparable stations by the ESOP program. Results from one colocation were less than the detection limit for both the DOE-SR program and ESOP; at the other colocation ESOP had a detection of 1519 pCi/L while the DOE-SR result was below the Minimum Detectable Concentration (MDC).

Two statistical tests were performed on the data. A Wilcoxon Rank Sum (WRS) test (a=0.05) was performed on the random sample results of relevant radionuclides using the null hypothesis that for tritium the SRS environmental population was the same as the South Carolina background population at the 0.05% significance level, or the populations are the same in distribution shape and location. Nonparametric tests are preferred even if the condition of normality was met due to the high efficiency of the combined tests for hypothesis testing especially where nondetects are a large percent of the data. The focus for comparison of the populations shifts from parameters to distribution shape and location. The tritium null hypothesis was not rejected at the 0.05 significance level for both the WRS and modified Quantile tests of the 2005 tritium data. The tritium null hypothesis was rejected at the 0.05 significance level for both the WRS and modified Quantile tests when the data for 2004 and 2005 were combined (two-year basis random sampling), indicating there was a significant difference in the tritium levels in vegetation between the two populations. However, a power calculation involving the medians indicated that many more samples are needed to support the alternate hypothesis "the SRS 50-Mile Perimeter and South Carolina tritium populations are different". Future analyses of additional random sampling are required to improve the power of the hypothesis test for tritium in vegetation before concluding that the populations are different.

Gamma in Vegetation

The naturally occurring isotope potassium-40 (K-40) was detected from all stations where gamma samples were collected in 2005. Because it is a natural isotope not produced by the SRS, K-40 results will not be discussed in this report, but are presented in section 3.2.4.

Cesium-137

Cesium-137 (Cs-137) was detected at all nine perimeter stations sampled in 2005. Seven of these stations produced Cs-137 results greater than the Minimum Detectable Activity (MDA) in all four months. AKN-008 exhibited the highest Cs-137 activity in February and May, 0.590 and 1.009 pCi/g, respectively. BWL-006 exhibited the highest activity in August, 0.801 pCi/g. AKN-005 had the highest November activity, 0.653 pCi/g.

Two randomly selected stations within 50 miles of SRS exhibited Cs-137 activity above the MDA, one in Bamberg county and one in Orangeburg county. One random background sample, from Sumter county, exhibited detectable Cs-137 activity.

Results of analysis for Cs-137 followed established trends in 2005. Station AKN-005 on the north side of the SRS exhibited detectable activity in all sampling months. This station has also exhibited Cs-137 activity from all samples collected in previous sampling years (section 3.2.3, Figure 2; SCDHEC, 2005b). A new station was added west of AKN-005 in 2005 to document CS-137 activities in this area near New Ellenton. This station, AKN-008, exhibited the highest monthly detection and annual average detection in 2005. A cluster of three stations on the southeast side of the SRS produced the second highest average Cs-137 activity for 2005, at BWL-006. One station from the northwest area of SRS exhibited detectable Cs-137 in all samples. These results are consistent with the results reported from 1998-2004.

Gamma analysis results for Cs-137 from ESOP and DOE-SR sampling in 2005 are presented in section 3.2.3, Table 2. The EMS air station on Patterson Mill Road, a colocation between the two programs, produced similar results for both programs (0.205 pCi/g, ESOP; 0.154 pCi/g, DOE-SR) as it had in most previous years. Another colocation at the Allendale Gate, reinstated by DOE-SR in 2004, produced dissimilar results (0.772 pCi/g, ESOP; 0.142 pCi/g, DOE-SR). Differences in analysis and sampling methods (e.g., ESOP collects leaves from trees, whereas EMS collects grass) may account for this disparity. For the other EMS stations, the closest ESOP stations were selected for comparison. For the most part, DOE-SR and ESOP data were rather similar, with less than 0.6 pCi/g difference, including for the EMS Talatha Gate station (the New Ellenton Gate) and AKN-005, which is approximately 1.9 miles east of New Ellenton. AKN-005 has consistently exhibited Cs-137 activity, usually the highest of the sites around SRS, while the EMS location was less than the detection limit. Average Cs-137 levels at the stations in Table 2 were compared, using only detections to calculate averages. The DOE-SR average (0.212 ± 0.080 pCi/g) was within one standard deviation of the ESOP average (0.323 ± 0.252 pCi/g).

Two statistical tests were performed on the data. Wilcoxon Rank Sum Test and modified Quantile tests were performed on the random sample results in 2005 using the null hypothesis that for Cs-137 the SRS environmental population was the same as the South Carolina background population at the 0.05% significance level. This hypothesis was not rejected, indicating that the SRS contribution to Cs-137 levels in nearby vegetation was not statistically significant. The random Cs-137 data cannot be compared on a two-year basis since the 2004 data were analyzed dry and the 2005 data were analyzed wet.

Gamma in Fungi

Cesium-137 (half-life of Cs-137 is 30.17 yrs.) was detected at 16 random quadrant fungi locations in 2005, and reflects the importance of bioconcentration in fungi of Cs-137 (Botsch, 1999). The lowest South Carolina background Cs-137 concentration detection in fungi (0.14 pCi/g) occurred in B20 or the Pineland Quadrant near the Savannah River floodplain above Hardeville (section 3.2.4). Compare this to the 48X higher detection (6.71 pCi/g) that occurred in the E21 or Clear Pond quadrant east of Olar in Bamberg County within the SRS 50-Mile Perimeter. The highest detection of Cs-137 in mixed fungi is approximately double the 1986 concentrations found in wild *Boletus* (3.75 pCi/g) and *Russula* (3.66 pCi/g) species by the Vermont State Environmental Radiation Surveillance Program (RADNET 2006). This difference may represent depositional track concentrations related to global fallout and not necessarily local nuclear power sources. The Cs-137 average above background for fungi (section 3.2.5, 1.23 pCi/g) was approximately 35 times above the background average in soil detected by the 2005 Surface Soil Project (SCDHEC 2005c, 0.035 pCi/g) in the same quadrants. This indicates a potential bioconcentration of Cs-137 in mixed fungi relative to soil concentrations of other chemicals (Seel 1995). The random sampling locations are located in Map 1, page ix.

Seven out of 24 radioisotopes surveyed were detected in random and nonrandom mixed fungi samples collected throughout South Carolina (DOE-SR perimeter included). The radioisotopes found in the SRS 50-Mile Perimeter fungi included potassium-40 (K-40), Cs-137, lead-212 (Pb-212), and Pb-214 (section 3.2.4). The surveyed radioisotopes found in fungi in the South Carolina background quadrants included beryllium-7 (Be-7), K-40, cobalt-58 (Co-58), Co-60, Cs-137, and Pb-214.

Subtraction of the South Carolina average random background concentrations left only K-40, Cs-137, Pb-212, and Pb-214 above the average background (section 3.2.5). Subtraction of the median background concentrations indicated the same radioisotopes. Be-7, Co-58, and Pb-212 half-lives are too short to have come from SRS reactors since they are no longer in operation. No nonrandom sample radioisotopes were detected (section 3.2.5) above the South Carolina Background average.

Random radioisotope maximum concentrations found in fungi included; Be-7 (6.44 pCi/g), found in the Westminster B16 quadrant within ten miles of the Oconee Nuclear Power Plant; K-40 (28.60 pCi/g) a naturally occurring radioactive material (NORM), found in the Jackson, E14 quadrant; Co-58 (0.11 pCi/g), found in the Salters, B19 quadrant, Black River floodplain below Kingstree; Co-60 (0.11 pCi/g), found in the same Salters sample, B19 quadrant, Black River floodplain below Kingstree; Pb-212 (0.40 pCi/g), found in the Long Branch, E24 quadrant near Salkehatchie River northwest of Barnwell; Pb-214 (0.68 pCi/g), found in the same Long Branch sample, E24 quadrant near Salkehatchie River northwest of Barnwell; and Cs-137 (6.71 pCi/g), found in the Clear Pond, E21 quadrant south of Bamberg.

Beryllium-7 has a half-life of 53.3 days and was probably from a local nuclear power source inside the Oconee Exclusion Zone for background sampling. The K-40 detection is a NORM throughout South Carolina. The Salters background quadrant sample was notable for having rare cobalt radionuclide detections probably not of SRS origin for the short-lived Co-58 releases should have decayed since SRS reactor closures. The absence of Co-58 and Co-60 in the SRS 50-mile perimeter samples suggests that the occurrence of these two isotopes in a background sample was probably from a local source. The “B” samples in general are background and not likely of SRS origin especially if not detected within 50-miles of SRS. The Long Branch location lead detections were downstream of the Williston area, and the Cs-137 detection was in a floodplain of Lemon Creek south of Bamberg. The amount of Cs-137 contamination due to SRS production activities is unknown since other sources deposited Cs-137 in South Carolina, e.g., atomic bomb testing in the ‘50s and ‘60s and Chernobyl.

Other radionuclides detected in 2004 samples (Ce-144) were not detected in the 2005 SRS random and nonrandom environmental perimeter samples. The SRS reactors have not been in operation since a 1992 test run at one reactor.

Statistical tests (Wilcoxon and modified Quantile) of the South Carolina background and SRS 50-mile perimeter populations were applied to the 2004 and 2005 data for radionuclides of concern (Eu-155, Cs-137, and cerium-144) to test the null hypothesis that the two populations of these radionuclides were of the same distribution shape and location (Michigan 2002, EPA 2000a). Cesium-137 was detected at 16 of 24 random quadrant fungi locations in 2005 and 10 of 24 locations in 2004. The hypothesis that the SRS perimeter random fungi Cs-137 population had the same shape and location as the South Carolina background random Cs-137 population was not rejected for the combined 2004 and 2005 samples by application of the Wilcoxon Rank Sum and modified Quantile tests at the 0.05% significance level. However, power calculation tables involving the median indicated that sufficient random sampling had not yet occurred to support the alternate hypothesis that the Cs-137 population within the 50-Mile SRS Perimeter is different in shape and location than the South Carolina Background Cs-137 population. Atomic bomb test fallout tracking charts and data in combination with additional sampling statistics may eventually produce enough evidence to conclude whether the SRS 50-Mile perimeter Cs-137 population is statistically different than the South Carolina background due to past SRS productions or atomic bomb test fallout. However, the presence of commercial nuclear power reactors may render the analysis inconclusive for radionuclides in common. The nonrandom fungi Cs-137 results (below an MDA of 0.040 pCi/g for 2005) were within one standard deviation of the random Cs-137 results (1.231 pCi/g average ±1.873 standard deviations, section 3.2.5). The highest Cs-137 detection occurred within the SRS 50-mile environmental perimeter in the E21 or Clear Pond quadrant (6.71 pCi/g) on the Lemon Creek floodplain south of Bamberg. DOE-SR did not collect fungi in 2005, but the SCDHEC 2005 maximum detection (6.71 pCi/g) and average above background (1.23 pCi/g) were far less than the 1983 (540 pCi/g) and 1984 (640 pCi/g) DOE-SR maximum Cs-137 detections in fungi (DuPont 1984). However, the maximum mixed fungi detection was approximately double some 1986 detections found in Vermont fungi (RADNET, 2006). The SCHEC average Cs-137 detection in mixed fungi was higher in 2005 (1.23 pCi/g) than in 2004 (0.20 pCi/g). The same probabilistic tests were applied to other radionuclides of concern over a two year basis, and the hypothesis that the “SRS 50-Mile Perimeter radionuclide population is not significantly different (alpha=0.05) than the South Carolina Background” was not rejected. However, all radionuclide concentration activities detected so far indicated that additional random sampling must continue before the power level (sampling number) can support any alternate hypothesis that the two populations are significantly different.

The radionuclide detections in general were possibly due to the occurrence of flood plain locations that may concentrate radionuclides through fungal bio-accumulation from up-gradient sources as opposed to direct aerial deposition.

Since the other commercial nuclear power plants can also produce the fission byproducts (Cs-137, Ce-144 and Eu-155), any detection of these radioisotopes cannot be assumed to be from DOE-SR alone.

ESOP will collect more samples from similar flood plain locations in the future. Consumers of wild fungi should be aware that fungi are bioconcentrators of certain naturally occurring and artificially produced heavy metal radioisotopes.

CONCLUSIONS AND RECOMMENDATIONS

ESOP conducted independent vegetation monitoring in 2005 at 16 locations around the perimeter of the SRS, three locations 25 miles from the center of SRS, 12 locations selected at random from within a 50-mile radius of SRS, and 12 background locations greater than 50 miles from SRS. Tritium was detected in vegetation at all but one of the perimeter stations, two 25-mile, and one of the 50-mile stations; tritium was not detected at any background site. As in previous years, activity levels were higher in vegetation collected from the western side of SRS. ESOP data confirms the DOE-SR conclusion that elevated tritium levels at the site perimeter are due to atmospheric releases from SRS, but that tritium levels decrease with increasing distance from SRS facilities.

A comparison of ESOP and DOE-SR tritium data was performed on samples. The results for one colocation were below the detection limits for both programs, while the results from the other colocation were very different. The only tritium detection reported by DOE-SR came from 25-mile stations north and south of SRS, while ESOP detected tritium at most perimeter locations. There are differences in analysis and sampling methods between the programs (e.g., ESOP collects leaves from trees, whereas EMS conducts annual grass collections), but the abundance of tritium detections by ESOP in tree leaves versus DOE-SR grass needs further investigation. DOE-SR data are reported in pCi/g without denoting whether this activity relates to a gram of water or a gram of wet vegetation. ESOP recommends that DOE-SR report tritium activity in a more relevant manner, such as picocuries per milliliter (pCi/ml) as in previous reports, to reflect the tritium activity in the water extracted from the sample.

The ESOP vegetation monitoring program was changed in 2005 to increase sampling near New Ellenton, S.C., where Cs-137 was detected in vegetation in previous years. Samples from eight previously established permanent stations were analyzed for gamma-emitting radionuclides. At these locations in 2005, Cs-137 was detected at levels similar to 1998-2004. The new station near New Ellenton exhibited the highest monthly and annual average Cs-137 activity. It is unclear why these sites have higher cesium levels, as they are not located near SRS facilities, nor in areas known to be affected by past releases. ESOP and DOE-SR results from the station on

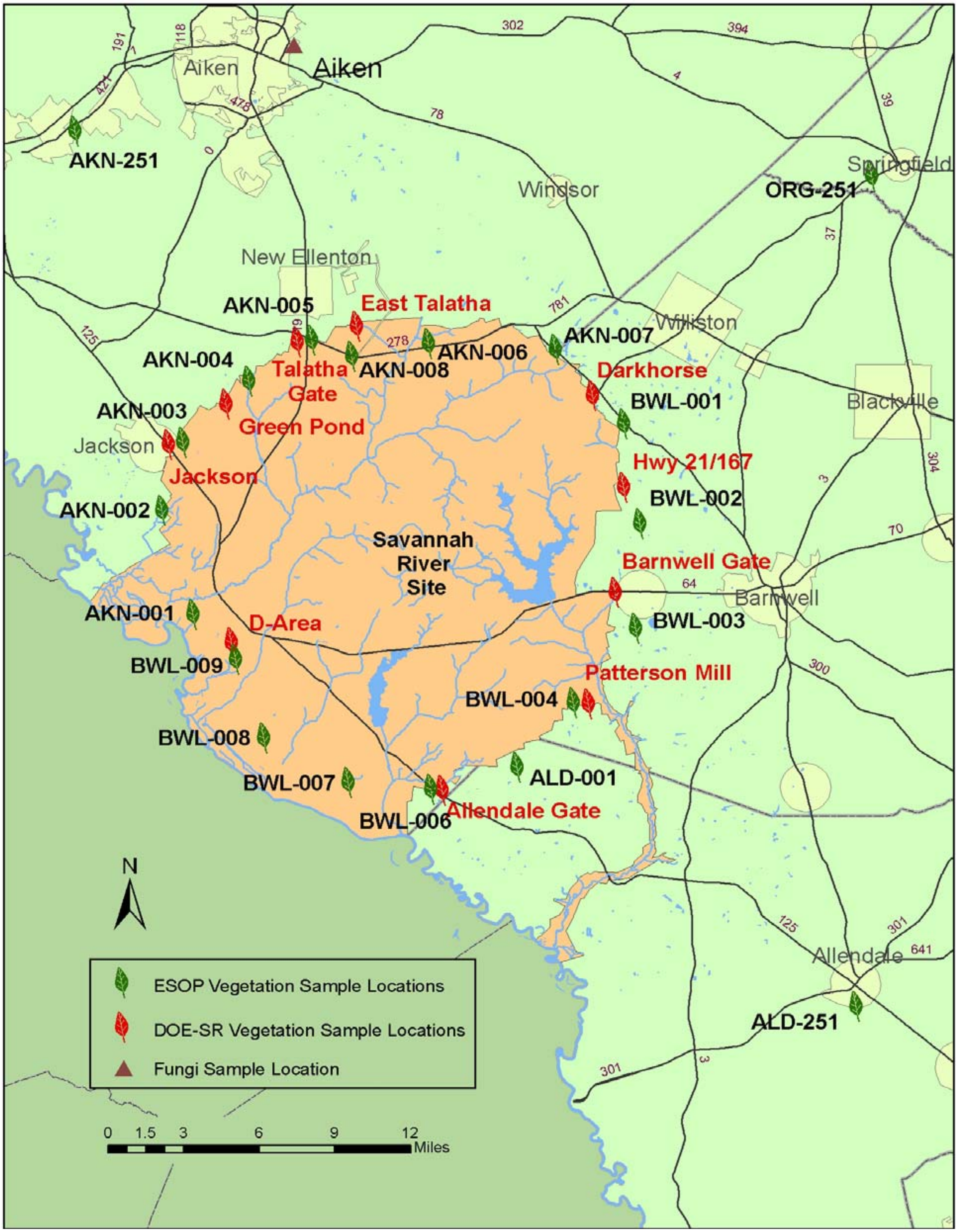
Patterson Mill Road exhibited similar Cs-137 activity levels, while results from another co-location at the Allendale Gate were quite different.

A quarterly sampling schedule will be continued in 2006. Sampling will again be conducted at randomly selected sites around South Carolina to determine background and near-SRS levels for tritium and gamma-emitting radionuclides.

SRS perimeter and South Carolina background Eu-155, Ce-144, and Cs-137 contaminant populations in mixed fungi were statistically tested on a two-year basis to determine if the assumption that the two populations are the same could be rejected. The alternate hypothesis that these two populations were significantly different was not accepted. Power calculation estimates indicated that increased random sampling must occur to support any alternate hypothesis that the populations are different. Some radionuclides detected in 2004 were not detected in 2005 (Eu-155, Ra-226, Ac-228, and Ce-144). Other single detections of Co-58 and Co-60 occurred in 2005 that were not detected in 2004. These detections may be from other local sources not related to SRS. Cesium-137 detections appear to be the dominant radionuclide of concern in 2005 since the average above background increased from 0.20 pCi/g in 2004 to 1.23 pCi/g in 2005. However, this may merely reflect the local soil types surveyed in a given year. The significance of any trending should be revealed by future statistical studies of several years of accumulated data. The radioisotope background contributions found in fungi in 2005 that may have originated from past atomic tests or commercial nuclear power companies cannot be distinguished from the DOE-SR contributions within a 50-mile perimeter of a center point within the SRS by SCDHEC to date. However, the Cs-137 concentration average above background in mixed fungi was 35 times higher than the Cs-137 concentrations above background in soil (SCDHEC 2005c) within the same quadrants. These results indicated that Cs-137 may become bioconcentrated in fungi, and represent increased exposure for the wild mushroom consumer, whether deer or human.

3.2.2
(Return to TOC)

Map 7. Terrestrial Vegetation Sampling Locations



3.2.3 Tables and Figures
(Return to TOC)

Radiological Monitoring of Terrestrial Vegetation

Figure 1. Average Tritium in Vegetation at SRS Perimeter Locations, 2001-2005

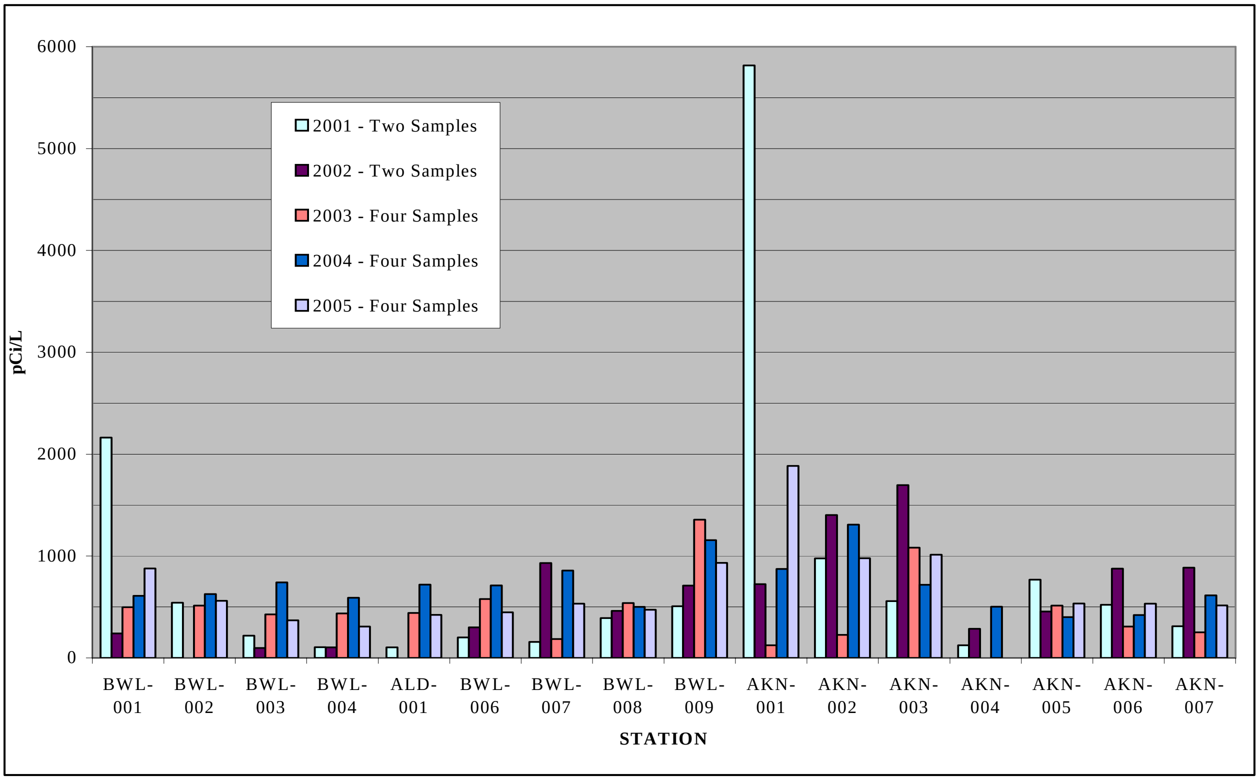
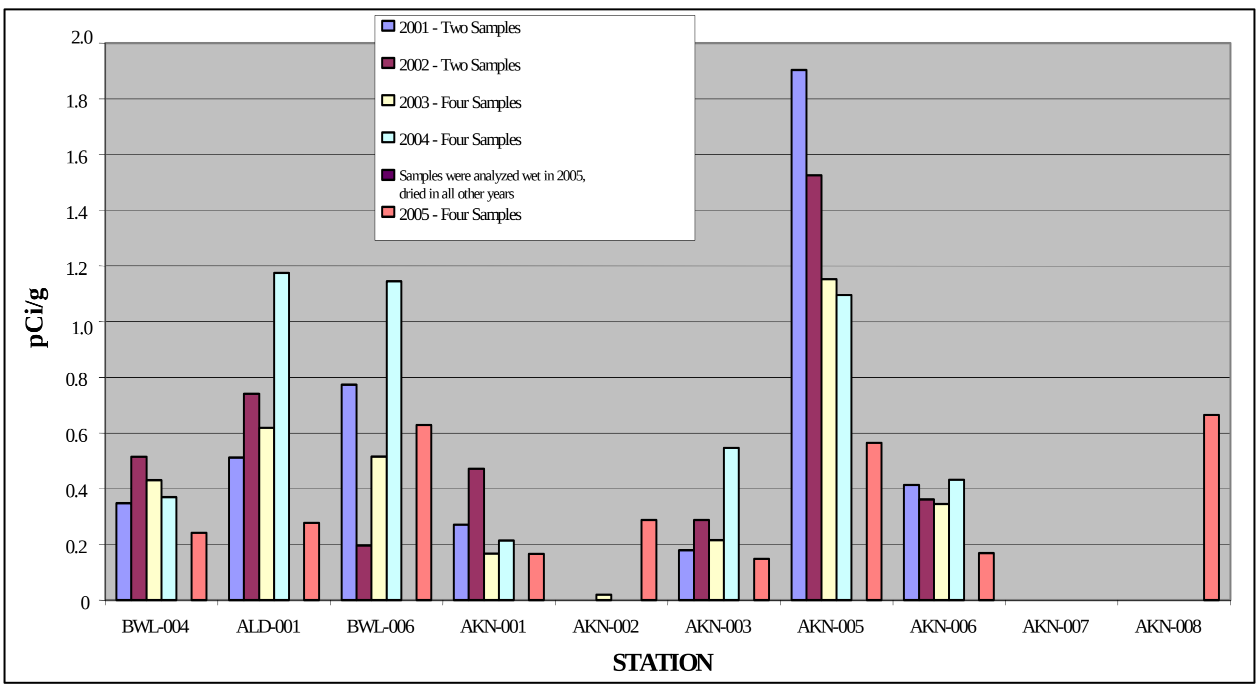


Figure 2. Average Cesium-137 in Vegetation at SRS Perimeter Locations, 2001-2005



Tables and Figures
(Return to TOC)

Radiological Monitoring of Terrestrial Vegetation

Table 1. Tritium analysis results from ESOP and DOE-SR sampling locations, 2005.

DOE-SR DATA (WSRC 2006)		**Tritium**		**ESOP DATA**		**Tritium**
Station	Date	pCi/g	pCi /L[a]	Station	Date	pCi/L
D-Area	5/5/2005	<MDC		BWL-009 [b]	5/13/2005	565
Jackson	7/20/2005	<MDC		AKN-003 [b]	8/8/2005	196
Green Pond	7/20/2005	<MDC		AKN-004 [b]	8/2/2005	<183
Talatha Gate	7/20/2005	<MDC		AKN-005 [b]	8/8/2005	<183
East Talatha	7/20/2005	<MDC		AKN-006 [b]	8/8/2005	<183
Darkhorse	7/20/2005	<MDC		BWL-001 [b]	8/2/2005	<183
Highway 21/167	7/20/2005	<MDC		BWL-002 [b]	8/2/2005	<183
Barnwell Gate	5/5/2005	<MDC				
				BWL-003	5/4/2005	256
Patterson Mill Road [c]	5/5/2005	<MDC		BWL-004 [c]	5/13/2005	1519
				ALD-001	5/13/2005	423
Allendale Gate [c]	5/5/2005	<MDC		BWL-006 [c]	5/13/2005	<175

Table 2. Cesium-137 analysis results from ESOP and DOE-SR sampling locations, 2005.

DOE-SR DATA (WSRC 2006)		**Tritium**		**ESOP DATA**		**Tritium**
Station	Date	pCi/g	pCi /L[a]	Station	Date	pCi/L
D-Area	5/5/2005	<MDC		BWL-009 [b]	5/13/2005	565
Jackson	7/20/2005	<MDC		AKN-003 [b]	8/8/2005	196
Green Pond	7/20/2005	<MDC		AKN-004 [b]	8/2/2005	<183
Talatha Gate	7/20/2005	<MDC		AKN-005 [b]	8/8/2005	<183
East Talatha	7/20/2005	<MDC		AKN-006 [b]	8/8/2005	<183
Darkhorse	7/20/2005	<MDC		BWL-001 [b]	8/2/2005	<183
Highway 21/167	7/20/2005	<MDC		BWL-002 [b]	8/2/2005	<183
Barnwell Gate	5/5/2005	<MDC				
				BWL-003	5/4/2005	256
Patterson Mill Road [c]	5/5/2005	<MDC		BWL-004 [c]	5/13/2005	1519
				ALD-001	5/13/2005	423
Allendale Gate [c]	5/5/2005	<MDC		BWL-006 [c]	5/13/2005	<175

<MDC denotes less than the WSRC Minimum Detectable Concentration
< - denotes less than reported Lower Limit of Detection
[a] Converted (See Section 5.1) [b] Comparable ESOP location [c] Colocation

3.2.4 Data

(Return to TOC)

Radiological Monitoring of Terrestrial Vegetation Data

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	AKN-001 - TNX Area				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	547	637	465	325
	+/- 2 sigma	114	108	97	92
	K-40 (pCi/g)	<0.294	3.805	1.875	2.962
	+/- 2 sigma		0.479	0.365	0.449
	Cs-137 (pCi/g)	0.216	0.090	0.071	0.288
	+/- 2 sigma	0.049	0.030	0.023	0.045

Station:	AKN-002 - Crackerneck gate				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	<200	463	408	561
	+/- 2 sigma		101	95	101
	K-40 (pCi/g)	<0.261	3.225	2.061	2.547
	+/- 2 sigma		0.475	0.373	0.426
	Cs-137 (pCi/g)	<0.037	0.065	<0.024	<0.026
	+/- 2 sigma		0.032		

Station:	AKN-003 - SRS Rd. 1				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	1200	548	196	538
	+/- 2 sigma	151	104	90	100
	K-40 (pCi/g)	<1.014	3.084	2.442	1.942
	+/- 2 sigma		0.535	0.426	0.395
	Cs-137 (pCi/g)	<0.039	0.168	0.134	0.143
	+/- 2 sigma		0.050	0.031	0.029

Station:	AKN-004 - SRS Rd. 1				
Sample Date:		02/08/05	05/13/05	08/02/05	11/10/05
Radionuclides	Tritium (pCi/L)	<200	617	<183	<185
	+/- 2 sigma		107		

Station:	AKN-005 - U.S. Hwy. 278				
Sample Date:		02/08/05	05/13/05	08/08/05	11/22/05
Radionuclides	Tritium (pCi/L)	787	586	<183	427
	+/- 2 sigma	122	100		99
	K-40 (pCi/g)	<0.975	2.644	2.116	1.908
	+/- 2 sigma		0.412	0.335	0.379
	Cs-137 (pCi/g)	0.447	0.605	0.557	0.653
	+/- 2 sigma	0.069	0.073	0.069	0.078

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	AKN-006 - U.S. Hwy. 278				
Sample Date:		02/08/05	05/13/05	08/08/05	11/22/05
Radionuclides	Tritium (pCi/L)	399	289	<183	277
	+/- 2 sigma	107	88		93
	K-40 (pCi/g)	<0.154	2.493	2.382	1.545
	+/- 2 sigma		0.409	0.346	0.379
	Cs-137 (pCi/g)	0.079	0.218	0.150	0.228
	+/- 2 sigma	0.036	0.038	0.028	0.036

Station:	AKN-007 - Aiken Co. Rd. 74				
Sample Date:		02/08/05	05/13/05	08/02/05	11/10/05
Radionuclides	Tritium (pCi/L)	2129	249	<183	1100
	+/- 2 sigma	165	86		120

Station:	AKN-008 - U.S. Hwy. 278				
Sample Date:		02/08/05	05/13/05	08/08/05	11/22/05
Radionuclides	K-40 (pCi/g)	1.810	3.33	2.476	2.149
	+/- 2 sigma	0.636	0.461	0.3572	0.3705
	Cs-137 (pCi/g)	0.590	1.009	0.687	0.377
	+/- 2 sigma	0.085	0.115	0.824	0.053

Station:	BWL-001 - U.S. Hwy. 278				
Sample Date:		02/08/05	05/04/05	08/02/05	11/10/05
Radionuclides	Tritium (pCi/L)	2331	374	<183	1707
	+/- 2 sigma	170	97		137

Station:	BWL-002 - Barnwell Co. Rd. 21				
Sample Date:		02/08/05	05/04/05	08/02/05	11/10/05
Radionuclides	Tritium (pCi/L)	417	202	<183	512
	+/- 2 sigma	108	88		99

Station:	BWL-003 - Barnwell Co. Rd. 54				
Sample Date:		02/08/05	05/04/05	08/02/05	11/10/05
Radionuclides	Tritium (pCi/L)	387	256	<183	411
	+/- 2 sigma	107	91		95

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	BWL-004 - Air Station 614-62G				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	<200	1519	1153	1323
	+/- 2 sigma		140	123	126
	K-40 (pCi/g)	<0.959	3.681	2.293	2.506
	+/- 2 sigma		0.461	0.361	0.391
	Cs-137 (pCi/g)	0.233	0.205	0.284	0.247
	+/- 2 sigma	0.051	0.034	0.042	0.041

Station:	ALD-001 - Allendale Co. Rd. 12				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	<200	423	386	193
	+/- 2 sigma		99	94	86
	K-40 (pCi/g)	<0.265	3.299	2.241	2.952
	+/- 2 sigma		0.446	0.386	0.440
	Cs-137 (pCi/g)	0.171	0.296	0.319	0.325
	+/- 2 sigma	0.047	0.044	0.046	0.053

Station:	BWL-006 - Allendale Gate				
Sample Date:		02/08/05	05/13/05	08/08/05	11/10/05
Radionuclides	Tritium (pCi/L)	<200	<175	<183	<185
	+/- 2 sigma				
	K-40 (pCi/g)	1.980	2.993	2.244	2.216
	+/- 2 sigma	0.446	0.427	0.364	0.417
	Cs-137 (pCi/g)	0.429	0.772	0.801	0.514
	+/- 2 sigma	0.061	0.092	0.093	0.067

Station:	BWL-007 - SRS Rd. A-17				
Sample Date:		02/07/05	05/13/05	08/29/05	11/25/05
Radionuclides	Tritium (pCi/L)	644	183	442	246
	+/- 2 sigma	117	88	101	91

Station:	BWL-008 - SRS Rd. A-13				
Sample Date:		02/07/05	05/13/05	08/29/05	11/25/05
Radionuclides	Tritium (pCi/L)	1636	928	957	759
	+/- 2 sigma	150	120	119	111

Station:	BWL-009 - D-Area				
Sample Date:		02/07/05	05/13/05	08/29/05	11/10/05
Radionuclides	Tritium (pCi/L)	2511	565	2898	1458
	+/- 2 sigma	175	105	171	130

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137
5. NS denotes Not Sampled

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	AKN-251 - Langley, SC				
Sample Date:		02/16/05	05/04/05	08/02/05	11/22/05
Radionuclides	Tritium (pCi/L)	312	1063	<183	544
	+/- 2 sigma	93	125		103

Station:	ALD-251 - Allendale, SC				
Sample Date:		02/16/05	05/04/05	08/02/05	11/23/05
Radionuclides	Tritium (pCi/L)	<173	<175	<183	<192
	+/- 2 sigma				

Station:	ORG-251 - Springfield, SC				
Sample Date:		02/16/05	05/04/05	08/02/05	11/22/05
Radionuclides	Tritium (pCi/L)	<173	191	<183	<192
	+/- 2 sigma		88		

Station:	B14 - Richland Co., SC	
Sample Date:		02/25/05
Radionuclides	Tritium (pCi/L)	<173
	+/- 2 sigma	
	K-40 (pCi/g)	2.655
	+/- 2 sigma	0.393
	Cs-137 (pCi/g)	<0.022
	+/- 2 sigma	

Station:	B22 - Fairfield Co., SC	
Sample Date:		02/25/05
Radionuclides	Tritium (pCi/L)	<173
	+/- 2 sigma	
	K-40 (pCi/g)	2.476
	+/- 2 sigma	0.581
	Cs-137 (pCi/g)	<0.040
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	B24 - Saluda Co., SC	
Sample Date:		02/25/05
Radionuclides	Tritium (pCi/L)	<173
	+/- 2 sigma	
	K-40 (pCi/g)	4.739
	+/- 2 sigma	0.623
	Cs-137 (pCi/g)	<0.033
	+/- 2 sigma	

Station:	E13 - Orangeburg Co., SC	
Sample Date:		02/16/05
Radionuclides	Tritium (pCi/L)	<173
	+/- 2 sigma	
	K-40 (pCi/g)	2.704
	+/- 2 sigma	0.557
	Cs-137 (pCi/g)	<0.039
	+/- 2 sigma	

Station:	E14 - Aiken Co., SC	
Sample Date:		02/16/05
Radionuclides	Tritium (pCi/L)	346
	+/- 2 sigma	95
	K-40 (pCi/g)	2.360
	+/- 2 sigma	0.519
	Cs-137 (pCi/g)	<0.033
	+/- 2 sigma	

Station:	B18 - Darlington Co., SC	
Sample Date:		05/24/05
Radionuclides	Tritium (pCi/L)	<177
	+/- 2 sigma	
	K-40 (pCi/g)	3.709
	+/- 2 sigma	0.445
	Cs-137 (pCi/g)	<0.029
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	B21 - Sumter Co., SC	
Sample Date:		05/24/05
Radionuclides	Tritium (pCi/L)	<177
	+/- 2 sigma	
	K-40 (pCi/g)	2.691
	+/- 2 sigma	0.404
	Cs-137 (pCi/g)	0.064
	+/- 2 sigma	0.023

Station:	E16 - Barnwell Co., SC	
Sample Date:		05/27/05
Radionuclides	Tritium (pCi/L)	<177
	+/- 2 sigma	
	K-40 (pCi/g)	3.437
	+/- 2 sigma	0.503
	Cs-137 (pCi/g)	<0.025
	+/- 2 sigma	

Station:	E18 - Orangeburg Co., SC	
Sample Date:		05/27/05
Radionuclides	Tritium (pCi/L)	<177
	+/- 2 sigma	
	K-40 (pCi/g)	2.369
	+/- 2 sigma	0.403
	Cs-137 (pCi/g)	0.347
	+/- 2 sigma	0.049

Station:	E21 - Bamberg Co., SC	
Sample Date:		05/27/05
Radionuclides	Tritium (pCi/L)	<177
	+/- 2 sigma	
	K-40 (pCi/g)	2.481
	+/- 2 sigma	0.400
	Cs-137 (pCi/g)	0.068
	+/- 2 sigma	0.029

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	**B13 - York Co., SC**	
Sample Date:		**08/10/05**
Radionuclides	**Tritium (pCi/L)**	<195
	+/- 2 sigma	
	K-40 (pCi/g)	4.319
	+/- 2 sigma	0.551
	Cs-137 (pCi/g)	<0.031
	+/- 2 sigma	

Station:	**B17 - Anderson Co., SC**	
Sample Date:		**08/11/05**
Radionuclides	**Tritium (pCi/L)**	<195
	+/- 2 sigma	
	K-40 (pCi/g)	2.64
	+/- 2 sigma	0.443
	Cs-137 (pCi/g)	<0.025
	+/- 2 sigma	

Station:	**B16 - Oconee Co., SC**	
Sample Date:		**08/31/05**
Radionuclides	**Tritium (pCi/L)**	<195
	+/- 2 sigma	
	K-40 (pCi/g)	4.633
	+/- 2 sigma	0.489
	Cs-137 (pCi/g)	<0.025
	+/- 2 sigma	

Station:	**E15 - Edgefield Co., SC**	
Sample Date:		**08/11/05**
Radionuclides	**Tritium (pCi/L)**	<195
	+/- 2 sigma	
	K-40 (pCi/g)	2.789
	+/- 2 sigma	0.426
	Cs-137 (pCi/g)	<0.026
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	E25 - Edgefield Co., SC	
Sample Date:		08/11/05
Radionuclides	Tritium (pCi/L)	<195
	+/- 2 sigma	
	K-40 (pCi/g)	2.696
	+/- 2 sigma	0.435
	Cs-137 (pCi/g)	<0.027
	+/- 2 sigma	

Station:	E26 - Edgefield Co., SC	
Sample Date:		08/11/05
Radionuclides	Tritium (pCi/L)	<195
	+/- 2 sigma	
	K-40 (pCi/g)	2.668
	+/- 2 sigma	0.409
	Cs-137 (pCi/g)	<0.024
	+/- 2 sigma	

Station:	B15 - Beaufort Co., SC	
Sample Date:		11/23/05
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	2.645
	+/- 2 sigma	0.397
	Cs-137 (pCi/g)	<0.023
	+/- 2 sigma	

Station:	B19 - Williamsburg Co., SC	
Sample Date:		11/17/05
Radionuclides	Tritium (pCi/L)	<185
	+/- 2 sigma	
	K-40 (pCi/g)	2.934
	+/- 2 sigma	0.358
	Cs-137 (pCi/g)	<0.021
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	B20 - Jasper Co., SC	
Sample Date:		11/23/05
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	0.759
	+/- 2 sigma	0.318
	Cs-137 (pCi/g)	<0.021
	+/- 2 sigma	

Station:	B23 - Georgetown Co., SC	
Sample Date:		11/17/05
Radionuclides	Tritium (pCi/L)	<185
	+/- 2 sigma	
	K-40 (pCi/g)	1.984
	+/- 2 sigma	0.418
	Cs-137 (pCi/g)	<0.022
	+/- 2 sigma	

Station:	E17 - Orangeburg Co., SC	
Sample Date:		11/30/05
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	0.922
	+/- 2 sigma	0.307
	Cs-137 (pCi/g)	<0.022
	+/- 2 sigma	

Station:	E20 - Aiken Co., SC	
Sample Date:		11/30/05
Radionuclides	Tritium (pCi/L)	<192
	+/- 2 sigma	
	K-40 (pCi/g)	1.697
	+/- 2 sigma	0.366
	Cs-137 (pCi/g)	<0.027
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Vegetation Analysis Results

(Return to TOC)

Station:	**E22 - Hampton Co., SC**	
Sample Date:		**11/23/05**
Radionuclides	**Tritium (pCi/L)**	<192
	+/- 2 sigma	
	K-40 (pCi/g)	2.055
	+/- 2 sigma	0.357
	Cs-137 (pCi/g)	<0.022
	+/- 2 sigma	

Station:	**E24 - Barnwell Co., SC**	
Sample Date:		**11/23/05**
Radionuclides	**Tritium (pCi/L)**	<192
	+/- 2 sigma	
	K-40 (pCi/g)	2.101
	+/- 2 sigma	0.362
	Cs-137 (pCi/g)	<0.022
	+/- 2 sigma	

Notes:
1. < denotes less than "detection limit"
2. blank spaces denote Not Applicable
3. K-40 denotes Potassium-40
4. Cs-137 denotes Cesium-137

Radiological Monitoring of Terrestrial Vegetation
Fungi Analysis Results Random Perimeter Samples

ID	E13	E14	E15	E16	E17	E18
Be-7	<mda	<mda	<mda	<mda	<mda	<mda
mda	1.274	0.727	0.607	0.877	0.869	0.892
Na-22	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.049	0.054	0.049	0.049	0.052	0.046
K-40	7.092	28.600	20.710	8.104	<mda	13.150
mda	0.359	0.363	0.252	0.367	0.445	0.373
Mn-54	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.045	0.048	0.039	0.043	0.052	0.044
Co-58	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.095	0.073	0.060	0.071	0.084	0.077
Co-60	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.040	0.050	0.038	0.046	0.051	0.043
Zn-65	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.114	0.131	0.119	0.112	0.122	0.118
Y-88	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.061	0.050	0.038	0.059	0.071	0.060
Zr-95	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.193	0.143	0.124	0.150	0.154	0.138
Ru-103	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.231	0.115	0.096	0.124	0.133	0.132
Sb-125	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.110	0.108	0.088	0.113	0.116	0.110
I-131	<mda	8hle	>8hle	8hle	8hle	8hle
mda	7.708	na	na	na	na	na
Cs-134	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.037	0.037	0.034	0.040	0.043	0.041
Cs-137	**1.744**	**1.624**	**0.199**	**1.640**	**0.907**	**1.999**
mda	0.036	0.040	0.036	0.040	0.046	0.039
Ce-144	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.228	0.193	0.167	0.203	0.229	0.207
Eu-152	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.065	0.063	0.051	0.065	0.073	0.066
Eu-154	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.046	0.045	0.036	0.046	0.051	0.047
Eu-155	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.080	0.083	0.066	0.083	0.094	0.084
Pb-212	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.042	0.044	0.035	0.045	0.051	0.046
Pb-214	<mda	0.219	<mda	<mda	<mda	0.235
mda	0.081	0.067	0.063	0.084	0.078	0.074
Ra-226	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.738	0.588	0.568	0.726	0.675	0.744
Ac-228	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.171	0.206	0.142	0.187	0.203	0.198
Th-234	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.419	0.468	0.368	0.464	0.513	0.470
Am-241	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.053	0.060	0.053	0.057	0.063	0.058

Notes:
1. ">8hle" means no data due to greater than eight half-lives elapsing.
2. "<mda" means less than a minimum detectable activity.
3. "E" represents random quadrants and "AC" represents a nonrandom sample.
4. Abbreviated radioisotopes are defined in the glossary list of radioisotopes.
5. "ID" means the identification quadrant number per the radionuclide tested.

Radiological Monitoring of Terrestrial Vegetation
Fungi Analysis Results Perimeter Samples

ID	E20	E21	E22	E24	E25	E26	AC
Be-7	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	1.088	1.007	1.162	1.721	0.709	1.006	0.660
Na-22	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.063	0.044	0.089	0.096	0.045	6.450	0.042
K-40	<mda	7.044	5.826	25.970	1.595	1.825	1.320
mda	0.557	0.338	0.604	0.693	0.383	0.521	0.335
Mn-54	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.065	0.043	0.082	0.093	0.047	0.067	0.042
Co-58	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.111	0.070	0.123	0.155	0.074	0.096	0.063
Co-60	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.063	0.041	0.080	0.091	0.043	0.061	0.032
Zn-65	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.150	0.107	0.182	0.233	0.106	0.158	0.095
Y-88	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.091	0.059	0.098	0.110	0.062	0.077	0.055
Zr-95	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.207	0.140	0.228	0.297	0.137	0.195	0.112
Ru-103	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.172	0.148	0.179	0.244	0.110	0.169	0.093
Sb-125	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.146	0.127	0.181	0.250	0.104	0.155	0.100
I-131	8hle	8hle	<mda	<mda	>8hle	>8hle	<mda
mda	na	na	12.200	17.860	na	na	6.260
Cs-134	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.055	0.038	0.066	0.091	0.039	0.060	0.034
Cs-137	**0.557**	**6.711**	**0.760**	**0.558**	<mda	<mda	<mda
mda	0.057	0.038	0.071	0.100	0.044	0.060	0.040
Ce-144	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.282	0.207	0.338	0.758	0.208	0.302	0.217
Eu-152	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.090	0.063	0.115	0.256	0.066	0.097	0.070
Eu-154	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.062	0.045	0.081	0.181	0.046	0.066	0.049
Eu-155	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.118	0.078	0.145	0.284	0.086	0.126	0.082
Pb-212	<mda	<mda	<mda	0.399	<mda	<mda	<mda
mda	0.064	0.041	0.079	0.099	0.029	0.071	0.044
Pb-214	<mda	<mda	<mda	0.675	<mda	<mda	<mda
mda	0.110	0.082	0.137	0.174	0.079	0.117	0.070
Ra-226	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	1.021	0.715	1.257	2.168	0.759	1.048	0.767
Ac-228	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.237	0.152	0.295	0.553	0.178	0.258	0.189
Th-234	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.652	0.433	0.805	1.453	0.473	0.696	0.417
Am-241	<mda	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.080	0.056	0.110	0.190	0.059	0.093	0.052

Notes:
1. ">8hle" means no data due to greater than eight half-lives elapsing.
2. "<mda" means less than a minimum detectable activity.
3. "E" represents random quadrants and "AC" represents a nonrandom sample.
4. Abbreviated radioisotopes are defined in the glossary list of radioisotopes.
5. "ID" means the identification quadrant number per the radionuclide tested.

Radiological Monitoring of Terrestrial Vegetation
Fungi Analysis Results Background Samples

ID VGF	B13	B14	B15	B16	B17	B18
Be-7	1.761	12.510	3.197	6.440	<mda	4.277
mda	0.463	0.925	0.760	2.151	3.396	1.234
Na-22	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.042	0.088	0.059	0.047	0.080	0.097
K-40	<mda	<mda	2.316	4.977	1.172	<mda
mda	1.002	2.443	0.514	0.298	0.498	1.063
Mn-54	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.044	0.079	0.059	0.050	0.079	0.101
Co-58	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.057	0.106	0.083	0.156	0.257	0.133
Co-60	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.046	0.079	0.058	0.040	0.072	0.105
Zn-65	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.097	0.195	0.128	0.133	0.237	0.250
Y-88	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.054	0.083	0.076	0.089	0.108	0.121
Zr-95	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.099	0.200	0.157	0.346	0.526	0.263
Ru-103	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.064	0.141	0.115	0.553	0.867	0.185
Sb-125	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.099	0.202	0.134	0.101	0.158	0.254
I-131	<mda	<mda	<mda	>8hle	>8hle	<mda
mda	0.657	2.431	4.370	na	na	4.188
Cs-134	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.037	0.074	0.051	3.754E-02.	0.064	0.095
Cs-137	<mda	<mda	<mda	<mda	**0.724**	**0.265**
mda	0.044	0.080	0.056	0.036	0.059	0.088
Ce-144	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.191	0.435	0.261	0.273	0.437	0.522
Eu-152	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.065	0.148	0.086	0.068	0.111	0.170
Eu-154	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.046	0.105	0.060	0.048	0.076	0.121
Eu-155	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.084	0.189	0.111	0.088	0.146	0.225
Pb-212	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.047	0.103	0.061	0.048	0.078	0.122
Pb-214	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.080	0.166	0.105	0.077	0.128	0.214
Ra-226	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.741	1.560	0.981	0.717	1.185	1.912
Ac-228	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.177	0.379	0.233	0.176	0.291	0.453
Th-234	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.473	]9.667E-01	0.614	0.444	0.702	1.180
Am-241	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.056	0.126	0.075	0.057	0.097	0.148

Notes:
1. ">8hle" means no data due to greater than eight half-lives elapsing.
2. "<mda" means less than a minimum detectable activity.
3. "E" represents random quadrants and "AC" represents a nonrandom sample.
4. Abbreviated radioisotopes are defined in the glossary list of radioisotopes.
5. "ID" means the identification quadrant number per the radionuclide tested.
6. All "B" quadrant samples were random.

Radiological Monitoring of Terrestrial Vegetation
Fungi Analysis Results Random Background Samples

ID VGF	B19	B20	B21	B22	B23	B24
Be-7	<mda	<mda	<mda	2.912	3.176	<MDA
mda	1.313	0.738	0.794	0.860	1.446	2.923
Na-22	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.083	0.059	0.062	0.065	0.094	0.097
K-40	<mda	<mda	<mda	3.289	<mda	3.997
mda	0.718	1.242	0.469	0.505	0.715	0.607
Mn-54	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.088	0.056	0.057	0.066	0.087	0.097
Co-58	0.112	<mda	<mda	<mda	<mda	<mda
mda	na	0.081	0.072	0.089	0.121	0.240
Co-60	0.112	<mda	<mda	<mda	<mda	<mda
mda	na	0.057	0.053	0.067	0.081	0.080
Zn-65	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.211	0.128	0.136	0.152	0.185	0.254
Y-88	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.065	0.075	0.073	0.082	0.104	0.167
Zr-95	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.221	0.150	0.150	0.177	0.254	0.486
Ru-103	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.163	0.112	0.116	0.131	0.190	0.594
Sb-125	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.197	0.125	0.132	0.150	0.221	0.210
I-131	<mda	<mda	<mda	<mda	<mda	>8hle
mda	6.390	4.660	4.021	4.326	9.593	na
Cs-134	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.070	0.048	0.049	0.058	0.081	0.076
Cs-137	**0.542**	**0.140**	**0.206**	<mda	**0.755**	<mda
mda	0.078	0.051	0.052	0.065	0.077	0.092
Ce-144	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.433	0.242	0.285	0.348	0.475	0.523
Eu-152	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.138	0.079	0.098	0.114	0.163	0.148
Eu-154	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.099	0.055	0.068	0.081	0.115	0.105
Eu-155	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.184	0.103	0.121	0.148	0.204	0.192
Pb-212	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.101	0.057	0.066	0.047	0.109	0.106
Pb-214	<mda	0.230	<mda	<mda	<mda	<mda
mda	0.167	0.085	0.109	0.131	0.183	0.163
Ra-226	<mda	<mda	<mda	<mda	<mda	<mda
mda	1.555	0.902	0.995	1.190	1.579	1.506
Ac-228	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.363	0.208	0.251	0.313	0.398	0.402
Th-234	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.953	0.582	0.631	0.770	1.026	0.970
Am-241	<mda	<mda	<mda	<mda	<mda	<mda
mda	0.116	0.071	0.082	0.097	0.134	0.124

Notes:
1. ">8hle" means no data due to greater than eight half-lives elapsing.
2. "<mda" means less than a minimum detectable activity.
3. "E" represents random quadrants and "AC" represents a nonrandom sample.
4. Abbreviated radioisotopes are defined in the glossary list of radioisotopes.
5. "ID" means the identification quadrant number per the radionuclide tested.
6. All "B" quadrant samples were random.

3.2.5 Summary Statistics

(Return to TOC)

Terrestrial Vegetation Radiological Monitoring
Terrestrial Vegetation

Tritium Levels (pCi/L) from SRS Perimeter Stations, 2005

Station	N (ND)	Average	Std Dev	Median	Minimum	Maximum
AKN-001	4 (0)	494	132	506	325	637
AKN-002	3 (1)	477	78	463	408	561
AKN-003	3 (1)	621	420	543	196	1200
AKN-004	1 (3)	NA	NA	NA	617	617
AKN-005	3 (1)	600	180	586	427	787
AKN-006	3 (1)	322	67	289	277	399
AKN-007	3 (1)	1159	941	1100	249	2129
BWL-001	3 (1)	1471	1000	1707	374	2331
BWL-002	3 (1)	377	159	417	202	512
BWL-003	3 (1)	351	83	387	256	411
BWL-004	3 (1)	1332	183	1323	1153	1519
ALD-001	3 (1)	334	124	386	193	423
BWL-006	0 (4)	NA	NA	NA	NA	NA
BWL-007	4 (0)	379	208	344	183	644
BWL-008	4 (0)	1070	387	943	759	1636
BWL-009	4 (0)	1858	1055	1985	565	2898

Cesium-137 Levels (pCi/g) from SRS Perimeter Stations, 2005

Station	N (ND)	Average	Std Dev	Median	Minimum	Maximum
AKN-001	4 (0)	0.166	0.103	0.153	0.071	0.288
AKN-002	3 (1)	0.288	0.195	0.373	0.065	0.426
AKN-003	3 (1)	0.148	0.018	0.143	0.134	0.168
AKN-005	4 (0)	0.565	0.088	0.581	0.447	0.653
AKN-006	4 (0)	0.169	0.069	0.184	0.079	0.228
AKN-008	4 (0)	0.666	0.263	0.639	0.377	1.009
BWL-004	4 (0)	0.242	0.033	0.240	0.205	0.284
ALD-001	4 (0)	0.277	0.072	0.307	0.171	0.325
BWL-006	4 (0)	0.629	0.186	0.643	0.429	0.801

Notes:
NA denotes Not Applicable
Averages exclude non-detects

Summary Statistics
Terrestrial Vegetation Radiological Monitoring

(Return to TOC)

Tritium Levels (pCi/L) in SRS Perimeter Vegetation Samples, 2005					
N (ND)	Average	Std Dev	Median	Minimum	Maximum
47 (17)	764	363	543	183	2898

Average excludes non-detects

Cs-137 Levels (pCi/g) in SRS Perimeter Vegetation Samples, 2005					
N (ND)	Average	Std Dev	Median	Minimum	Maximum
34 (2)	0.350	0.082	0.307	0.065	1.009

Average excludes non-detects

Tritium Levels (pCi/L) in 25-mile Radius Vegetation Samples, 2005					
N (ND)	Average	Std Dev	Median	Minimum	Maximum
4 (8)	528	386	428	191	1063

Average excludes non-detects

Tritium Levels (pCi/L) in 50-mile Radius Vegetation Samples, 2005					
N (ND)	Average*	Std Dev*	Median*	Minimum*	Maximum
12 (11)	115	73	96	86.5	346

* Includes non-detects calculated as MDA x 0.5

Tritium Levels (pCi/L) in S.C. Background Vegetation Samples, 2005					
N (ND)	Average*	Std Dev*	Median*	Minimum*	Maximum
12 (12)	92	5	93	86.5	97.5

* Includes non-detects calculated as MDA x 0.5

Cs-137 Levels (pCi/g) in 50-mile Radius Vegetation Samples, 2005					
N (ND)	Average*	Std Dev*	Median*	Minimum	Maximum
12 (10)	0.046	0.096	0.013	0.068	0.347

* Includes non-detects calculated as MDA x 0.5

Cs-137 Levels (pCi/g) in S.C. Background Vegetation Samples, 2005					
N (ND)	Average*	Std Dev*	Median*	Minimum*	Maximum
12 (11)	0.018	0.015	0.013	0.010	0.064

* Includes non-detects calculated as MDA x 0.5

Notes:

N	Number of samples
ND	Non-detect
Std Dev	Standard Deviation

Summary Statistics
(Return to TOC)

Terrestrial Vegetation Radiological Monitoring
Fungi

SRS Perimeter or "E" Data Set					Background or "B" Data Set				E-B Results	
ID[2]	#D[4]	Average	sd[1]	Median	#D	Average	sd	Median	Average	Median
Be-7					7	4.9	3.66	3.2	<Bkg[3]	<Bkg
K-40	10	11.992	10.216	8.104	5	3.15	1.47	3.29	8.842	4.814
Co-58					1	0.11		0.11	<Bkg	<Bkg
Co-60					1	0.11		0.11	<Bkg	<Bkg
Cs-137	10	1.67	1.987	0.907	6	0.44	0.27	0.4	1.23	0.507
Pb-212	1	0.397		0.397					0.397	0.397
Pb-214	3	0.376	0.259	0.235	1	0.23		0.23	0.146	0.005
Compare soil E-B Cs-137 average (0.035 pCi/g) to fungi (1.23 pCi/g) for the same quadrants.										
Compare Cs-137 1.23 pCi/g (SC 2005) to the 3.55 pCi/g in *boletus* and 3.66 pCi/g in *rusula* species (Radnet 1986).										

Notes:
1. Sd = standard deviation of variance.
2. ID = identification of the detected radionuclide. All others sampled were not detected.
3. <Bkg = less than the background average.
4. #D = the number of quadrant detections.
5. The only nonrandom sample detection (1.320 pCi/g K-40) was at the Old Aiken County Landfill.

3.3 Radiological Monitoring of Edible Vegetation (Return to TOC)

3.3.1 Summary

Plants in general may accumulate radionuclides depending upon many factors including species, tissue type (e.g. leaf vs. fruit), soil-water-plant relationships, soil type, and the chemical nature of the radionuclide in the soil. Vegetation can also be contaminated internally by uptake of radionuclides through the root system. As a result, radioactive materials could be transported through the human body via the consumption of food products containing radioactivity.

The Environmental Surveillance and Oversight Program (ESOP) began 2005 edible vegetation sampling in February. Food products, including fruits, leafy vegetables, soybeans and honey were collected in 2005. Thirty-three samples were collected from 21 sampling locations: five randomly selected background locations, 11 randomly selected perimeter locations, and five non-randomly selected perimeter sampling locations (Map 8, section 3.3.2). The non-random locations were selected according to plant availability, and the cooperation of local farmers and gardeners.

For the sampling year 2006, ESOP plans to continue sampling using the quadrant system format, conducting some strontium analysis for comparison purposes, and narrowing the sampling list to a more focused grouping of vegetables. For better comparisons with DOE-SR data, DOE-SR may consider reporting what types of fruits or greens were collected at what locations in their data tables.

RESULTS AND DISCUSSION

<u>Tritium</u>

Tritium was detected in seven of the total 33 ESOP samples collected across South Carolina (section 3.3.4). Of these seven detections, the highest tritium detection, found in blackberries from a Barnwell location within 50-miles of the SRS, was 0.550 picocuries per gram (pCi/g). The lowest tritium detection, found in grapes, was 0.195 pCi/g from the New Ellenton Quad (E3).

The ESOP summary statistical tritium values for all of South Carolina vegetation sampled were as follows: an average of 0.275 pCi/g (± 0.120 pCi/g), and a median value of 0.233 pCi/g. The tritium values for locations within 50-miles of the SRS were an average of .278 pCi/g (± 0.120 pCi/g) and a median of 0.212 pCi/g. The only background sample having a detection of tritium was corn, collected within 80-miles (B2) of the SRS with a tritium value of 0.253 pCi/g. All other background locations were further than the 80-mile perimeter of the SRS and had no detections of tritium.

In comparison, DOE-SR reported tritium detections in five of the total 19 edible vegetation samples. The total overall average was 0.314 pCi/g (± 0.292 pCi/g) and median of 0.136 pCi/g. The only food product that could be compared between the two programs was greens (WSRC, 2006). ESOP collected eight total samples of a variety of greens (turnips, bok choy, Chinese cabbage, cabbage and collards). Of these eight samples, the only ESOP greens sample having a detection of tritium was turnips (greens and roots) collected within 50-miles (E1) of the SRS with tritium values of 0.201 pCi/g and 0.212 pCi/g, respectively (WSRC, 2006). The average was 0.207 pCi/g (± 0.008 pCi/g), and a median of 0.207 pCi/g. The DOE-SR reported a total of five green samples, all of which were collards. Of these five samples, two samples had detections of tritium: 0.549 pCi/g, 0.705 pCi/g, respectively (WSRC, 2006). Both samples were collected within their 0-10 mile quadrants. The DOE-SR average was 0.627 pCi/g (± 0.110 pCi/g), and a median of 0.627 pCi/g. The ESOP average is within approximately four standard deviations of the DOE-SR average. A logical assumption can be made that DOE-SR tritium values are higher than ESOP tritium values because DOE-SR sampling locations were closer in proximity to the SRS.

Figure 1 in section 3.3.3 depicts the average tritium concentrations for 2004-05. The highest average for those two years occurred in blackberries with 0.970 pCi/g, and the lowest average occurred in passion fruit with 0.189 pCi/g.

Gamma-emitting radionuclides

No man-made gamma-emitters were detected in the any of the ESOP food products collected for 2005 (section 3.3.4). DOE-SR reported four Cs-137 detections in greens for 2005. The average Cs-137 detected value was 0.056 pCi/g (± 0.039 pCi/g), and the median value was 0.045 pCi/g for the DOE-SR results.

Other Analytes

Potassium-40 (K-40) is a naturally occurring radionuclide that is found in soil and in fertilizers applied to soil. It is the predominant radionuclide in foods and human tissues (PNL, 2004). K-40 was detected in all food samples collected, except honey, with concentrations ranging from a minimum detection of 0.193 pCi/g to maximum detection of 7.326 pCi/g.

The K-40 average across South Carolina for all samples was 2.75 pCi/g (± 1.81 pCi/g) and a median of 2.33 pCi/g. For those samples located within the 50-mile perimeter of the SRS, the K-40 average for all food products was 2.75 pCi/g (± 1.97 pCi/g), and the median was 2.09 pCi/g. Food products collected as background samples located outside of 50-miles of the SRS had a K-40 average of 2.385 pCi/g (±0.294 pCi/g) and a median of 2.33 pCi/g.

Figure 2 in section 3.3.3 shows 2004-05 average K-40 for all edible vegetation collected across SC. The highest was in soybeans at a concentration of 5.205 pCi/g and the lowest was at a concentration of 1.245 pCi/g.

Naturally occurring radioactive isotopes of lead include Pb-212 (part of the Thorium-228 decay chain) and Pb-214 (part of the Radium-226 decay chain), which decay both by beta emission and gamma emission. Lead isotopes in general have relatively short half-lives compared to other radioactive isotopes. The half-life of Pb-214 for example is about 27 minutes. Lead (Pb-212 and Pb-214) was found in one pear sample (0.203 pCi/g, 0.155 pCi/g, respectively) from a location within 50- miles of the SRS. Since these isotopes are so short lived they would not contribute a measurable health dose at end of a year.

Strontium 89/90 (Sr-89-90) is another radioactive isotope. Exposure can occur through breathing the air, eating food grown in contaminated soil or drinking water. (ATSDR, April 2004). DOE-SR reported strontium 89/90 (Sr-89/90) in two samples of greens. The average and median values were 0.423 pCi/g (± 0.354 pCi/g).

All summary statistics are given in section 3.3.5.

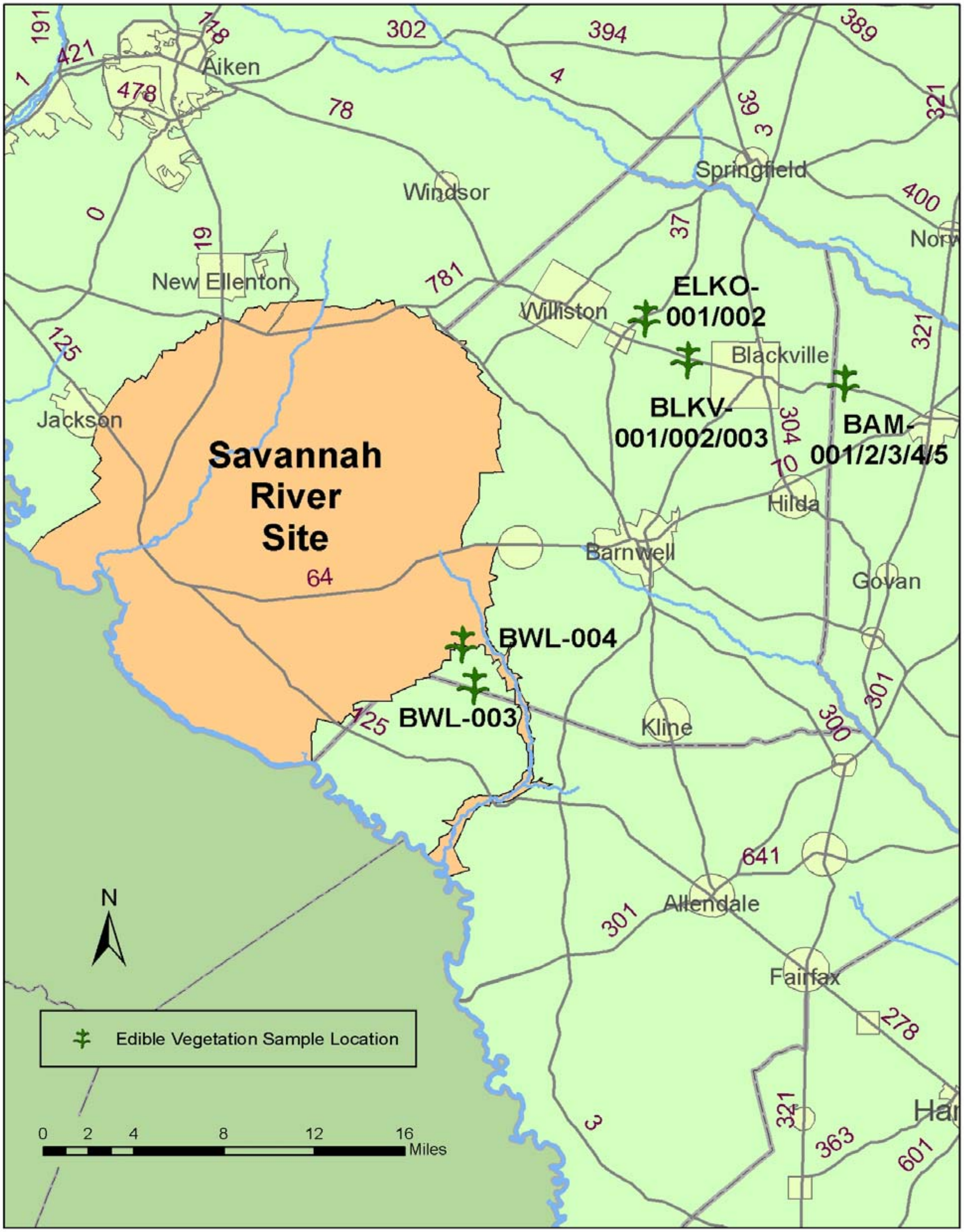
CONCLUSIONS AND RECOMMENDATIONS

Comparisons between ESOP and DOE-SR data could only be made on detection data due to the differences in the way the two groups report what is collected. ESOP edible vegetation samples collected for the season were found to have concentrations of tritium, K-40, Pb-212 and Pb-214 while DOE-SR reported detections of tritium Cs-137 and Sr-89/90

The only food product that could be compared between the ESOP and DOE-SR programs was greens. ESOP collected nine total samples of a variety of greens (turnips, bok choy, Chinese cabbage, cabbage and collards). Of these 9 samples, the only ESOP greens sample having a detection of tritium was turnips (greens and roots) collected within 50-miles (E1) of the SRS. The DOE-SR reported a total of five green samples, all of which were collards. Of these five samples, two were collected within their 0-10 mile quadrants and had detections of tritium. In comparing the statistical data and sampling locations, the assumption can be made that DOE-SR tritium values are higher than ESOP tritium values because DOE-SR sampling locations were closer in proximity to the SRS.

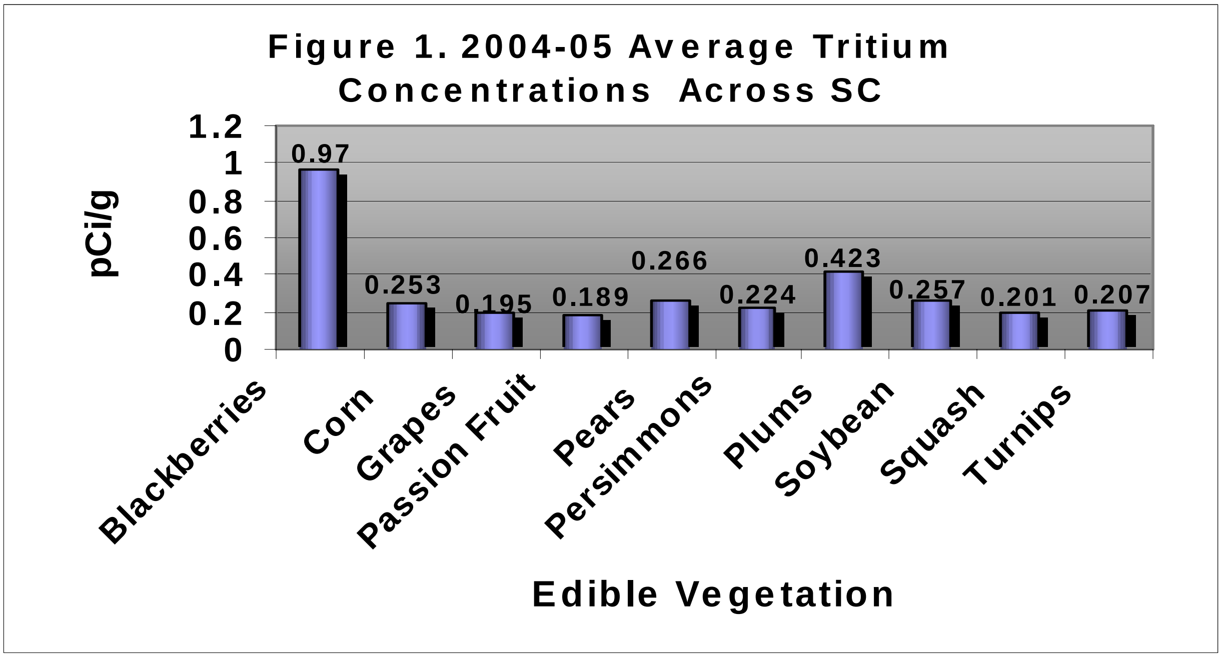
For the sampling year 2006, ESOP plans to continue sampling using the quadrant system format, conducting some strontium analysis for comparison purposes, and narrowing the sampling list to a more focused grouping. For better comparisons with DOE-SR data, DOE-SR may consider reporting what types of fruits or greens were collected at what locations in their data tables.

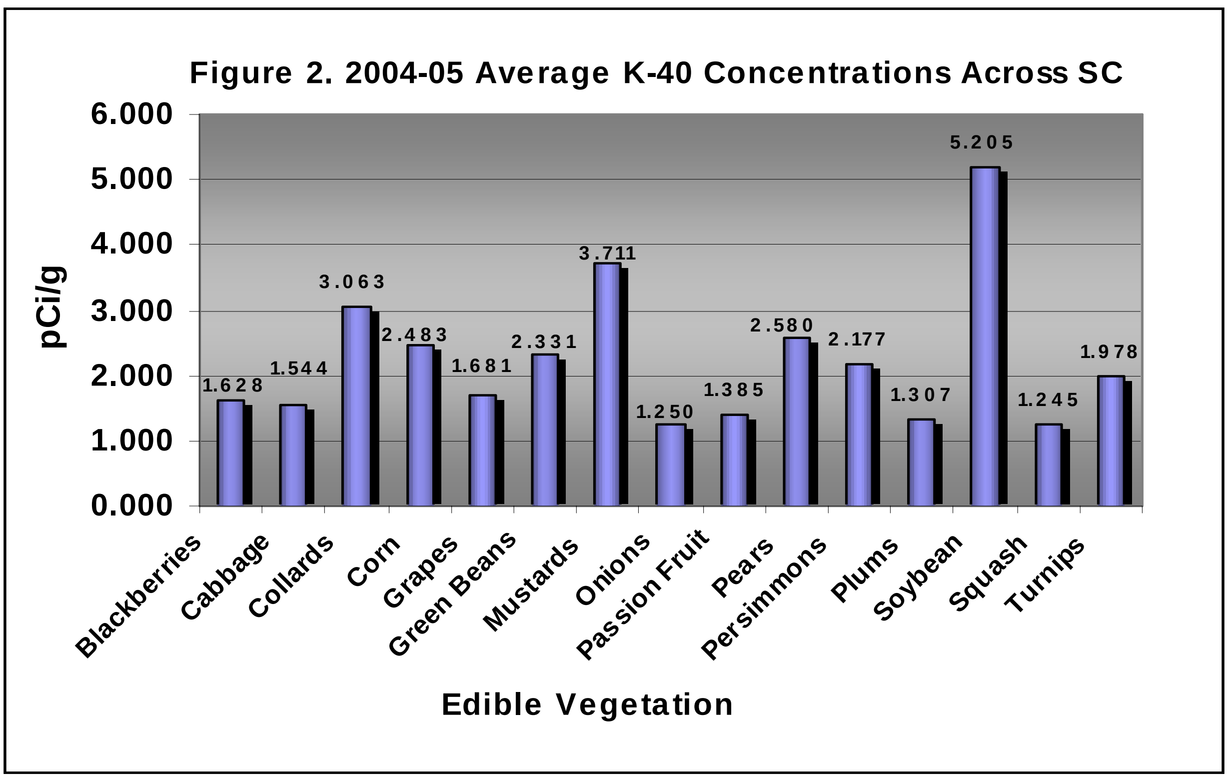
3.3.2
(Return to TOC)
Map 8. Edible Vegetation Monitoring Project



3.3.3 Tables and Figures
(Return to TOC)

Radiological Monitoring of Terrestrial Vegetation





3.3.4 Data

(Return to TOC)

Edible Vegetation Monitoring Data

Edible Vegetation Radiological Monitoring

(Return to TOC)

Random Sampling Data

Sample Location:		ESTE1-001	ESTE1-002	ESTE1-003	FURE1-001
Sample Date:		6/17/05	6/17/05	6/17/05	6/17/05
Type		Turnips	Turnips	Squash	Squash
Radionuclides					
Tritium	(pCi/g)	0.201	0.212	0.201	<167
+/-2	sigma	80.000	81.000	80.000	NA
K-40	(pCi/g)	1.405	1.682	1.245	2.042
+/-2	sigma	0.355	0.389	0.391	0.427
MDA		0.174	0.175	1.606	0.159
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.021	0.018	0.018	0.023
Pb-212	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.021	0.021	0.021	0.023
Pb-214	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.04	0.037	0.039	0.045
Sample Location:		EVE2-001	EVE5-001	EVE5-002	EVE5-003
Sample Date:		10/7/05	10/7/05	10/7/05	10/7/05
Type		Soybeans	Soybeans	Pears	Turnips
Radionuclides					
Tritium	(pCi/g)	0.257	<191	<191	<191
+/-2	sigma	91.000	NA	NA	NA
K-40	(pCi/g)	6.409	4.000	7.326	2.846
+/-2	sigma	0.650	0.492	0.720	0.510
MDA		0.199	0.168	0.225	0.245
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.025	0.022	0.026	0.027
Pb-212	(pCi/g)	<MDA	<MDA	0.203	<MDA
+/-2	sigma	NA	NA	0.027	NA
MDA		0.025	0.022	0.029	0.029
Pb-214	(pCi/g)	<MDA	<MDA	0.155	<MDA
+/-2	sigma	NA	NA	0.045	NA
MDA		0.046	0.043	0.050	0.051

NOTE:
NA= Not Applicable

Edible Vegetation Radiological Monitoring

(Return to TOC)

Random Sampling Data

Sample Location:		EVE6	EVE4	EVE3X	EVE8-001
Sample Date:		10/12/05	10/12/05	10/12/05	10/17/05
Type		Pears	Pears	Grapes	Persimmons
Radionuclides					
Tritium	(pCi/L)	<191	<191	0.195	<191
+/-2	sigma	NA	NA	88	NA
K-40	(pCi/g)	1.555	2.925	2.097	2.339
+/-2	sigma	0.3899	0.4376	0.368	0.367
MDA		0.2143	0.2253	0.1802	0.132
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.026	0.022	0.021	0.021

Sample Location:		EVE8-002	EVE7	EVE9	EVE10
Sample Date:		10/17/05	10/17/05	10/17/05	10/21/05
Type		Pears	Grapes	Persimmons	Persimmons
Radionuclides					
Tritium	(pCi/L)	<191	<191	<191	<191
+/-2	sigma	NA	NA	NA	NA
K-40	(pCi/g)	0.708	1.737	2.530	1.823
+/-2	sigma	0.302	0.382	0.378	0.334
MDA		0.163	0.160	0.131	0.134
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA
MDA		0.017	0.018	0.017	0.018

Sample Location:		PINEB2-001	FELB3-001	EVB24	EVB5	ALVB9-001
Sample Date:		06/17/05	06/27/05	10/17/05	10/24/05	07/11/05
Type		Corn	Corn	Persimmons	Persimmons	Green Beans
Radionuclides						
Tritium	(pCi/L)	253.000	<167	<191	<191	<167
+/-2	sigma	83.000	NA	NA	NA	NA
K-40	(pCi/g)	2.064	2.868	2.335	2.328	2.331
+/-2	sigma	0.499	0.596	0.380	0.367	0.630
MDA		0.203	0.255	0.135	0.137	0.252
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	Na	NA	NA	NA
MDA		0.024	0.028	0.016	0.017	0.032

NOTE:
NA= Not Applicable

Edible Vegetation Radiological Monitoring

(Return to TOC)

Non-Random Sampling Data

Sample Location:		BAM-001	BAM-002	BAM-003	BAM-004	BAM-005	ELKO-001
Sample Date:		2/7/05	2/7/05	2/7/05	2/7/05	2/7/05	2/7/05
Type		Onions	BokChoy	Chinese Cabbage	Collards	Honey	Collards
Radionuclides							
Tritium	(pCi/L)	<185	<185	<185	<185	<185	<185
+/-2	sigma	NA	NA	NA	NA	NA	NA
K-40	(pCi/g)	1.250	4.393	1.007	3.199	<MDA	3.263
+/-2	sigma	0.440	0.695	0.447	0.546	NA	0.534
MDA		0.209	0.234	0.192	0.221	<0.016	0.197
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA	NA	NA
MDA		<0.022	<0.032	<0.024	<0.024	<0.02	<0.025
Sample Location:		ELKO-002	BLKV-001	BLKV-002	BLKV-003	BWL-003	BWL-004
Sample Date:		2/7/05	2/7/05	2/7/05	2/7/05	6/23/05	6/23/05
Type		Cabbage	Collards	Fescue	Rye	Plums	Blackberries
Radionuclides							
Tritium	(pCi/g)	<185	<185			0.330	0.550
+/-2	sigma	NA	NA			86.000	96.000
K-40	(pCi/g)	0.193	3.726	6.866	6.072	0.819	0.858
+/-2	sigma	0.4582	0.7235	0.9319	0.8951	0.305	0.336
MDA		0.2262	0.303	0.336	0.35	0.200	1.443
Cs-137	(pCi/g)	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA
+/-2	sigma	NA	NA	NA	NA	NA	NA
MDA		<0.022	<0.033	<0.040	<0.0400	0.017	0.017

NOTE:
NA= Not Applicable

Data Not Reported

3.3.5 Summary Statistics
Edible Vegetation Radiological Monitoring

(Return to TOC)

Environmental And Background Data

			Tritium	K-40	Pb-212	Pb-214
Sample Location:	Sample Date:	Type	pCi/g	pCi/g	pCi/g	pCi/g
BWL-004	6/23/05	Blackberries	0.550	0.858	<MDA	<MDA
BAM-002	2/7/05	BokChoy	<MDA	4.393	<MDA	<MDA
ELKO-002	2/7/05	Cabbage	<MDA	0.193	<MDA	<MDA
BAM-003	2/7/05	Chinese Cabbage	<MDA	1.007	<MDA	<MDA
BAM-004	2/7/05	Collards	<MDA	3.199	<MDA	<MDA
BLKV-001	2/7/05	Collards	<MDA	3.726	<MDA	<MDA
ELKO-001	2/7/05	Collards	<MDA	3.263	<MDA	<MDA
FELB3-001	06/27/05	Corn	<MDA	2.868	<MDA	<MDA
PINEB2-001	06/17/05	Corn	0.253	2.064	<MDA	<MDA
BLKV-002	2/7/05	Fescue	<MDA	6.866	<MDA	<MDA
EVE3X	10/12/05	Grapes	0.195	2.097	<MDA	<MDA
EVE7	10/17/05	Grapes	<MDA	1.737	<MDA	<MDA
ALVB9-001	07/11/05	Green Beans	<MDA	2.331	<MDA	<MDA
BAM-005	2/7/05	Honey	<MDA	<MDA	<MDA	<MDA
BAM-001	2/7/05	Onions	<MDA	1.250	<MDA	<MDA
EVE4	10/12/05	Pears	<MDA	2.925	<MDA	<MDA
EVE5-002	10/7/05	Pears	<MDA	7.326	0.203	0.155
EVE6	10/12/05	Pears	<MDA	1.555	<MDA	<MDA
EVE8-002	10/17/05	Pears	<MDA	0.708	<MDA	<MDA
EVB24	10/17/05	Persimmons	<MDA	2.335	<MDA	<MDA
EVB5	10/24/05	Persimmons	<MDA	2.328	<MDA	<MDA
EVE10	10/21/05	Persimmons	<MDA	1.823	<MDA	<MDA
EVE8-001	10/17/05	Persimmons	<MDA	2.339	<MDA	<MDA
EVE9	10/17/05	Persimmons	<MDA	2.530	<MDA	<MDA
BWL-003	6/23/05	Plums	0.330	0.819	<MDA	<MDA
BLKV-003	2/7/05	Rye	<MDA	6.072	<MDA	<MDA
EVE2-001	10/7/05	Soybeans	0.257	6.409	<MDA	<MDA
EVE5-001	10/7/05	Soybeans	<MDA	4.000	<MDA	<MDA
ESTE1-003	6/17/05	Squash	0.201	1.245	<MDA	<MDA
FURE1-001	6/17/05	Squash	<MDA	2.042	<MDA	<MDA
ESTE1-001	6/17/05	Turnips	0.201	1.405	<MDA	<MDA
ESTE1-002	6/17/05	Turnips	0.212	1.682	<MDA	<MDA
EVE5-003	10/7/05	Turnips	<MDA	2.846	<MDA	<MDA
Average	includes Background		0.275	2.704	0.203	0.155
Standard Deviation			0.120	1.8132	N/A	N/A
Median			0.253	2.330	0.203	0.155
n =			8	32	1	1

Summary Statistics
Edible Vegetation Radiological Monitoring

(Return to TOC)

Environmental Data

Sample Location:	Sample Date:	Type	Tritium pCi/g	K-40 pCi/g	Pb-212 pCi/g	Pb-214 pCi/g
BWL-004	6/23/05	Blackberries	0.550	0.858	<MDA	<MDA
BAM-002	2/7/05	BokChoy	<MDA	4.393	<MDA	<MDA
ELKO-002	2/7/05	Cabbage	<MDA	0.193	<MDA	<MDA
BAM-003	2/7/05	Chinese Cabbage	<MDA	1.007	<MDA	<MDA
BAM-004	2/7/05	Collards	<MDA	3.199	<MDA	<MDA
BLKV-001	2/7/05	Collards	<MDA	3.726	<MDA	<MDA
ELKO-001	2/7/05	Collards	<MDA	3.263	<MDA	<MDA
BLKV-002	2/7/05	Fescue	<MDA	6.866	<MDA	<MDA
EVE3X	10/12/05	Grapes	0.195	2.097	<MDA	<MDA
EVE7	10/17/05	Grapes	<MDA	1.737	<MDA	<MDA
BAM-005	2/7/05	Honey	<MDA	<MDA	<MDA	<MDA
BAM-001	2/7/05	Onions	<MDA	1.250	<MDA	<MDA
EVE4	10/12/05	Pears	<MDA	2.925	<MDA	<MDA
EVE5-002	10/7/05	Pears	<MDA	7.326	0.203	0.155
EVE6	10/12/05	Pears	<MDA	1.555	<MDA	<MDA
EVE8-002	10/17/05	Pears	<MDA	0.708	<MDA	<MDA
EVE10	10/21/05	Persimmons	<MDA	1.823	<MDA	<MDA
EVE8-001	10/17/05	Persimmons	<MDA	2.339	<MDA	<MDA
EVE9	10/17/05	Persimmons	<MDA	2.530	<MDA	<MDA
BWL-003	6/23/05	Plums	0.330	0.819	<MDA	<MDA
BLKV-003	2/7/05	Rye	<MDA	6.072	<MDA	<MDA
EVE2-001	10/7/05	Soybeans	0.257	6.409	<MDA	<MDA
EVE5-001	10/7/05	Soybeans	<MDA	4.000	<MDA	<MDA
ESTE1-003	6/17/05	Squash	0.201	1.245	<MDA	<MDA
FURE1-001	6/17/05	Squash	<MDA	2.042	<MDA	<MDA
ESTE1-001	6/17/05	Turnips	0.201	1.405	<MDA	<MDA
ESTE1-002	6/17/05	Turnips	0.212	1.682	<MDA	<MDA
EVE5-003	10/7/05	Turnips	<MDA	2.846	<MDA	<MDA
Average	includes Background		0.278	2.757	0.203	0.155
Standard Deviation			0.129	1.971	N/A	N/A
Median			0.212	2.097	0.203	0.155
n =			7	27	1	1

Summary Statistics
Edible Vegetation Radiological Monitoring

(Return to TOC)

Background Data

			Tritium	K-40
Sample Location:	Sample Date:	Type	pCi/g	pCi/g
FELB3-001	06/27/05	Corn	<MDA	2.868
PINEB2-001	06/17/05	Corn	0.253	2.064
ALVB9-001	07/11/05	Green Beans	<MDA	2.331
EVB24	10/17/05	Persimmons	<MDA	2.335
EVB5	10/24/05	Persimmons	<MDA	2.328
Average			0.253	2.385
Standard Deviation			N/A	0.294
Median			0.253	2.331
n =			1	5

Environmental Data - Leafy Vegetables

			Tritium
Sample Location:	Sample Date:	Type	pCi/g
ESTE1-001	6/17/05	Turnips	0.201
ESTE1-002	6/17/05	Turnips	0.212
EVE5-003	10/7/05	Turnips	<MDA
BAM-002	2/7/05	BokChoy	<MDA
ELKO-002	2/7/05	Cabbage	<MDA
BAM-003	2/7/05	Chinese Cabbage	<MDA
BAM-004	2/7/05	Collards	<MDA
BLKV-001	2/7/05	Collards	<MDA
ELKO-001	2/7/05	Collards	<MDA
Average			0.207
Standard Deviation			0.008
Median			0.207
n =			2

SRS Greens Data

Media	Sample Location	Sample Date	Tritium
Greens	NE-Quadrant 0-10 Miles	1/3/2005	0.549
	NW Quadrant 0-10 Miles	1/3/2005	0.705
	SE Quadrant 0-10 Miles	1/6/2005	<MDA
	SE Quadrant 25 Miles	1/3/2005	<MDA
	SW Quadrant 0-10 Miles	1/6/2005	<MDA
Average			0.627
Standard Deviation			0.110
Median			0.627
n =			2

Summary Statistics
Edible Vegetation Radiological Monitoring

(Return to TOC)

SRS Comparative data						
	Media	Sample Location	Sample Date	Tritium	Cs-137	Sr-89/90
Greens		NE-Quadrant 0-10 Miles	1/3/2005	0.549	0.023	<MDA
		NW Quadrant 0-10 Miles	1/3/2005	0.705	<MDA	<MDA
		SE Quadrant 0-10 Miles	1/6/2005	<MDA	0.113	0.673
		SE Quadrant 25 Miles	1/3/2005	<MDA	0.04	0.172
		SW Quadrant 0-10 Miles	1/6/2005	<MDA	0.05	<MDA
Pecans		NE Quadrant 0-10 Miles	12/15/2005	0.136	<MDA	<MDA
		NW Quadrant 0-10 Miles	12/13/2005	0.083	<MDA	<MDA
		SE Quadrant 0-10 Miles	12/15/2005	0.098	<MDA	<MDA

Total Tritium Average	0.314		
Total Tritium Standard Deviation	0.292		
Total Tritium Median	0.136		
Average Cesium-137 Greens		0.056	
Standard Deviation Cesium-137 Greens		0.039	
Median Greens		0.045	
Average Strontium 89/90 Greens			0.423
Standard Deviation Strontium Greens			0.354
Median Greens			0.423

3.4 Radiological Monitoring of Dairy Milk

(Return to TOC)

3.4.1 Summary

The Department of Energy-Savannah River (DOE-SR) has historically monitored radionuclides in cow milk collected from dairies around the Savannah River Site. During 2005, DOE-SR collected cow milk samples from five dairy locations. The South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Program (ESOP) collected milk at seven cow dairy locations (five perimeter and two background) to provide an independent source of data on concentrations of radionuclides in milk.

ESOP personnel collected the cow milk samples on a quarterly basis in 2005 (Map 9, section 3.4.2). No samples were collected during the third quarter of 2005 due to travel restrictions. Cow milk samples from each quarter were analyzed for tritium and select gamma-emitting radionuclides (Iodine-131, Cesium-137, Cobalt-60). Samples collected from the first quarter were analyzed for Strontium-89, 90.

ESOP did not detect any tritium or gamma-emitting radionuclides in cow milk collected during 2005. Strontium-89 was detected in a sample collected from one location, while Strontium-90 was detected in samples collected from six of the seven locations.

RESULTS AND DISCUSSION

Tritium

DOE-SR uses all data to calculate means including tritium data below the Lower Limit of Detection (LLD). ESOP does not use numbers less than the corresponding MDA because they cannot be accurately quantified. All ESOP cow milk samples collected during 2005 had tritium levels that were below the lower limit of detection (LLD). The highest tritium value reported by DOE-SR was 178 picocuries per Liter (pCi/L) (± 98.2 pCi/L) from a sample collected in Denmark, SC (WSRC, 2006). The tritium results for all milk samples collected by ESOP are given in section 3.4.4. No summary statistics were calculated for tritium.

Gamma-emitting radionuclides

Iodine-131, cesium-137, and cobalt-60 are all manmade radioactive elements. All analytical results for these radionuclides were below the respective MDA for the seven dairy locations samples by the ESOP milk monitoring program. For the DOE-SR samples collected, the highest concentration recorded for gamma-emitting radionuclides was 3.38 pCi/L (± 0.876 pCi/L) for Cs-137 and 2.21 pCi/L (± 1.16 pCi/L) for Co-60. DOE-SR did not analyze for I-131. All ESOP analytical results for gamma-emitting radionuclides are located in section 3.4.4. No summary statistics were calculated for these radionuclides.

Strontium

Strontium-90 analysis was performed on cow milk samples collected during the first quarter. All dairy locations had detections for Sr-90. The range for these detections was 0.327 pCi/L to 0.622 pCi/L, with the minimum detection in a sample from Govan, SC and the maximum detection in a sample from Johnston, SC. The average for Sr-90 was 0.466 pCi/L (± 0.096 pCi/L). DOE-SR reported a detect of 3.43 pCi/L (± 1.26 pCi/L) in a sample collected from Waynesboro, GA and a detect of 4.11 pCi/L (±1.20 pCi/L) in a sample collected from Denmark, SC. Results from both monitoring programs are well below the EPA's average annual Maximum Contaminant Level (MCL) for Sr-90 in Drinking Water (8pCi/L). Figure 1 in section 3.4.3 shows Sr-90 trends for ESOP cow milk collected from 1998-2005. All analytical results and summary statistics for ESOP strontium data are located in section 3.4.4.

CONCLUSIONS AND RECOMMENDATIONS

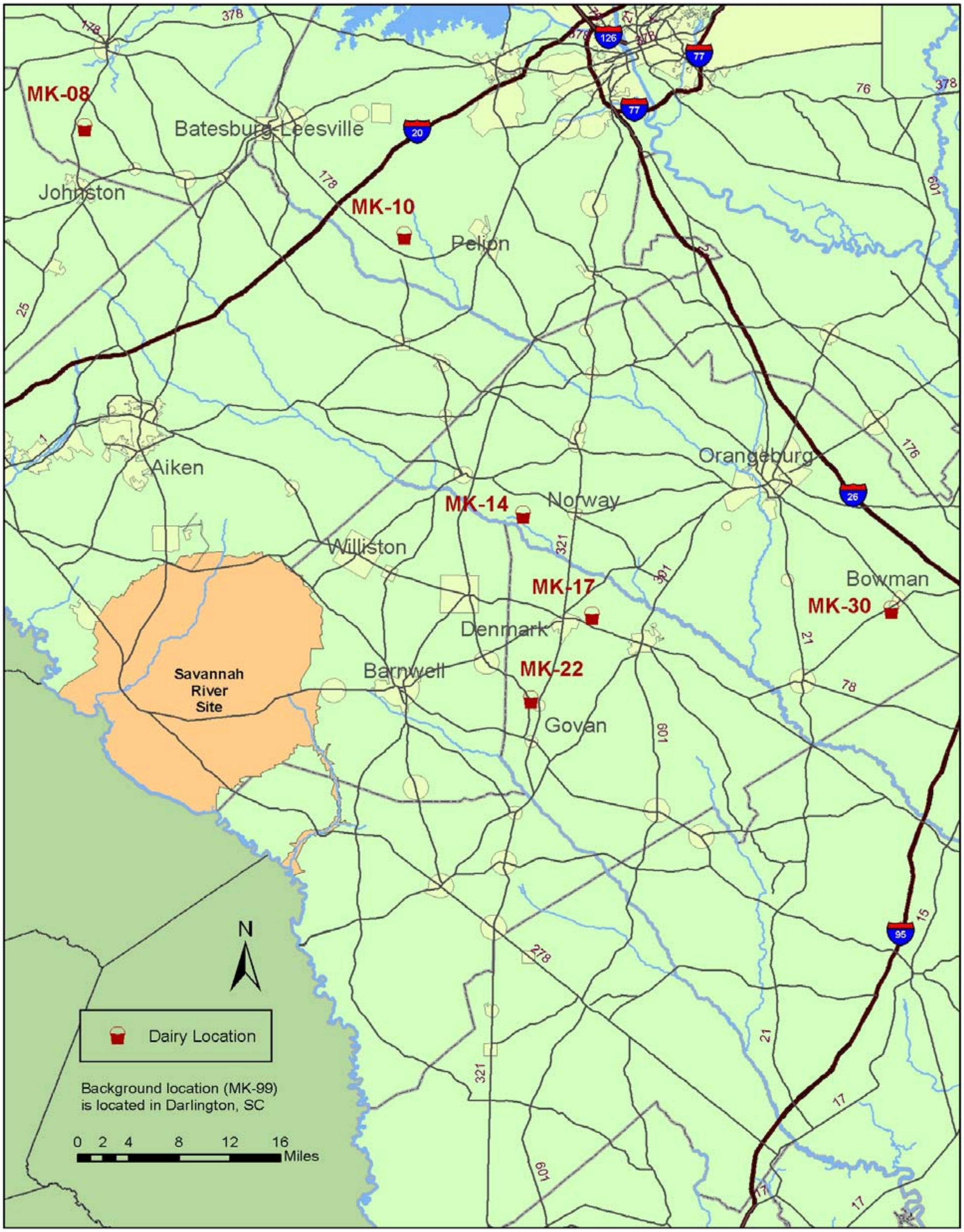
The DOE-SR uses all analytical results, including below minimum detection levels (MDL), to compute means. Therefore, dairy milk analytical data comparisons between ESOP and DOE-SR are limited in scope. Additionally, milk samples were not randomly collected. Therefore, no statistical testing between ESOP and DOE-SR data was conducted.

A large portion of the radioactive contamination observed in collected milk samples may be attributed to fallout from past nuclear testing. Additionally, radionuclides within soil and plants can potentially be redistributed as a result of farming practices and controlled burns. ESOP will continue to monitor tritium and gamma-emitting radionuclides in cow milk to ensure the safety of milk consumption by the public. Additionally, strontium analysis will be conducted on samples collected from each quarter in 2006 in order to more closely follow the monitoring program of DOE-SR.

3.4.2

(Return to TOC)

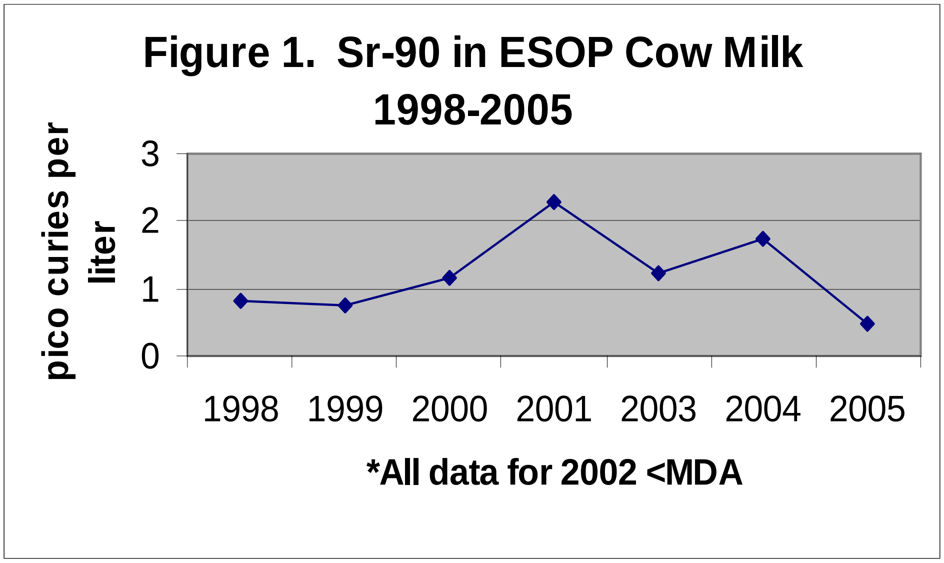
Map 9. Radiological Monitoring Locations for Dairy Milk



3.4.3 Tables and Figures

(Return to TOC)

Radiological Monitoring of Dairy Milk



3.4.4 Data

(Return to TOC)

Radiological Monitoring of Dairy Milk

Radiological Monitoring of Dairy Milk
Gamma Data for Cow Milk

(Return to TOC)

Sample ID		MK- 8			
Sample Location		Johnston, SC			
Sample Date		23 MAR 05	06 JUN 05	3rd QTR	16 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD				
	LLD	261	244		240
	Co - 60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.44	2.19		2.14
	I-131 Activity	<MDA	8 HLE	NS	<MDA
	+/-2 SD				
	MDA	3.39			39.68
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.70	1.78		2.14

Sample ID		MK- 10			
Sample Location		Leesville, SC			
Sample Date:		23 MAR 05	07 JUN 05	3rd QTR	16 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD				
	LLD	261	245		240
	Co - 60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.35	2.18		2.04
	I-131 Activity	<MDA	8 HLE	NS	<MDA
	+/-2 SD				
	MDA	3.55			50.16
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.70	2.04		1.94

Sample ID		MK- 14			
Sample Location		Norway, SC			
Sample Date:		22 MAR 05	03 JUN 05	3rd QTR	14 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD				
	LLD	261	258		242
	Co - 60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.29	2.12		1.74
	I-131 Activity	<MDA	8 HLE	NS	<MDA
	+/-2 SD				
	MDA	3.45			42.97
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.63	1.96		1.94

Notes:

1. NS = No Sample
2. SD = Standard Deviation
3. LLD = Lower Limit of Detection
4. MDA = Minimum Detectable Activity
5. 8 HLE = More than 8 half lives have elapsed

Radiological Monitoring of Dairy Milk
Gamma Data for Cow Milk

(Return to TOC)

Sample ID		MK-17			
Sample Location		Denmark, SC			
Sample Date:		22 MAR 05	03 JUN 05	3rd QTR	14 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD				
	LLD	262	258		242
	Co-60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.44	1.86		2.31
	I-131 Activity	<MDA	8 HLE	NS	<MDA
	+/-2 SD				
	MDA	3.53			44.58
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.59	1.54		2.17

Sample ID		MK-22			
Sample Location		Govan, SC			
Sample Date:		22 MAR 05	02 JUN 05	3rd QTR	14 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD	NA	NA		
	LLD	261	258		241
	Co-60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.41	2.07		2.08
	I-131 Activity	<MDA	8 HLE	NS	<MDA
	+/-2 SD				
	MDA	3.16			41.28
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.69	2.11		2.12

Notes:
1. NS = No Sample
2. SD = Standard Deviation
3. LLD = Lower Limit of Detection
4. MDA = Minimum Detectable Activity
5. 8 HLE = More than 8 half lives have elapsed

Radiological Monitoring of Dairy Milk
Gamma Data for Cow Milk

(Return to TOC)

Sample ID		MK-30			
Sample Location		Bowman, SC			
Sample Date:		27 JAN 05	02 JUN 05	3rd QTR	22 DEC 05
Radionuclides:	Tritium Activity	<LLD	<LLD	NS	<LLD
	+/-2 SD				
	LLD	263	258		239
	Co-60 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.31	2.06		1.97
	I-131 Activity	8 HLE	8 HLE	NS	<MDA
	+/-2 SD				
	MDA				32.10
	Cs-137 Activity	<MDA	<MDA	NS	<MDA
	+/-2 SD				
	MDA	2.70	2.02		2.03

Sample ID		MK-99			
Sample Location		Darlington, SC			
Sample Date:		1 QTR	01 JUN 05	3rd QTR	29 DEC 05
Radionuclides:	Tritium Activity	NS	<LLD	NS	<LLD
	+/-2 SD				
	LLD		259		240
	Co-60 Activity	NS	<MDA	NS	<MDA
	+/-2 SD				
	MDA		2.17		2.00
	I-131 Activity	NS	8 HLE	NS	<MDA
	+/-2 SD				
	MDA				18.14
	Cs-137 Activity	NS	<MDA	NS	<MDA
	+/-2 SD				
	MDA		1.83		1.81

Notes:
1. NS = No Sample
2. SD = Standard Deviation
3. LLD = Lower Limit of Detection
4. MDA = Minimum Detectable Activity
5. 8 HLE = More than 8 half lives have elapsed

Radiological Monitoring of Dairy Milk
Strontium Data for Cow Milk

(Return to TOC)

Sample ID		MK-8	MK-10	MK-14	MK-17	MK-22	MK-30
Sample Location		Johnston, SC	Leesville, SC	Norway, SC	Denmark, SC	Govan, SC	Bowman, SC
Sample Date:		22 MAR 05	23 MAR 05	22 MAR 05	22 MAR 05	22 MAR 05	27 JAN 05
Radionuclides:	Sr - 89 Activity	<MDA	<MDA	**0.826**	<MDA	<MDA	<MDA
	+/-2 SD			**0.341**			
	MDA	0.163	0.382	**0.373**	0.183	0.174	0.932
	Sr - 90 Activity	**0.622**	**0.425**	**0.480**	**0.477**	**0.327**	**0.464**
	+/-2 SD	**0.242**	**0.242**	**0.215**	**0.254**	**0.242**	**0.270**
	MDA	**0.363**	**0.408**	**0.331**	**0.425**	**0.433**	**0.463**

Notes:
1. No sample was collected from location #99 for the 1st quarter
2. SD = Standard Deviation
3. MDA = Minimum Detectable Activity

Summary statistics for Strontium-90 (Detects only)

Sr-90	AVG	ST DEV	MEDIAN	MAX	MIN
	0.466	0.096	0.471	0.622	0.327

3.5 FFA Oversight Monitoring

(Return to TOC)

3.5.1 Summary

The South Carolina Department of Health and Environmental Control's Environmental Surveillance and Oversight Program (ESOP) personnel provided Quality Assurance / Quality Control oversight of Department of Energy – Savannah River (DOE-SR) pre-characterization sampling activities at a selected Site Evaluation area on May 4, 2005. Oversight activities included splitting soil samples, observing sampling activities, and ensuring adherence to Westinghouse Savannah River Company sampling protocol.

Observation of sampling activities and the splitting of soil samples was limited to a few locations at the Early Construction and Operations Disposal Site (ECODS) G-5 (Map 10, section 3.5.2). Samples were acquired through the use of hand augering. The sampling performed by DOE-SR contractors was done in accordance with established DOE-SR protocols and procedures.

Unlike other ECODS, ECODS G-5 was not utilized as a waste disposal trench but as a firing range by DOE-SR security personnel in the early 1950s (WSRC, 2003a).

ESOP soil sampling values were compared to the associated United States Environmental Protection Agency's Region IX Preliminary Remediation Goals and the corresponding DOE-SR reported values. No residential exceedances were detected by ESOP sampling. Overall, a statistical analysis demonstrated that DOE-SR analytical averaged results were comparable to ESOP results.

RESULTS AND DISCUSSION

All analytical data is in section 3.5.4.

Map 11 depicts the selected SE area location on the SRS. The preliminary evaluation performed by DOE-SR contractors assessed the extent of contamination at the SE area location through the sampling of soil in a key location (i.e. down-gradient). Guidance provided by the USEPA (USEPA, 1992) was utilized by ESOP personnel for site inspections. No deviations from established DOE-SR sampling procedures and protocols were observed. SCDHEC's ASD performed the TAL analyses for metals on the split soil samples.

A review of DOE-SR analytical data indicated detections of arsenic above the established USEPA Region IX Residential Preliminary Remediationi Goals (PRG)(Table 1, section 3.5.3) for non-radionuclides (USEPA, 2004b). Residential PRGs are more conservative than industrial worker PRGs (Table 2, section 3.5.3).

Overall DOE-SR analytical averaged results were within two standard deviations (SD) of ESOP results except for calcium (section 3.5.5). The variation in WSRC's average calcium result of 67 mg/kg (± 4SD where one SD = 6.4 mg/kg) is most likely associated with the heterogeneous nature of the soil associated with sampling interval B (section 3.5.5).

CONCLUSIONS AND RECOMMENDATIONS

The project attempted to evaluate WSRC site evaluation monitoring strategy and procedures, provide an independent source of information concerning results of monitoring, and evaluate sampling protocol through observation of sampling for adherence to established WSRC standard operating procedures. The results demonstrate that Arsenic exceeded the established residential PRG. In addition, statistical tests demonstrate that the majority of DOE-SR analytical results were comparable with ESOP results.

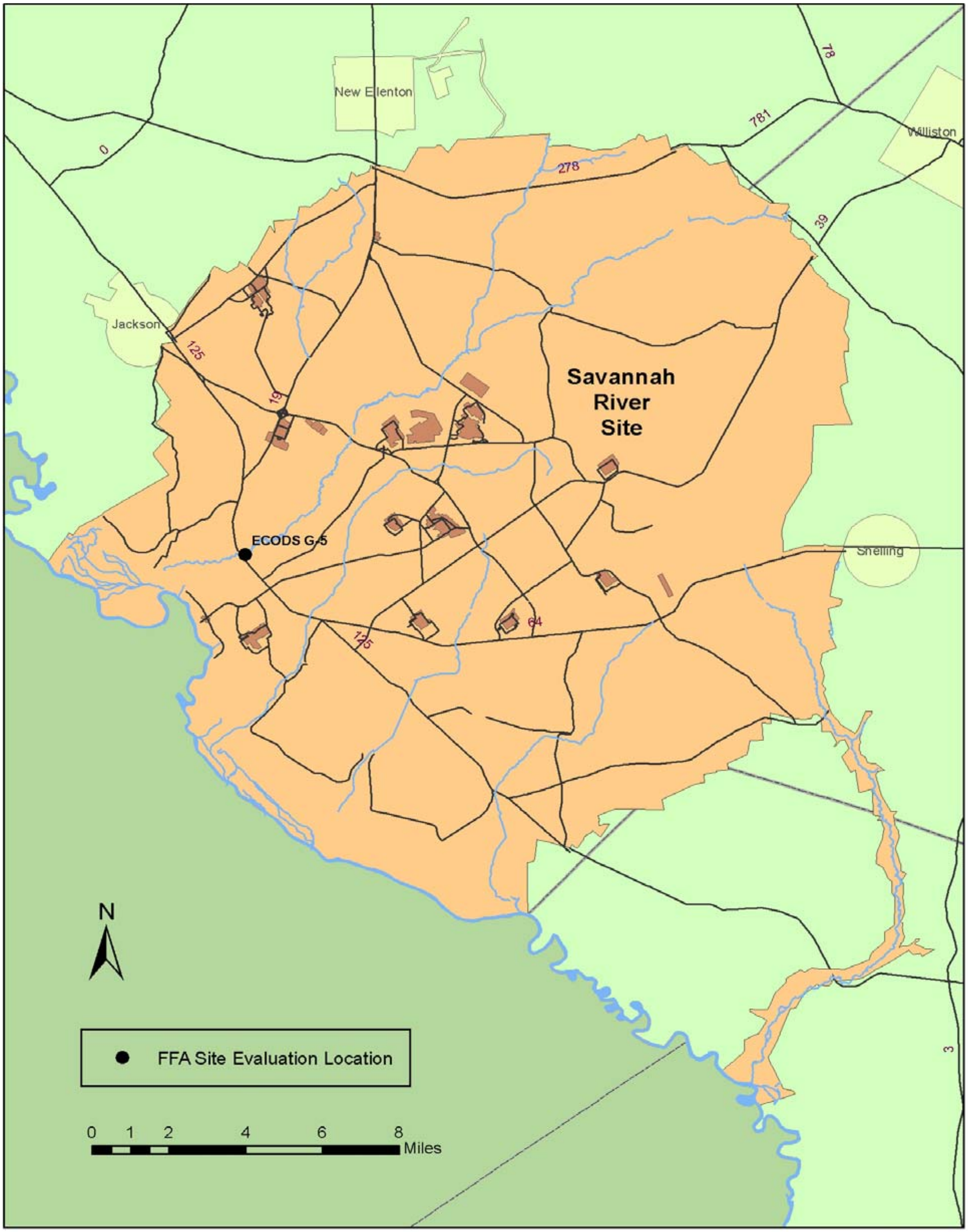
QA/QC oversight of DOE-SR contractor's pre-characterization sampling activities at selected SE areas will continue as needed. Continued oversight will provide assurance to the public that DOE-SR contractors' SE sampling activities adhere to prescribed procedures and independent sampling results are obtained.

Due to several lab detection levels (Arsenic @ <10 mg/kg) quantified above the established PRG, it is recommended that SCDHEC laboratory processes be evaluated to determine if lower detection levels can be achieved. Otherwise, soil samples may be sent to a contract lab for reduced detection limits.

3.5.2

(Return to TOC)

Map 10. Federal Facility Agreement Evaluation Site



3.5.3 Tables and Figures
(Return to TOC)

FFA Oversight Monitoring

Table 1 - PRG Exceedances {Early Construction and Operational Disposal Site (ECODS)

Analyte	Location	SRS Result	SCDHEC Result	PRG Residential
Arsenic	EG5-46A	**1.75**	<10	0.39
Arsenic	EG5-46B	**1.61**	<10	0.39
Arsenic	EG5-48A	**1.60**	<10	0.39
Arsenic	EG5-48B	**1.55**	<10	0.39

Note:

- 1. SCDHEC's lab current method detection limit is < 10 mg/kg. Future samples may be shipped to a contract lab for analysis if lower detection limits are required.
- 2. Results in mg/kg

Table 2. USEPA Region 9 Preliminary Remediation Goals

Analyte (mg/kg)	**Metals**	**Residential**	**Industrial**
	Aluminum	76,000	100,000
	Antimony	31	410
	Arsenic	0.39	1.6
	Barium	5,400	67,000
	Beryllium	150	1,900
	Cadmium	37	450
	Calcium	None	None
	Chromium	210	450
	Cobalt	900	1,900
	Copper	3,100	41,000
	Iron	23,000	100,000
	Lead	400	800
	Magnesium	None	None
	Manganese	1,800	19,000
	Mercury	23	310
	Nickel	1,600	20,000
	Potassium	None	None
	Selenium	390	5,100
	Silver	390	5,100
	Sodium	None	None
	Thallium	5.2	67
	Vanadium	78	1,000
	Zinc	23,000	100,000

3.5.4 Data

(Return to TOC)

FFA Oversight Monitoring and Support Data

FFA Oversight Monitoring and Support Data

(Return to TOC)

ECODS G-5					
Sample Date: 05/04/05					
Sample Locations:		EG5-46A	EG5-46B	EG5-48A	EG5-48B
Analyte (mg/kg)	Aluminum	19,000	12,000	6,200	4,800
	Antimony	9.1	5.9	<5.0	<5.0
	Arsenic	<10	<10	<10	<10
	Barium	120	56	61	43
	Beryllium	1.6	0.47	1.6	1.4
	Cadmium	<1.0	<1.0	<1.0	<1.0
	Calcium	160	95	420	86
	Chromium	12	15	6.7	3.0
	Cobalt	<2.0	<2.0	<2.0	<2.0
	Copper	3.8	3.1	2.3	1.4
	Iron	2,700	1,700	4,400	1,300
	Lead	23	17	10	5.9
	Magnesium	380	230	220	130
	Manganese	160	17	310	90
	Mercury	<0.10	<0.10	<0.10	<0.10
	Nickel	5.8	2.8	3.4	2.8
	Potassium	220	190	130	<100
	Selenium	<10	<10	<5.0	<10
	Silver	<3.0	<3.0	<3.0	<3.0
	Sodium	12	<10	<10	<10
	Thallium	<50	<50	<50	<50
	Vanadium	5.4	8.2	3.7	<2.0
	Zinc	13	5.7	12	7.7

3.5.5 Summary Statistics
FFA Oversight Monitoring

(Return to TOC)

SCDHEC					
Analyte (mg/kg)	**EG5-46A**	**EG5-48A**	**Average**	**Standard Deviation**	**Median**
Aluminum	19,000	6,200	12600.0	9051	12600.0
Barium	120	61	90.5	42	90.5
Beryllium	1.6	1.6	1.6	0	1.6
Calcium	160	420	290.0	183.8	236.9
Chromium	12	6.7	9.4	3.7	9.4
Copper	3.8	2.3	3.1	1.1	3.1
Iron	2,700	4,400	3550.0	1202.1	3550.0
Lead	23	10	16.5	9.2	16.5
Magnesium	380	220	300.0	113.1	300.0
Manganese	160	310	235.0	106.1	235.0
Nickel	5.8	3.4	4.6	1.7	4.6
Potassium	220	130	175.0	63.6	175.0
Vanadium	5.4	3.7	4.6	1.2	4.6
Zinc	13	12	12.5	0.7	12.5
WSRC					
Analyte (mg/kg)	**EG5-46A**	**EG5-48A**	**Average**	**Standard Deviation**	**Median**
Aluminum	32,400	6,600	19,500	18243.4	19,500
Barium	118	56.8	87	43.3	87
Beryllium	1	1.6	1	0.4	1
Calcium	153	320	237	118.1	237
Chromium	13	5.6	9	5.2	9
Copper	4.4	2.4	3	1.4	3
Iron	2,770	3,350	3,060	410.1	3,060
Lead	9.54	4.24	6.89	3.7	7
Magnesium	481	239	360	171.1	360
Manganese	125	333	229	147.1	229
Nickel	6.26	3.55	4.905	1.9	5
Potassium	298	167	232.5	92.6	233
Vanadium	8.69	5.64	7.165	2.2	7
Zinc	15	13.8	14.4	0.8	14

Summary Statistics
FFA Oversight Monitoring

(Return to TOC)

SCDHEC					
Analyte (mg/kg)	**EG5-46B**	**EG5-48B**	**Average**	**Standard Deviation**	**Median**
Aluminum	12,000	4,800	8,400	5091	8,400
Barium	56	43	50	9	50
Beryllium	0.47	1.4	1	0.7	1
Calcium	95	86	91	6.4	91
Chromium	15	3	9	8.5	9
Copper	3.1	1.4	2	1.2	2
Iron	1,700	1,300	1,500	282.8	1,500
Lead	17	5.9	11	7.8	11
Magnesium	230	130	180	70.7	180
Manganese	17	90	54	51.6	54
Nickel	2.8	2.8	3	0.0	3
Zinc	5.7	7.7	7	1.4	7

WSRC					
Analyte (mg/kg)	**EG5-46B**	**EG5-48B**	**Average**	**Standard Deviation**	**Median**
Aluminum	17,900	4,420	11,160	9531.8	11,160
Barium	62.6	36.9	50	18.2	50
Beryllium	0.198	0.849	1	0.5	1
Calcium	70.5	63.7	67	4.8	67
Chromium	16	2.97	9	9.2	9
Copper	4.1	1.23	3	2.0	3
Iron	1,860	920	1,390	664.7	1,390
Lead	8.24	2.02	5	4.4	5
Magnesium	318	152	235	117.4	235
Manganese	14	49.9	32	25.4	32
Nickel	4.86	2.46	4	1.7	4
Zinc	8.47	7.89	8	0.4	8

4.1 Radiological Monitoring of Fish Adjacent To SRS (Return to TOC)

4.1.1 Summary

The Environmental Surveillance and Oversight Program (ESOP) conducts fish monitoring for radionuclide activity in an effort to determine the magnitude, extent, and trends of radionuclide levels. Five largemouth bass (*Micropterus salmoides)* and five catfish (*Ameiurus catus* or *Ictalurus punctatus*) were collected from nine sample locations. Studies have shown that these species bioaccumulate measurable amounts of radionuclides. Sunfish (Family: Centrarchidae) were collected from all locations as part of an ongoing effort to sample additional species each study year.

Fish were collected using boat mounted electrofishing equipment. Samples were collected at five stations where creeks from the Savannah River Site (SRS) meet the Savannah River (Map 11, section 4.1.2). In addition, samples were collected at one Savannah River station upstream of the SRS, two stations downstream of the SRS, and one background location. All fish were composited by species and sample location, and separated into edible and nonedible homogeneous portions. Edible composites were analyzed for gamma-emitting isotopes and tritium. Nonedible composites were analyzed for gamma-emitters and strontium.

The Department of Energy-Savannah River (DOE-SR) also conducts fish monitoring to assess the environmental effects of current and historical releases of radionuclides. ESOP data were compared to DOE-SR reported results. Discrepancies in these results could be attributed to the natural variation of radionuclide levels. Although there are differences between reported values, the data is consistent with historically reported data. In the past, samples have been collected and split between ESOP and DOE-SR for analyses, and no discrepancies in the data results were found. This would potentially rule out methodology differences and substantiate that differences result from the variability in samples analyzed by the two programs.

Independent monitoring of radionuclide levels in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. The information provided will assist in advising, informing, and protecting the people at risk, and in comparing current and historical data. The additional species collected in 2006 will be common carp (*Cyprinus carpio*).

RESULTS AND DISCUSSION

Fish collections were conducted from April 11 through September 22, 2005. Five largemouth bass were collected from eight of nine locations; three bass were collected from the Stokes Bluff site. Five channel catfish were collected at three Savannah River locations; one was collected from Stevens Creek. White catfish were collected at the other five locations. Bluegill were collected at four locations on the Savannah River, redbreast sunfish, warmouth, and black crappie were each collected at one location. In addition, a mix of bluegill and black crappie were collected at the Steel Creek station in order to provide enough tissue for analysis. Redear sunfish were collected at the Stevens Creek location.

A total of 125 fish was collected. Fifty-two composites and four individual fish samples were processed. The Region 5 tritium laboratory analyzed aliquots from all edible samples. Edible and non-edible samples were sent to the Radiological Environmental Monitoring Division in Columbia, SC for radiological analysis of gamma-emitting radionuclides (section 4.1.4). Portions of some non-edible samples were sent to Severn-Trent Laboratories (STL) in Richland, WA and Eberline Services, Albuquerque, NM for strontium analysis. Activity levels of radionuclides for Savannah River and ESOP historical data from 2001 – 2005 are reported in section 4.1.4. Summary statistics are presented in section 4.1.5. Tritium results represent the activity level in the water distilled from the fish tissue. Cesium results represent the activity level in the wet sample itself. Strontium results from STL represent the activity level in an aliquot of dried fish tissue. Dry and wet strontium activity is presented for the data from the Eberline laboratory.

Tritium

Activity levels of tritium were analyzed in 26 edible portions of bass, catfish, and sunfish composites and two individual samples. The Stevens Creek, NSBLD, and Stokes Bluff locations were the only sampling areas that did not exhibit detectable tritium activity in any samples (section 4.1.3, Figure 1a). The Stevens Creek station is located above a spillway for a hydroelectric generating plant, which completely blocks movement of fish from the lower Savannah River.

Four of eight bass samples from the Savannah River exhibited detectable tritium activity, with an average of 1017 ± 1065 pCi/L. The composite from the Fourmile Creek location had the highest reported tritium activity, 2572 pCi/L.

Three Savannah River catfish samples exhibited tritium activity, with an average of 457 ± 184 pCi/L. The highest tritium level observed in the catfish composites, 669 pCi/L, was from the Fourmile Creek location.

Five of the sunfish samples exhibited tritium activity, with an average of 1200 ± 1832 pCi/L. The highest tritium level exhibited in 2005, 4468 pCi/L, was in a bluegill composite, again from the Fourmile Creek location.

Samples from downstream of SRS exhibited little or no tritium activity in 2005. Similarly, 2005 data were generally lower than ESOP historically reported data (section 4.1.3, Figures 1b,1c) (SCDHEC, 2005b).

Cesium

Activity levels of Cs-137 were analyzed in 52 edible and nonedible portions of bass, catfish, and sunfish composites, and four individual samples. The Stevens Creek background location, NSBLD, and Stokes Bluff were the only locations where Cs-137 was not detected in any sample (section 4.1.3**,** Figure 2a/3a/4). Consistent with historically reported ESOP data, higher levels of Cs-137 were reported from locations adjacent to the SRS (section 4.1.3, Figure 2b,2c/3b,3c) (SCDHEC, 2005b).

Six of eight edible bass composites from Savannah River locations exhibited detectable levels of Cs-137, ranging from 0.053 to 0.547 pCi/g, with an average of 0.201 ± 0.177 pCi/g. The sample from the Fourmile Creek location had the highest reported activity level. Cs-137 levels reported above 0.05 pCi/g were observed in all edible bass composites from the five locations adjacent to the SRS and the Hwy. 301 Bridge area. Cs-137 activity was detected in nonedible bass composites from all five creek mouth locations adjacent to SRS but not the Hwy. 301 area

Only two edible and three nonedible catfish composites, from locations adjacent to SRS, exhibited detectable levels of Cs-137. The Cs-137 levels in these samples ranged from 0.028 to 0.143 pCi/g. The Steel Creek location exhibited the highest activity in the edible sample, Lower Three Runs for the nonedible sample.

Five edible sunfish composites from Savannah River locations exhibited detectable levels of Cs-137, ranging from 0.038 to 0.209 pCi/g, with an average of 0.110 ± 0.073 pCi/g. The sample from the Beaver Dam Creek location had the highest reported activity level. Cs-137 activity was observed in four of the five locations adjacent to the SRS and the Hwy. 301 Bridge area. Cs-137 activity in nonedible sunfish composites was detected from two creek mouth locations and the Hwy. 301 area.

Strontium

Portions of 27 nonedible composites from all nine stations were selected for Sr-89,90 analysis in 2005 (section 4.1.3, Figure 5a). The NSBLD location was the only site where strontium was not detected in a sample. Figures 5b and 5c show historically reported ESOP data for Sr-89,90 (SCDHEC, 2005b). Averages noted below include the Stevens Creek background location.

Levels of Sr-89,90 in bass ranged from 0.078 to 0.752 pCi/g, with an average of 0.334 ± 0.218 pCi/g. The sample from the Stokes Bluff location had the highest reported activity level. Sr-89,90 levels reported at or above 0.300 pCi/g were observed in all bass composites from locations adjacent to and downstream of the SRS.

Strontium levels in catfish samples ranged from 0.064 to 0.606 pCi/g, with an average of 0.286 ± 0.182 pCi/g. The Highway 301 location exhibited the highest activity, the upstream control station on Stevens Creek exhibited the second highest.

All sunfish composites analyzed exhibited detectable levels of Sr-89,90, ranging from 0.087 to 0.458 pCi/g, with an average of 0.220 ± 0.142 pCi/g. The sample from the Steel Creek location had the highest reported activity level, the Hwy. 301 Bridge area exhibited the second highest.

Individual Fish Analyses

Larger, older fish may bioaccumulate more contaminants over time (USEPA, 2000b). ESOP analyzed and compared data from a single large fish versus the composite it was a part of in order to ascertain the impact a large fish might have on a composite sample. One bass was harvested from the Beaver Dam Creek location for separate tritium and gamma analyses.

An aliquot of the edible single sample portion was analyzed for tritium. Tritium was detected in the individual sample at an activity just above the LLD, while no tritium was detected in the corresponding composite sample.

Results of the cesium-137 analysis of the edible single and composite samples were 0.181 and 0.096 pCi/g, respectively. The nonedible single sample portion exhibited a Cs-137 activity of 0.105, the result for the composite was 0.042 pCi/g.

DOE-SR Program

ESOP bass and catfish data collected for this project in 2005 was compared to DOE-SR reported information (WSRC, 2006). Data comparison summaries are located in section 4.1.4. One difference between the two programs is that ESOP analyzes one composite type from each species for each location, whereas the DOE-SR program analyzes three per location. Therefore, a single composite for an ESOP location was compared to the average of the three DOE-SR composites reported.

Neither ESOP nor DOE-SR found detectable tritium levels at the location upstream of SRS near Augusta, Georgia, nor at Beaver Dam Creek (section 4.1.4). From the Fourmile Creek location down-stream to the Hwy. 301 bridge, ESOP tritium values from largemouth bass and catfish were consistently higher than the DOE-SR data, with the exception of catfish from Hwy. 301 where neither program detected tritium. Cs-137 was detected in largemouth bass from most locations by both programs in 2005, but not as frequently in catfish. Cs-137 results for bass and catfish from ESOP and DOE-SR were less than 1.00 pCi/g. Except for the ESOP catfish sample from NSBL&D, Sr-89,90 was detected at all locations by both programs, although all values were again less than 1.00 pCi/g.

For direct comparisons of data between the two programs, only averages of detections were used. For tritium in largemouth bass, DOE-SR results were within one standard deviation of the ESOP results; catfish results were within two standard deviations. For Cs-137 in edible bass and all non-edible samples, DOE-SR results were within one standard deviation of the ESOP results. For edible catfish samples, DOE-SR results were outside of three standard deviations. Sr-89,90 results for bass and catfish were within two standard deviations. Discrepancies in these results could be attributed to the natural variation in bioaccumulation among individual fish, as evidenced by the variation in the single versus composite fish samples analyzed by ESOP. In 1999, catfish samples were collected and split between SCDHEC and DOE-SR for analyses, and no discrepancies in the data results were found.

CONCLUSIONS AND RECOMMENDATIONS

A review of ESOP data indicates that DOE-SR operations have impacted fish. Higher levels of radionuclides are found in Savannah River fish collected adjacent to and downstream of SRS compared to upstream. Fish from background locations tend not to exhibit detectable levels of man-made radionuclides.

The project attempted to determine if activity levels in larger fish might impact a composite of relatively smaller fish. Separate portions of one bass, considerably larger than the other fish sampled, were analyzed and compared to their respective composites. Results of the tritium and gamma analyses showed no large differences between the samples. Collections of larger fish will continue in 2006 to provide additional data for assessment.

ESOP project data was compared to DOE-SR reported information (WSRC, 2006). Based on standard deviations, compared tritium, Cs-137, and Sr-89,90 data were generally similar. Discrepancies in results could be due to the natural variation of radionuclide levels in individual fish.

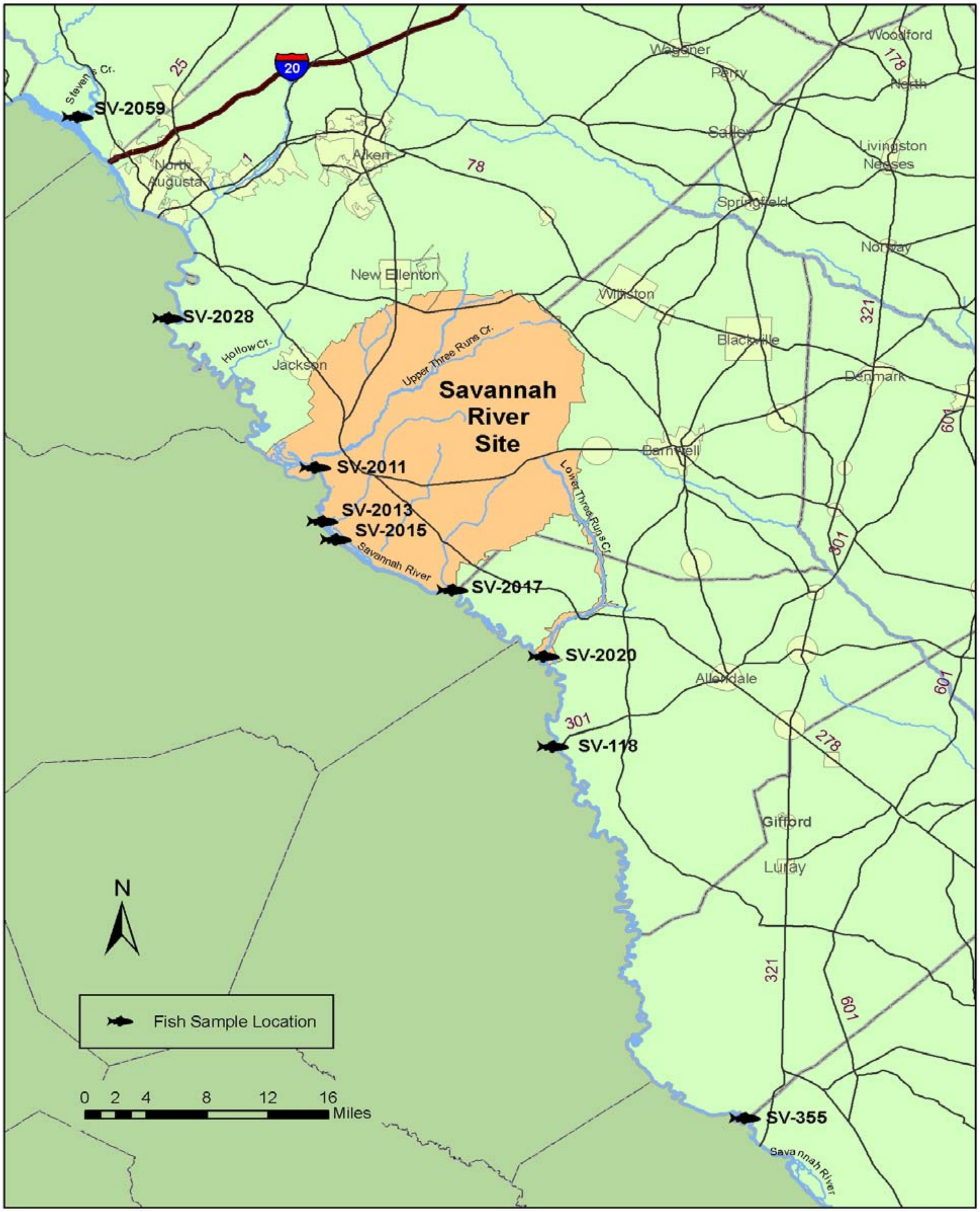
The ESOP 2005 fish collections included members of the Sunfish family (Centrarchidae), several species of which are listed in the South Carolina Fish Consumption Advisories (SCDHEC, 2006a). The ESOP monitoring program will collect common carp in 2006 in addition to the target species. This will augment the existing data on Savannah River fish, and provide information for human health assessment.

Independent monitoring of radionuclide levels in Savannah River fish will continue along with evaluating the DOE-SR Radiological Fish Monitoring Program. Continued monitoring will provide a better understanding of actual radionuclide levels, their extent, and trends. Several important benefits can be realized as a result. Foremost is the ability for SCDHEC Bureau of Water and the Division of Health Hazard Evaluation to further evaluate the potential human health risk associated with consumption of Savannah River fish. SCDHEC will be able to better advise, inform, and protect those people at risk. Another benefit will be the ability to compare this data with historical data. Data comparison will also be part of the further evaluation of the DOE-SR program, allowing the data reported by DOE-SR to be verified. This independent verification will provide credibility and confidence in the DOE-SR data and its uses.

4.1.2

(Return to TOC)

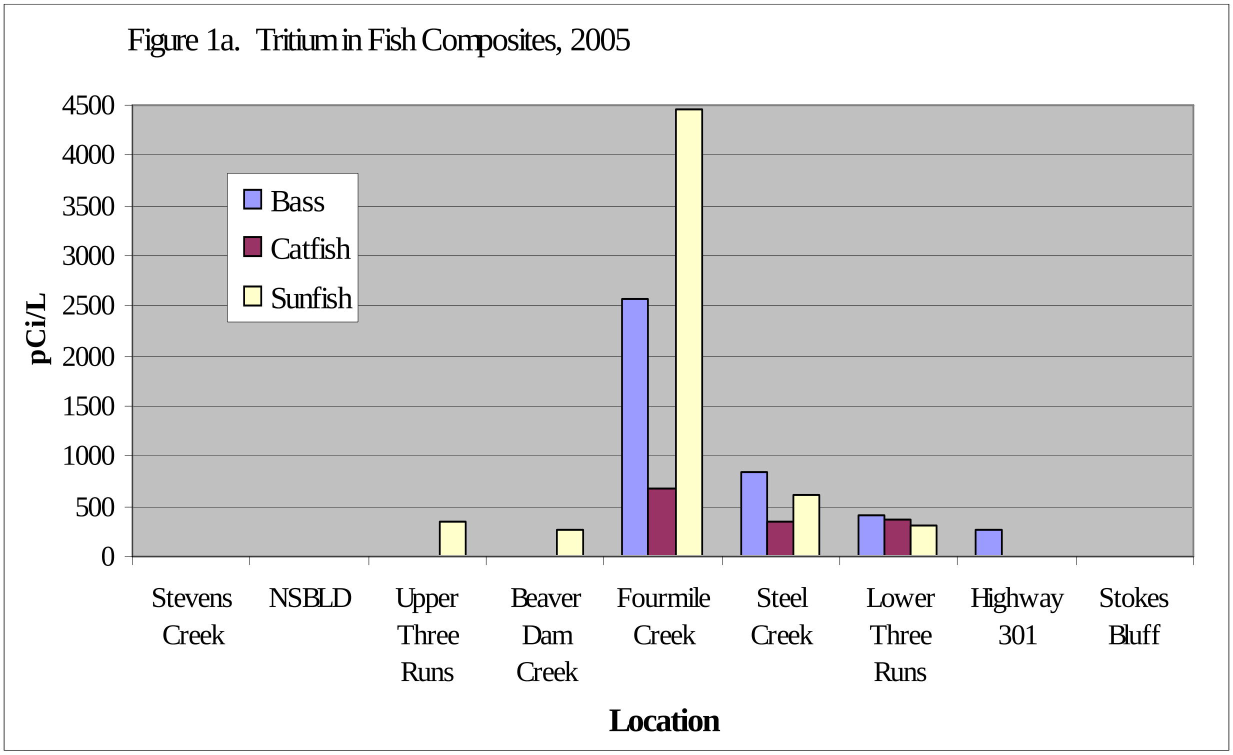
Map 11. Radiological Monitoring of Fish Associated With SRS

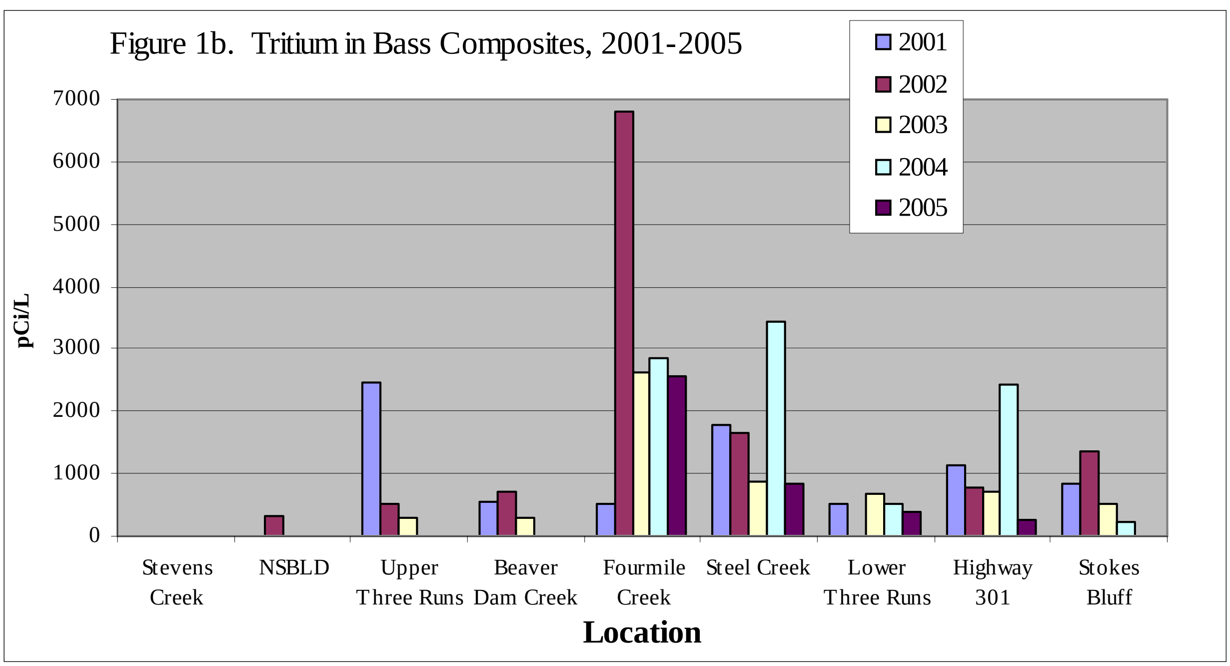


4.1.3 Tables and Figures

(Return to TOC)

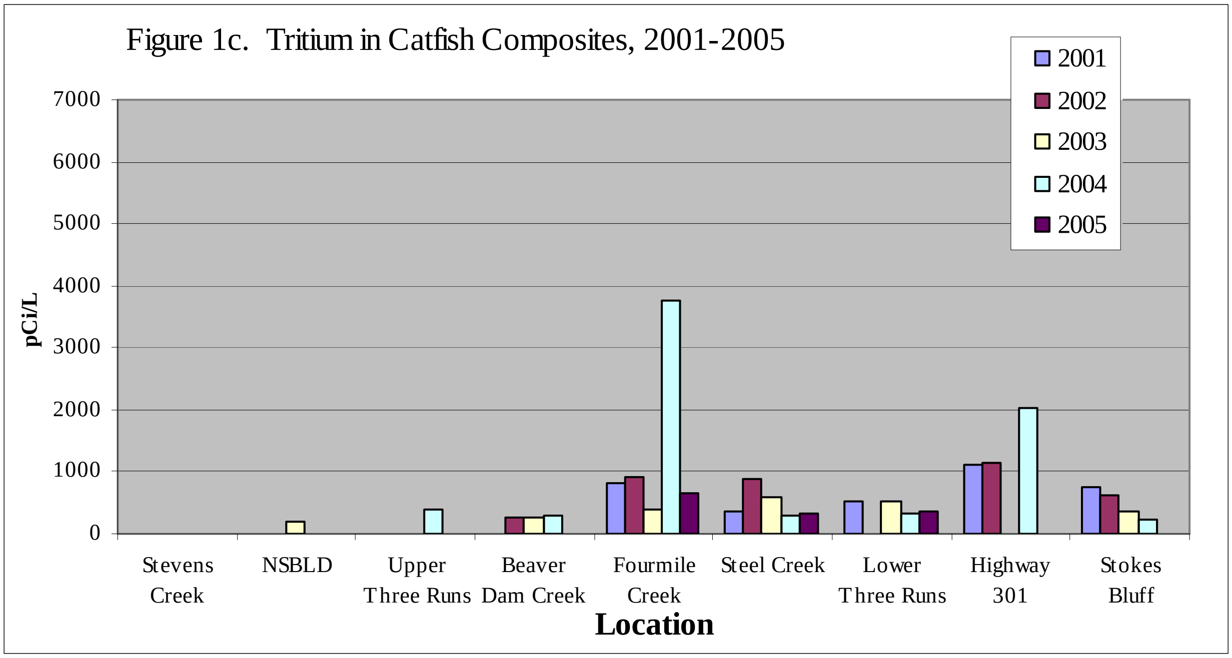
Radiological Fish Monitoring

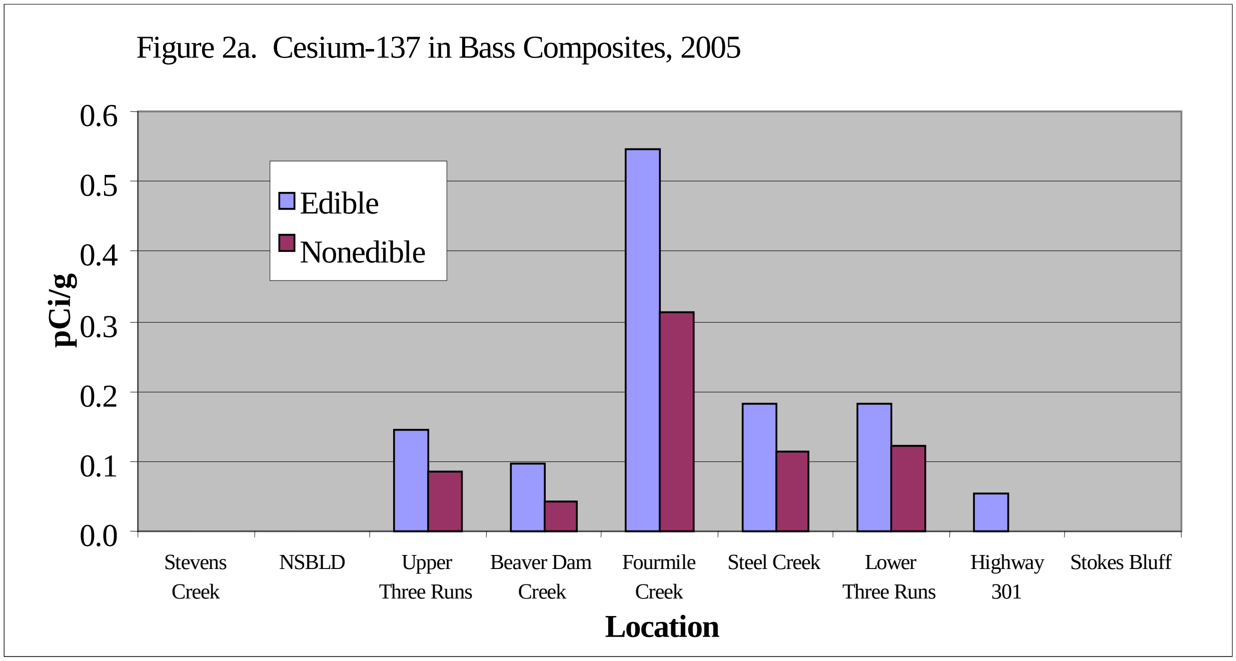




Tables and Figures
Radiological Fish Monitoring

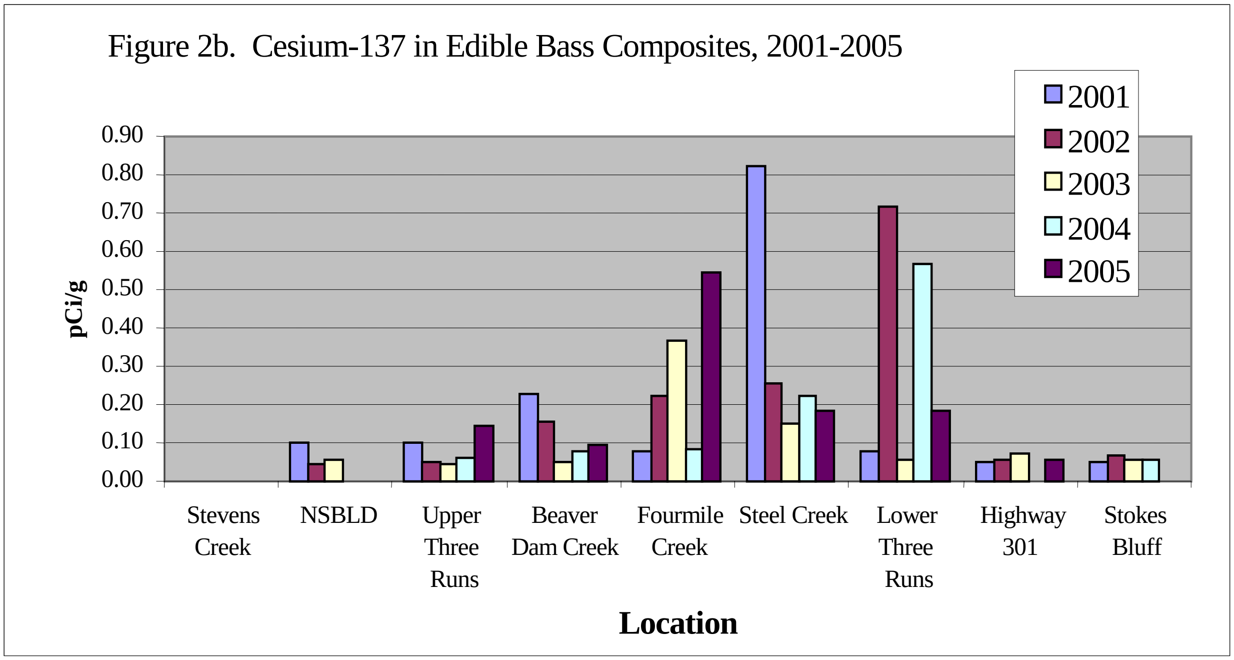
(Return to TOC)

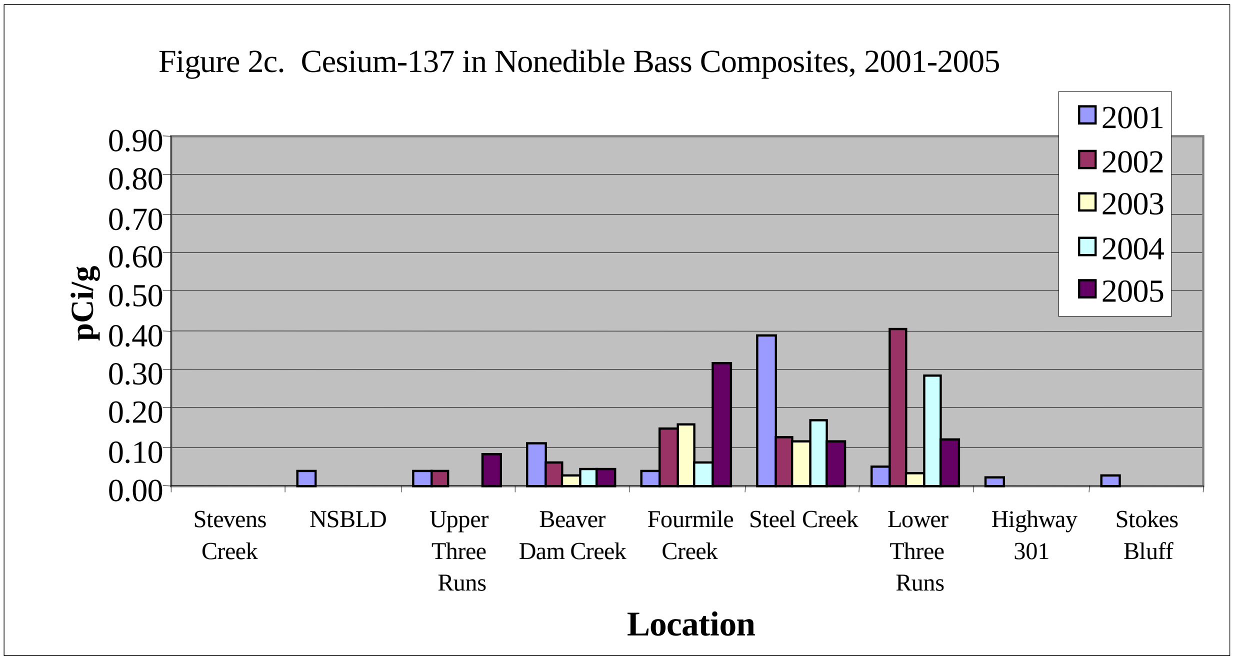




Tables and Figures
Radiological Fish Monitoring

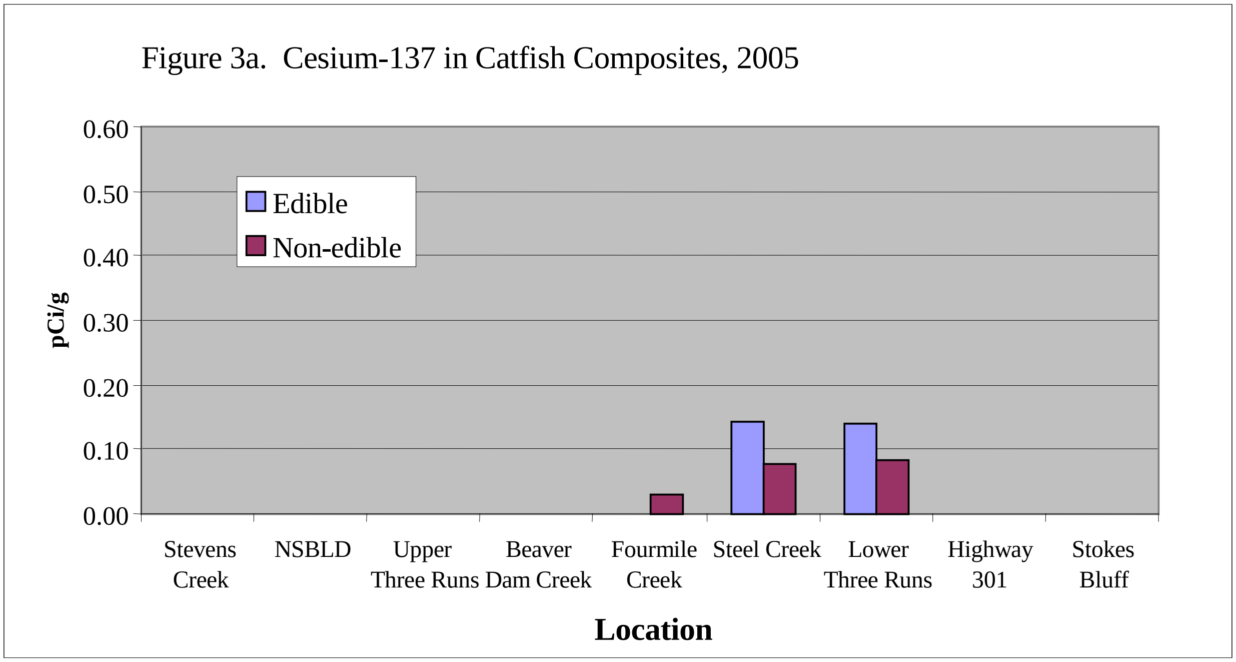
(Return to TOC)

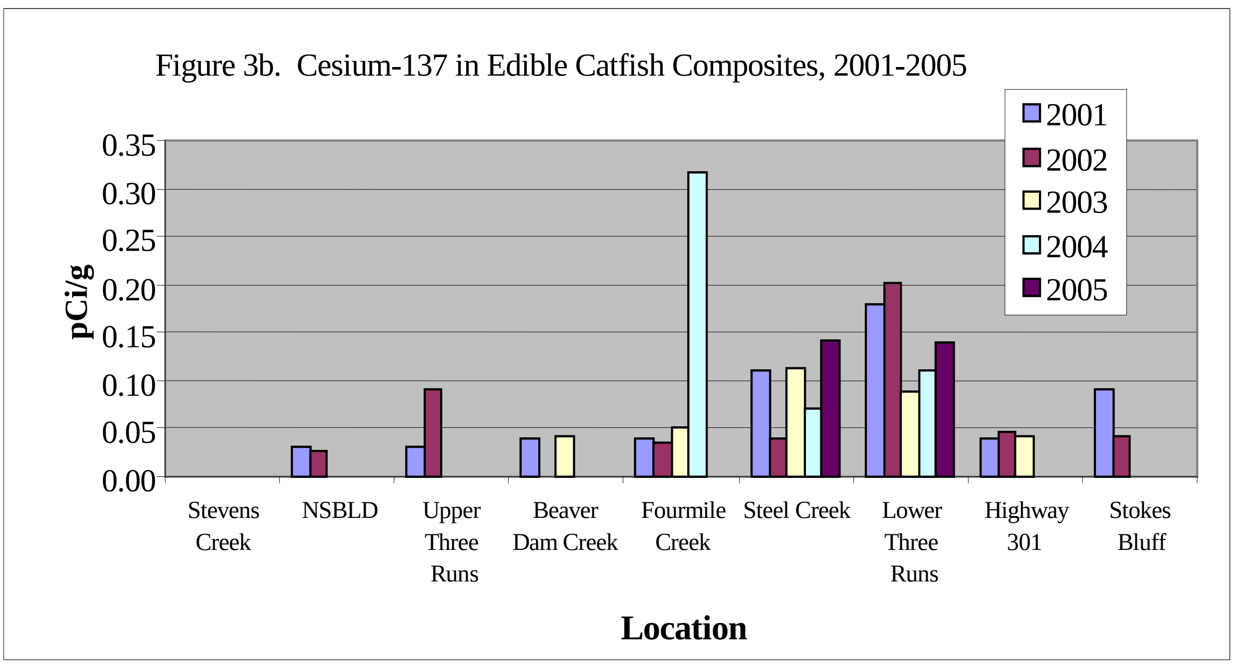




Tables and Figures
Radiological Fish Monitoring

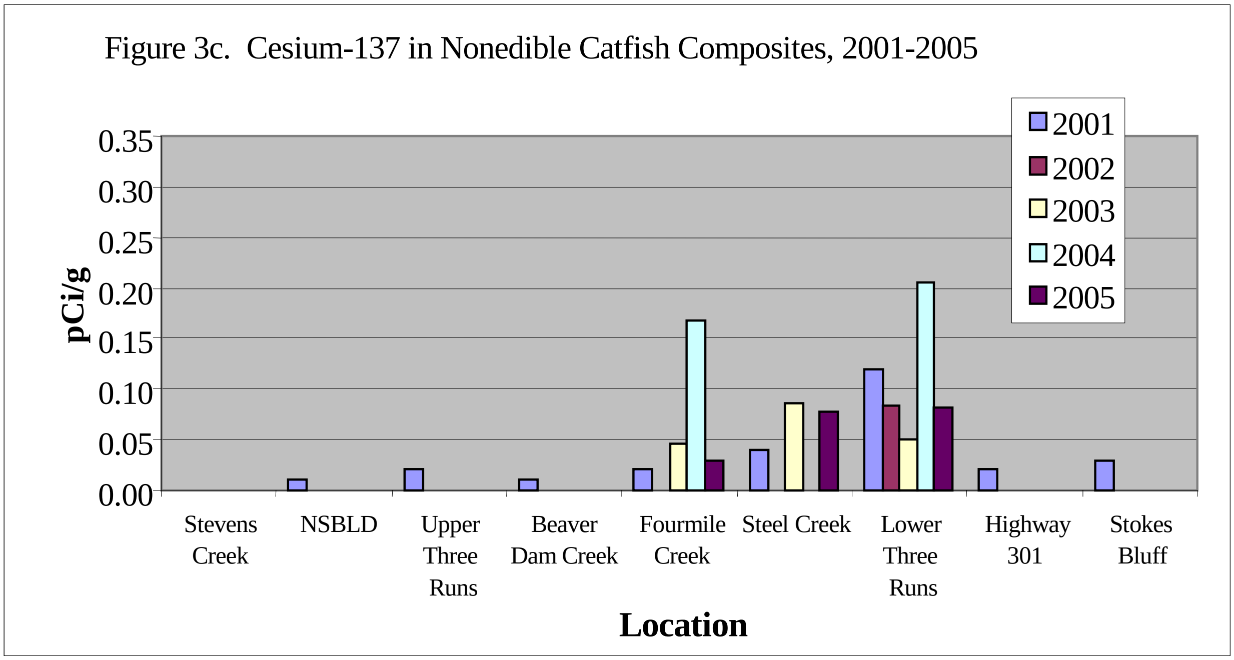
(Return to TOC)

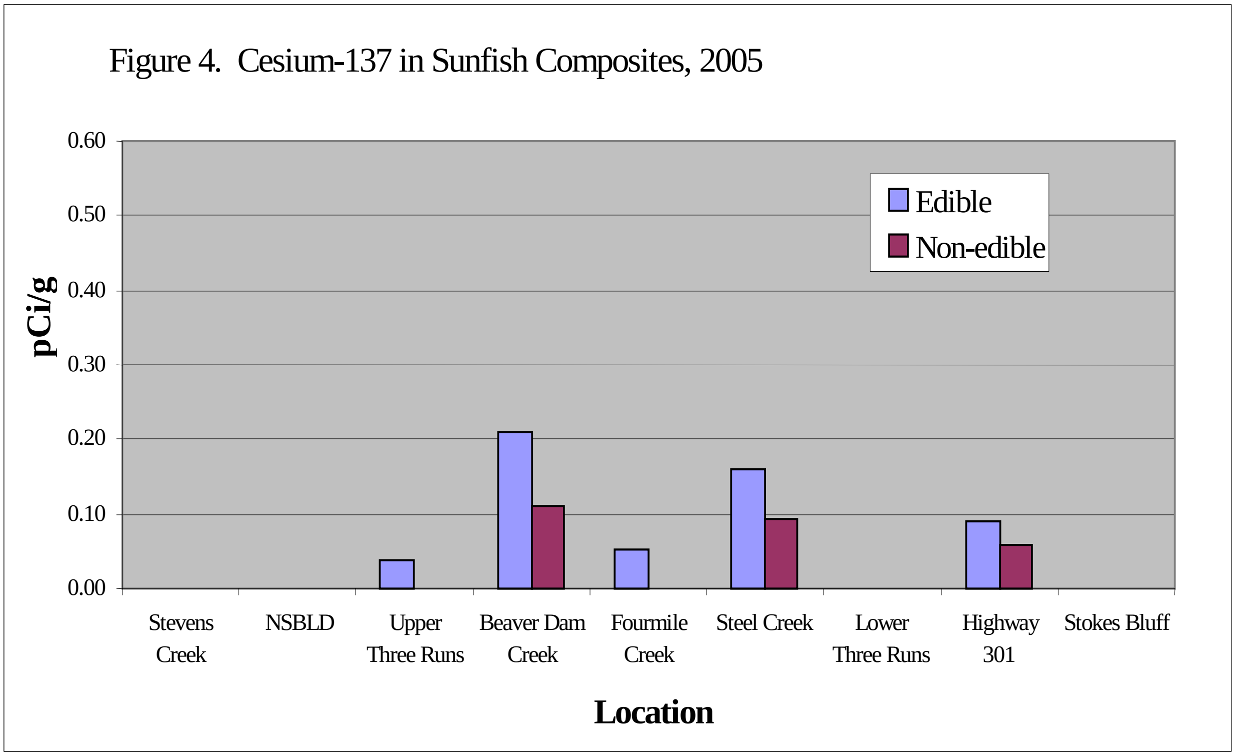




Tables and Figures
Radiological Fish Monitoring

(Return to TOC)





Tables and Figures
Radiological Fish Monitoring

(Return to TOC)

Figure 5a. Strontium-89,90 in Non-edible Fish Composites, 2005

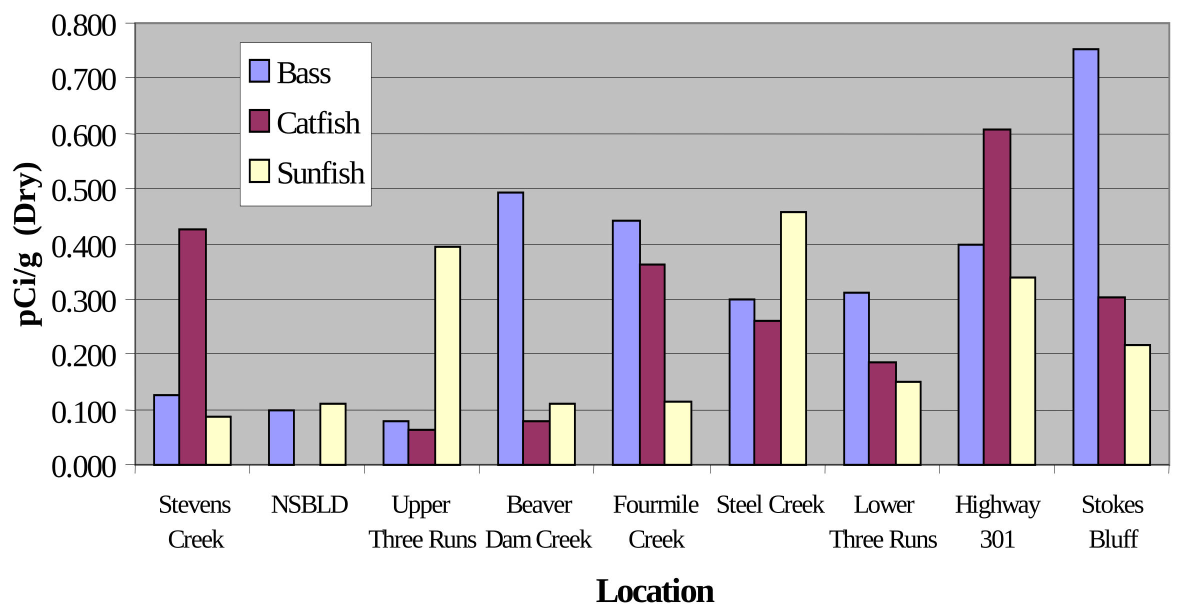
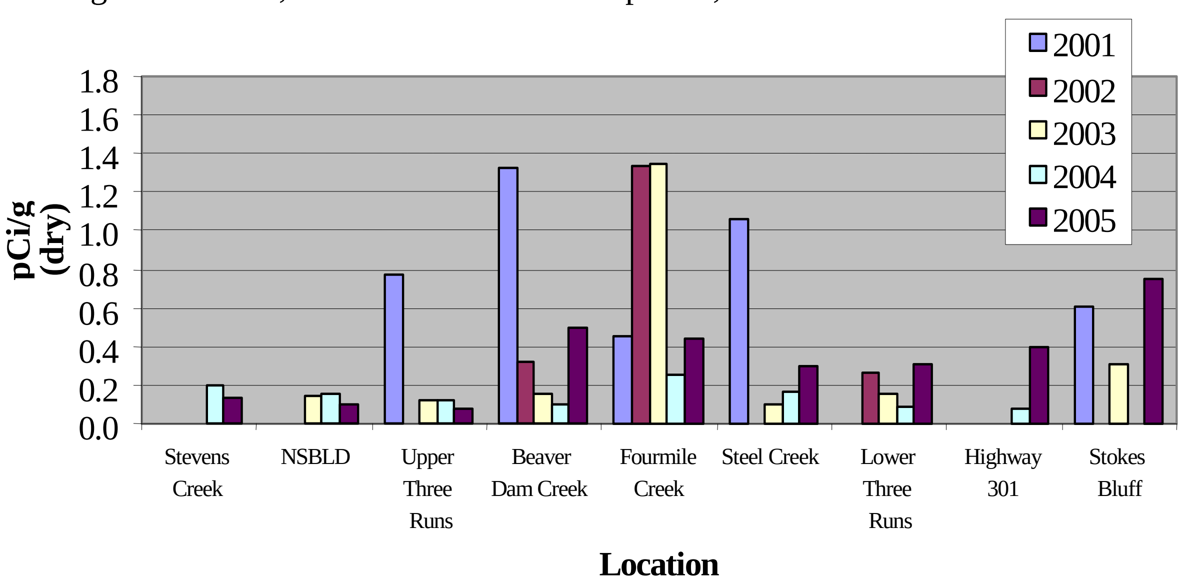


Figure 5b. Sr-89,90 in Nonedible Bass Composites, 2001-2005

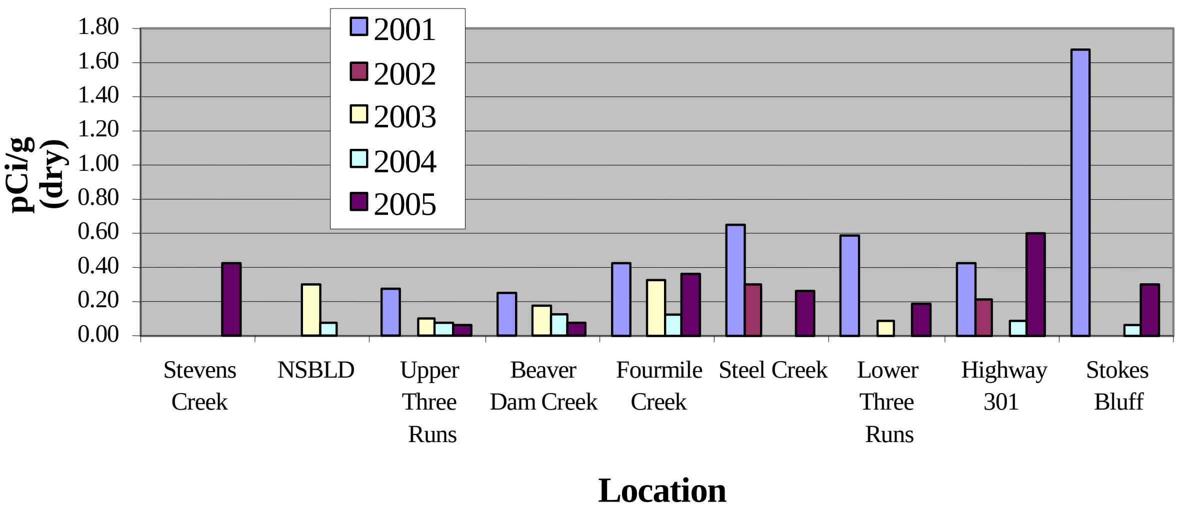


1. Stevens Creek not analyzed in 2001, 2002, and 2003
2. NSBLD not analyzed only in 2001 and 2002
3. Steel Creek and Stokes Bluff not analyzed in 2002

Tables and Figures
Radiological Fish Monitoring

(Return to TOC)

Figure 5c. Sr-89,90 in Non-edible Catfish Composites, 2001-2005



1. Stevens Creek analyzed only in 2005
2. NSBLD and Stokes Bluff not analyzed in 2002

4.1.4 Data

(Return to TOC)

Radiological Monitoring of Fish in the Savannah River

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Stevens Creek	Stevens Creek	Stevens Creek
Sample Station	SV-2059	SV-2059	SV-2059
Sample Date	4/11/2005	4/11/2005	4/11/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L) +/- 2 Sigma	<185	Not Analyzed	<185
Cs-137 (pCi/g) +/- 2 Sigma MDA	Non-detect 0.022	Non-detect 0.016	Non-detect 0.020
Sr-89/90 (pCi/g - **Dry**) +/- 2 Sigma MDA	Not Analyzed	0.127 0.044 0.078	Not Analyzed
Sr-89/90 (pCi/g - **Wet**) +/- 2 Sigma MDC		Not Available	

Only one channel catfish collected

Sample Location	Stevens Creek	Stevens Creek	Stevens Creek
Sample Station	SV-2059	SV-2059	SV-2059
Sample Date	4/11/2005	4/11/2005	4/11/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Redear Sunfish	Redear Sunfish
Tritium (pCi/L) +/- 2 Sigma	Not Analyzed	<182	Not Analyzed
Cs-137 (pCi/g) +/- 2 Sigma MDA	Non-detect 0.019	Non-detect 0.021	Non-detect 0.018
Sr-89/90 (pCi/g - **Dry**) +/- 2 Sigma MDA	0.426 0.038 0.029	Not Analyzed	0.087 0.034 0.063
Sr-89/90 (pCi/g - **Wet**) +/- 2 Sigma MDC	0.160 0.014 0.011		Not Available

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	NSBLD	NSBLD	NSBLD
Sample Station	SV-2028	SV-2028	SV-2028
Sample Date	4/20/2005	4/20/2005	4/20/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	<182	Not Analyzed	<182
+/- 2 Sigma			
Cs-137 (pCi/g)	Non-detect	Non-detect	Non-detect
+/- 2 Sigma			
MDA	0.019	0.022	0.018
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.100	Not Analyzed
+/- 2 Sigma		0.038	
MDA		0.068	
Sr-89/90 (pCi/g - **Wet**)		Not Available	
+/- 2 Sigma			
MDC			

NSBLD - New Savannah Bluff Lock & Dam

Sample Location	NSBLD	NSBLD	NSBLD
Sample Station	SV-2028	SV-2028	SV-2028
Sample Date	4/20/2005	4/20/2005	4/20/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Black Crappie	Black Crappie
Tritium (pCi/L)	Not Analyzed	<182	Not Analyzed
+/- 2 Sigma			
Cs-137 (pCi/g)	Non-detect	Non-detect	Non-detect
+/- 2 Sigma			
MDA	0.018	0.025	0.022
Sr-89/90 (pCi/g - **Dry**)	Non-detect	Not Analyzed	0.109
+/- 2 Sigma			0.035
MDA	0.057		0.060
Sr-89/90 (pCi/g - **Wet**)			Not Available
+/- 2 Sigma			
MDC			

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Upper Three Runs	Upper Three Runs	Upper Three Runs
Sample Station	SV-2011	SV-2011	SV-2011
Sample Date	4/21/2005	4/21/2005	4/21/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	<182	Not Analyzed	<182
+/- 2 Sigma			
Cs-137 (pCi/g)	0.144	0.084	Non-detect
+/- 2 Sigma	0.030	0.025	
MDA	0.019	0.020	0.019
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.078	Not Analyzed
+/- 2 Sigma		0.037	
MDA		0.070	
Sr-89/90 (pCi/g - **Wet**)		Not Available	
+/- 2 Sigma			
MDC			

Sample Location	Upper Three Runs	Upper Three Runs	Upper Three Runs
Sample Station	SV-2011	SV-2011	SV-2011
Sample Date	4/21/2005	4/21/2005	4/21/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Warmouth	Warmouth
Tritium (pCi/L)	Not Analyzed	342	Not Analyzed
+/- 2 Sigma		96	
Cs-137 (pCi/g)	Non-detect	Non-detect	0.038
+/- 2 Sigma			0.018
MDA	0.024	0.027	0.017
Sr-89/90 (pCi/g - **Dry**)	0.064	Not Analyzed	0.396
+/- 2 Sigma	0.028		0.064
MDA	0.054		0.086
Sr-89/90 (pCi/g - **Wet**)	Not Available		0.106
+/- 2 Sigma			0.017
MDC			0.023

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Beaver Dam Creek	Beaver Dam Creek	Beaver Dam Creek
Sample Station	SV-2013	SV-2013	SV-2013
Sample Date	4/25/2005	4/25/2005	4/25/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L) +/- 2 Sigma	<182	Not Analyzed	<182
Cs-137 (pCi/g) +/- 2 Sigma MDA	0.096 0.028 0.019	0.042 0.019 0.017	Non-detect 0.014
Sr-89/90 (pCi/g - **Dry**) +/- 2 Sigma MDA	Not Analyzed	0.493 0.041 0.025	Not Analyzed
Sr-89/90 (pCi/g - **Wet**) +/- 2 Sigma MDC		0.163 0.014 0.008	

Sample Location	Beaver Dam Creek	Beaver Dam Creek	Beaver Dam Creek
Sample Station	SV-2013	SV-2013	SV-2013
Sample Date	4/25/2005	4/25/2005	4/25/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Bluegill	Bluegill
Tritium (pCi/L) +/- 2 Sigma	Not Analyzed	264 88	Not Analyzed
Cs-137 (pCi/g) +/- 2 Sigma MDA	Non-detect 0.017	0.209 0.036 0.021	0.111 0.028 0.020
Sr-89/90 (pCi/g - **Dry**) +/- 2 Sigma MDA	0.080 0.033 0.062	Not Analyzed	0.111 0.035 0.060
Sr-89/90 (pCi/g - **Wet**) +/- 2 Sigma MDC	Not Analyzed		Not Available

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Fourmile Creek	Fourmile Creek	Fourmile Creek
Sample Station	SV-2015	SV-2015	SV-2015
Sample Date	4/25/2005	4/25/2005	5/23/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	2572	Not Analyzed	669
+/- 2 Sigma	159		108
Cs-137 (pCi/g)	0.547	0.314	Non-detect
+/- 2 Sigma	0.066	0.045	
MDA	0.019	0.017	0.018
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.442	Not Analyzed
+/- 2 Sigma		0.074	
MDA		0.067	
Sr-89/90 (pCi/g - **Wet**)		Not Available	
+/- 2 Sigma			
MDC			

Sample Location	Fourmile Creek	Fourmile Creek	Fourmile Creek
Sample Station	SV-2015	SV-2015	SV-2015
Sample Date	5/23/2005	4/25/2005	4/25/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Bluegill	Bluegill
Tritium (pCi/L)	Not Analyzed	4468	Not Analyzed
+/- 2 Sigma		199	
Cs-137 (pCi/g)	0.028	0.053	Non-detect
+/- 2 Sigma	0.014	0.021	
MDA	0.018	0.019	0.016
Sr-89/90 (pCi/g - **Dry**)	0.364	Not Analyzed	0.113
+/- 2 Sigma	0.031		0.022
MDA	0.018		0.074
Sr-89/90 (pCi/g - **Wet**)	0.122		0.039
+/- 2 Sigma	0.010		0.016
MDC	0.006		0.025

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Steel Creek	Steel Creek	Steel Creek
Sample Station	SV-2017	SV-2017	SV-2017
Sample Date	6/28/2005	6/28/2005	5/5/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	836	Not Analyzed	340
+/- 2 Sigma	114		96
Cs-137 (pCi/g)	0.182	0.113	0.143
+/- 2 Sigma	0.029	0.022	0.026
MDA	0.018	0.018	0.018
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.300	Not Analyzed
+/- 2 Sigma		0.027	
MDA		0.023	
Sr-89/90 (pCi/g - **Wet**)		0.102	
+/- 2 Sigma		0.009	
MDC		0.008	

Sample Location	Steel Creek	Steel Creek	Steel Creek
Sample Station	SV-2017	SV-2017	SV-2017
Sample Date	5/5/2005	6/28/2005	6/28/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Crappie/Bluegill	Crappie/Bluegill
Tritium (pCi/L)	Not Analyzed	625	Not Analyzed
+/- 2 Sigma		107	
Cs-137 (pCi/g)	0.078	0.160	0.094
+/- 2 Sigma	0.023	0.031	0.028
MDA	0.017	0.018	0.016
Sr-89/90 (pCi/g - **Dry**)	0.262	Not Analyzed	0.458
+/- 2 Sigma	0.022		0.038
MDA	0.015		0.023
Sr-89/90 (pCi/g - **Wet**)	0.095		0.191
+/- 2 Sigma	0.008		0.016
MDC	0.006		0.009

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Lower Three Runs	Lower Three Runs	Lower Three Runs
Sample Station	SV-2020	SV-2020	SV-2020
Sample Date	4/28/2005	4/28/2005	4/28/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	403	Not Analyzed	362
+/- 2 Sigma	98		92
Cs-137 (pCi/g)	0.182	0.122	0.140
+/- 2 Sigma	0.034	0.030	0.348
MDA	0.017	0.019	0.203
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.313	Not Analyzed
+/- 2 Sigma		0.029	
MDA		0.024	
Sr-89/90 (pCi/g - **Wet**)		0.100	
+/- 2 Sigma		0.009	
MDC		0.008	

Sample Location	Lower Three Runs	Lower Three Runs	Lower Three Runs
Sample Station	SV-2020	SV-2020	SV-2020
Sample Date	4/28/2005	4/28/2005	4/28/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Redbreast Sunfish	Redbreast Sunfish
Tritium (pCi/L)		302	Not Analyzed
+/- 2 Sigma		95	
Cs-137 (pCi/g)	0.082	Non-detect	Non-detect
+/- 2 Sigma	0.025		
MDA	0.019	0.023	0.019
Sr-89/90 (pCi/g - **Dry**)	0.186	Not Analyzed	0.151
+/- 2 Sigma	0.017		0.022
MDA	0.014		0.028
Sr-89/90 (pCi/g - **Wet**)	0.070		0.048
+/- 2 Sigma	0.006		0.007
MDC	0.005		0.009

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Hwy. 301	Hwy. 301	Hwy. 301
Sample Station	SV-118	SV-118	SV-118
Sample Date	5/6/2005	5/6/2005	5/6/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	257	Not Analyzed	<195
+/- 2 Sigma	93		
Cs-137 (pCi/g)	0.053	Non-detect	Non-detect
+/- 2 Sigma	0.022		
MDA	0.020	0.017	0.020
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.400	Not Analyzed
+/- 2 Sigma		0.037	
MDA		0.032	
Sr-89/90 (pCi/g - **Wet**)		0.125	
+/- 2 Sigma		0.011	
MDC		0.010	

Sample Location	Hwy. 301	Hwy. 301	Hwy. 301
Sample Station	SV-118	SV-118	SV-118
Sample Date	5/6/2005	5/11/2005	5/11/2005
Sample Cut	Non-edible	Edible	Non-edible
Species	Catfish	Bluegill	Bluegill
Tritium (pCi/L)	Not Analyzed	<195	Not Analyzed
+/- 2 Sigma			
Cs-137 (pCi/g)	Non-detect	0.090	0.058
+/- 2 Sigma		0.021	0.021
MDA	0.017	0.016	0.018
Sr-89/90 (pCi/g - **Dry**)	0.606	Not Analyzed	0.340
+/- 2 Sigma	0.054		0.029
MDA	0.042		0.021
Sr-89/90 (pCi/g - **Wet**)	0.191		0.136
+/- 2 Sigma	0.017		0.012
MDC	0.013		0.008

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	Stokes Bluff	Stokes Bluff	Stokes Bluff
Sample Station	SV-355	SV-355	SV-355
Sample Date	7/8/2005	7/8/2005	7/8/2005
Sample Cut	Edible	Non-edible	Edible
Species	Bass	Bass	Catfish
Tritium (pCi/L)	<195	Not Analyzed	<195
+/- 2 Sigma			
Cs-137 (pCi/g)	Non-detect	Non-detect	Non-detect
+/- 2 Sigma			
MDA	0.016	0.020	0.017
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	0.752	Not Analyzed
+/- 2 Sigma		0.067	
MDA		0.055	
Sr-89/90 (pCi/g - **Wet**)		0.269	
+/- 2 Sigma		0.024	
MDC		0.020	

Sample Location	Stokes Bluff	Stokes Bluff	Stokes Bluff
Sample Station	SV-355	SV-355	SV-355
Sample Date	7/8/2005	7/8/2005	7/8/2005
Sample Cut	Non-edible	Non-edible	Non-edible
Species	Catfish	Bluegill	Bluegill
Tritium (pCi/L)	Not Analyzed	<195	Not Analyzed
+/- 2 Sigma			
Cs-137 (pCi/g)	Non-detect	Non-detect	Non-detect
+/- 2 Sigma			
MDA	0.017	0.032	0.016
Sr-89/90 (pCi/g - **Dry**)	0.302	Not Analyzed	0.217
+/- 2 Sigma	0.026		0.027
MDA	0.019		0.033
Sr-89/90 (pCi/g - **Wet**)	0.101		0.087
+/- 2 Sigma	0.009		0.011
MDC	0.006		0.013

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
Radionuclides Data

(Return to TOC)

Sample Location	BDC - Individual	BDC - Individual
Sample Station	SV-2013	SV-2013
Sample Date	4/25/2005	4/25/2005
Sample Cut	Edible	Non-edible
Species	Bass	Bass
Tritium (pCi/L)	200	Not Analyzed
+/- 2 Sigma	85	
Cs-137 (pCi/g)	0.181	0.105
+/- 2 Sigma	0.034	0.021
MDA	0.022	0.014
Sr-89/90 (pCi/g - **Dry**)	Not Analyzed	Not Analyzed
+/- 2 Sigma		
MDA		
Sr-89/90 (pCi/g - **Wet**)		
+/- 2 Sigma		
MDC		

Tritium results (pCi/L) represent the activity level in the water distilled from the fish tissue
Cs-137 results represent the activity level in actual fish tissue
Strontium results represent the activity level in an aliquot of fish tissue

Radiological Monitoring of Fish Data
ESOP Historical Data, 2000-2005

(Return to TOC)

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible
	Species		Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass
2005	Radionuclide	Tritium (pCi/L)	ND	ND	ND	ND	2572	836	403	257	ND
2004			ND	ND	ND	ND	2865	3442	526	2425	227
2003			ND	ND	292	292	2,621	888	666	705	508
2002			ND	**332**	**524**	**718**	6,801	1,637	ND	**763**	1,348
2001			ND	ND	2,462	562	525	1,768	530	1,148	858
2005	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	0.14	0.10	0.55	0.18	0.18	0.05	ND
2004			ND	ND	0.06	0.08	0.09	0.23	0.57	ND	0.06
2003			ND	0.05	0.04	0.05	0.37	0.15	0.06	0.07	0.06
2002			ND	0.04	0.05	0.16	0.22	0.26	0.72	0.06	0.06
2001			ND	0.10	0.10	0.23	0.08	0.82	0.08	0.05	0.05

Year	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible
	Species		Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass	Bass
2005	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	0.08	0.04	0.31	0.11	0.12	ND	ND
2004			ND	ND	ND	0.04	0.06	0.17	0.28	ND	ND
2003			ND	ND	ND	0.03	0.16	0.11	0.03	ND	ND
2002			ND	ND	0.04	0.06	0.15	0.13	0.40	ND	ND
2001			ND	0.04	0.04	0.11	0.04	0.39	0.05	0.02	0.03
2005	Radionuclide	Sr-89,90 (pCi/g **DRY**)	0.13	0.10	0.08	0.49	0.44	0.30	0.31	0.40	0.75
2004			0.20	0.16	0.12	0.10	0.25	0.17	0.09	0.08	ND
2003			NA	0.15	0.12	0.16	1.35	0.10	0.16	ND	0.31
2002			NA	NA	ND	0.33	1.34	NA	0.26	ND	NA
2001			NA	NA	0.77	1.32	0.45	1.06	ND	ND	0.60

Notes: ND - Non-Detect
NA - Not Analyzed
Bold denotes failed laboratory QA

Stevens = Stevens Creek
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Fourmile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Highway 301
Stokes = Stokes Bluff

Radiological Monitoring of Fish Data
ESOP Historical Data, 2000-2005

(Return to TOC)

Year			Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible	Edible
	Species		Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish
2005	Radionuclide	Tritium (pCi/L)	ND	ND	ND	ND	669	340	362	ND	ND
2004			ND	ND	377	282	3761	295	315	2042	228
2003			ND	209	ND	277	388	583	537	ND	354
2002			ND	ND	ND	271	931	890	ND	1150	621
2001			ND	ND	ND	ND	810	360	530	1104	736
2005	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	ND	ND	ND	0.14	0.14	ND	ND
2004			ND	ND	ND	ND	0.32	0.07	0.11	ND	ND
2003			ND	ND	ND	0.04	0.05	0.11	0.09	0.04	ND
2002			ND	0.03	0.09	ND	0.04	0.04	0.20	0.05	0.04
2001			ND	0.03	0.03	0.04	0.04	0.11	0.18	0.04	0.09

Year			Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Location		Stevens	NSBLD	UTR	BDC	FMC	STC	LTR	Hwy. 301	Stokes
	Sample Station		SV-2059	SV-2028	SV-2011	SV-2013	SV-2015	SV-2017	SV-2020	SV-118	SV-355
	Sample Cut		Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible	Non-Edible
	Species		Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish	Catfish
2005	Radionuclide	Cs-137 (pCi/g wet)	ND	ND	ND	ND	0.03	0.08	0.08	ND	ND
2004			ND	ND	ND	ND	0.17	ND	0.21	ND	ND
2003			ND	ND	ND	ND	0.05	0.09	0.05	ND	ND
2002			ND	ND	ND	ND	ND	ND	0.08	ND	ND
2001			ND	0.01	0.02	0.01	0.02	0.04	0.12	0.02	0.03
2005	Radionuclide	Sr-90 (pCi/g **DRY**)	0.43	ND	0.06	0.08	0.36	0.26	0.19	0.61	0.30
2004			NA	0.07	0.08	0.13	0.13	ND	ND	0.08	0.06
2003			NA	0.30	0.10	0.17	0.32	ND	0.09	ND	ND
2002			NA	NA	ND	ND	ND	0.30	ND	0.21	NA
2001			NA	ND	0.28	0.25	0.43	0.65	0.59	0.43	1.68

Notes: ND - Non-Detect
NA - Not Analyzed
Stevens = Stevens Creek
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Fourmile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Highway 301
Stokes = Stokes Bluff

Radiological Monitoring of Fish Data
ESOP and DOE-SR Data Comparison

(Return to TOC)

Table 1
Tritium Activity Levels in Edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	<LLD
	SRS	3	<MDC
UTR	SCDHEC	1	<LLD
	SRS	3	<MDC
BDC	SCDHEC	1	<LLD
	SRS	3	<MDC
FMC	SCDHEC	1	2.03
	SRS	3	0.98
STC	SCDHEC	1	0.66
	SRS	3	0.23
LTR	SCDHEC	1	0.32
	SRS	3	<MDC
Hwy. 301	SCDHEC	1	0.20
	SRS	3	<MDC
Average	SCDHEC	4	0.80
	SRS	2	0.60
Standard Deviation	SCDHEC	4	0.84
	SRS	2	0.53

Table 2
Tritium Activity Levels in Edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	<LLD
	SRS	3	<MDC
UTR	SCDHEC	1	<LLD
	SRS	3	0.05**
BDC	SCDHEC	1	<LLD
	SRS	3	<MDC
FMC	SCDHEC	1	0.53
	SRS	3	0.10
STC	SCDHEC	1	0.27
	SRS	3	0.07**
LTR	SCDHEC	1	0.29
	SRS	3	0.10
Hwy. 301	SCDHEC	1	<LLD
	SRS	3	<MDC
Average	SCDHEC	3	0.36
	SRS	4	0.08
Standard Deviation	SCDHEC	3	0.14
	SRS	4	0.02

Table 3
Cesium-137 Activity Levels in Edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	0.05**
UTR	SCDHEC	1	0.14
	SRS	3	0.10
BDC	SCDHEC	1	0.10
	SRS	3	0.11
FMC	SCDHEC	1	0.55
	SRS	3	0.18
STC	SCDHEC	1	0.18
	SRS	3	0.25
LTR	SCDHEC	1	0.18
	SRS	3	0.11
Hwy. 301	SCDHEC	1	0.05
	SRS	3	0.03
STOKES	SCDHEC	1	< MDA
	SRS	3	<MDC
Average	SCDHEC	6	0.20
	SRS	7	0.12
Standard Deviation	SCDHEC	6	0.18
	SRS	7	0.07

Table 4
Cesium-137 Activity Levels in Edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	<MDC
UTR	SCDHEC	1	< MDA
	SRS	3	0.04*
BDC	SCDHEC	1	< MDA
	SRS	3	0.04 **
FMC	SCDHEC	1	< MDA
	SRS	3	0.06
STC	SCDHEC	1	0.14
	SRS	3	0.08*
LTR	SCDHEC	1	0.14
	SRS	3	0.09
Hwy. 301	SCDHEC	1	< MDA
	SRS	3	<MDC
STOKES	SCDHEC	1	<MDA
	SRS	3	0.06**
Average	SCDHEC	2	0.14
	SRS	6	0.06
Standard Deviation	SCDHEC	2	0.002
	SRS	6	0.02

Notes:
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Four Mile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Savannah River at U.S. Hwy. 301
STOKES = Stokes Bluff

MDA = Minimum Detectable Activity
MDC = Minimum Detectable Concentration
SRS data from WSRC 2005
SRS results are averages
* includes one result below MDC
** includes two results below MDC
Averages calculated using detections only

Radiological Monitoring of Fish Data
ESOP and DOE-SR Data Comparison

(Return to TOC)

Table 5
Cesium-137 Activity Levels in Non-edible Bass
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	<MDC
UTR	SCDHEC	1	0.08
	SRS	3	0.08
BDC	SCDHEC	1	0.04
	SRS	3	0.09
FMC	SCDHEC	1	0.31
	SRS	3	0.19
STC	SCDHEC	1	0.11
	SRS	3	0.20
LTR	SCDHEC	1	0.12
	SRS	3	0.08
Hwy. 301	SCDHEC	1	< MDA
	SRS	3	0.02*
Average	SCDHEC	5	0.14
	SRS	6	0.11
Standard Deviation	SCDHEC	5	0.11
	SRS	6	0.07

Table 6
Cesium-137 Activity Levels in Non-edible Catfish
pCi/g

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	< MDA
	SRS	3	<MDC
UTR	SCDHEC	1	< MDA
	SRS	3	< MDC
BDC	SCDHEC	1	< MDA
	SRS	3	0.03**
FMC	SCDHEC	1	0.03
	SRS	3	<MDC
STC	SCDHEC	1	0.08
	SRS	3	0.04**
LTR	SCDHEC	1	0.08
	SRS	3	0.08
Hwy. 301	SCDHEC	1	< MDA
	SRS	3	<MDC
Average	SCDHEC	3	0.06
	SRS	3	0.05
Standard Deviation	SCDHEC	3	0.03
	SRS	3	0.02

Table 7
Strontium-**89,90** Activity Levels in Non-edible Bass
pCi/g **(DRY)**

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	0.10
	SRS	3	0.07
UTR	SCDHEC	1	0.08
	SRS	3	0.08
BDC	SCDHEC	1	0.49
	SRS	3	0.06
FMC	SCDHEC	1	0.44
	SRS	3	0.33
STC	SCDHEC	1	0.30
	SRS	3	0.08
LTR	SCDHEC	1	0.31
	SRS	3	0.07
Hwy. 301	SCDHEC	1	0.40
	SRS	3	0.06
Average	SCDHEC	7	0.36
	SRS	7	0.11
Standard Deviation	SCDHEC	7	0.22
	SRS	7	0.10

Table 8
Strontium-**89,90** Activity Levels in Non-edible Catfish
pCi/g **(DRY)**

Location	Agency	# of samples	Result
NSBLD	SCDHEC	1	<MDC
	SRS	3	0.08
UTR	SCDHEC	1	0.06
	SRS	3	0.06
BDC	SCDHEC	1	0.08
	SRS	3	0.07
FMC	SCDHEC	1	0.36
	SRS	3	0.07
STC	SCDHEC	1	0.26
	SRS	3	0.06
LTR	SCDHEC	1	0.19
	SRS	3	0.06
Hwy. 301	SCDHEC	1	0.61
	SRS	3	0.06
Average	SCDHEC	6	0.27
	SRS	7	0.07
Standard Deviation	SCDHEC	6	0.19
	SRS	7	0.01

Notes:
NSBLD = New Savannah Bluff Lock and Dam
UTR = Upper Three Runs
BDC = Beaver Dam Creek
FMC = Four Mile Creek
STC = Steel Creek
LTR = Lower Three Runs
Hwy. 301 = Savannah River at U.S. Hwy. 301

MDA = Minimum Detectable Activity
MDC = Minimum Detectable Concentration
SRS data from WSRC 2005
SRS results are averages
* includes one result below MDC
** includes two results below MDC
Averages calculated using detections only

4.1.5 Summary Statistics Radiological Monitoring of Fish

(Return to TOC)

Tritium levels (pCi/L) in Savannah River Fish, 2005

Species	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	4 (4)	1017	1065	619.5	257	2572
Catfish	3 (5)	457	184	362	340	669
Sunfish	5 (3)	1200	1832	342	264	4468

Edible composites only
Non-detects ( ) excluded from computations
Tritum not detected at Stevens Creek

Cs-137 levels (pCi/g) in Savannah River Fish, 2005

Species	Composite Type	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	Edible	6 (2)	0.201	0.177	0.163	0.053	0.547
	Nonedible	5 (3)	0.135	0.105	0.113	0.042	0.314
Catfish	Edible	2 (6)	0.141	0.002	0.141	0.140	0.143
	Nonedible	3 (5)	0.063	0.030	0.078	0.028	0.082
Sunfish	Edible	5 (3)	0.110	0.073	0.090	0.090	0.209
	Nonedible	3 (5)	0.088	0.027	0.094	0.058	0.111

Non-detects ( ) excluded from computations
Cs-137 not detected at Stevens Creek

Sr-89,90 levels (pCi/g - Dry) in Stevens Creek and Savannah River Fish, 2005

Species	N	Average	Standard Deviation	Median	Minimum Detect	Maximum Detect
Largemouth bass	9 (0)	0.334	0.218	0.313	0.078	0.752
Catfish	8 (1)	0.286	0.182	0.282	0.064	0.606
Sunfish	9 (0)	0.220	0.142	0.151	0.087	0.458

Non-edible composites only
Non-detects ( ) excluded from computations

N - denotes number of samples
Tritium results(pCi/L) represent the activity level in the water distilled from the fish tissue.
Cs-137 results represent the activity level in actual fish tissue.
Strontium results represent the activity level in an aliquot of dried fish tissue.

(Return to TOC)

4.2 Radiological Monitoring of Game Animals Adjacent to SRS

4.2.1 Summary

White-tailed deer have access to a number of contaminated areas on the Savannah River Site (SRS), and consequently are a vector for the redistribution of contaminants, including cesium-137 (Cs-137), to off-site locations. Consumption of these wildlife species can result in the transfer of contaminants to humans. The radionuclide of concern is Cs-137 because of its relatively long physical half-life of 30 years, and its availability to game animals and associated health risk to humans.

The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) conducts independent non-regulatory oversight of game animal monitoring activities at the SRS. The game animal project addresses concerns of potentially contaminated white-tailed deer migrating off the SRS by analyzing samples collected off-site. In 2005, SCDHEC analyzed muscle tissue for Cs-137 from 66 deer from within a five-mile study area adjacent to the SRS. Fifteen tissue samples were collected and analyzed from a background location 120 miles northeast of the SRS. Study area and background data were similar, with a higher average Cs-137 concentration in deer samples from the background area.

The precise ranging behavior of individual deer on the SRS is unknown. Deer have access to contaminated areas on-site and it is possible that some animals migrate off-site where they can be harvested by local hunters. Sampling by ESOP of deer harvested off-site can provide valuable information concerning the potential off-site exposure to Cs-137. ESOP off-site dose estimates are lower than DOE-SR modeled values for the local hunting population.

RESULTS AND DISCUSSION

Analytical results are listed under each zone in section 4.2.4.

A total of 81 deer samples were collected. Sixty-six samples were collected within five miles of the SRS perimeter (Map 12, section 4.2.2). Fifteen deer background samples were collected 120 miles northeast of the SRS. ESOP compared total Cs-137 activities to DOE-SR results.

<u>Cesium-137 Activity</u>

Cs-137 and the naturally occurring K-40 were the only isotopes detected in game samples collected in 2005. Cs-137 is readily incorporated into the human body because of its similarity to K-40 in physiological processes (Davis 1963). The Cs-137 concentrates in animal skeletal muscles, which are selectively consumed by hunters (Brisbin, 1975). Cs-137 is an important radionuclide because of its relatively long physical half-life of 30 years and its associated health risks (Haselow, 1991). Cs-137 emits both beta and gamma radiation, contributing to both internal and external radiation exposure, which may be associated with gastrointestinal, genetic, hemopoietic, and central nervous system damage (Bond, 1965). Because of these concerns, Cs-137 will be the only isotope discussed in this report.

Cs-137 activities from the 66 white-tailed deer perimeter samples ranged from < MDA to 4.32 picocuries per gram (pCi/g), with an average of 1.00 ± 0.87 pCi/g (section 4.2.4.). Sample results from the 15 deer collected 120 miles northeast of the SRS ranged from 0.48 pCi/g to 1.65 pCi/g, with an average of 1.19 ± 0.38 pCi/g. DOE-SR reported an approximate field measurement range of 1 pCi/g to 8.1 pCi/g, with an average of 2.32 pCi/g, from 215 deer harvested on the SRS in 2005 (WSRC 2006). Average SCDHEC study area and background, and DOE-SR on-SRS Cs-137 levels for the past five years (section 4.2.4.) are indicated in Figure 1. The study area Cs-137 average result (1.00 ± 0.87 pCi/g) is within one standard deviation of the SCDHEC background result (1.19 ± 0.38 pCi/g). The 2001 to 2005 SCDHEC average Cs-137 activity (1.50 ± 0.44 pCi/g) was approximately three standard deviations different from the DOE-SR average (2.90 ± 1.88 pCi/g).

CONCLUSIONS AND RECOMMENDATIONS

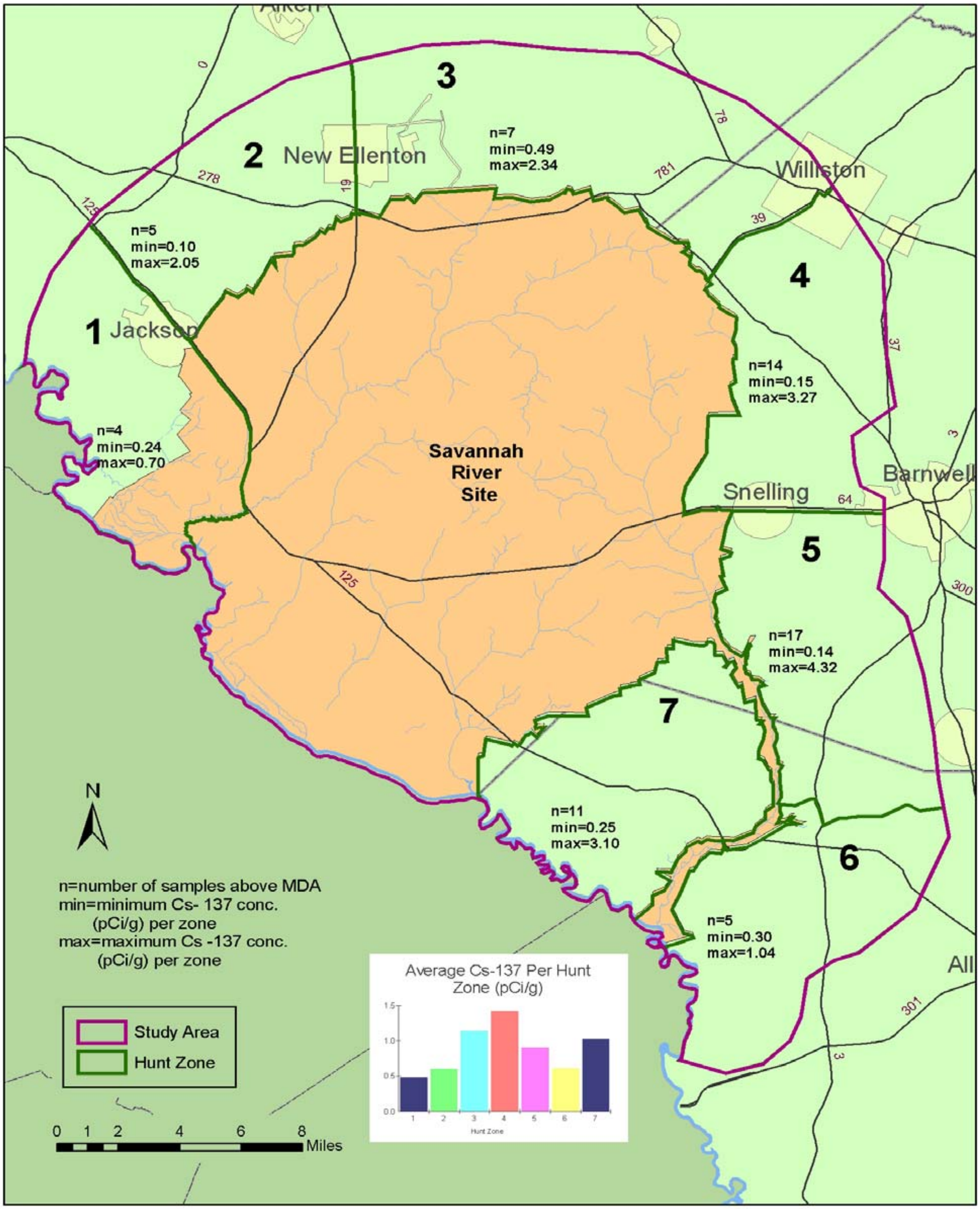
Although Cs-137 was deposited on the SRS from site operations, levels found in the study and background locations are likely results of global aboveground nuclear weapons testing (WSRC, 1997). DOE-SR does not collect game animal samples within the SCDHEC study area and off-site hunter doses are based on DOE-SR models; therefore, no direct comparisons could be made between ESOP and DOE-SR data.

Age, sex, body weight, soil type and location of collection may affect the Cs-137 activities found in white-tailed deer (Haselow, 1991). A portion of the elevated Cs-137 activity found in deer harvested in hunt units five and seven may be attributed to historic SRS operations. These operations released known Cs-137 contamination to Steel Creek and Lower Three Runs, their floodplains, and the Savannah River swamp, all of which impact hunt zones five and seven. Further research may be needed to help determine why elevated Cs-137 activities are found in other hunt units.

The precise ranging behavior of individual deer on the SRS is unknown. Deer have access to contaminated areas on-site and it is possible that some animals migrate off-site where they can be harvested by local hunters. Sampling by ESOP of deer harvested off-site can provide valuable information concerning the potential off-site exposure to Cs-137.

4.2.2 (Return to TOC)

Map 12. Radiological Monitoring of Game Animals Adjacent to SRS

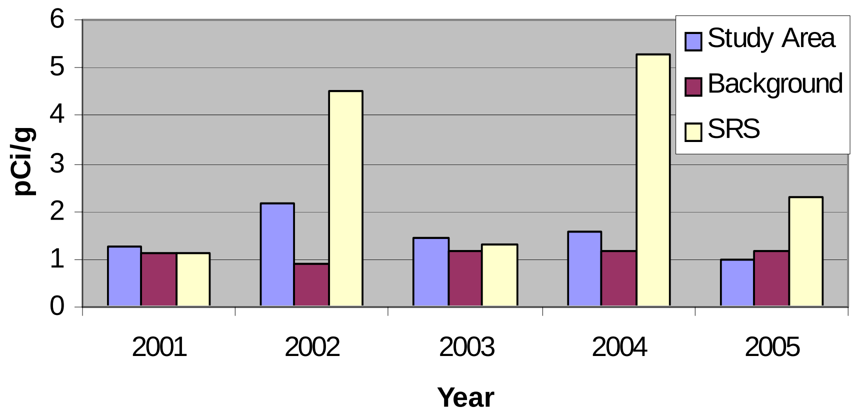


4.2.3 Tables and Figures

(Return to TOC)

Radiological Monitoring of Game Animals Adjacent to SRS

Figure 1. Average Cs-137 Concentration In Deer



4.2.4 Data

(Return to TOC)

Radiological Monitoring of Game Animals Adjacent to SRS

Radiological Monitoring of Game Animals Adjacent to SRS Background Deer Data

(Return to TOC)

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2005	12/22/2005	12/22/2005	12/22/2005	12/22/2005
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Doe	Doe	Buck
Weight	Pounds	100	97	92	100	90
Cesium-137	(pCi/g) wet	0.80	1.08	0.81	1.65	0.48
Uncertainty	(+/- 2sig)	0.10	0.14	0.10	0.18	0.06
MDA	(pCi/g) wet	0.04	0.04	0.03	0.03	0.02

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2005	12/22/2005	12/22/2005	12/22/2005	12/22/2005
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Doe	Buck	Doe
Weight	Pounds	100	95	65	87	100
Cesium-137	(pCi/g) wet	0.73	1.59	1.60	1.58	1.52
Uncertainty	(+/- 2sig)	0.09	0.17	0.18	0.18	0.17
MDA	(pCi/g) wet	0.03	0.03	0.04	0.04	0.03

Sample Location		Background	Background	Background	Background	Background
Sample Date		12/22/2005	12/22/2005	12/22/2005	12/22/2005	12/22/2005
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Buck	Buck	Doe
Weight	Pounds	87	87	115	85	107
Cesium-137	(pCi/g) wet	1.38	1.25	0.84	1.15	1.45
Uncertainty	(+/- 2sig)	0.16	0.15	0.10	0.13	0.16
MDA	(pCi/g) wet	0.04	0.04	0.03	0.03	0.03

Notes:
MDA - Minimum Detectable Activity

Radiological Monitoring of Game Animals Adjacent to SRS (Return to TOC)
Game Animal Monitoring Deer Data

Sample Location		Zone-1	Zone-1	Zone-1	Zone-1	Zone-1	Zone-1
Sample Date		10/21/2005	10/21/2005	10/21/2005	10/21/2005	10/21/2005	10/21/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Buck	Buck	Buck	Doe	Buck	Doe
Weight	Pounds	155	125	125	105	105	105
Cesium-137	(pCi/g) wet	0.58	<MDA	<MDA	0.38	0.24	0.70
Uncertainty	(+/- 2sig)	0.06	NA	NA	0.05	0.04	0.08
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.03	0.04

Sample Location		Zone-2	Zone-2	Zone-2	Zone-2	Zone-2	Zone-2
Sample Date		9/18/2005	10/7/2005	10/19/2005	10/19/2005	11/9/2005	11/30/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Buck	Buck	Doe	Doe	Doe	Doe
Weight	Pounds	105	115	45	100	115	100
Cesium-137	(pCi/g) wet	0.10	0.33	2.05	0.45	< MDA	0.28
Uncertainty	(+/- 2sig)	0.04	0.05	0.22	0.05	NA	0.05
MDA	(pCi/g) wet	0.02	0.03	0.02	0.03	0.02	0.02

Sample Location		Zone-3	Zone-3	Zone-3	Zone-3	Zone-3	Zone-3
Sample Date		8/19/2005	10/19/2005	10/19/2005	11/14/2005	11/19/2005	11/20/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Buck	Doe	Doe	Doe	Buck	Doe
Weight	Pounds	145	60	75	100	75	145
Cesium-137	(pCi/g) wet	0.53	1.94	2.34	0.63	1.27	0.75
Uncertainty	(+/- 2sig)	0.06	0.21	0.24	0.07	0.13	0.09
MDA	(pCi/g) wet	0.03	0.03	0.03	0.02	0.02	0.03

Sample Location		Zone-3
Sample Date		11/20/2005
Species		Deer
Sex		Buck
Weight	Pounds	130
Cesium-137	(pCi/g) wet	0.49
Uncertainty	(+/- 2sig)	0.06
MDA	(pCi/g) wet	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Monitoring of Game Animals Adjacent to SRS
(Return to TOC)

Game Animal Monitoring Deer Data

Sample Location		**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**
Sample Date		9/15/2005	9/17/2005	9/23/2005	9/25/2005	9/25/2005	9/26/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Doe	Doe	Doe	Buck
Weight	Pounds	110	110	105	100	100	50
Cesium-137	(pCi/g) wet	0.60	1.02	1.32	0.31	1.04	1.93
Uncertainty	(+/- 2sig)	0.06	0.08	0.11	0.04	0.09	0.14
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.03	0.02

Sample Location		**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**	**Zone-4**
Sample Date		10/19/2005	10/19/2005	10/19/2005	10/19/2005	10/19/2005	10/19/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Doe	Doe	Doe	Doe
Weight	Pounds	105	85	105	85	45	75
Cesium-137	(pCi/g) wet	2.09	0.82	3.27	0.15	2.68	2.30
Uncertainty	(+/- 2sig)	0.22	0.09	0.34	0.04	0.28	0.24
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.03	0.02

Sample Location		**Zone-4**	**Zone-4**
Sample Date		10/19/2005	10/23/2005
Species		Deer	Deer
Sex		Doe	Buck
Weight	Pounds	95	175
Cesium-137	(pCi/g) wet	1.86	0.49
Uncertainty	(+/- 2sig)	0.19	0.06
MDA	(pCi/g) wet	0.02	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Monitoring of Game Animals Adjacent to SRS (Return to TOC)
Game Animal Monitoring Deer Data

Sample Location		Zone-5	Zone-5	Zone-5	Zone-5	Zone-5	Zone-5
Sample Date		9/15/2005	10/1/2005	10/2/2005	10/3/2005	10/11/2005	10/11/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Buck	Doe	Doe	Doe
Weight	Pounds	120	160	115	120	50	105
Cesium-137	(pCi/g) wet	0.14	1.00	0.30	0.20	0.60	0.34
Uncertainty	(+/- 2sig)	0.04	0.08	0.04	0.20	0.05	0.04
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.02	0.02

Sample Location		Zone-5	Zone-5	Zone-5	Zone-5	Zone-5	Zone-5
Sample Date		10/12/2005	10/14/2005	10/16/2005	10/18/2005	10/23/2005	10/24/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Buck	Doe	Doe	Doe	Buck	Buck
Weight	Pounds	110	98	100	105	115	195
Cesium-137	(pCi/g) wet	0.30	0.80	0.81	0.93	0.17	4.32
Uncertainty	(+/- 2sig)	0.04	0.07	0.07	0.10	0.04	0.30
MDA	(pCi/g) wet	0.02	0.02	0.02	0.03	0.02	0.02

Sample Location		Zone-5	Zone-5	Zone-5	Zone-5	Zone-5
Sample Date		10/29/2005	10/29/2005	11/03/05	11/19/05	11/23/2005
Species		Deer	Deer	Deer	Deer	Deer
Sex		Buck	Buck	Buck	Doe	Doe
Weight	Pounds	100	120	120	105	125
Cesium-137	(pCi/g) wet	1.46	0.23	0.88	2.06	0.92
Uncertainty	(+/- 2sig)	0.12	0.03	0.08	0.15	0.10
MDA	(pCi/g) wet	0.02	0.02	0.02	0.02	0.02

Notes:
MDA - Minimum Detectable Activity

Radiological Monitoring of Game Animals Adjacent to SRS

(Return to TOC)

Game Animal Monitoring Deer Data

Sample Location		Zone-6	Zone-6	Zone-6	Zone-6	Zone-6
Sample Date		11/25/2005	11/25/2005	11/25/2005	11/25/2005	11/25/2005
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Buck	Doe	Doe	Doe
Weight	Pounds	85	152	105	105	110
Cesium-137	(pCi/g) wet	0.58	0.30	0.34	1.04	0.79
Uncertainty	(+/- 2sig)	0.07	0.04	0.05	0.11	0.09
MDA	(pCi/g) wet	0.03	0.02	0.02	0.02	0.02

Sample Location		Zone-7	Zone-7	Zone-7	Zone-7	Zone-7	Zone-7
Sample Date		8/24/2005	10/1/2005	10/1/2005	10/6/2005	10/13/2005	10/13/2005
Species		Deer	Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Doe	Doe	Buck	Doe
Weight	Pounds	105	42	100	100	130	110
Cesium-137	(pCi/g) wet	0.30	0.38	0.67	0.44	0.25	1.53
Uncertainty	(+/- 2sig)	0.06	0.06	0.09	0.06	0.05	0.17
MDA	(pCi/g) wet	0.03	0.04	0.03	0.02	0.03	0.03

Sample Location		Zone-7	Zone-7	Zone-7	Zone-7	Zone-7
Sample Date		10/15/2005	11/10/2005	11/19/2005	11/11/05	11/23/05
Species		Deer	Deer	Deer	Deer	Deer
Sex		Doe	Doe	Doe	Doe	Doe
Weight	Pounds	100	93	92	110	95
Cesium-137	(pCi/g) wet	1.22	3.10	1.12	0.61	1.71
Uncertainty	(+/- 2sig)	0.14	0.32	0.12	0.08	0.18
MDA	(pCi/g) wet	0.03	0.03	0.03	0.03	0.02

Notes:
MDA - Minimum Detectable Activity

4.2.5 Summary Statistics

(Return to TOC)

Radiological Monitoring of Game Animals Adjacent to SRS

Cs-137 concentrations (pCi/g wet weight) in deer collected in 2005

	N	Average	Std.Dev.	Median	Min.	Max.
Study Area	66	1	0.87	0.70	< MDA	4.32
Background	15	1.19	0.38	1.25	0.48	1.65

Cs-137 concentrations (pCi/g wet weight) in deer collected in 2001 - 2005

	Year	N	Average	Std.Dev	Median	Min.	Max.
Study Area	2001	35	1.27	1.19	0.75	0.06	4.06
Background	2001	5	1.14	0.22	1.26	0.78	1.34
SRS	2001	79	1.13	NA	NA	1	2
Study Area	2002	56	2.18	1.86	1.68	0.37	8.86
Background	2002	6	0.90	0.41	0.76	0.58	1.67
SRS	2002	1316	4.49	NA	NA	1	18
Study Area	2003	50	1.46	1.31	1.09	0.07	5.80
Background	2003	7	1.17	0.88	0.78	0.49	2.92
SRS	2003	1128	1.29	NA	NA	1	17.1
Study Area	2004	50	1.60	1.10	1.31	0.07	4.56
Background	2004	15	1.16	0.63	1.18	0.34	2.44
SRS	2004	817	5.26	NA	NA	1	48.3
Study Area	2005	66	1	0.87	0.70	< MDA	4.32
Background	2005	15	1.19	0.38	1.25	0.48	1.65
SRS	2005	215	2.32	NA	NA	1	8.1
Study Area	'01 - '05	257	1.50	0.44	1.09	0.06	8.86
Background	'01 - '05	48	1.31	0.37	1.18	0.34	2.92
SRS	'01 - '05	3555	2.90	1.88	2.32	1	48.3

Notes:
N - Number of Samples
NA - No Standard Deviation Given
Min - Minimum
Max - Maximum
MDA - Minimum Detectable Activity
Std.Dev - Standard Deviation

5.1 2005 Critical Pathway (Return to TOC)

5.1.1 Summary

The Department of Energy Savannah River (DOE-SR) operates a government facility located in South Carolina that produced nuclear materials for national defense during the cold war era. Throughout its' operational history, there have been documented instances of radiological materials released to the environment during production activities. A critical pathway assessment of the Savannah River Site (SRS) was performed. This included a review of DOE documented instances of radiological materials released to the environment during the site's history in addition to recent data from DOE-SR and the South Carolina Department of Health and Environmental Control (SCDHEC) Environmental Surveillance and Oversight Progam (ESOP). Emphasis was placed on releases that occurred during the past eight years (1993-2000) and on more recent dose estimates to the Maximally Exposed Individual (MEI) through 2005. The ESOP survivalist-sportsman scenario dose projections were compared to the phase III "Draft for Public Comment" SRS Dose Reconstruction scenario projections by the United States Center for Disease Control (CDC, 2004), and indicated an expected drop in public dose exposure over the next 39-yr period. From these document reviews and recent data, the primary radiological contaminants released by the SRS and the exposure pathways leading from the SRS to the surrounding public were identified. This assessment of radiological contaminants includes dose contributions to four possible critical pathway scenarios. Some nonradiological contamination monitoring results are summarized, but the reader is referred to the SCDHEC Bureau of Land and Waste Management for additional risk information.

ESOP found that the dose to the survivalist-sportsman MEI was 11.95 mrem in 2005. The total dose that included possible naturally occurring radioactive material (NORM) above background in 2005 gave an ingestion pathway dose of 81.76 %, inhalation pathway dose of 16.07 %, and direct exposure pathway dose of 2.18%. The following dose scenarios indicate the potential average dose to the various members of the public from 1999 through 2005: MEI sportsman (10.41 mrem), average sportsman (1.96 mrem), farmer (1.02 mrem), and general public (0.14 mrem). The primary MEI media dose pathways were game–animal (84.29%), soil & sediment (6.71%), fish (4.97%), groundwater wells with NORM above background (1.97%), boat landing river water (0.52%), milk (0.49%), ambient beta-gamma (0.34%), public water supply wells (0.33%), public water supply river water (0.31%), edible vegetation, rainwater, and air (0.03% each). The primary radionuclides contributing to dose from 1999 through 2005, excluding possible NORM, included cesium-137 (55.19%), tritium (2.22%), strontium-89/90 (1.04%), strontium-89 (0.80%), europium-155 (0.52%), strontium-90 (0.05%), cerium-144 (0.02%), and Pu-239/240 (0.01%). Possible NORM contributions above background included unspecified and assigned alpha and beta (25.01%), radium-226 (10.97%), actinium-228 (1.08%), uranium-234 (0.64%), lead-214 (0.62%), radium-228 (0.35%), lead-212 (0.15%), uranium-235 (0.12%), uranium-238 (0.10%), and americium-243 (0.01%).

These findings indicate that environmental monitoring programs should focus on the sportsman ingestion, soil exposure, other ingestion, and inhalation pathways. Appropriate early warning monitoring should minimize the risk to the public and the environment from accidental releases of hazardous substances.

RESULTS AND DISCUSSION

PRIMARY RADIOLOGICAL CONTAMINANTS

The primary atmospheric contaminants were identified using the Radiological Assessments Corporation (RAC) Report, SRS Environmental Reports, and ESOP Project Reports (section 5.1.2, Table 1). The RAC Report documented the major activities and releases from the beginning of SRS operations through 1992 by reviewing SRS environmental data, point discharge releases and information that was considered classified. Since the RAC report data collection ended in 1992, the SRS Environmental Data Reports were used from 1993 to present date to close the data gap.

In evaluating the information published in the RAC report several issues became apparent. Primarily, SRS atmospheric and liquid discharges had decreased dramatically by the time all five reactors were closed in 1988. Additionally, several of the radiological contaminants released during the operational history of the site had short half lives and were no longer significant in terms of human exposure. Therefore, this report only used SRS Environmental Data Reports from 1993 through 2005 to represent major radionuclides that had been released or were still being released. As a result, only radionuclides that would contribute at least 1 percent (considered conservative for this project) or more to the total dose for the maximally exposed individual (MEI) were considered. The MEI is simply a hypothetical person who remains in an uncontrolled area around the perimeter of the SRS that would receive the greatest possible dose equivalent from all potential pathways of the SRS operations (WSRC, 2001a).

The ESOP Project Reports were used as an independent source of data for environmental samples collected on and adjacent to the SRS to evaluate findings from the RAC and SRS Environmental Data Reports.

Atmospheric Contaminants

The RAC Report presents a list of radionuclides and corresponding screening values for all pathways for those living near the SRS based on the method used by the National Council on Radiation Protection and Measurements (NCRP). This method considers factors such as environmental transport mechanisms, exposure pathways and radiation dosimetry. The first step in the screening method identified I-131 and tritium to be the major contributors of atmospheric contamination. A second step in the screening method revealed I-129, I-131, tritium, argon-41 (Ar-41), and Pu- 239,240 ranking among the top of the contribution list for at least two of the seven exposure pathways (RAC, 1999). Other radionuclides identified are shown in Table 1.

The diffuse and fugitive atmospheric releases reported in the SRS Environmental Reports list all of the radionuclides that were released from unmonitored sources such as ponds and contaminated land areas (section 5.1.3). Of the many radionuclides listed, the following appear most consistently: tritium, C-14, Co-60, nickel-63 (Ni-63), Sr-89,90, Zr-95, Ru-106, antimony-125 (Sb-125), Cs-134, Cs-137, Ce-144, Eu-154, Eu-155, Pu-238, Pu-239, Am-241, and Cm-244. Another source of data, the Potential Radiation Doses section of the SRS Environmental Data Reports, were also used to help identify primary atmospheric contaminants. Only radionuclides from atmospheric releases between 1993 and 2005, that made up greater than or equal to 1 percent of the total dose to the MEI, were considered (section 5.1.3). A list of these radionuclides are also shown in Table 1. The radionuclides that consistently contribute more than 1 percent of the total dose to the MEI are tritium, I-129, Cs-137, Pu-238, and Pu-239.

The 1999 Radiological Atmospheric Monitoring Project and 1998 Terrestrial Vegetation Radiological Monitoring Project Reports were also reviewed to identify which radionuclides were consistently being detected in atmospheric samples on and adjacent to the SRS. The radionuclides listed in Table 2 are typically found in air and vegetation samples (SCDHEC, 2000b). Tritium in stream water and carbon-14 in air stack releases by SRS are observed and used to verify calculated release data (WSRC, 1998c). Cesium-137 was observed in ESOP edible vegetation.

Nearly all radionuclides listed in the RAC and SRS reports are calculated with mathematical transport models based on historical release information (RAC) or current release documents (SRS). Environmental data from DOE-SR and ESOP serve as verification for the calculated dose estimates to the public and the environment.

An evaluation of the data indicates that the current important radionuclides from a public health perspective are tritium, I-129, Cs-137, and plutonium isotopes. These radionuclides contributed greater than 1 percent of the total dose to the MEI from atmospheric releases from 1993 – 2005. Tritium, I-129 and Pu-239 were also listed in the RAC Report as radionuclides that rank among the top contributors for at least two of the seven exposure pathways. Two other radionuclides listed in the RAC Report, I-131 and Ar-41, are no longer of concern due to their short half-lives.

Tritium, gross alpha and beta, U-234, U-238, Am-241, and Pu-238 were detected by WSRC air samplers in 2005 (WSRC, 2006). These contaminants are not generally detectable at SRS offsite locations with the exception of tritium. The observed excess alpha and beta were near natural background levels and assumed to be NORM. No detectable gamma-emitting radionuclides were detected in WSRC rainwater samples. TLD exposure rates varied between 62 and 116-mrem per year.

Liquid Contaminants

The first screening step in the RAC Report identified sixteen radiological contaminants, including Cs-137 and tritium, that dominate all pathways. The second screening step further narrowed this list of contaminants to tritium, phosphorus-32 (P-32), sulfur-35 (S-35), Co-60, Zn-65, Tc-99, Sr-90, I-131, Cs-137, and uranium as radionuclides found in at least one surface water pathway (RAC 1999).

The radionuclides from liquid releases between 1993 and 2005 that made up greater than or equal to 1 percent of the total dose to the MEI are listed in section 5.1.3. These radionuclides are also shown in section 5.1.2, Table 2.

The radionuclides that were detected on a routine basis by the ESOP are listed in Table 2. These radionuclides were found in surface water, sediment and fish on and adjacent to the SRS (SCDHEC, 2000b).

An evaluation of the data indicates that the current important radionuclides from a public health perspective are tritium, Sr-90, I-129, Cs-137, and Pu-239. These radionuclides consistently contributed more than 1 percent of the total dose to the MEI (from 1993 – 2005). ESOP Project Reports verify the presence of tritium, Sr-90, I-129 and Cs-137 in the environment. The RAC Report also supports this by listing tritium, Sr-90, I-129, and Cs-137 in their second screening step. Other radionuclides listed in the RAC Report second screening step, such as P-32, S-35, Co-60, Zn-65, I-131 are not considered significant due to their short half-lives. Tc-99 and uranium may become important radionuclides in the future because of their long half-lives. No public water supply exceeded the alpha, beta, or tritium limits for drinking water in 2005.

PRIMARY EXPOSURE PATHWAYS

The two main environmental pathways from the SRS to the surrounding public are atmospheric and liquid. An exposure pathway diagram is depicted in section 5.1.3. The environmental mediums receiving mostly atmospheric releases include air, soil, and food. The environmental mediums receiving mostly liquid releases are food, surface water, and ground water. These environmental mediums are part of exposure pathways to the public. The atmospheric and resuspended soil contamination contribute to the inhalation, plume (atmospheric releases that can effect the public through dermal contact), and ground exposure pathways. The drinking water, swimming, boating and shoreline exposure pathways are created when surface water is used for drinking water and recreational purposes. The consumption of vegetation, milk, fish and game-animal (also known as the sportsman exposure pathway) contributes to the food medium or pathway.

Exposure routes connect the exposure pathways to the surrounding public. The three exposure routes include inhalation, dermal absorption, and ingestion. Inhalation includes breathing in atmospheric plumes, and resuspended soil and sediments. Dermal absorption and ingestion can occur through atmospheric and liquid plumes, swimming, boating and shoreline exposure pathways. Food and water environmental mediums lead to the surrounding public's ingestion exposure routes.

Data from the Potential Radiation Doses section of the WSRC SRS Environmental Data Reports for 1993 through 2006 were used to graph exposure pathway trends for both atmospheric and liquid releases. Data used for atmospheric releases were taken from the MAXDOSE-SR computer modeling code using the consumption of cow milk pathway. The data tables used to develop Figures 1 - 3 can be found in section 5.1.3.

<u>Atmospheric Pathway</u>

The dose to the MEI from DOE-SR atmospheric releases is shown in section 5.1.2, Figure 1. Since 1993, the potential inhalation and vegetation exposure pathways from aerial contamination have been dominant during the last thirteen years. Other pathways that represent a smaller fraction of the atmospheric dose include cow milk, meat, ground and plume.

Air

The air medium consists of inhalation and plume exposure pathways. As shown in Figure 1 (also, section 5.1.3), the plume exposure pathway has not exceeded one percent of the total dose to the MEI in the last eleven years. However, the inhalation exposure pathway has contributed more than 1 percent of the total dose. Tritium accounts for the majority of the total dose to the MEI from air releases since 1993 (section 5.1.3).

Soil

The soil medium includes the accumulation of radionuclides in the ground exposure pathway from atmospheric releases. This does not appear to be a significant source of the overall MEI dose. WSRC detected the following radionuclides in soil samples offsite: Co-60, Cs-137, Sr-89,90, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, and Cm-244 (WSRC, 2006).

Food

Vegetation, cow milk and meat are classified as exposure pathways under the food medium. Vegetation contributes substantially to the total dose of the MEI (Figure 1). Tritium accounts for the majority of this dose from air releases (section 5.1.3). Cesium-137 and Sr-89,90 was found in collards and milk, Co-60 was found in peanuts, and tritium was found in collards, beef, and pecans (WSRC, 2006).

Vegetation

Bermuda grass was sampled by WSRC in 2005 and found the following radionuclides that could impact herbivores: tritium, Cs-137, Sr-89/90, U-234, U-235, U-238, Pu-238, and Am-241 at SRS perimeter locations (WSRC 2006).

In summary, the inhalation and vegetation exposure pathways are the most significant contributors from the atmospheric pathway. These two exposure pathways directly affect the inhalation and ingestion exposure routes of the surrounding public. Tritium is detected most often in the inhalation and vegetation exposure pathways.

Liquid Pathway

Figure 2 in section 5.1.2 illustrates a graph of the potential dose to the MEI from liquid releases. Consumption of fish and water dominate the liquid environmental pathway. Exposure pathways from shoreline, boating, and swimming contribute less than one percent of the total dose to the MEI (section 5.1.3).

Food

Fish is a very dominant exposure pathway in the food environmental medium. This pathway has contributed a greater portion of the dose to the MEI during the last eleven years (Figure 2). Cs-137 and Sr-90 are the predominant radionuclides detected in fish (SCDHEC, 2000b). Aquatic food product detections included Cs-137, Sr-89/90, tritium, and Pu-238 in WSRC, 2005 samples.

Surface Water

A portion of the dose from the liquid pathway was contributed by consumption of the surface water environmental medium. Boating and swimming are also considered part of this environmental medium, though only for dermal absorption and for incidental ingestion while swimming.

Groundwater

Localized contaminated groundwater on the SRS intersects onsite streams that ultimately discharge into the Savannah River.

Sediments

Cesium-137, Sr-89,90, Co-60, Pu-238, Pu-239, U-234, U-235, and U-238 were observed in river and stream sediments (WSRC, 2006). Due to flooding, the swamp area between Steel Creek Landing and Little Hell Landing was contaminated by SRS operations with Cs-137 and Co-60. Cesium-137 detections in this area in 2005 varied from 65 pCi/g in soil to 1.25 pCi/g in vegetation and was observed up to 5 miles away from the site boundary. The strontium-90 maximum in soil was 1.25 pCi/g, and 0.31 pCi/g in vegetation. No correlation was observed between any of the detected radionuclides in swamp soil.

Sportsman Exposure Pathway

The sportsman exposure pathway is the dose to local hunters and fishermen.
This exposure pathway has drawn a considerable amount of attention since 1993 (section 5.1.2, Figure 3) due to the differences in dose exposure noted between onsite and offsite hunters. The sportsman exposure pathway is influenced by the food and surface water environmental mediums (section 5.1.3).

A sportsman dose is presented in the Potential Radiation Doses section of the SRS Environmental Reports (section 5.1.3). Figure 3 compares the MEI dose from all releases (atmospheric and liquid) to the sportsman dose. The MEI dose from all releases between the years 1993 - 2005 is not above 1.0 millirem (mrem) (Figure 3). Conversely, the onsite hunter dose has consistently been higher than the offsite hunter. The offsite hunter and offsite fisherman have the second and third highest dose to the MEI, respectively. All three of the sportsman doses are greater than all other exposure pathways combined (section 5.1.3).

The dose to the sportsman exposure pathway is largely influenced by Cs-137 uptake in the SRS deer population. Other radionuclides such as Sr-90, Sr-89/90, Ra-226 and Ra-228 also exceed the SRS benchmark values for the onsite recreational hunter (WSRC, 2000c). These radionuclides bioaccumulate in deer harvested onsite, and are passed on to the local hunters. Deer harvested onsite are monitored by SRS personnel before the harvested animal leaves the SRS. SRS personnel also calculate the cumulative annual dose for each individual hunter for the animals they have harvested throughout the year. Data from SRS deer and hog hunts resulted in the detection (WSRC, 2000c) of Cs-137 ranging from 1 pCi/g (lab) to 8.1 pCi/g (field measurement). Sr-89, 90 in bone ranged from 1.0 to 1.9 pCi/g.

Dose Reconstruction Reports

ESOP attended Citizen Advisory Board (CAB) meetings on a regular basis, and reviewed the information contained in the reports in order to assess the ESOP and SRS environmental programs.

The Phase III "Draft for Public Comment" SRS Dose Reconstruction Report (CDC, 2004) made important recommendations based on analysis of various scenarios for critical pathway assessments. This report attempted to address the public health consequences of SRS operations to children born in 1955 and 1964 for the 39 year period since plant operations began.

The CDC designed the Dose Reconstruction project to take place in five phases. The project included input from open public participation, CABs, and the SRS Health Effects Subcommittee (SRSHES). These committees reflect the diversity of the communities and make recommendations to SRS and the CDC. The SRSHES advised the CDC on the adequacy of their health research and public health activities associated with the SRS Dose Reconstruction Project.

Phase I (completed 1995) copied documents, established an electronic database, and described SRS areas and processes. Phase II (completed 2001) included source term development, and pathway analysis up to 1992 that resulted in a 1400 page report entitled, " Savannah River Site Environmental Dose Reconstruction Project, Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval, Evaluation of materials Released from the Savannah River Site (Phase II)".

In the Phase III "Draft for Public Comment", the CDC (2004 Draft) intended to use the International Atomic Energy Agency (IAEA) Safety Series Report No. 19 for a screening analysis of SRS. The purpose was to determine what radiological releases might have biological significance and warrant further investigation in Phases III and IV. Phase III level 1 screening was for all pathways, and level 2 screening was for each individual pathway. The CDC revised their approach to include seven hypothetical sets of individuals performing realistic and extreme activities on and near the SRS. The scenarios included families that lived and worked in the SRS area, while bearing children and engaging in radiation exposure activities during the years of SRS releases. The MEI sportsman living in the swamps downriver was not a scenario addressed by the CDC study. However, the outdoors family and near river family studies incorporated some of the same elements (fish consumption). The ESOP and SRS environmental reports highlight the importance of external exposure during game animal harvesting, especially deer and hogs, and game animal consumption to the overall dose to the MEI.

The conclusions of the "Draft for Public Comment" (CDC, 2004) phase III SRS Dose Reconstruction Report study are quoted as follows:

1. Doses and risks are small for all receptors and scenarios relative to doses and risks from background radiation over the 39-year period of the study.
2. For people who ate fish from the Savannah River or Lower Three Runs Creek, fish ingestion was the most significant pathway, and the most important radionuclides were generally cesium-137, phosphorus-32, and strontium-90.
3. For people who did not eat fish from bodies of water contaminated by releases of

4. radionuclides to water, milk and beef were the most significant pathways and iodine-131 and tritium were the most important radionuclides.
5. Immersion in argon-41 was a significant, generally small, but constant contributor to dose.
6. Large doses occurred in years corresponding to large releases from the Savannah River Site especially iodine-131; for the Adult Male, Adult Female, and Child Born in 1955, and a large fraction of the total dose was received during the years 1955-1961.
7. There were important differences in doses, pathway significance, and radionuclide significance between children born in 1955 and children born in 1964—those born in 1955 experienced the large iodine releases early in the site history, while those born in 1964 did not experience them.
8. Doses caused by ingesting fish, from Lower Three Runs Creek were significant and higher than doses caused by ingesting fish from the Savannah River.
9. For air releases, the variations in air dispersion of radionuclides from the site generally produced a significant, but not dominant, variation in estimated doses.
10. Consideration of uncertainty in the variables used to estimate doses could cause an estimated dose to be higher or lower than the corresponding point-estimate result. The mean of the distribution of total dose for any receptor ranged between 2.15 to 1.07 times the corresponding point-estimate dose; thus, the means of the uncertain doses were close to the corresponding point –estimate values.
11. The use of hypothetical scenarios to demonstrate the interactions of a range of receptor behaviors with the site and release characteristics was an effective analytical tool.

The largest point-estimate dose for the hypothetical receptors was 0.94-rem (940-mrem) over the 39-year period for the Outdoor Family Child born in 1955. The annual average radiation background exposure for the general U. S. population would result in 14 rem of dose (360-mrem times 39-years) from naturally occurring radioactive materials (NORM) and medical sources during the same 39-year period. Thus, the 39-year average from background sources not associated with the SRS was 14.9 times greater than the expected dose from SRS operations during that study period. The statistical uncertainties resulted in a newborn mean dose (1955 maximum dose) of 1.3-rem with a median of 1.1-rem for the 39-year period. The maximum dose was 6-rem and the minimum was 0.25-rem**.** Consideration of these uncertainties would change the range comparison for background to dose from approximately 2.33:1(14:6 mrem) for the maximum to 56:1 (14:0.25 mrem) for the minimum dose exposure. That is, the average annual background was at least 2.33 times greater than the maximum 39-yr SRS dose observed for the CDC scenarios. The corresponding risk of cancer incidence was 0.10 percent to 0.024 percent for cancer fatality (CDC 2004).

These CDC scenarios represent risk to the local population born during either 1955 or 1964. The relevant pathways over a 39-year period were fish (produced 50% of the ingestion dose for 8 of 12 receptor scenarios, and 83% of the dose for 10 of 12 receptors), and beef (highest % for the remaining two scenarios) for the CDC (2004) scenarios exposed to water releases. The percent of total ESOP dose data detected from 1999-2005 indicates that the fish dose was approximately 25.45% and the deer average dose was 19.51% for that same period (SCDHEC 2005d). The greatest contributors to dose during the 39-year period for the fish and beef pathways (CDC 2004) were Cs-137, Sr-90, P-32, and I-131.

The ESOP data for the period 1999-2005 excluding NORM above background indicated that the primary contributors to dose (>1% of dose) were Cs-137, H-3, and Sr-89/90. Since the DOE-SR nuclear reactors were shutdown in 1988 except for a test run of K reactor in 1992 (WSRC 1999c), any reactor release radionuclide with a half-life less than 1.4 years is no longer relevant in 2005. It takes ten half-lives to reduce the radionuclide concentration to less than 0.1%. Thus, P-32 (14.29 day half-life) and I-131 (8.04 day half-life), which were major contributors to dose when released, are no longer of concern. However, Cs-137 (half-life 30.17-years) and Sr-90 (half-life 28.60-years), and some long-lived daughter products of other radionuclides may still be sources of dose.

The contributions to dose from the CDC (2004) air pathway were greatest for milk and beef for over 75% of the critical pathway scenarios. The major contributors to air dose during the time of release for these scenarios were I-131 and tritium (H-3). Due to the shutdown of all SRS reactors by 1992, I-131 is no longer a factor due to its short half-life (8.04–days). Only H-3 is a concern for the public and the environmental air dose today since it continues to be released both by the SRS and Plant Vogtle, and its half-life is 12.28 years. Argon-41, with a half-life of 1.83-hours, was only relevant as an air immersion dose the same day of release. The air dose release was approximately 10% of the dose for all scenarios compared to the water release dose.

The absence of P-32 and I-131 dose in the water pathway and I-131 and Ar-41 in the air release pathways should result in reduced exposure to dose for today's life-style scenarios. Compare the CDC scenario 1300 mrem (range 250 mrem to 6000 mrem) total dose for the radionuclides of significance to Table 3 (section 5.1.2) projected average dose for a future 39-year period based on extrapolated 2002-2005 DOE-SR and ESOP Sportsman MEI dose estimates. The 2002-2005 DOE-SR dose estimates and the 2002-2005 ESOP maximum detection data were totaled, averaged, and multiplied by 39 years to project a dose average exposure for the ESOP survivalist-sportsman MEI. This 39-yr extrapolated dose average estimate (to year 2041) was compared to the previous 39-year CDC scenario maximum estimates (through 1991) as a worst-case scenario. Note that this comparison does not predict a 39-yr dose total, but does project the average dose over a 39-yr period based on 4 years of recent data.

ESOP sampling for the period 2002 through 2005 (Table 3) detected 56.93 mrem of the DOE-SR (WSRC 2006, Table 6-4) estimated dose (69.17 mrem) for the offsite categories listed or 82.3 % of the potential dose estimate. The ESOP projected offsite average dose estimate for 2002 to 2041, based on a four-year average detection level for the (2002-2005) survivalist-sportsman MEI dose media, would be 555.55 mrem. The SRS Sportsman MEI based on the DOE SRS Environmental Reports from 2002-2005 with similar pathways would give a projected minimum 39-year average exposure of 674.41 mrem. These two dose average estimates of the offsite dose total for the next 39-year period were near the low end of the CDC 1955/1964 related scenarios dose results range (250 mrem to 6000 mrem) for previous 39-year periods that included operating reactors. If the SRS onsite average dose (Table 3) is added to the ESOP survivalist-sportsman who takes part in SRS hunts, the MEI 39-yr exposure would add an average of 1313 mrem to both of the DOE-SR and ESOP projections to give a range of 1868 mrem to 1988 mrem of exposure over the next 39-year period (2002 to 2041) for the ESOP projected MEI scenario. The ESOP offsite 39-year average dose projection for the MEI appears to have a downward trend despite the addition of possible NORM to some of the 2004 and 2005 media dose. As the last three years of average detected dose were added to the 2002 data, the yearly average offsite sportsman dose dropped from 28.50 mrem in 2003 to 15.53 mrem in 2004, and 14.23 mrem in 2005. Thus, the 39-yr projected dose is expected to continue to drop in future years due to radionuclide half-life decay as long as the SRS production levels continue to drop. However, the total dose for the survivalist-sportsman 39-yr MEI would accumulate on a yearly basis and not an average basis, and the trend line is uncertain due to future DOE-SR mission changes.

Thus, extrapolation of DOE-SR and ESOP recent dose data to an average dose over a future 39-year period indicated a wide range of possible dose exposures to the MEI sportsman that was primarily dependent on whether the survivalist-sportsman consumed deer from onsite or offsite. The SRS (onsite:offsite) total dose ratio (1313:674), for the average of SRS comparable data (2002-2005 period), indicated that the onsite potential contamination for the ESOP survivalist-sportsman scenario (134.70 mrem) was approximately two times higher than the offsite dose (69.17 mrem). If the CDC scenarios had included onsite exposures for the onsite hunter and fisherman, then the 39-year maximum for an SRS onsite hunter could have been greater than the mean dose of 1300 mrem for an Outdoor Family Child born in 1955. The CDC point estimate uncertainty maximum of 2.15 (2.15 times 940-mrem) allows for the possibility of this dose reaching 2021-mrem. Compare this with the unqualified addition of the ESOP 39-year projected DOE-SR onsite hunter dose (1313 mrem) to the 39-yr projected offsite dose (674.11 mrem), which would raise the future 39-yr possible maximum dose to 1987.73 mrem. This highly unlikely maximum additional dose for the survivalist-sportsman (1987/14040) would add 14.15 percent to the 39-yr NORM plus medical dose for this worst-case scenario.

The CDC estimate included specific radionuclides that are no longer of concern and not part of the ESOP projection estimate. Note that the ESOP worst-case scenario projected range (1868.37 mrem and 1987.73 mrem) using comparable DOE-SR and ESOP data from 2002 through 2005 to make a 39-yr projection is far less than the maximum possible dose (6000 mrem) for the child born in 1955. Thus, the transport of potential dose to the public through onsite hunting has declined as expected due to reduced operations at the DOE-SR and decay factors for the relevant radionuclides.

The 39-year CDC maximum point estimate dose of 940-mrem was greater than the ESOP (555-mrem) projection and the DOE-SR dose (674-mrem) estimate projections for the offsite survivalist-sportsman scenario. DOE-SR calculated data models are very conservative and expected to produce a greater dose than the ESOP actual radionuclide detections in the environment. However, the new ESOP survivalist-sportsman MEI scenario does use a few more conservative exposure rates for observed data than the site-specific calculations used by DOE-SR. These different approaches still resulted in the ESOP detected dose being less than the DOE-SR calculated dose and serves to confirm that DOE-SR dose estimates are conservative. Reduced future offsite exposure was expected since the major dose contributors (I-131, Ar-41, and P-32) associated with reactor operations and processing are no longer dominant factors. The addition of an onsite survivalist-sportsman dose estimate to the Outdoor Family Child and River Dweller CDC scenario would have increased the dose estimates for the past 39-yr periods considered by the CDC, but would be within the CDC uncertainty range.

The maximum dose exposure to the survivalist-sportsman MEI occurred with the onsite hunter, the offsite sportsman, and the creek mouth fisherman in that order. The air and liquid dose pathways were responsible for approximately 0.42% of the potential dose experienced by the worst-case scenario for the offsite survivalist-sportsman from 2002 to 2005. Thus, the nonsportsman public exposed to only offsite Savannah River water and air in 2005 should receive a dose of less than 2.34 mrems (0.06*39 from Table 5) over the next 39 years. The ESOP 2002 -2005 air and liquid data extrapolated as a dose-projection ((0.24/4)*39 from Table 3) produced the same estimate (2.34 mrems).

Primary Nonradiological Contaminants

Guidance for Critical Pathway Considerations

The ESOP nonradionuclide portion of the critical pathway report does not estimate risk to the public (see EPA or FFA reports for risk analyses), but does list the possible pollutants and pathways to the public and the environment for releases in 2005. The Emergency Planning and Community Right-to-Know Act (EPCRA), the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Superfund Amendments and Reauthorization Act (SARA), the National Environmental Policy Act (NEPA), the Safe Water Drinking Act (SDWA), the Clean Water Act (CWA), the National Pollutant Discharge Elimination System (NPDES), the Clean Air Act (CAA), the National Emission Standards for Hazardous Pollutants (NESHAP), the Toxic Substances Control Act (TSCA), and the Federal Facility Compliance Act (FFCAct) ensure that known wastes are frequently monitored and remedial action taken as needed.

The SRS Federal Facility Agreement (FFA) was entered into by CERCLA, DOE, EPA Region IV, and SCDHEC August 16, 1993. This is an enforceable agreement and the FFA sets the milestones for environmental remediation at SRS. The FFA identifies site evaluation units for which investigations are required. Potential contaminants from RCRA/CERCLA waste management units are evaluated under FFA. Remediation recommendations are based on the results of a baseline risk assessment for human health and the environment. Public participation is required under CERCLA in the selection of remediation alternatives. Public comments and further analyses result in a record of decision (ROD) that documents the remedial action and rational. The administrative record file documents the remedial alternatives and provides for public review.

SRS Monitoring of Nonradionuclides

SRS monitors nonradiological chemicals and metals in wastewater, surface water, drinking water, sediment, ground water, fish, and air. Monitoring includes the following:

1. The airborne emissions from SRS stacks are routinely monitored. Air pollution comes mainly from sulfur dioxide, oxides of nitrogen, carbon monoxide, total particulate matter <10 microns, volatile organic compounds and ozone (VOCs), gaseous fluorides, lead and other toxics. These are permitted releases with compliance standards.
2. NPDES permitted liquid release monitoring includes chemical, bacteriological, lead and copper, synthetic organic, and volatile organics. The only NPDES permit exceedence in 2005

occurred at SRNL due to the collapse of a section of channel bank that resulted in a high total suspended solids (TSS).
3. Biological and water quality surveys of the Savannah River conducted by the Patrick Center for Environmental Research of the Academy of Natural Sciences of Philadelphia (ANSP) or other grant research.
4. Some groundwater contamination beneath SRS is monitored by wells for solvents, metals, and other operation byproducts.
5. Short and long term surveys on the effects of SRS effluents on the environment.
6. Mitigation Action Plans monitor re-vegetation or reforestation in affected areas.
7. Underground tanks store gasoline and diesel fuel.
8. Soil vapor extraction units and air strippers contribute to air toxins or contaminants and volatile organic chemicals (VOCs).

The SCDHEC Contaminant Inventory at SRS

The SCDHEC Bureau of Land & Waste Management maintains a groundwater contaminant inventory. The portion for site name, contaminant type, and whether discharging to a water body, name of water body and remarks are indicated in section 5.1.2, Table 4. Table 4 is "Excerpts from the SCDHEC Bureau of Land and Waste Management South Carolina Groundwater Contaminant Inventory", and indicates the status of contaminants and RCRA units. Nonradiological risk assessments are not done by the ESOP, since risk is rated on a case-by-case basis by the SCDHEC Bureau of Land & Waste Management. The contaminants discharging to a water body are highlighted in bold font. These water bodies ultimately discharge into the Savannah River where additional monitoring occurs. Refer to the glossary for abbreviations. The toxic chemicals that are frequently sampled at various SRS locations are listed in section 5.1.3.

Table 4 indicates that the primary contaminants of concern are radionuclides, metals, and VOC. Hazardous chemical storage information at SRS is presented in a Tier II Inventory Report to the state each calendar year (section 5.1.3). Release values for regulated chemicals that exceed established thresholds for releases to air, water, land, underground injection, and offsite transfers are indicated on form R of the EPCRA report. The toxic chemical releases have dramatically decreased at SRS since the year 1988 when releases were in the millions of pounds per year to typically less than or slightly greater than hundreds of thousands of pounds per year. This coincides with the cessation of nuclear reactor production at SRS in 1989. Decreases in chemicals of concern include chlorine, lead, Freon 113, and 1,1,1-trichloroethane (WSRC reports since 1989).

NEPA evaluates the potential environmental impact of proposed activities and examines alternatives. Categorical exclusions or environmental impact statements are typical documentation in environmental assessments. Compensation for unavoidable losses attributable to development activities may result.

The Federal Insecticide, Fungicide, and Rodenticide Act limits the application of pesticides. The application of herbicides are also monitored. The Clean Air Act is regulated by the EPA and SCDHEC (Reg 61-62). SRS is classified as a major source with one permit, and emission sources are identified by area designations, point identification numbers, and source description.

The permit is renewable at five-year intervals. Typical hazardous air pollutants include radionuclides, ozone-depleting substances (ODSs), benzene, asbestos, some consumer products and industrial supplies such as degreasers, solvents, metals, batteries, and diesel fuel. Air emissions inventories and air dispersion modeling are used to demonstrate compliance at the boundary line by comparing the results to SCDHEC Standard No.8 (61-62.5). New sources must be permitted using air dispersion modeling. Only sources greater than 1,000 pounds per month for any single, toxic, air pollutant are regulated by permits. The mineral asbestos is regulated by SCDHEC (R61-86.1) and is disposed of at approved sites. Class I ODSs (Title VI, CAAA) are 10 times more ozone depleting than hydrochlorofluorocarbons (HCFCs) and include chlorofluorocarbons (CFCs), Halon, carbon tetrachloride, methyl chloroform, methyl bromide, and hydrobromofluorocarbons (HBFCs).

TSCA EPA regulatory programs control the use, storage, and disposal of specified chemicals such as polychlorinated biphenyls (PCBs). PCBs were confirmed to be present in two groundwater-monitoring wells in M-Area and in the Ford Building in N-Area.

The Endangered Species Act, National Historic Preservation Act, and Floodplains/Wetlands Environmental Reviews require environmental assessments to evaluate potential impacts of SRS activities and proposals.

The Environmental Monitoring Section (EMS) personnel respond to unplanned environmental releases when requested.

Non-permitted Releases

Non-permitted releases to the environment of a reportable quantity (RQ) for a hazardous substance requires notification to the National Response Center. This includes oil spills on navigable waters (CWA & CERCLA). Exemptions may be permitted or covered by a continuous-release notification. Exemptions have been granted SRS at specified times for glycol and asbestos.

Only reportable releases and unusual occurrences are considered for their applicable critical pathways. ESOP may sample for selected nonradiological chemicals of concern in the environment.

Nonradionuclide Surveillance Results

Mercury is the primary nonradionuclide that potentially impacts the sportsman public. WSRC observed slightly higher levels of mercury in 2005 than in 2004. Bass had the highest observed concentrations (4.08 ug/g at Steel Creek), bream at Augusta Lock & Dam (1.25 ug/g), and catfish at the mouth of Steel Creek (2.11 ug/g) (WSRC 2006).

The major contaminants of concern in groundwater on SRS are trichloroethylene, perchloroethylene, and radionuclides. All surface water parameters met the Freshwaters Standard for South Carolina streams except for nitrates on Fourmile and pH on Upper Three Runs. The trend in pH is typical of some blackwater streams, and the nitrates are wastewater treatment plant discharge.

Mercury in fish is the only public notice advisory issued on a continuing basis by SCDHEC. Volatile organic chemical releases are diluted by river water and the down gradient water suppliers. Drinking water is monitored for maximum contaminant levels (MCL) by SCDHEC. ESOP continues to monitor offsite groundwater wells and streams for radionuclides and nonradiological contaminants of concern.

CONCLUSIONS AND RECOMMENDATIONS

The primary radiological contaminants currently released into the atmosphere by the SRS and detected by the 2005 cow-milk pathway were tritium, I-129, Pu-238, Am-241, Pu-239, Cs-137, Sr-90, non-volatile beta, and alpha (WSRC 2006). The 2005 ESOP MEI dose detections assignable to atmospheric deposition, excluding probable NORM, came mostly from the Cs-137 in deer, unspecified alpha in soil assigned as Pu-239, U-235 in soil, Eu-155 in soil, tritium in cow milk and drinking water, and Sr-89 in cow milk. The probable NORM would add Ac-228, Pb-214, and Ra-226. Radionuclides that made up the major contaminant dose for liquid releases at the SRS included Cs-137, tritium, alpha, Sr-90, and non-volatile beta (WSRC 2006). The 2005 ESOP dose detections assignable to the liquid pathway, excluding probable NORM, came mostly from Cs-137 in fish, Sr-89/90 in fish, unspecified alpha in drinking water, tritium in fish and drinking water, and unspecified beta in drinking water. The probable NORM detections would add Ra-226 in ground water (SCDHEC 2005b).

The major radionuclides released from DOE-SR in detectable concentrations from 1993 through 2005 were tritium, I-129, Cs-137, and Pu-239 (atmospheric releases), and Cs-137, tritium, alpha, I-129, beta, Pu-239 and Sr-90 (liquid releases). It should be noted that the SRS Environmental Reports from 1993 through 2005 assigned unspecified alpha and beta concentrations to Pu-239, and Sr-90, respectively. The alpha- and beta-emitting radionuclides (WSRC 2001a) contributed substantial unspecified dose based on the Pu-239 and Sr-90 dose factors. Therefore, Pu-239 and Sr-90 doses are potentially inflated due to the incorporation of the dose from naturally occurring alpha- and beta-emitters.

Also, some naturally occurring NORM above background may reflect local soil characteristics rather than contributions from the SRS, but were assumed of SRS origin if above the South Carolina average background.

The ESOP radionuclide percent of dose detections from 1999 through 2005 assignable to manmade activity included Cs-137 (55.19%), tritium (2.22%), Sr-89/90 (1.04%), Sr-89 (0.80%), Eu-155 (0.52%), Sr-90 (0.05%), Ce-144 (0.02%), Pu-239/240 (0.01%), Pu-238 (0.004%), and Tc-99 (0.002%). The balance included unknown alpha and beta assigned as Pu-239 (24.74%) and Sr-90 (0.27%) respectively. The other radionuclides that were potential NORM included Ra-226 (10.97%), ambient beta-gamma (1.08%), Ac-228 (1.08%), U-234 (0.64%), Pb-214 (0.62%), Ra-228 (0.35%), Pb-212 (0.15%), U-235 (0.12%), U-238 (0.10%), and Am-243 (0.01%). Other radionuclides were not detected at significant figure dose or were not greater than the average South Carolina background radionuclide average.

The WSRC 2006 report, Table 6-4, of “maximum potential all-pathway and sportsman doses” calculated the external exposure, ingestion, and inhalation routes of public exposure to radionuclides. The onsite game animal, offsite game animal, fish, and direct external radiation exposure pathways were the primary contributors of dose. Feral hog consumption was the greatest contributor to ESOP offsite dose in 2002, but it was not sampled in 2005 (no samples found). Ingestion of foods such as offsite game animals, fish, vegetation, and surface water are important contributors to the public's potential dose. Although highly variable, the potential dose involving game animal radionuclide concentrations should be greater than the fish exposure from year to year. Cesium-137 provides the highest potential dose to the single hunter (7.64 mrem in 2005) who consumes all the edible portion of the maximum contaminated deer. ESOP plans to investigate possible contributions (fungi consumption) that may affect this highly variable game animal radionuclide concentration. Radionuclides released into the atmospheric and liquid pathways also provided a significant dose to exposure pathways. However, the primary source of radiological exposure today is presently provided through the sportsman dose scenario. The sportsman dose received by onsite and offsite hunters, and offsite fishermen from 1993 through 2005 was greater than all other exposure pathways combined (WSRC 1994a&b, 1995a&b, 1996a&b, 1997a&b, 1998a&b, 1999a&b, 2000a&b, 2001a&b, 2003b, 2004, 2005, 2006). Both the ESOP and DOE-SR dose estimates and detections were less than the air and liquid USDOE dose limits.

A higher onsite dose and ESOP projected 39-yr exposure for the survivalist-sportsman indicated that long-lived radionuclides still present in and around the SRS will play a major role in determining dose exposure to the survivalist-sportsman, the public and environment in the future. The ESOP 39 year projected survivalist-sportsman scenario offsite estimates of 555 mrem (from ESOP data) and 674 mrem (from DOE-SR data) are less than the CDC scenario closest point estimate (940-mrem) for a previous 39 year period. The ESOP projection from actual detections was expected to be less than the very conservative DOE-SR dose estimates. The projected dose for a future 39-yr period would be expected to be less than the CDC past 39-yr estimate when nuclear reactors were in operation at SRS. The ESOP estimate is entirely from observed data, but assumed more conservative consumption rates for some media. DOE-SR and CDC projections involved modeling and very conservative assumptions.

Four ESOP conservative scenarios for public exposure to radionuclides are summarized (section 5.1.2, Table 5) and the results in millirem (mrem) of dose exposure given below (SCDHEC, 2006b). Note that two standard deviations added onto the MEI (worst case scenario) result in a possible dose average of 27.77 mrem from 1999 to 2005. A potential dose addition based on DOE-SR onsite hunter (8.8-mrem) and offsite feral hogs (2.8 mrem) (WSRC 2006, Table 6-4) added to the offsite ESOP detected dose (11.95-mrem) would increase the potential onsite plus offsite dose estimate to 23.55 mrem in 2005. Thus, the additional dose potential and two-standard deviation MEI dose were well under the DOE standard of 100-mrem.

Potential atmospheric and liquid release scenarios that may increase the dose to the surrounding public may include the following:

- releases of Am-241, plutonium and uranium radionuclides from MFFF facility through the air and surface water environmental mediums (Duke, Cogema, Stone, & Webster 1998);
- computer models predict a high concentration of tritium migrating to Upper Three Runs from ORWBG (WSRC 2001a) and the Savannah River;
- radionuclides such as C-14, I-129, Np-237 and Tc-99 may be an ORWBG contaminant to monitor in the future because of their long half-lives.

These findings indicated that environmental monitoring programs should focus on the survivalist-sportsman, swamp sediment and soil exposure and inhalation, drinking water, vegetation, and air exposure pathways. The down-gradient wells, surface water, sediments, plants, and animals should be carefully monitored for any signs of the very contaminants that are present at tank farms, basins and seepage areas. Early detection is paramount to protecting the public and the environment should there be a release to the environment.

LIMITATIONS OF THIS STUDY

This assessment is based on a document review and current estimates of dose exposure to the survivalist-sportsman MEI. ESOP personnel have not verified referenced material used in this assessment. ESOP will continue to monitor the SRS and adjacent area for the primary radiological and nonradiological contaminants associated with DOE-SR operations. Increased background and SRS perimeter sampling by ESOP started in 2004 and should improve the evaluation of background and perimeter concentrations. The lack of observations due to the limitations or unavailability of extremely low-level isotopic analysis in past analyses may significantly affect comparison of future and past dose estimates. Budgetary constraints limit the number and types of radionuclides that can be sampled in a given year and contribute to the variance in dose estimates.

5.1.2 Tables and Figures
Critical Pathway

(Return to TOC)

Table 1. Primary Atmospheric Contaminants Identified in the RAC Report, SRS Environmental Reports and ESOP Project Reports

RAC Report	SRS Environmental Reports	ESOP Project Reports
tritium	tritium	tritium
C-14	C-14	Cs-137
Ar-41	*I-129*	alpha
Sr-89,90	*Sr-89,90*	beta
I-129	*Ru-106*	Sr-89,90
I-131	*Cs-137*	U-238
Cs-137	*U-234*	Am-243
ruthenium-103 (Ru-103)	*U-235,238*	
Ru-106	*Cm-244*	
Am-241	*Pu-238*	
Pu-238	*Pu-239*	
Pu-239,240	*Am-241*	
uranium	*alpha*	
	nonvolatile beta	

Notes: Sampled radionuclides are not italicized, whereas italicized radionuclides are calculated using computer models of sources. Some computer modeling results are also verified by measurements such as real-time measurements of tritium in the streams and C-14 stack releases.

Tables and Figures
Critical Pathway

(Return to TOC)

Table 2. Primary Liquid Contaminants Identified in the RAC Report, SRS Environmental Reports and ESOP Project Reports

RAC Report Reports	SRS Environmental Reports	ESOP Project
tritium	*tritium*	tritium
P-32	*Sr-89,90*	Sr-90
S-35	*Sr-90*	I-129
Co-60	*I-129*	Cs-137
Zn-65	*Cs-137*	alpha
Sr-89	*U-234*	beta
Sr-90	*Pu-239*	Ra-226,228
Y-91	*alpha*	U-238
Zr, Nb-95	*nonvolatile beta*	
Tc-99	*Tc-99*	
I-129	*U-235*	
I-130	*U-238*	
Cs-137	*Pu-238*	
Pu-238		
Pu-239		
plutonium-240 (Pu-240)		
uranium		

Notes: Sample data are not italicized, and italicized data are calculated using computer models. Liquid releases are based on measured concentrations and flow rates.

Tables and Figures
Critical Pathway

(Return to TOC)

Table 3. Comparison of 39-yr projections for Dose (mrem) to the MEI

PATHWAYS	SRS (1)	SCDHEC (2)	CDC (3)	
Dose Totals (mrem)4	**2002-2005**	**2002-2005**	**1955/1964 Point Estimate and Range**	
Air	0.24	0.01		
Liquid	0.41	0.23		
CM Fisherman	2.14	1.97		
Swamp Soil (FM)7	1.90	0.03		
Offsite deer	36.10	46.09		
Soil Exposure(OFS)6	16.10	3.83		
Hog	12.28	4.77		
Total Offsite Sportsman	69.17	56.93		
Avg Offsite Sportsman/yr	17.29	14.23		
39-yr Offsite Dose	674.41	555.05	940.00	250-6000 mrem
Total Onsite HunterDose	134.70			
Avg Onsite Hunter	33.68			
39-yr Onsite Hunter	1313.33			
39-yr SRS Sportsman	**1987.73**	555.05		
Adding Onsite Hunter		**1868.37**		

Notes:
1. The SRS data came from the WSRC SRS Environmental Report estimates which are totaled and averaged for the sportsman scenario, and utilizes maximum exposure for air and liquid at SRS boundary.
2. The SCDHEC data uses maximum detections except for the onsite hunter (WSRC).
3. The CDC scenarios largest point estimate dose for a 39-yr study period.
4. All dose is given in millirems (mrem) and is rounded off at 0.005-mrem.
5. Data comparisons limited to the air, river water, hunter-fisherman scenario.
6. "OFS" is offsite.
7. "SFM" is swamp fisherman soil.
8. "CM" is creek mouth fisherman.

Tables and Figures
Critical Pathway

(Return to TOC)

Table 4. Excerpts from the SCDHEC Bureau of Land and Waste Management SC Groundwater Contamination Inventory

2. Site Name	4. Contamination Type	7. Is contaminant plume discharging to water body?	8. If yes, name of surface water body.	12. Remarks
SRS: A-Area Burn/R/P				Groundwater incorporated into A/M Groundwater OU (RCRA unit – not FFA)
SRS: C-Area B/R/P	**VOC**	**Yes**	**Fourmile Branch**	
SRS: C-Reactor Groundwater OU	**Rads, VOC**	**Yes**	**Fourmile Branch and Castor Creek**	
SRS: CMP Pits	VOC	No	--	
SRS: Central Shops Groundwater OU	VOC	No	--	
SRS: D-Area BRP				Remedial action completed.
SRS: D-Area Groundwater Operable Unit	Rads, Metals, VOC	No	--	
SRS: D-Area Oil Seepage Basin	VOC	No	--	
SRS: General Separations Area Eastern GW OU	Rads, VOC	No	--	
SRS: General Separations Area Western Groundwater Operable Unit	**Rads, VOC**	**Yes**	**Upper Three Runs**	
SRS: H-Area Coal P/R	Rads, Metals	No	--	
SRS: K-Area B/R/P	VOC	No	--	
SRS: K-Area Coal PRB				Remedial action completed.
SRS: K-Reactor GW OU	**Rads, VOC**	**Yes**	**Indian Grave Branch**	
SRS: L-Area BRP	VOC	No	--	
SRS: L-Area Southern Groundwater OU	Rads, VOC	Yes	L-Lake	
	Rads, VOC	Yes	Steel Creek	
SRS: Misc Chem Basin				Groundwater incorporated into A/M Groundwater OU (RCRA unit, not FFA)
SRS: P-Area B/R/P	VOC	No	--	
SRS: P-Reactor Groundwater OU	Rads, VOC	Yes	Steel Creek	
SRS: R-Area AC Basin				Remedial action completed. No groundwater action.
SRS: Rd A Chem Basin				Monitoring has been terminated. No Action ROD has been approved.
SRS: R-Area Groundwater OU	Rads, VOC	No	--	
SRS: R-Area Rubble Pile & BRP				Remedial action completed. No groundwater action.
SRS: TNX GW OU	VOC	Yes	Savannah River Swamp	
SRS: R-Area Reactor Seepage Basin	Rads	No	--	Mixing Zone Application

Tables and Figures
Critical Pathway

(Return to TOC)

Table 5. ESOP Potential Dose Scenarios

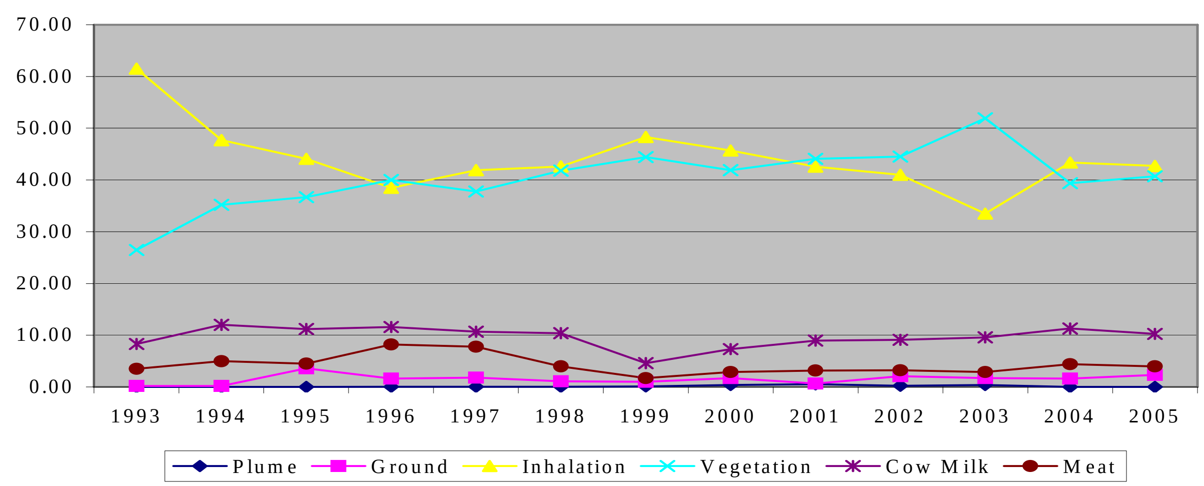
	2005	1999-2005		
		Average	Standard Deviation	Median
MEI [1]	11.95	10.41	7.91	6.66
Public Criteria Dose [2]	0.06	0.14	0.16	0.08
Farmer [3]	3.63	1.02	1.63	0.14
Average Sportsman [4]	4.25	1.96	1.71	1.16

Notes:
1. The maximum exposed individual (MEI) is the worst-case scenario for a single hunter.
2. The non-sportsman public dose deletes sports food, sediments, and soil.
3. The farmer scenario adds the sediments, soil, and maximum well water dose to #2.
4. The average sportsman replaces the MEI deer dose with average deer dose.

Tables and Figures
Critical Pathway

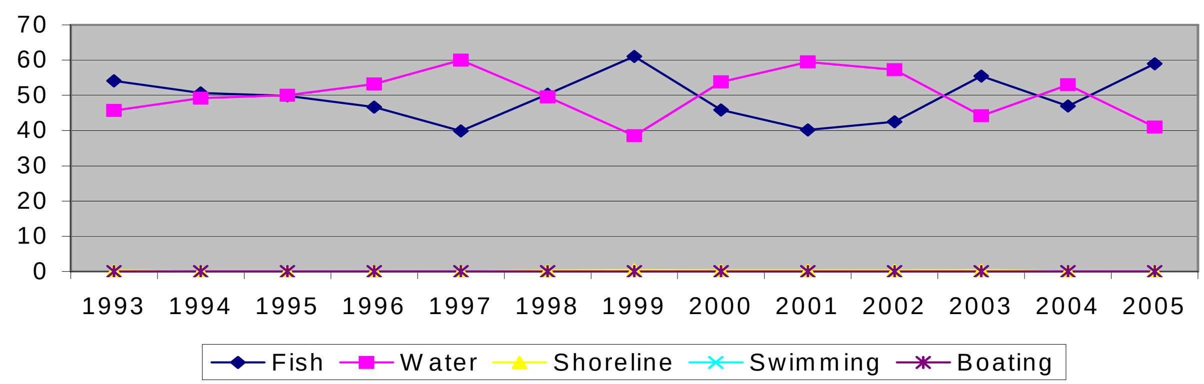
(Return to TOC)

Figure 1. Percent of Total Dose to the MEI from Atmospheric Releases



Notes:
Data came from the SRS Environmental Reports (WSRC) for 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 and 2006.

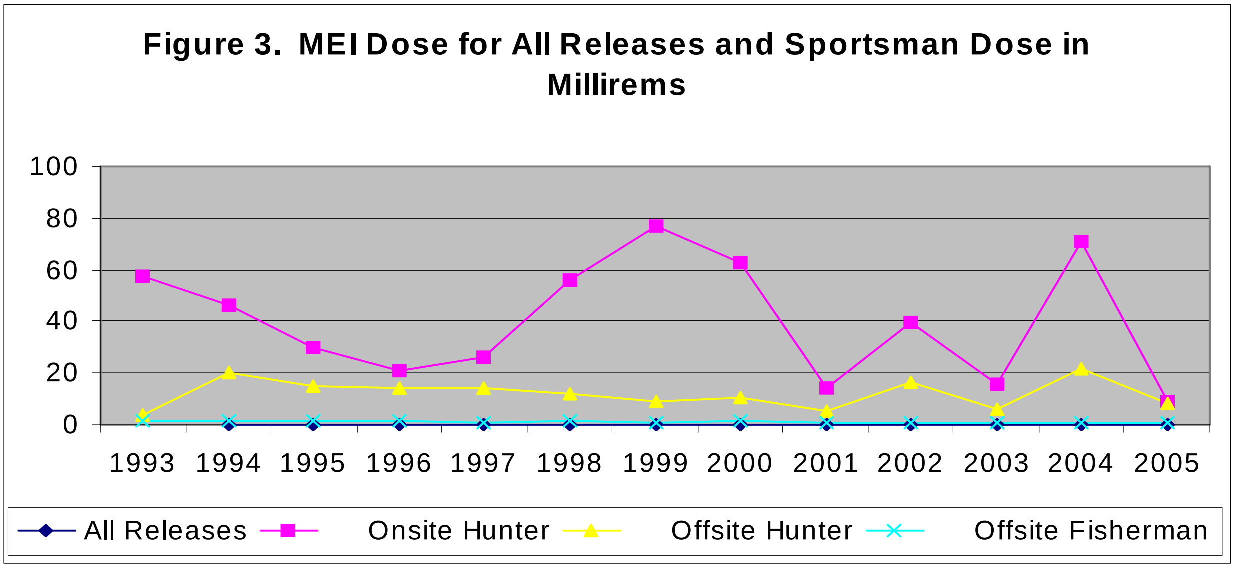
Figure 2. Percent of Total Dose to the MEI from Liquid Releases



Notes:
Data came from the SRS Environmental Reports (WSRC) for 1993, 1994, 1995, 1996, 1997,1998,1999, 2000, 2001, 2002, 2003, 2004, 2005 and 2006

Tables and Figures
Critical Pathway

(Return to TOC)



Notes:
1. Data came from the SRS Environmental (WSRC) Reports for 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, and 2006.

5.1.3 Data
(Return to TOC)

Critical Pathway Data

Notes:
1. All release data comes from Washington (formerly Westinghouse) Savannah River Company reports (WSRC1993-2006)

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data in Curies

(Return to TOC)

Radionuclide	1993	1994	1995	1996	1997	1998
Al-26		3.50E-14	1.50E-14			
Am-241			1.81E-16	4.20E-07	8.70E-07	5.75E-06
Am-241, 243	8.86E-13	8.86E-10				
Am-243			2.30E-17	1.76E-05	1.76E-05	1.89E-05
Ba-133					3.00E-12	
Be-7		1.50E-13				
C-14	4.00E-06	3.50E-13	9.80E-15	5.88E-09	1.85E-08	9.68E-05
Ca-45		1.00E-15				
Ca-47		1.00E-16				
Cd-109		5.00E-14	5.21E-14			
Ce-139			1.00E-16			
Ce-141			5.30E-05			4.16E-05
Ce-144	1.13E-13	1.13E-10	2.32E-04	7.36E-06	6.11E-06	1.45E-04
Cf-249						5.27E-16
Cf-251						2.17E-14
Cl-36		1.00E-15				
Cm-242			2.03E-16	2.03E-16	8.19E-12	1.58E-07
Cm-242, 244	7.33E-12	7.32E-09				
Cm-243		1.00E-13	4.90E-14			
Cm-244				1.28E-04	1.28E-04	1.30E-04
Cm-245					1.88E-12	2.08E-13
Cm-246						9.37E-07
Cm-248		9.20E-18	9.20E-18			
Co-57		2.50E-14	2.50E-14		1.04E-09	9.40E-11
Co-58			2.60E-05		1.67E-12	1.27E-04
Co-60	3.34E-17	1.08E-13	2.71E-05	4.71E-07	9.13E-07	1.38E-04
Cr-51			1.00E-16			1.21E-04
Cs-134	1.40E-17	2.01E-13	2.98E-05	2.49E-15	1.21E-09	1.31E-04
Cs-137	4.33E-11	1.08E-08	1.40E-02	4.33E-03	4.19E-03	4.89E-03
Eu-152					5.32E-09	4.19E-08
Eu-154	3.44E-13	3.44E-10		6.42E-06	6.42E-06	5.74E-06
Eu-155	1.63E-13	1.63E-10		1.66E-06	1.66E-06	1.10E-06
Fe-55						3.90E-04
H-3 (total)	4.31E+01	1.31E+02	3.32E+01	2.23E+02	1.53E+02	9.31E+02
Hg-203		2.00E-12	1.00E-12			
I-129	6.88E-07			3.83E-06	1.22E-07	1.29E-05
I-131			2.05E-02			
Mn-54		1.50E-15			4.80E-12	
Na-22					1.11E-09	7.76E-11
Nb-95			2.67E-05	1.55E-15	1.55E-15	1.13E-04

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data in Curies

(Return to TOC)

Radionuclide	1993	1994	1995	1996	1997	1998
Ni-59				2.51E-08	3.24E-10	8.33E-13
Ni-63	2.00E-07	2.06E-13	2.00E-13		2.29E-09	8.21E-06
Np-237		7.40E-15		4.66E-08	1.38E-09	1.01E-09
Np-239				2.17E-07	2.17E-07	
Pa-231				1.00E-09	1.00E-09	1.00E-09
Pa-234					2.26E-10	
Pm-144					1.34E-12	
Pm-147			7.92E-07	6.75E-06	1.01E-08	9.79E-10
Pu-236		1.90E-17				
Pu-238	4.63E-12	5.18E-07	6.61E-06	5.19E-06	3.55E-04	3.28E-04
Pu-239	4.70E-07	6.45E-07	2.21E-06	1.83E-04	6.92E-06	1.41E-03
Pu-240				2.11E-07	1.11E-06	1.12E-06
Pu-241				3.75E-06	5.16E-05	6.02E-05
Pu-242					3.66E-11	1.59E-07
Ra-226					1.24E-08	8.64E-06
Ra-228					1.75E-10	2.13E-05
Rb-86		2.00E-15	2.00E-15			
Ru-103			3.72E-05			2.26E-05
Ru-106	4.96E-12	4.97E-09	1.80E-04	7.00E-02	7.00E-02	2.26E-05
S-35	2.00E-06	6.85E-12	5.26E-12			
Sb-124					3.36E-12	
Sb-125	7.27E-15	7.27E-12	1.19E-04	2.28E-04	5.93E-07	5.27-05
Sc-46		1.00E-16				
Se-75		6.00E-16				
Se-79				2.47E-08	2.15E-10	1.85E-11
Sn-113			3.80E-16			
Sn-126				6.79E-09	3.36E-15	1.29E-13
Sr-85		5.00E-15	5.20E-16			
Sr-89,90	1.11E-04	3.75E-04	3.03E-04		8.21E-05	2.58E-02
Sr-90				4.75E-04		
Tc-99				2.65E-08	3.61E-08	2.82E-05
Th-228					2.15E-10	9.44E-06
Th-230					2.03E-10	1.02E-05
Th-232				1.28E-08	1.40E-10	7.51E-07
Th-234					2.26E-10	
U-233				1.62E-08	2.11E-08	2.35E-06
U-234				2.93E-07	1.45E-05	1.83E-05
U-235			1.44E-15	4.10E-05	4.84E-07	2.10E-06
U-235, 238	4.74E-05	8.12E-06				
U-236				5.79E-08	4.84E-07	2.39E-09
U-238			2.87E-09	1.35E-06	3.45E-05	5.12E-05
Y-88			9.10E-16			
Zn-65		2.60E-13	6.24E-05	1.46E-16	3.69E-12	2.23E-05
Zr-95	2.39E-14	2.39E-11	4.51E-05	2.13E-05	2.13E-05	1.71E-05

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

(Return to TOC)

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Ac-228	1.66E-06	1.80E-06	4.07E-06	1.72E-06	1.64E-06	1.60E-07	5.71E-07
Ag-110							1.09E-10
Am-241	8.44E-06	1.24E-04	1.15E-04	1.16E-04	1.13E-04	6.92E-06	5.74E-04
Am-243	4.28E-06	6.02E-06	9.90E-07	4.84E-08	7.95E-06	6.27E-08	5.58E-08
Am-244							3.33E-10
Ar-39		3.30E-05					
Ba-133		5.40E-10					
C-14	4.92E-04	8.39E-05	8.76E-05	1.19E-04	9.42E-05		1.09E-04
Cd-109							3.04E-06
Ce-139							4.61E-06
Ce-141	4.16E-05	4.16E-05	4.16E-05	4.16E-05	4.16E-05	4.16E-05	2.65E-05
Ce-144	1.45E-04	1.44E-04	1.43E-04	3.01E-04	1.43E-04	1.42E-04	9.06E-05
Cf-251						4.31E-07	4.31E-07
Cm-242	3.10E-07	4.47E-07	1.43E-08		2.03E-16	2.03E-06	2.25E-08
Cm-243				6.23E-07	4.92E-07	4.92E-07	1.39E-04
Cm-244	6.74E-06	6.19E-05	4.76E-05	4.77E-05	4.79E-05	8.62E-07	5.74E-07
Cm-245		1.04E-13	4.18E-07				2.94E-08
Cm-246	2.91E-06	3.98E-06	1.01E-06				
Co-57	2.01E-04	3.61E-10				8.34E-10	8.18E-08
Co-58	1.27E-04	1.27E-04	1.27E-04	1.27E-04	1.27E-04	1.27E-04	8.11E-05
Co-60	1.28E-04	8.58E-04	8.59E-04	8.58E-04	8.57E-04	1.30E-04	1.06E-04
Cr-51	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04	1.21E-04	6.49E-05
Cs-134	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	1.31E-04	8.66E-05
Cs-135						2.25E-09	
Cs-137	6.11E-03	2.07E-03	2.22E-03	1.47E-02	1.42E-02	1.21E-02	1.59E-02
Eu-152	1.21E-10	4.13E-05	4.15E-05	4.13E-05	4.13E-05		8.68E-08
Eu-154	5.74E-06	1.51E-05	1.53E-05	1.67E-05	1.51E-05	4.37E-09	8.38E-06
Eu-155	1.10E-06	6.81E-07	7.85E-07	8.28E-07	6.76E-07	3.72E-09	8.76E-07
H-3 (total)	4.71E+02	6.12E+02	6.07E+02	1.26E+03	2.37E+03		8.67E+03
Hg-203	2.23E-10	2.23E-10	2.29E-10				1.60E-07
I-129	2.50E-03	1.71E-03	1.29E-06	8.65E-04	8.62E-04		4.61E-03
K-40						2.76E-08	5.61E-07
Kr-85		2.00E-03		1.19E-04			
Mn-54		1.30E-10	2.52E-08		9.46E-07	9.46E-07	
Na-22		7.90E-11	2.09E-08	1.97E-09			2.31E-08
Nb-94	3.95E-10	3.95E-10	4.56E-08				
Nb-95	1.13E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04	7.20E-05
Ni-59	1.02E-09	4.17E-13				2.06E-08	2.08E-08
Ni-63	5.89E-07	5.09E-06	4.38E-06	1.81E-06	1.43E-06	1.45E-06	1.45E-06

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

(Return to TOC)

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Np-237	2.23E-10	2.26E-10	1.09E-08	8.50E-09		5.12E-08	5.37E-06
Np-239	4.51E-09		1.24E-07	7.08E-09		7.79E-09	7.79E-09
Pa-233	2.23E-10	2.23E-10	2.29E-10				5.13E-06
Pa-234			1.76E-08		4.98E-06	7.81E-07	8.10E-07
Pa-234m						4.82E-10	
Pb-212						1.03E-09	7.49E-07
Pb-214	2.23E-10		6.58E-07	6.58E-07	1.60E-06	9.46E-07	
Pm-144						4.05E-13	
Pm-147	3.49E-09	1.30E-05	1.34E-05	1.30E-05	1.30E-05	5.35E-15	2.27E-05
Pm-148m							1.40E-11
Pr-144	3.45E-09	3.68E-13		1.00E-07			1.48E-07
Pr-144m		4.43E-15					
Pu-236			1.22E-10	3.66E-10	2.58E-10	1.31E-07	6.93E-10
Pu-238	1.45E-03	7.57E-05	3.99E-05	5.86E-04	2.25E-04	3.89E-04	7.32E-04
Pu-239	1.68E-05	1.86E-03e	1.94E-03	1.90E-03	1.91E-03	1.09E-04	4.03E-04
Pu-240	1.46E-06	1.99E-07	8.51E-07	1.57E-05	1.14E-04	3.38E-06	3.89E-05
Pu-241	6.47E-05	4.09E-06	6.70E-06	1.42E-04	4.36E-05	8.35E-07	1.60E-03
Pu-242	1.53E-08	7.03E-09	2.09E-08	3.98E-06	5.25E-08	5.90E-08	7.15E-08
Ra-226	1.25E-05	1.74E-05	5.25E-06	9.97E-07			1.01E-06
Ra-228	1.87E-05	2.74E-05	4.16E-06	9.46E-07		1.50E-07	3.10E-08
Rh-106							8.81E-08
Ru-103	4.23E-05	4.23E-05	4.23E-05	4.23E-05	4.23E-05	4.23E-05	2.44E-05
Ru-106		1.04E-05	9.92E-07	1.04E-03	1.40E-06	2.18E-08	2.90E-07
Sb-124	2.23E-10	5.63E-10	8.09E-09			1.54E-08	1.54E-08
Sb-125	5.27E-05	5.34E-05	5.37E-05	2.61E-04	2.01E-04	2.00E-04	1.79E-04
Se-79		4.47E-09		1.26E-05	9.95E-06	1.00E-05	1.00E-05
Sn-113		6.20E-10				5.64E-10	2.23E-07
Sn-123							4.91E-11
Sn-126	3.13E-15	6.45E-14				3.01E-09	1.03E-08
Sr-89	7.02E-04	3.72E-03e				1.62E-06	2.50E-06
Sr-90			3.57E-03	3.85E-03	3.52E-03	3.10E-04	1.97E-02
Tc-99	6.22E-05	8.75E-05	1.89E-06	6.04E-03	4.77E-03	4.77E-03	4.77E-03
Te-127							7.66E-11
Te-129							7.74E-12
Th-228	2.75E-07	5.76E-07	3.97E-06			9.38E-10	5.50E-06
Th-229						5.77E-09	
Th-230	1.22E-05	1.74E-05	2.71E-06			5.82E-10	1.03E-06
Th-231				4.63E-13		4.63E-13	4.48E-08
Th-232	1.64E-06	2.58E-06	1.75E-06			9.71E-10	3.14E-06
Th-234	4.10E-06	1.04E-04	1.03E-04	9.98E-05	1.04E-04	1.08E-06	1.25E-06

1. Empty cells indicate no data reported.

Critical Pathway
Diffuse and Fugitive Atmospheric Release Data

(Return to TOC)

Radionuclide	1999	2000	2001	2002	2003	2004	2005
U-232			4.46E-11	7.37E-06	3.64E-06	3.64E-06	3.46E-06
U-233	2.38E-06	1.50E-08	3.90E-08	4.32E-05	3.31E-05	3.95E-05	4.00E-05
U-234	5.29E-05	3.59E-04	2.84E-04	3.31E-04	5.18E-04	7.99E-04	3.37E-05
U-235	5.89E-06	1.44E-05	6.59E-06	8.46E-06	1.27E-05	2.37E-04	2.90E-06
U-236	5.20E-09	4.16E-11	7.17E-10	3.45E-06	2.30E-05	3.29E-05	1.79E-06
U-238	9.49E-05	4.47E-04	3.18E-04	3.19E-04	1.14E-03	7.30E-04	1.82E-05
Y-88							4.47E-07
Y-91							5.89E-09
Zn-65	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	2.23E-05	1.29E-05
Zr-85		1.07E-09					
Zr-95	1.71E-05	1.68E-05	1.68E-05	1.72E-05	1.68E-05	1.68E-05	1.06E-05
Alpha	1.47E-03	5.86E-04	1.33E-03	5.47E-04	4.15E-04	5.70E-04	2.60E-04
Nonvolatile Beta	2.74E-02	3.47E-02					
Beta-Gamma			3.22E-02	2.50E-02	2.49E-02	2.57E-02	1.89E-02

1. Empty cells indicate no data reported.

Critical Pathway (Return to TOC)

Radionuclides that consist of greater than or equal to 1% of the total dose from atmospheric releases.

Radionuclides	1993	1994	1995	1996	1997	1998	
C-14				4.3			
Cs-137			4.4	1.5	1.6	1.2	
H-3	89	88.0	77.5	68.0	71.3	66.8	
I-129	2.5	2.4	4.8	11.0	8.6	10.3	
Pu-238	3.1	5.0	2.8	2.3	3.0	2.1	
Pu-239	3.5	2.7	7.9	5.0	8.0	15.0	
Ru-106				5.0	5.5		
Sr-90						3.4	
U-235, 238		1.4					
U-238				1.1			
Radionuclides	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Am-241		1.64	1.82	1.01			4.67
Cs-137	1.3	1.90		2.45	1.85	2.01	2.96
H-3	27.8	49.53	51.24	49.67	38.8	73.93	65.82
I-129	4.2	3.34	15.93	17.74	33.27	9.94	9.77
Pu-238	8.2	2.53		3.92	1.25	2.57	5.16
Pu-239		22.86	15.65	13.82	12.23	1.83	3.47
Sr-90							2.17
U-234	1.2					1.08	
U-238					1.29		
Alpha	41.6	7.78	8.93	6.51	6.12	4.19	2.11
Nonvolatile Beta	13.5	6.48	2.9	2.5	1.9	2.69	2.12

1. Empty cells indicate no data reported.

Critical Pathway (Return to TOC)
Radionuclides that consist of greater than or equal to 1% of the total dose from liquid releases.

Radionuclides	1993	1994	1995	1996	1997	1998	
Cs-137	51.0	47.3	46.8	43.2	35.8	47.2	
H-3 (oxide)	40.5	41.7	43.2	40.5	39.8	36.3	
I-129		1.7		2.1	2.2	1.6	
Pu-239	2.2	4.0	4.3	8.8	17.2	9.4	
Sr-89, 90		5.3					
Sr-90	5.5		5.4	4.2	3.6	3.8	
Radionuclides	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cs-137	59.11	42.89	35.84	39.1	53	42	57
H-3 (oxide)	25.08	41.41	38.14	40.02	31	36	32
I-129	1.89	3.29	4.19	3.93	2	5	
Sr-89, 90	1.91	1.36					
Sr-90				1.03	1	3	1
U-234	1.72						
Alpha	9.00	9.89	18.43	1.13	2	11	8
Nonvolatile Beta		1.11	2.69	14.75	10	2	

1. Empty cells indicate no data reported.

Critical Pathway

(Return to TOC)

Percent of total dose to MEI from atmospheric and liquid releases

MEI from Atmospheric Releases (MAXIGASP-SR Code) Percent of Total Dose

DOE-SR	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Plume	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.4	0.5	0.2	0.4	0.0	0.0
Ground	0.2	0.2	3.6	1.6	1.8	1.1	1.0	1.7	0.7	2.1	1.7	1.6	2.3
Inhalation		47.7	44.1	38.5	41.9	42.6	48.3	45.7	42.6	41.0	33.5	43.4	42.7
Vegetation	26.5	35.2	36.7	40.0	37.8	41.8	44.4	41.9	44.1	44.5	51.9	39.4	40.7
Cow Milk	8.3	12.0	11.2	11.6	10.7	10.4	4.6	7.3	9.0	9.1	9.6	11.3	10.3
Meat	3.5	5.0	4.5	8.2	7.8	4.0	1.7	2.9	3.2	3.2	2.9	4.4	4.0

1993-2005	Avg	sd	Median
Plume	0.1	0.2	0.1
Ground	1.5	0.9	1.6
Inhalation	42.7	4.0	42.6
Vegetation	40.4	6.0	40.9
Cow Milk	9.6	2.0	10.0
Meat	4.3	1.9	3.8

MEI from Liquid Releases Percent of Total Dose

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Fish	54.1	50.7	49.9	46.7	39.9	50.3	61.0	45.8	40.2	42.5	55.4	47.0	59.0
Water	45.7	49.2	50.0	53.2	60.0	49.6	38.5	53.9	59.5	57.2	44.2	53.0	41.0
Shoreline	0.2	0.0	0.0	0.1	0.0	0.2	0.4	0.3	0.3	0.3	0.4	<1	<1
Swimming	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<1	<1
Boating	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<1	<1

1993-2005	Avg	sd	Median
Fish	49.4	6.7	48.5
Water	50.4	6.7	51.5
Shoreline	0.2	0.1	0.2
Swimming	0.0	0.0	0.0
Boating	0.0	0.0	0.0

Committed dose (mrem) for MEI and sportsman pathways.

Path / Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
All Pathway		0.23	0.2	0.19	0.18	0.19	0.28	0.18	0.18	0.18	0.19	0.15	0.13
ONS Hunter	57.3	46	30	21	26	56	77	63	14	39.5	15.6	70.8	8.8
OFS Hunter	4.1	20	15	14	14	12	9.1	10.1	0.53	12.2	1.2	17.3	8.3
OFS Fisherman	1.3	1.3	1.2	1.7	0.65	1.6	0.61	1.18	1.74	0.62	0.66	0.71	0.52

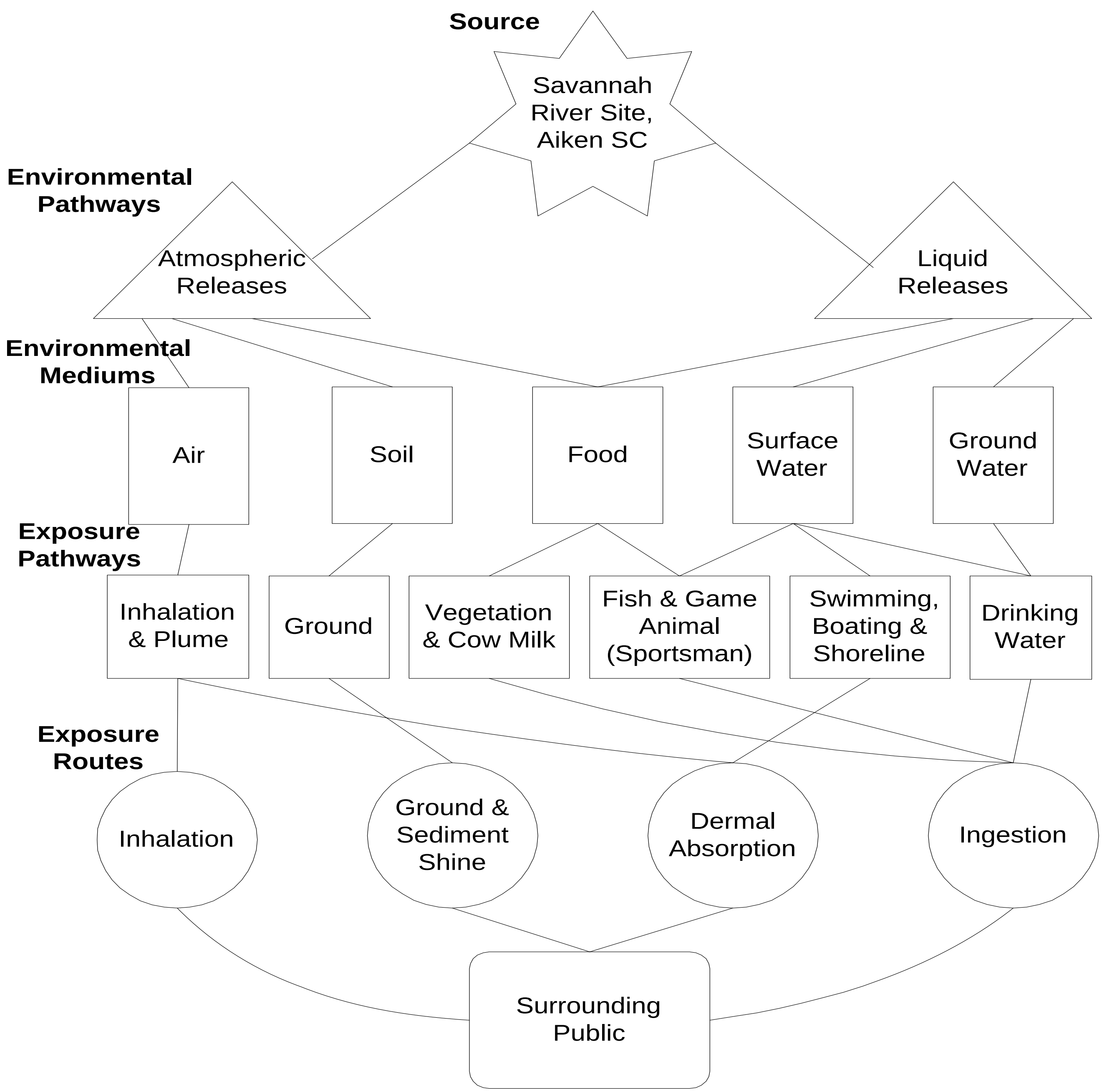
1. Empty cells indicate no data reported.

Statistics	Avg	SD	Median
All Pathway	0.19	0.04	0.185
ONS Hunter	40.4	23	39.5
OFS Hunter	10.6	5.92	12
OFS Fisherman	1.06	0.45	1.18

Critical Pathway

(Return to TOC)

SRS Exposure Pathway



Notes:
1. Plume refers to external direct exposure while enveloped in a gaseous cloud
2. Shine refers to external direct exposure mostly beta-gamma.
3.. Swimming includes incidental ingestion of water
4. Drinking water has many possible sources including river water, ground water, rain water.

Critical Pathway

(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Savannah River Technology Center (SRTC) Atmospheric Releases in Curies

Now Savannah River National Lab (SRNL)

Radionuclide	1993	1994	1995	1996	1997	1998	
Am-241,243	1.34E-06	2.75E-07					
Cm-242,244	6.83E-06	3.90E-06					
Co-60		6.16E-06	2.46E-06	8.55E-06		2.65E-07	
Cs-137	1.51E-06	2.57E-06	2.94E-07	1.22E-06		2.30E-06	
I-131	5.92E-05	4.77E-05	4.07E-05	2.98E-05	2.98E-05	8.29E-06	
I-133	1.96E-03	1.98E-03	1.72E-03	5.94E-04	4.92E-04	1.59E-04	
I-135		2.96E-01	7.19E-02				
Pu-238	1.00E-08	7.87E-08					
Pu-239	9.41E-06	1.56E-06	1.75E-06	6.67E-06	2.47E-06	6.71E-06	
Sr-89,90	1.19E-05	2.34E-06	7.31E-06			2.66E-05	
U-235,238	2.89E-08	3.94E-08					
Xe-135	3.19E-02	2.17E-02	1.49E-02	1.20E-03			
Radionuclide	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cs-137		8.85E-08					
I-131	1.01E-05	6.96E-06	6.13E-06	1.24E-05	8.38E-07		
I-133	1.25E-04	1.18E-04	4.26E-04	1.64E-04			
Alpha	1.75E-06	9.16E-07	1.49E-08		2.36E-07	1.74E-07	1.11E-06
Beta-Gamma					1.60E-06	6.13E-06	1.88E-06

SRTC/TNX Liquid Releases in Curies

Radionuclide	1993 *	1994*	1995*	1996	1997	1998	
H-3 (oxide)	1.29E-01	2.27E-01	8.84E-01	8.78E-01	1.82E+00	1.52E+00	
Pu-238			7.80E-06	6.71E-06	1.78E-06	1.47E-05	
Pu-239	2.66E-04	5.70E-05	6.01E-04	3.41E-04	3.38E-03	4.41E-03	
Sr-89,90	2.02E-03	1.62E-03	1.28E-03		4.10E-03	4.24E-03	
Sr-90				9.31E-04			
U-234			1.24E-04	5.06E-05	1.06E-04	8.48E-05	
U-235			7.29E-06	1.43E-06	3.44E-06	2.83E-06	
U-238			1.33E-04	5.00E-05	1.11E-04	7.83E-05	
Radionuclide	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
H-3	1.46E+00	1.18E+00	7.94E-01	7.75E-01	9.35E-01	4.23E-01	4.95E-01
Pu-238	7.73E-06	4.17E-06	2.92E-06	1.89E-06	1.84E-06		1.69E-05
Pu-239		5.76E-07					1.20E-06
U-234	8.39E-05	1.31E-04	4.28E-05	2.00E-04	3.37E-04	1.17E-04	7.59E-05
U-235	2.99E-06	4.93E-06	7.92E-07	1.01E-05	2.27E-05	6.08E-06	3.57E-06
U-238	7.92E-05	1.34E-04	4.90E-05	1.89E-04	3.16E-04	1.13E-04	6.96E-05
Alpha	5.25E-03	3.57E-03	3.09E-03	2.72E-03	7.19E-03	2.56E-03	2.61E-03
Nonvolatile Beta	4.63E-03	3.55E-03					
Beta-Gamma			3.05E-03	2.80E-03	1.02E-02	4.53E-03	5.20E-03

1. Empty cells indicate no data reported.
2. *Includes liquid releases from TNX.

Critical Pathway

(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Reactor Materials Atmospheric Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Am-241			3.61E-08	1.06E-08	1.18E-08	2.17E-08
Cm-244			9.02E-09	2.43E-09	2.03E-10	4.90E-09
Cs-137			3.01E-06	3.94E-07		
Pu-238			4.40E-09	2.23E-09	4.41E-09	4.76E-08
Pu-239	3.50E-06	7.82E-07	1.62E-05	2.78E-05	6.85E-06	5.09E-05
Sr-89,90	8.32E-05	4.30E-05	1.69E-04		4.16E-05	5.05E-04
Sr-90				4.04E-05		
U-232						1.20E-06
U-234			1.73E-06	6.81E-06	4.02E-06	3.39E-05
U-235			2.66E-05	1.06E-06	6.37E-07	6.21E-06
U-235,238	1.55E-05	1.15E-05				
U-238			1.20E-06	1.09E-06	1.00E+00	6.32E-05

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241	1.46E-08		5.72E-09				
Cm-244	1.69E-08		2.23E-09				
Cs-137	3.36E-07	3.36E-07					
Pu-238	7.16E-09	2.29E-08	3.67E-09				
Pu-239	2.39E-08	2.39E-08	1.37E-08				
U-232	1.33E-08						
U-234	1.41E-05	5.13E-06	3.43E-06				
U-235	2.68E-06	7.71E-07	5.16E-07				
U-238	1.07E-05	5.41E-07	4.93E-07				
Alpha	7.23E-05	1.28E-05					
Nonvolatile Beta	1.84E-03						
Beta-Gamma		3.19E-05	1.10E-05				

Reactor Materials Liquid Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Am-241			1.14E-06	6.72E-05	2.11E-06	1.34E-05
Cm-244			3.52E-06	1.19E-05	4.14E-07	
Pu-238			2.86E-05	4.01E-05		3.19E-06
Pu-239	7.64E-05	1.33E-04	1.05E-05		1.14E-03	2.38E-03
Sr-89,90			1.04E-03			3.25E-03
U-234			1.17E-05	3.55E-05	2.68E-05	7.02E-06
U-235			9.37E-07			4.17E-06
U-238			1.98E-05	5.83E-05	5.71E-05	5.38E-05

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241							3.27E-05
Pu-238			2.85E-05				1.48E-05
Pu-239			2.31E-06				
U-234	1.24E-02		3.10E-05	4.66E-05	2.28E-05	2.28E-05	9.79E-05
U-235							1.05E-05
U-238	1.37E-02		3.55E-05	5.11E-05	1.60E-05	1.60E-05	1.04E-04
Alpha	3.56E-03		2.59E-03	1.93E-03	1.26E-03	1.26E-03	2.49E-03
Nonvolatile Beta	9.97E-04						
Beta-Gamma			1.73E-04	6.09E-04	5.18E-04	5.18E-04	3.23E-03

1. Empty cells indicate no data reported.

Critical Pathway

(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Separations Atmospheric Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Am-241				1.27E-05	1.44E-05	3.31E-05
Am-241,243	1.42E-04	5.59E-05	3.04E-05			
C-14	1.69E-02	3.71E-02		8.11E+00	3.10E-02	7.01E-02
Ce-144			2.22E-07	6.77E-07	4.22E-06	
Cm-242,244	4.96E-05	1.22E-05	3.39E-06			
Cm-244				4.47E-06	2.49E-05	3.67E-06
Co-57				5.76E-09	2.07E-07	
Co-60	5.89E-09		2.84E-07	3.85E-07	3.45E-07	
Cs-134	1.49E-06	8.41E-09	3.22E-07	1.97E-07	1.43E-06	2.32E-07
Cs-137	5.28E-04	1.49E-04	5.25E-04	4.82E-04	4.17E-04	3.77E-04
Eu-154			3.02E-07	1.87E-07	1.54E-07	
Eu-155			7.50E-07	8.33E-07	4.93E-06	
H-3 (total)	1.52E+05	1.36E+05	8.37E+04	4.37E+04	5.23E+04	5.86E+04
I-129	4.96E-03	3.80E-03	4.70E-03	1.04E-02	7.08E-03	1.25E-02
I-131	8.89E-05	2.19E-05	1.29E-05	5.74E-05	2.91E.05	5.29E-05
Kr-85				5.47E+03	9.62E+03	1.70E+04
Pu-238	1.21E-03	1.61E-03	5.85E-04	4.79E-04	3.30E-05	1.15E-04
Pu-239	1.06E-03	7.55E-04	4.04E-04	2.65E-04	5.12E-05	1.12E-04
Ru-106	5.76E-09	1.19E-08	6.46E-07	9.18E-07		1.08E-05
Sb-124			1.81E-07			
Sb-125			9.45E-07	2.61E-07		1.79E-07
Sr-89,90	1.88E-03	1.58E-03	1.59E-03		2.20E-04	3.23E-04
Sr-90				4.04E-05		
U-234			1.27E-04	2.44E-04	8.03E-06	2.62E-05
U-235				4.67E-05	6.25E-07	1.57E-06
U-235,238	1.86E-03	2.22E-03	1.41E-03			
U-238				1.37E-03	1.94E-05	6.92E-05
Xe-135			1.87E-02			4.95E-02
Zn-65		4.44E-06				

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241	3.01E-05	2.19E-05	1.52E-04	2.68E-05	2.85E-05	1.90E-05	7.48E-06
C-14	2.50E-02	1.33E-01	1.70E-01	9.00E-02	5.00E-01		
Cm-244	2.59E-05	1.49E-05	3.90E-06	3.44E-06	6.62E-06	5.36E-06	1.69E-06
Co-57	4.69E-08	3.26E-07					
Co-60	1.00E-06	1.78E-06	4.40E-08	1.77E-06	3.05E-06		
Cs-134	5.72E-08	2.38E-08	1.94E-08				
Cs-137	8.41E-03	6.07E-03	1.18E-03	5.51E-04		1.26E-04	8.00E-05
Eu-154		1.31E-06			4.32E-06		
Eu-155		3.34E-06					
H-3 (total)	4.79E+04	4.11E+04	4.44E+04	4.38E+04	4.65E+04	5.11E+04	
I-129	4.77E-03		1.29E-02	1.69E-02		9.41E-03	
I-131			2.05E-06				
Kr-85	3.74E+04	5.28E+04	6.47E+04	3.15E+04	6.30E+04		
Pu-238	5.27E-04	2.83E-04	9.15E-05	4.25E-05	4.11E-05	2.09E-05	9.62E-06
Pu-239	1.34E-04	1.88E-04	2.62E-04	8.01E-05	4.36E-04	1.69E-04	4.79E-05
Sr-89,90	3.11E-04	1.74E-04					
Sr-90			1.42E-04	1.93E-04	1.92E-04	1.12E-04	4.01E-05
U-234	2.02E-05	3.35E-05	3.85E-05	2.55E-05	5.09E-05	4.39E-05	1.59E-05
U-235	1.34E-06	2.84E-06	3.91E-06	2.07E-06	4.69E-06	3.06E-06	2.31E-06
U-238	3.61E-05	7.29E-05	9.33E-05	6.43E-05	3.50E-04	1.09E-04	3.12E-05
Xe-135	1.94E-02						
Alpha	4.46E-05	5.83E-05	3.69E-05	4.02E-04	8.04E-04	1.88E-05	6.35E-06
Nonvolatile Beta	3.27E-04						
Beta-Gamma		1.16E-04	1.70E-04	2.34E-04	4.16E-04	1.17E-03	3.52E-04

1. Empty cells indicate no data reported.

Critical Pathway
(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Separations Liquid Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Am-241			8.60E-07	4.03E-06	7.81E-06	3.93E-06
Cm-244			1.11E-07	6.23E-07	2.93E-06	2.36E-06
Cs-134						1.01E-04
Cs-137	2.33E-01	9.35E-02	6.55E-02	9.35E-02	4.49E-02	1.82E-01
H-3	9.88E+03	7.73+03	7.83E+03	5.81E+03	5.24E+03	6.73E+03
I-129	2.20E-02	7.39E-02	9.49E-03	7.82E-02	7.82E-02	7.82E-02
Pm-147	7.03E-03	1.54E-03	2.63E-03	4.80E-04		
Pu-238			2.48E-06	2.61E-03	9.57E-04	9.80E-04
Pu-239	8.65E-03	1.32E-02	9.57E-03	1.52E-02	3.39E-02	2.77E-02
Sr-89,90	2.41E-01	1.59E-01	1.88E-01		1.40E-01	2.70E-01
Sr-90				1.21E-01		
Tc-99		8.80E-03				
U-234			1.03E-05	6.90E-03	2.30E-02	3.99E-02
U-235				2.08E-04	7.23E-04	1.70E-03
U-235,238	1.14E-05	1.00E-05	1.56E-05			
U-238				9.59E-03	2.57E-02	4.78E-02

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241	1.83E-06	5.01E-06	1.35E-06	4.08E-06	1.32E-04	4.33E-05	
Cm-244	1.26E-06	7.01E-06	1.22E-06	1.97E-06	1.05E-04	1.52E-05	
Co-60	4.94E-04	4.94E-04					
Cs-137	1.02E-01	8.79E-02	5.80E-02	3.56E-02	2.10E-01	6.70E-02	1.34E-01
H-3	4.68E+03	4.09+03	3.03E+03	1.86E+03	2.95E+03	1.76E+03	1.74E+03
I-129	7.82E-02	7.82E-02	7.82E-02	7.82E-02	7.82E-02	7.82E-02	8.00E-03
Pu-238	9.98E-05	8.12E-06	1.36E-05	9.57E-06	1.50E-04	2.13E-04	
Pu-239	1.97E-06	1.36E-05	5.12E-06	2.57E-06	8.48E-05	6.29E-05	
Sr-89,90	1.20E-01	5.44E-02					
Sr-90			2.04E-02	3.41E-02	9.67E-02	9.23E-02	3.76E-02
Tc-99			4.56E-02	1.94E-02		4.86E-03	4.43E-03
U-234	8.60E-02	2.05E-05	2.03E-05	2.96E-05	3.37E-04	1.31E-04	3.80E-04
U-235	6.33E-04	1.20E-06	9.05E-07	7.94E-07	1.63E-06	2.66E-06	1.27E-05
U-238	1.08E-02	4.70E-05	3.87E-05	4.88E-05	3.73E-04	1.98E-04	2.04E-04
Alpha	2.05E-02	1.13E-02	1.98E-02	1.81E-02	2.43E-02	8.39E-03	9.06E-03
Nonvolatile Beta	2.23E-02						
Beta-Gamma		1.92E-02	5.63E-02	1.94E-02	1.01E-01	1.93E-02	1.12E-02

1. Empty cells indicate no data reported.

Critical Pathway

(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Heavy Water Atmospheric Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Co-60						
Cs-137			2.58E-06	1.11E-06	2.85E-06	
H-3 (total)	4.48E+02	3.01E+02	3.28E+02	3.29E+02	3.53E+02	4.04E+02
Pu-239	8.42E-07		2.39E-05	6.39E-06	2.28E-05	2.98E-05
Sr-89,90	7.19E-06	1.53E-06	1.57E-04		1.83E-04	2.61E-04
Sr-90				9.48E-05		
Radionuclide	**1999**	**2001-2005**				
Co-60	1.18E-06					
H-3 (total)	2.31E+02					
Alpha	1.05E-05					
Nonvolatile Beta	1.23E-04					

1. Empty cells indicate no data reported.
2. *Includes TNX.

Heavy Water/TNX Liquid Releases in Curies

Radionuclide	1993	1994	1995	1996*	1997*	1998*
Co-60			2.28E-03			
H-3 (oxide)	4.99E+02	2.62E+02	6.28E+02	1.83E+02	4.02E+02	3.98E+02
Pu-238			1.63E-06	1.97E-06	7.68E-07	2.59E-06
Pu-239		6.52E-04	4.98E-04	4.19E-04	1.12E-03	1.70E-03
Sr-89,90	4.65E-02	1.08E-02	1.15E-02		5.09E-03	3.22E-03
Sr-90				5.38E-03		
U-234			1.63E-06	7.45E-07	1.52E-06	9.20E-06
U-235			3.88E-06		1.37E-07	4.30E-07
U-235,238				1.75E-06		
U-238					9.19E-06	2.39E-05
Radionuclide	**1999***	**2000***	**2001-2005**			
H-3 (oxide)	2.13E+02	1.29E-01				
Pu-238	1.14E-06	2.25E-06				
Pu-239		1.77E-07				
U-234	4.88E-06	3.35E-06				
U-235		5.20E-08				
U-238	1.00E-05	4.67E-06				
Alpha	1.04E-03	4.93E-04				
Nonvolatile Beta	3.21E-03					
Beta-Gamma		1.02E-03				

1. Empty cells indicate no data reported.
2. *Includes TNX.

Critical Pathway

(Return to TOC)

Summaries of Additional Radioactive Atmospheric and Liquid Releases from SRS

Reactors Atmospheric Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Co-60			2.78E-05			
Cs-137	1.04E-04	6.40E-06	4.68E-04	1.76E-05	2.48E-04	3.50E-05
H-3 (total)	3.85E+04	2.37E+04	1.26E+04	1.10E+04	5.23E+03	2.28E+04
I-131		4.42E-07				
Pu-239	4.11E-06	6.33E-07	2.78E-04	6.74E-05	2.92E-04	2.19E-04
Ru-106	3.99E-06					
Sr-89,90	1.81E-04	1.08E-04	3.29E-03		1.80E-03	1.62E-03
Sr-90				1.05E-03		

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241				1.68E-08	3.52E-08	1.04E-07	8.63E-08
Cm-244							2.55E-08
Co-60				3.59E-08			
Cs-137	2.32E-05	1.22E-05		4.36E-08	1.70E-07	1.70E-07	
H-3 (total)	3.04E+03	3.11E+03	2.41E+03	2.20E+03	1.10E+03	1.18E+03	6.44E+02
I-131							
Pu-238				2.98E-07	1.46E-08		
U-234					1.62E-07		1.33E-07
U-235					2.31E-08		
U-238				1.25E-08	5.24E-08	1.10E-07	8.39E-08
Alpha	5.09E-04	7.65E-05	5.49E-05	4.72E-05	3.39-05	1.53E-05	7.44E-06
Nonvolatile Beta	1.19E-03						
Beta-Gamma		8.31E-04	3.81E-04	4.08E-04	2.68E-04	6.27E-04	7.09E-05

1. Empty cells indicate no data reported.

Reactors Liquid Releases in Curies

Radionuclide	1993	1994	1995	1996	1997	1998
Cs-137	1.29E-02	4.72E-02	1.76E-04	2.30E-02	2.86E-03	1.16E-02
H-3	2.29E+03	2.42E+03	2.97E+03	2.73E+03	2.91E+03	3.44E+03
Pu-238				1.36E-04	4.24E-05	4.90E-04
Pu-239	5.97E-04	3.51E-04	4.95E-03	1.07E-02	1.10E-02	1.36E-03
Sr-89,90	1.87E-01	2.14E-01	1.97E-01	1.35E-01	6.46E-02	2.21E-02
U-234				1.19E-03	4.45E-03	6.70E-03
U-235				1.81E-05	4.91E-05	7.16E-05
U-238				8.21E-04	3.83E-03	5.09E-03

Radionuclide	1999	2000	2001	2002	2003	2004	2005
Am-241							2.03E-08
Co-60		1.13E-03					
Cs-137	3.24E-04	2.16E-04	2.25E-02			6.56E-04	1.91E-04
H-3	1.40E+03	1.25E+03	1.28E+03	9.93E+02	1.36E+03	9.21E+02	7.62E+02
Pu-239	9.96E-05						
Sr-89,90	1.37E-02	2.84E-05					
Sr-90			5.92E-05	4.24E-04		1.73E-05	
U-234	3.93E-03						
U-235	2.50E-04						
U-238	3.10E-03						
Alpha	6.45E-04	1.44E-03	3.26E-03	1.65E-03	3.04E-03	2.51E-03	2.46E-03
Nonvolatile Beta	2.40E-02						
Beta-Gamma		2.01E-02	2.56E-02	1.81E-02	3.42E-02	3.14E-02	9.98E-03

1. Empty cells indicate no data reported.

Critical Pathway
SRS Toxic Chemical List

(Return to TOC)

ACETALDEHYDE
ACETAMIDE
ACETIC ANHYDRIDE
ACETONITRILE
ACETOPHENONE
2-ACETYLAMINOFLUORINE
ACROLEIN
ACRYLAMIDE
ACRYLIC ACID
ACRYLONITRILE
ALDICARB
ALLYL CHLORIDE
P-AMINODIPHENYL
AMMONIUM CHLORIDE
ANILINE
O-ANISIDINE
P-ANISIDINE
ANTIMONY COMPOUNDS
ANTIMONY
ANTIMONY PENTACHLORIDE
ARSENIC PENTOXIDE
ARSENIC
BENZENE
BENZIDINE
BENZOTRICHLORIDE
BENZYL CHLORIDE
BERYLLIUM OXIDE
BERYLLIUM SULFATE
BERYLLIUM
BIPHENYL
BIS (CHLOROMETHYL) ETHER
BIS(2-ETHYLHEXYL)PHTHALATE (DEHP)
BROMOFORM
1,3-BUTADIENE
1-BUTANETHIOL
N-BUTYLAMINE
CADMIUM OXIDE
CHLORAMBEN
CHLORDANE
CHLORINE
CHLOROACETIC ACID
2-CHLOROACETOPHENONE
CHLOROBENZENE
CHLOROBENZILATE
CHLOROFORM
CHLOROMETHYL METHYL ETHER
P-CHLORONITROBENZENE
CHLOROPRENE
CHROMIUM (+6) COMPOUNDS
COBALT COMPOUNDS
COBALT
CRESOLS/CRESYLIC ACID
M-CRESOL
O-CRESOL
P-CRESOL
CUMENE
CYANAMIDE
CYANIC ACID
CYANIDE
CYANIDE COMPOUNDS
CYANOACETAMIDE
CYANOGEN
2,4-D, SALTS AND ESTERS
DDE
DIAZOMETHANE
DIBENZOFURAN
1,2-DIBROMO-3-CHLOROPROPANE
DIBUTYL PHTHALATE
P-DICHLOROBENZENE
3,3-DICHLOROBENZIDINE
1,3-DICHLOROPROPENE
DICHLORVOS
DIETHANOLAMINE
N,N-DIETHYLANILINE
DIETHYL PHTHALATE
DIETHYL SULFATE

Critical Pathway
SRS Toxic Chemical List

(Return to TOC)

DIISODECYL PHTHALATE
3,3-DIMETHOXYBENZIDENE
3,3-DIMETHYLBENZIDENE
DIMETHYL CARBAMOYL CHLORIDE
DIMETHYL FORMAMIDE
1,1-DIMETHYL HYDRAZINE
1,2-DIMETHYL HYDRAZINE
DIMETHYL PHTHALATE
DIMETHYL SULFATE
4-DIMETHYLAMINOAZOBENZENE
M-DINITROBENZENE
4,6-DINITRO-O-CRESOL AND SALTS
2,4-DINITROPHENOL
2,4-DINITROTOLUENE
DIOCTYL PHTHALATE
1,4-DIOXANE
1,2-DIPHENYLHYDRAZINE
EPICHLOROHYDRIN
1, 2-EPOXYBUTANE
ETHANETHIOL
ETHANOLAMINE
ETHYL ACRYLATE
ETHYL BENZENE
ETHYL CHLORIDE
ETHYLENE DIBROMIDE
ETHYLENE DICHLORIDE
ETHYLENE GLYCOL
ETHYLENE OXIDE
ETHYLENE THIOUREA
ETHYLENE IMINE
ETHYLIDENE DICHLORIDE
FORMALDEHYDE
FORMAMIDE
FORMIC ACID
FURFURAL
FURFURYL ALCOHOL
GLYCIDALDEHYDE
GLYCOL ETHERS
HEPTACHLOR
HEXACHLOROBENZENE
HEXACHLOROBUTADIENE
HEXACHLOROCYCLOHEXANE
HEXACHLOROCYLOPENTADIENE
HEXACHLOROETHANE
HEXACHLORONAPTHALENE
HEXAMETHYLENE-1, 6-DIISOCYANATE
HEXAMETHYLPHOSPHORAMIDE
HEXANE
HYDRAZINE
HYDROCHLORIC ACID
HYDROGEN CYANIDE
HYDROGEN SULFIDE
HYDROQUINONE
ISOPHORONE
ISOPROPYLAMINE
KEPONE
KETENE
LEAD ARSENATE
LEAD(+2) ARSENATE
LINDANE
MALATHION
MALEIC ANHYDRIDE
MANGANESE COMPOUNDS
MANGANESE
MERCURY
METHANOL(METHYL ALCOHOL)
METHOXYCHLOR
METHYL BROMIDE
METHYL CHLORIDE
METHYL CHLOROFORM
METHYLENE BIPHENYL ISOCYANATE
4,4-METHYLENE BIS(2-CHLOROANILINE)
4,4-METHYLENEDIANILINE
METHYL ETHYL KETONE (2-BUTANONE)
METHYL HYDRAZINE
METHYL IODIDE

Critical Pathway
SRS Toxic Chemical List

(Return to TOC)

METHYL ISOBUTYL KETONE
METHYL ISOCYANATE
METHYL MERCAPTAN
METHYL METHACRYLATE
METHYLAMINE
METHYLENE CHLORIDE
METHYL TERT-BUTYL ETHER
MINERAL FIBERS, FINE
MINERAL OIL MIST (PARAFFIN OIL)
MIREX
NAPHTHALENE
A-NAPHTHYLAMINE
B-NAPHTHYLAMINE
NICKEL CARBONYL
NICKEL OXIDE
NICKEL SULFATE
NICKEL
NITRIC ACID
P-NITROANILINE
NITROBENZENE
4-NITROBIPHENYL
NITROGEN MUSTARD
NITROGLYCERIN
P-NITROPHENOL
1-NITROPROPANE
2-NITROPROPANE
P-NITROSOPHENOL
N-NITROSO-N-METHYLUREA
N-NITROSODIMETHYLAMINE
N-NITROSOMORPHOLINE
P-NITROTOLUENE
OCTACHLORONAPHTHALENE
OXALIC ACID
PARAQUAT
PARATHION
PENTACHLOROPHENOL
PHENOL
P-PHENYLENEDIAMINE
PHENYLHYDRAZINE
PHOSGENE (CARBONYL CHLORIDE)
PHOSPHINE
PHOSPHORIC ACID
PHOSPHORUS
PHTHALIC ANHYDRIDE
PICRIC ACID
POLYCHLORINATED BIPHENYLS
POLYCHLORINATED BIPHENYL (AROCLOR 1232)
POLYCHLORINATED BIPHENYL (AROCLOR 1242)
POLYCHLORINATED BIPHENYL (AROCLOR 1254)
POLYCHLORINATED BIPHENYL (AROCLOR 1260)
POLYCHLORINATED BIPHENYLS (AROCLORS)
POLYCYCLIC ORGANIC MATTER
1,3-PROPANE SULTONE
B-PROPIOLACTONE
PROPIONALDEHYDE
PROPOXUR
PROPYLENE DICHLORIDE
PROPYLENE OXIDE
1,2-PROPYLENIMINE
PYRETHRIN I
PYRETHRIN II
PYRETHRUM
QUINOLINE
QUINONE
ROTENONE
SELENIUM COMPOUNDS
SELENIUM
SELENIUM DIOXIDE
SODIUM HYDROXIDE
STYRENE
STYRENE OXIDE
SULFURIC ACID
TETRACHLORINATED DIBENZO-P-DIOXINS
1, 1, 2, 2-TETRACHLOROETHANE
TETRACHLOROETHYLENE (PERCHLOROETHYLENE)
TITANIUM TETRACHLORIDE

Critical Pathway
SRS Toxic Chemical List

(Return to TOC)

TOLUENE
2, 4-TOLUENEDIAMINE
TOLUENE DIISOCYANATE
TOLUENE-2,4-DIISOCYNANATE
O-TOLUIDINE
TOXAPHENE
1,2,4-TRICHLOROBENZENE
1,1,2-TRICHLOROETHANE
2,4,6-TRICHLOROPHENOL
TRIETHYLAMINE
TRIFLURALIN
2,2,4-TRIMETHYLPENTANE
URETHANE (CARBAMIC ACID ETHYL ESTER)
VINYL ACETATE
VINYL BROMIDE
VINYL CHLORIDE
VINYL FLUORIDE
VINYLIDENE CHLORIDE
XYLENE
M-XYLENE
O-XYLENE
P-XYLENE
XYLIDINE

6.1 2005 Dose Calculation (Return to TOC)

6.1.1 Summary

Atmospheric and liquid discharges from the Savannah River Site (SRS) are monitored by the Department of Energy – Savannah River (DOE-SR) contractor Westinghouse Savannah River Company, Environmental Monitoring Section. The Environmental Surveillance and Oversight Program (ESOP) of the South Carolina Department of Health and Environmental Control (SCDHEC) also monitors the SRS and perimeter areas under an Agreement in Principle with the DOE. DOE-SR and ESOP used data from these monitoring activities to calculate the potential radiation dose to the surrounding public. ESOP implemented a Radiological Dose Calculation Project in 2002 to calculate the potential exposure or dose to the public around the SRS, and evaluated DOE-SR dose results published in the SRS Environmental Reports.

The dose estimates produced by ESOP were calculated from radiation activity concentrations for all exposure media sampled including air, thermoluminescent dosimeters (TLD), milk, edible vegetation, soil, surface water, sediments, drinking water, fish, groundwater, and game animals. Dose concentrations were calculated using standard dose calculations based on the International Commission of Radiological Protection (ICRP) publications 30/48 and the U. S. Environmental Protection Agency (USEPA) Federal Guidance Report updates 11 and 12 from the Oak Ridge National Laboratory. Data provided to this project were collected from locations off the SRS and summarized as annual average concentrations for each contaminant to calculate the potential radiation dose to the maximally exposed individual (MEI). The MEI was defined as a hypothetical adult member of the surrounding population who received the maximum dose from the SRS routine air and liquid releases. Consumption rates used in this project were found in publications by the Nuclear Regulatory Commission, the USEPA, the D.M. Hamby publication and a 1995 Strange and Chamberlin Multimedia Environmental Pollutant Assessment System exposure pathway model.

Background evidence collected in excess of 50 miles from the SRS suggested that some radiological contamination was due to fallout from other nuclear plants, past nuclear tests, cosmic components, and naturally occurring radioisotopes. A random sample average South Carolina background dose for each project media radioisotope was subtracted from a perimeter dose average detected within 50 miles of the SRS. The dose was calculated from data collected at ESOP fixed monitoring stations and random locations accessible to the public around the perimeter of the SRS. All resultant radiological activity concentrations above background, with the exception of up-gradient groundwater and tritium from power plants, were assumed to have originated from the SRS. The ESOP dose calculations were an independent estimate of radiological dose to the public near the perimeter of the SRS.

This project used dose instead of risk so that direct comparisons of dose magnitude can be made with data published in the SRS Environmental Reports. USEPA and SCDHEC both use risk calculations when determining clean-up levels at Comprehensive Environmental Resource Compensation and Liability Act (CERCLA) and Resource Conservation Recovery Act (RCRA) sites.

RESULTS AND DISCUSSION

Radiation exposures to the MEI from each exposure media were categorized into primary exposure routes and pathways (atmospheric, liquid pathways) that are subdivided into other more specialized exposure pathways or media. The dose from the radionuclides were organized to represent an additive dose estimate (Table 1, section 6.1.2) for 2005 occurring in specialized pathways which represented types of media exposure and lifestyle (e. g., potable and nonpotable drinking water media, farmer, general public and the sportsman lifestyle scenarios). Note that all drinking water doses are not added together, since a source or a maximum exposure for a particular scenario had to be assumed. A brief comparison was made to dose values published by the DOE-SR. This comparison assisted the ESOP in evaluating the 2005 DOE-SR environmental monitoring program.

The Atmospheric Pathway

ESOP Air Inhalation Dose Results

Because radiological activity was difficult to detect at the SRS boundary, DOE-SR used a MAXDOSE-SR computer-modeling program to estimate the dose values to the MEI (WSRC 2002a, b). Data used in the DOE-SR monitoring program were from stack emissions as well as diffuse and fugitive emissions around the SRS (WSRC 1999a & b, 2000a & b, 2001a & b, 2003b, 2004, 2005, 2006). Figure 1 in section 6.1.2 shows the comparable dose values above background in mrem, calculated by ESOP for different media and pathways from 1999 to 2005 (SCDHEC 2005b). The 0.002-mrem ESOP MEI air dose in 2005 was typical of detections in past years of less than 0.01-mrems, and below the DOE-SR 2005 air dose estimate of 0.05-mrems. This difference in the air pathway was due primarily to the fact that the DOE-SR air dose was calculated from release estimates from diffuse and fugitive sources and represents a conservative potential dose.

The inhalation pathway dose attributed to resuspended soil and sediment was more significant (1.92 mrem), and was predominantly influenced by unknown alpha (1.91 mrem) being assigned as a Pu-239 dose, which is biased on the very conservative side for dose estimation. This resuspended soil alpha from a six-inch average depth was not backed up by air filter detections close to SRS, and is most likely due to NORM alpha (Table 1). The actual air filter average detection of 0.002-mrem is only 0.10% of the potential resuspended alpha possible detection (1.909-mrem), which in total (filters plus soil resuspension) is 19.21% of the DOE allowed air standard. The potential inhalation dose (MEI 0.01-mrem plus NORM contribution1.92-mrem) was 16.14% of the overall dose detected by ESOP samples. However, the MEI inhalation dose excluding probable NORM was only 0.12% of the total MEI dose. Thus, the potential air inhalation dose resident in NORM soils was much greater than the MEI exposure from man-made radionuclides. This is part of the 300-mrem United States annual average NORM dose. The 1999 to 2005 air inhalation dose average for the SRS 50-Mile Perimeter was less than 0.01-mrem at two significant figures.

The NORM dose estimates from coastal plains soils were included in the DOE-SR perimeter overall dose only because they were greater than a random background average that included piedmont soils (lead “Pb”-214, actinium “Ac”-228, radium “Ra”-226, uranium “U”-235). Some of these probable NORM occurring in the soil and sediment samples may possibly be of DOE-SR origin since these thorium and uranium decay series release by-products were processed or stored at the SRS. The soil sample from the floodplain of the North Fork Edisto River, Quadrant E18 (SCDHEC 2005) contained possible contributions to the resuspended soil exposure. Some of the U-235 dose could be due to erosion of saprolitic formations (rather than an aerial deposition) from upstream areas that are known to contain higher levels of naturally occurring uranium and radium (SCDHEC 2005b).

DOE-SR potential soil exposure was calculated by WSRC as 3.18 mrem total for the hunter and fisherman exposed to Savannah River swamp soil (WSRC, 2006 Table 6-4). The ESOP total NORM detections from soil and sediment including ambient beta-gamma shine from TLD detections was 2.20 mrem (Table 1). An additional 0.03 mrem was attributed as MEI dose. Thus, the potential dose from resuspended NORM was much greater and should have been detected by air samplers if the soil NORM was resuspended.

Thermoluminescent Dosimeter (TLD) Dose Results

The TLD are replaced quarterly and deployed one meter above the soil in various locations to measure ambient beta-gamma continually. The TLD exposures above background levels are considered as originating from artificial sources. The direct exposure from all SRS perimeter TLD, minus the outer perimeter background TLD, averaged 0.25-mrem in 2004 for unknown beta/gamma activity and zero-mrem in 2005. Use of the average outer perimeter locations as background instead of a single location allowed for the effects of differing soil types and the resident NORM on TLD exposure. Background cosmic radiation accumulated by the TLD during airline transport to and from the vendor for analysis was subtracted from the TLD yearly averages to obtain the gamma dose at the SRS perimeter locations (SCDHEC, 2005b). ESOP plans to establish a background location near Beaufort, South Carolina in 2007. The average TLD detected dose was 0.04-mrem (±0.09) for 1999-2005 (section 6.1.4).

DOE-SR TLD that could be matched with ESOP TLD locations gave an outer perimeter (background) ambient beta-gamma greater than the inner perimeter TLD (closer to SRS). Both perimeter population center results were influenced by building material NORM. The similarly located TLD outer perimeter averages from both programs were less than the Aiken building TLD control.

ESOP Edible Vegetation Dose Results

The ESOP MEI total dose above background for edible vegetation (leafy and fruits) came from only one radionuclide (tritium at 0.002 mrem total). The MEI dose from vegetable consumption was far less than that typically received from watching TV (SCDHEC, 2006) for one year (1 mrem/yr). The edible vegetation dose average within the SRS 50-Mile Perimeter for the 2003-2005 period was 0.01 mrem (±0.01).

DOE-SR detected Cs-137, Sr-89/90 and tritium in collards, Co-60 in peanuts, and tritium in pecans. A potential off-site dose of 0.049 mrem was estimated by DOE-SR for the agricultural irrigation pathway. Thus, the deposition or uptake of these radionuclides was far less than expected.

ESOP Soil Exposure Dose Results

Six gamma-producing radioisotopes produced detectable concentrations in surface soil samples. Surface soil dose was considered to come from ingestion, direct radiation exposure, and inhalation of resuspended soil (including dried sediments) due to farming and wind erosion. NORM detection levels greater than background may reflect soil type source differences and the levels of dissolved radionuclides in groundwater. The probable total NORM detections were 30.13% (Table 1) of the total dose detected in the 2005 ESOP samples. The MEI dose excluding NORM was 8.35 mrem versus 11.95 mrem, if the NORM was added. Most of this added NORM was due to assigning unspecified resuspended alpha as Pu-239 and the detection of Ra-226 in some DNR wells. NORM detection levels greater than background that were also by-products or stored by DOE-SR were considered as originating from an SRS aerial deposition or upstream liquid source (SRS streams). All dose in soils came from cesium “Cs”-137, europium “Eu”-155, U-235, Ra-226, Pb-214, Ac-228 and unknown alpha, and totaled less than 2.23 mrem or 18.66% of the total MEI dose that included soil NORM (section 6.1.3). The exclusion of possible NORM dose would reduce the soil contribution to 0.03 mrem (0.36% of MEI), and the overall MEI dose to 8.35 mrem. Unknown alpha detections were assumed to come from Pu-239 and gave the highest total dose (1.92 mrem) for surface soil ingestion, direct exposure, and resuspension inhalation. Unknown alpha can be any alpha decay radionuclide and therefore the non-NORM soil dose is potentially far less than the calculation based on Pu-239. NORM was included in the overall DOE-SR perimeter dose because it was greater than the background average that included piedmont soils. Local NORM greater than the South Carolina background probably reflects local variations in the levels of radionuclides that contribute to the national average.

The ingestion of contaminated sediment and soil along the banks of SRS streams during consumption of aquatic food (fish), and inhalation of resuspended soil (dried sediment and soil on stream banks and in fields) in windy conditions contributed to the MEI dose (section 6.1.3). Wet soil and clothing greatly reduce beta penetration to the skin and direct exposure to gamma (shine) from surface soil. The 1999-2005 soil average dose was 0.70 mrem (±1.19) within the SRS 50-Mile Perimeter, and sediment was 0.00 mrem (±0.01) at two significant digits.

The DOE-SR soil exposure results indicated significant exposure from a combination of external exposure, incidental ingestion, and inhalation of Savannah River soil (WSRC, 2006 Table 6-4). This exposure pathway is covered primarily under the Sportsman Pathway (section 7.4) of this report.

Milk Dose Results

The ESOP MEI total dose above background for cow milk in 2005 (section 6.1.3) was 0.002 mrem/yr. That dose was due to strontium-89 (Sr-89) found in liquid whole milk. Milk produced one of the lowest detected doses, and is tied with vegetation as the third highest food group detection sampled in 2005 (Figure 2, section 6.1.2), but is well below the deer and fish radionuclide detection levels. The ESOP overall average cow milk dose since 1999 was 0.05 mrem with a range of 0 to 0.18 mrem (section 6.1.4). This milk dose was far less than that received by watching TV for one year (1 mrem). The overall dose range for DOE-SR cow milk samples was 0.01 to 0.09 mrem. DOE-SR data includes detections less than the MDC level normally detected by ESOP and results in a lower detection average (WSRC 2006).

Thus, DOE-SR and ESOP environmental samples are producing approximately the same dose range for milk consumption. The dominant dose in past milk sampling came from Cs-137 in goat milk and Sr-89 in 2004 cow milk solids. The 1999-2005 average milk-dose within the SRS 50-Mile Perimeter was 0.05 mrem (±0.07).

The Liquid Pathway

ESOP Drinking Water Dose Results

Five drinking water dose values were calculated by ESOP for the 2005 liquid exposure pathway (section 6.1.3). First, a drinking water dose maximum (0.06 mrem) was calculated for drinking water customers of Beaufort/ Jasper and Port Wentworth public utilities based only on detections above an MDA. The river water studies represented a maximum overall average dose to the downstream public of 0.06 mrems from the liquid pathway or 1.5 % of the EPA 4-mrem drinking water standard. Second, a drinking water dose (<0.06 mrem) was calculated for a member of the public who drank surface water from the Steel Creek and Little Hell boat landings, and River Mile 118.8 (Hwy 301). The highest water dose came from the potential consumption of Savannah River water by the survivalist MEI (0.06 mrem). Third and fourth, the Public Water Systems groundwater wells (0.04 mrem) and the South Carolina Department of Natural Resources (SCDNR) groundwater monitoring wells (1.40-mrem) represented the potential dose that may occur in PWS wells and private wells. The SCDNR groundwater dose was due mostly to probable NORM with a Ra-226 average (1.39 mrem) greater than the 2005 background. The remainder (0.01 mrem) was unspecified beta detection. Fifth, rainwater contained the minimal dose and indicated the potential dose from cistern water supplies at individual homes (0.02 mrem). The individual drinking water dose exposure should be no greater than a single source maximum.

The ESOP MEI was assumed to use river and boat landing water sources for drinking and cooking, and treated water from well water systems. A survivalist type of individual might consume water from the Hwy 301, Little Hell, and Steel Creek boat landing surface water sources. Free flowing artesian water is present at the Hwy 301 and Little Hell boat landings. Contamination at these Savannah River boat-landing locations was possibly reduced by the influx of fresh artesian water. The maximum ESOP MEI drinking water dose from river surface water at these boat landings was 0.04 mrem.

Radium-226 contributed the largest overall (ground water and river water) total water dose from all sources (1.39 mrem), unspecified alpha second (0.095 mrem), tritium third (0.058 mrem), and unspecified beta fourth (0.011 mrem). The inclusion of unspecified alpha and beta dose (as Pu-239 and Sr-90 respectively) probably represent counting some of the same dose twice and inflates the dose calculations by recounting the same source and inflating it as Pu-239 or Sr-90. For example, uranium isotopes, Ra-226, and Ra-228 dose also contribute significant dose to the overall gross alpha detections.

The up-gradient public water supply wells were assumed to represent the NORM dose possible from very deep private wells (1.39 mrem). It was not unusual for private wells in some areas of Aiken County to be drilled to a depth of 300 or more feet. These wells were deep enough to accumulate dissolved NORM from up-gradient sources of saprolitic granite that occur in the aquifer recharge areas (Colquhoun 1983). The higher detections for total uranium, Ra-226, Ra-228, and gross alpha/beta occurred mostly in wells of less than 150-foot depth terminated in the Steed's Pond aquifer. These wells are up-gradient and north of the SRS, which probably contains leached NORM from up-gradient saprolitic granite. Typical tritium levels should be the leading indicator of contamination in groundwater, but most PWS and DNR well water detections were less than the lower limit of detection and the highest tritium levels for these wells averaged <390 pCi/L (SCDHEC, 2005b). The tritium background levels vary by source averages, but typically ranged from 270 to 374 pCi/L in 2005. Groundwater was not monitored off-SRS by the DOE-SR.

The ESOP Savannah River liquid pathway maximum dose detection was less than 0.07 mrem during the previous five years, but DOE-SR potential dose estimates were 0.09 to 0.22 mrems during that same period. ESOP composites tend to give lower sample results than grab samples due to the dilution effect of combining higher sample detections with lower sample detections. Another dilution effect was due to the increasing volume from tributary streams that occurred between the MEI drinking water location and the public water intakes that are farther downstream.

The ESOP surface water dose at boat landings averaged 0.05 mrem (± 0.02) within the SRS perimeter for the period 1999-2005. The yearly Savannah River water dose averaged 0.03 mrem (± 0.02) at the downstream water suppliers, Beaufort-Jasper and City of Savannah for the same period. This was within one standard deviation of the DOE-SR yearly drinking water average over the same period (0.05 mrem), and the 2005 average of 0.03 mrem. Differences are primarily attributable to sampler positioning and locations. Also, public water supply wells were within one standard deviation of the Savannah River drinking water results for the seven-year period (0.03 ± 0.05 mrem). DOE-SR does not monitor off-SRS PWS wells. However, note that the DNR wells show a possible local potential NORM dose increase in some wells (section 6.1.3 and section 6.1.4).

<u>Fisherman Dose Results</u>

The total dose above background from all fish collected by ESOP in 2005 was 1.33 mrem, and the average dose from equal consumption of the four fish species surveyed was 0.44 mrem (section 6.1.3). Bass contained the highest dose to the MEI for Cs-137 (0.48 mrem), Sr-89/90 (0.13 mrem), and sunfish contained the highest tritium (0.004 mrem). The MEI survivalist would probably take advantage of all edible fish. However, the highest total dose for bass (0.62 mrem) and per radionuclide gave the same result and represented the MEI fish consumption dose for ESOP.

ESOP used sediment data from SV-2018, SV-2019, and SV-118 that was greater than the background at SV-2010 to estimate accidental ingestion, inhalation, and direct exposure to resuspended dried sediment from stream banks (0.003 mrem). The soil, sediment, and TLD dose was used to estimate the typical external exposure (after subtracting the background) expected for the sportsman around the perimeter of the SRS (2.20 mrem). The swamp fisherman MEI fished in all locations around the perimeter of SRS.

The DOE-SR maximum off-SRS fisherman dose (0.24 mrem) was lower than that observed by ESOP (0.62 mrem). Figure 1 shows the average fish dose from 1999 to 2005 and illustrates that fish were the second most important contributor to the MEI dose during that period. The importance of soil is heavily influenced by possible NORM included within the soil category. Section 6.1.4 clearly indicates that if the MEI deer dose maximum for a single hunter is used in place of the average, then deer replaces soil as the number one dose source and fish moves to third. The exclusion of this probable NORM soil dose can be justified in that the air filters did not confirm the NORM dose, which was mostly due to calculating unknown alpha as Pu-239. This NORM dose is included as a possible added dose only because it was above the South Carolina background. Cesium-137 can bioaccumulate (3000:1 for water) in fish and was second only to tritium as the dominant contaminant in the DOE-SR cumulative liquid pathway (WSRC, 2006). Cesium-137 releases from leaking fuel elements to the liquid pathway occurred in the 1950s and 1960s, and due to its long half-life (30.2 yrs) continues to contaminate fish today. The liquid releases show up primarily in the aquatic biota (fish and crustaceans) and sediments. The fish dose was 7.43% of the MEI dose (8.35 mrem), but was 14.59% of the 2005 average sportsman dose that included the average deer dose instead of the highest known hunter dose (section 6.1.4). The 1999-2005 average fish dose was 0.52 mrem (±0.29) within the SRS 50-Mile Perimeter.

All-Pathway Dose

The DOE-SR All-Pathway dose excludes the sportsman dose and refers to the combined air and liquid doses from inhalation of air particulates and ingestion of water near the site boundary. These combined dose estimates are much less than the dose received from watching TV for one year (1 mrem).

An ESOP drinking water dose maximum (0.059 mrem) was calculated for the downstream drinking water customers of Beaufort/ Jasper and City of Savannah public utilities. This is more than up-gradient public water supply wells (0.04 mrem). Only DNR up gradient groundwater wells gave a higher dose (1.399 mrem), which is mostly attributable to Ra-226 (NORM) leached from saprolitic granite (97.22% of potential groundwater dose). Probable NORM is not an SRS contribution to MEI dose, but is included as part of the total dose only because it is greater than the South Carolina background. This dose above the South Carolina background was mostly from shallow wells of <150 feet that represent the local NORM dose possible in private wells located down-gradient of or within saprolitic granite. The 2005 ESOP average (0.03 ± 0.02 mrem) for all water sources sampled (PWS river water, PWS wells, DNRGW wells, rainwater and boat landing water) was within one standard deviation of DOE-SR downriver samples (0.03 mrem average at the downstream water suppliers). The DOE-SR average of downstream and near SRS samples (0.08 mrem near the SRS boundary) was 0.055 mrem overall. The DOE-SR overall dose average of the two extreme river locations (0.055 mrem) was within one standard deviation of the overall ESOP sampled river water (PWSRW, Boat Landings) sources (0.05 ± 0.01 mrem,). River water dose is a result of upstream sources, rainwater, and groundwater aquifers (seeps, springs, artesian wells, e.g.). The ESOP results indicated that the average radiation exposure from all five sources, including NORM detections, was approximately 0.32 mrem/yr (±0.61 mrem). Thus, NORM contributions potentially increase the average water dose by a factor of five. The ESOP MEI who drank untreated river water near Savannah River boat landings would have received 0.04-mrem or 1.0% of the DOE 4-mrem standard.

The ESOP air data was 0.002 mrem and added to the All-Pathway (air plus liquid) dose. The DOE-SR all-pathway dose was based on the MEI near the SRS boundary. The ESOP MEI All-Pathway detected maximum dose (liquid plus air) was 0.061 mrem compared to the DOE-SR potential dose estimate of 0.13 mrem (WSRC 2006). Thus, DOE-SR calculated estimates for public dose exposure continue to be conservative.

Sportsman Pathway

The fish average dose (0.44 mrem) and fish MEI dose (0.62 mrem) were greater than the deer average dose (0-mrem) for ESOP samples. However, the MEI statistics (based on a maximum dose received by a single hunter instead of an average dose) reverse this trend and deer become the dominant dose contributor (7.64 mrem). Figures 1 and 2, as well as section 6.1.4, show that a trend change can occur when a maximum deer dose was substituted for an average deer dose. Soil exposure was the highest media contributor to average dose for ESOP in 2005 (Table 2, section 6.1.2), but this dose contains probable NORM above the South Carolina background. Fish and deer alternated between first and second in the previous five years average dose, and that trend continues if the NORM dose is eliminated. Deer always replaced fish as the number one dose contributor when the MEI maximum doses were compared. Compare the 2005 ESOP MEI deer consumption maximum dose (7.64 mrem) to the 0.00 mrem average deer dose, and to the 0.62 mrem maximum fish dose and 0.44 mrem average fish dose. The ESOP seven-year MEI deer dose calculation average (9.50 ± 5.47 mrem) is based on actual field data (Figure 3, section 6.1.2) and is more than the DOE-SR off-SRS MEI seven-year deer dose average (7.35 ± 6.01 mrem), but either is within one standard deviation of the other. The DOE-SR used a computer model to estimate the dose values to the MEI from the sportsman exposure pathway.

The DOE-SR MEI calculation for fish was based on the fish sample with the highest concentration. ESOP based its own fish MEI on the total of the highest radioisotope concentrations, irrespective of species, since the MEI eats all types of fish. Sunfish had the highest tritium detection average (0.004 mrem) while bass had the highest Cs-137 (0.484 mrem) and Sr-89/90 (0.134 mrem). The seven-year average of DOE-SR sampled fish (0.52 mrem, ±0.26) is within one standard deviation of the ESOP sampled fish (0.52 mrem, ±0.29).

The sportsman comparable media average (Table 2) of air, liquid, soil, and food exposure pathways shows that the DOE-SR average (2.24 ± 2.71 mrem) and ESOP (2.64 ± 3.89 mrem) are within one standard deviation overall. Thus, both organizations environmental sampling programs seem to be detecting approximately the same comparable dose despite differences in media and radionuclides sampled, and differences in dose calculation factors. The seven-year average sportsmen scenario (1.96 ± 1.71 mrem) statistics for the SRS 50-Mile perimeter are included in section 6.1.4.

The three main routes of dose exposure to the sportsman excluding probable NORM were ingestion, direct external absorption, and inhalation in that order. Food (wild game) was the main pathway of dose exposure (Table 1, 99.88%) if possible NORM was excluded for the swamp dwelling MEI who resided downriver below the SRS swamp, killed and ate deer, caught and ate fish from the SRS stream mouths, drank milk from local dairies, and consumed local vegetables. The 2005 ESOP highest MEI food pathway dose (section 6.1.3) excluding probable NORM was deer (91.50%), fish (7.43%), milk (0.24%), and vegetables (0.24%). The combination of ground exposure factors excluding NORM with MEI deer and fish consumption (Table 1) for the ESOP sportsman MEI (8.30 mrem) was less than the comparable DOE-SR (8.82 mrem) estimates (WSRC, 2006 Table 6-4). The potential resuspension of unspecified alpha was probably NORM since the air filters did not detect this additional dose found in soil of six-inch average depth. This comparison excluded the DOE-SR feral hog data, since ESOP did not sample feral hogs in 2005. The exclusion of probable NORM (2.20 mrem) and the addition of the ESOP All-Pathway dose estimate (0.06 mrem) brings the total comparable dose (8.36 mrem) to just under the comparable DOE-SR maximum potential All-Pathway and Sportsman dose estimate (8.95 mrem), which excludes the onsite hunter and offsite hog data. Thus, ESOP detected 93.41% of the DOE-SR estimated dose from these media, and indicates that the DOE-SR dose estimates for 2005 were conservative based on radionuclide detections by ESOP.

The dominant dose by radioisotope is given in section 6.1.4 with Cs-137, alpha as Pu-239, Ra-226, H-3, beta-gamma, Ac-228, and Sr-89/90 providing over 97.46 % of the potential dose (1999-2005) above background. The exclusion of probable NORM above background contributed by unspecified alpha, beta, Ra-226, Ac-228 and other natural decay series radionuclides changed the major radionuclide contaminant order (greater than 1% of dose) to Cs-137, H-3, and Sr-89/90 (section 6.1.4). Figure 1 represents the dose above background detected in sample media collected for the ESOP survey of the SRS perimeter from 1999 through 2005. The highest concentrations for each radioisotope, irrespective of species, were added to represent the maximum possible dose for the media (e.g. fish). Historically, ESOP found that MEI deer consumption contributed the highest overall dose (77.78%) from 1999 through 2005 followed by soil (6.67%) with probable NORM, hogs (6.51%) with no background sample, fish (4.97%), groundwater (1.97%) with NORM, ingestion of Savannah River surface water (0.52%), milk (0.49%), public water supply wells (0.33%), TLD (0.34%), public water supply river water (0.31%), sediments (0.04%), air (0.03%), edible vegetation (0.03%), and rainwater (0.03%) (section 6.1.4, MEI % of all media column).

The deer results in Figure 1 were based on an overall average dose minus an average background dose, whereas the MEI deer results in Figure 2 were based on a maximum deer dose being consumed by one individual. The highest average pathway dose (excludes MEI deer and probable NORM) in 2005 came from ingestion: fish (0.622 mrem), surface water (0.06 mrem), and soil (0.02 mrem). The remainder of the average pathway dose came from direct exposure (0.01 mrem) and air (0.002 mrem). The average deer dose in 2005 was less than background.

During the past five years (section 6.1.4), the dose to the MEI for fish has been <1 mrem for both organizations (Figure 3). The difference between the ESOP deer detections and the DOE-SR estimates was possibly due to the methods of calculating the dose value. ESOP used actual deer data collected from the field, while the DOE-SR used a computer model based on the radionuclide levels in on-SRS deer to calculate a MEI dose exposure value for off-SRS deer. The deer MEI dose value has varied greatly during the past four years possibly due to numerous diet and weather related factors (resuspension and deposition of radionuclides). The low DOE-SR dose in 2001 was due to the limited number of hunts conducted after the September 11, 2001 terrorist attack (WSRC 2002a).

Factors influencing dose estimates included fluctuation of the deer and fish populations due to disease, predation, and available food. Deer, for example, consume certain types of edible mushrooms when available (Du Pont 1983). Mushrooms are the number one bioconcentrator of some heavy metals and radioisotopes (Botsch, 2000; Kalac, 2001). The availability of these mushrooms may be determined by factors that enhance or reduce radionuclide concentrations (e.g. controlled burns, deforestation, and weather). It may be possible in the future to correlate Cs-137 peak concentrations that occur in mushrooms and deer with weather and resuspension activities.

Other game-animals (feral hogs) are harvested by sportsmen, but ESOP does not have hog data (2005) to compare with the DOE-SR hog data. Also, the 2005 ESOP survivalist-sportsman MEI scenario gave a total dose of 8.35 mrem that did not include off-SRS feral hogs (2.8-mrem; WSRC, 2006). Thus, the potential MEI dose can be higher (8.35 plus 2.8 gives 11.15 mrem) than that cited for the survivalist-sportsman off-SRS MEI comparison. When the ESOP and DOE-SR comparable media were combined (Table 2), the average dose was 2.44 ± 3.30 mrem for the MEI. Note also that the combined media averages from the two separate environmental sampling programs produced results that were within one standard deviation of each other on a similar media basis. The potential MEI dose could be even higher, if other game were included. The worst-case scenario estimations by the DOE-SR were usually conservative since the ESOP average deer sample dose per year was many times smaller (section 6.1.4and SRS 2006). The MEI deer hunter maximum exposure was always several times higher than the average deer dose, which means that a small sample set using the maximum detection would still provide a conservative estimate of dose to the average deer hunter. Also, the two programs detected the same trend changes (Figure 3).

Deer Meat Dose Results

The DOE-SR off-SRS deer hunter dose (WSRC, 2006 Table 6-4) was estimated from the on-SRS deer dose, and represented a maximum that would not be expected from off-SRS deer on an average basis. The DOE-SR total off-SRS estimated deer dose that included soil exposure was 8.3 mrem based on the average Cs-137 in all deer and not the maximum detected dose. The higher on-SRS average deer dose estimate (8.8 mrem, WSRC 2006) and the lower off-SRS detected dose (ESOP, 7.64 mrem plus 0.03 mrem MEI soil) average 8.24 mrem. The differences between on and off site may be due to the available food in each habitat, and the contamination contained in that vegetation. The average of the DOE-SR estimated off-SRS deer dose (WSRC, 2006 Table 6-4) without soil exposure (5.4 mrem) and the ESOP observed off-SRS (7.64 mrem) dose for the consumption of deer in 2005 was 6.52 mrem. This was less than 25% of the average exposure from cosmic radiation in one year (26 mrem). The 1999-2005 ESOP SRS 50-Mile Perimeter average yearly deer dose was 9.50 mrem (±5.47).

Total MEI Dose

The DOE-SR data for the MEI came from the SRS Environmental Report for 2005 (WSRC, 2006). Table 2 shows similar media and pathway doses that were used to compare the ESOP survivalist-sportsman MEI scenario with DOE-SR MEI potential dose data. Table 1 totals are different than the Table 4 totals, since drinking water results were not used in Table 2. The total dose for the swamp dwelling survivalist-sportsman MEI who consumed the maximum deer dose was 11.95 mrem. The total exposure to the average sportsman consuming the average deer dose was only 4.25 mrem in 2005 (section 6.1.4). The averages of comparable media doses in Table 2, ESOP (2.64 mrem ±3.89) and DOE-SR (2.24 mrem ±2.71) were within one standard deviation of each other. This demonstrates that the two programs were detecting similar environmental data. However, a large standard deviation in comparison to the average may indicate that more sampling was needed. Alternately, a high standard deviation may simply represent a highly variable environmental parameter for a particular media. The median may be a better indicator of the dose central tendency in highly variable environmental data if the sampling number is sufficiently large. Thus, the typical exposure for a member of the general public who was a sportsman may be less than the 1.16 mrem (1999-2005 Avg Sportsman median, section 6.1.4).

The food pathways dominate the dose to the swamp dwelling MEI, and either the deer or fish dose may dominate in a particular year on an average dose basis. The primary cause of this fluctuation was apparently due to the variability in deer radionuclide concentration.

The DOE-SR potential air dose from Table 2 is 0.5% of the DOE 10 mrem air standard. The DOE-SR potential liquid dose is 2.0 % of the EPA 4-mrem drinking water standard. The total ESOP detected dose (includes probable NORM) for the survivalist-sportsman scenario from all pathways (approximately 11.95 mrem) gives a dose that is 11.95% of the 100 mrem DOE standard for allowable dose to the public and environment.

The ESOP detected air dose was only 0.002-mrem compared to the DOE-SR calculated potential air dose of 0.05 mrem, which indicated that depositions of the possible DOE-SR aerial contamination within the 50-mile SRS perimeter were minimal. Thus, most of the aerial depositions were either very close to the release stacks and within the SRS boundary or outside of the SRS 50-Mile sampling perimeter.

The ESOP calculated total dose (mrem/yr) to the MEI for the past five years is shown in Figure 1, section 6.1.3, and section 6.1.4. The MEI dose became highly variable when the game animal dose was added. The greatest difference between ESOP and DOE-SR 2005 *average* dose results occurred in the game animal pathway (ESOP zero mrem and DOE-SR 5.4 mrem). This was due to a South Carolina background deer dose average greater than the SRS 50-Mile sampling perimeter dose for ESOP samples. The DOE-SR off-SRS deer dose estimate was based on on-SRS deer moving off-SRS. Comparatively, ESOP used only detected data collected from actual monitoring activities to establish dose for the detected radioisotopes. DOE-SR used all calculated data per DOE approved procedures whether negative or less than an MDC. The actual ESOP off-SRS MEI dose including NORM (11.95 mrem) was greater than the DOE-SR (11.75 mrem) estimated off-SRS all-pathway plus sportsman potential dose total (WSRC 2006, Table 6-4) due to the inclusion of possible NORM. The similarity (within one standard deviation) of the average dose estimates for the ESOP (2.63 mrem, ±3.89) and DOE-SR (2.24 mrem, ±2.71) comparable media data (Table 2) seems to indicate that the two programs are accurately detecting the overall dose exposure to the public.

When comparing the total dose to the MEI from SRS operations, it is important to be aware of the total dose received each year from naturally occurring radiation. Figure 4, section 6.1.2 depicts the average total doses received each year by people living in the Southeastern Region of the U.S. (composite from SCDHEC 2006 website and 2001 SRS Environmental Report). The ESOP MEI received 8.35 mrem (11.95 mrem including probable NORM) in 2005, which was less than half that received by the individual through exposure to cosmic radiation (26 mrem).

The detected dose to the MEI of 11.95 mrem in 2005 should also be compared to the Health Physics Society 1994 Position Statement, which states in part that “for purposes of a lifetime risk, a site-specific dose rate of 10-30 mrem/yr greater than the regional average is well within the natural variations of background and should be considered equivalent to background without demonstrable increased risk”. However, statistical analysis of future ESOP random data may demonstrate if the assumption, that the SRS 50-Mile Perimeter and South Carolina background radionuclide populations are the same, can be rejected.

CONCLUSIONS AND RECOMMENDATIONS

The ESOP MEI survivalist-sportsman detected dose was 11.95 mrem in 2005 and averaged 10.41 mrem (±7.91) over the last seven years. The maximum potential dose to the MEI All-Pathway and Sportsman doses calculated by DOE-SR (WSRC, 2006 Table 6-4) could have added 8.8 mrem for the on-SRS hunter (deer plus hog) to each of the previous estimates. Thus, the potential MEI dose to the public that takes part in on-SRS and off-SRS deer hunts was less than 19.21 mrem in 2005 (10.41 plus 8.8). The very conservative worst-case scenario estimates average far less than the 100-mrem DOE limit. The maximum MEI was not established since hog data from SRS indicated there may be other significant contributors to the overall MEI pathway that are not yet surveyed by ESOP. However, DOE-SR monitors individual hunters on-SRS to insure that they do not exceed the DOE 100 mrem standard (WSRC, 2003).

Four dose scenario estimates were calculated based on ESOP data from 1999 to 2005 (section 6.1.4). The worst case MEI dose received that includes possible NORM above the South Carolina background was 11.95 mrem in 2005 and averaged 10.41 mrem (±7.91) annually from 1999 to 2005. The average sportsman who was not the MEI was exposed to 4.25 mrem of dose in 2005 and averaged 1.96 mrem (±1.71) annually from 1999 to 2005. The farmer, who was not a hunter, but inhaled, ingested, or received direct exposure from soil received a dose of 3.63 mrem in 2005 and averaged 1.02 mrem (±1.63) annually from 1999 to 2005. The general public who was not a sportsman and was not exposed to swamp soils received less than 0.06 mrem of dose in 2005 and averaged 0.14 mrem (±0.16) annually from 1999 to 2005.

The four ESOP conservative scenarios for public exposure to radionuclides are summarized in section 6.1.2, table 3 as millirem (mrem) of dose exposure, which includes possible NORM. Note that two-standard deviations added onto the MEI (worst case scenario) result in a possible dose average of 27.77 mrem from 1999 to 2005. A potential dose addition based on the DOE-

SR onsite hunter (8.8 mrem) and offsite feral hogs (2.8 mrem) added to the offsite ESOP detected dose (11.95 mrem) would increase the potential onsite plus offsite dose estimate to 23.55 mrem in 2005. Thus, both the additional DOE-SR calculated dose-potential added to the ESOP detected MEI (23.55 mrem), and the two-standard deviation (11.95 plus 2x7.91) ESOP detected MEI upper dose limit (27.77 mrem) are well under the DOE standard of 100 mrem.

The ESOP 2005 air (0.02% of DOE standard) and liquid (1.50% of DOE standard) dose estimates were well within the respective 10 mrem and 4 mrem DOE limits. The potential total dose to the ESOP MEI was very small when compared to radiation doses received from natural sources (11.95 versus 300-mrem), which is 3.98 % of the average NORM dose in the southeastern United States.

Historically, the greatest media contributors to the *average* dose determined by ESOP from 1999 thru 2005 (section 6.1.4, % All Media Avg) that included possible NORM were soil and sediment (34.38%), fish (25.45%), deer (19.51%), DNR groundwater (10.07%), Savannah River boat landing surface water (2.66%), milk (2.52%), public water supply well groundwater (1.68%), ambient beta-gamma (1.75%), public water supply river water (1.59%), air and edible vegetation (0.14% each), and rainwater (0.14%). The main radionuclide contributors to dose (section 6.1.4) including possible NORM above background from 1999 to 2005 were Cs-137 (55.19%), unspecified alpha (24.74%), Ra-226 (10.97%), H-3 (2.22%), unspecified beta-gamma (TLD 1.08%), Ac-228 (1.08%), Sr-89/90 (1.04%), and others that contributed less than 1% of the dose each (Sr-89, U-234, Pb-214, Eu-155, Ra-228, unspecified beta, Pb-212, U-235, U-238, Sr-90, Ce-144, Am-243, Pu-239/240, Pu-238, and Tc-99). Note that possible NORM were included in the averages only because these were detections above background. NORM contributed approximately 30.13% of the dose detected by ESOP in 2005. Exclusion of possible NORM changed the significant radionuclide order to Cs-137, H-3, Sr-89/90, Sr-89, Eu-155, Sr-90, Ce-144, Pu-239/240, Pu-238, and Tc-99. Ingestion dominated the MEI dose (99.88%), direct exposure was 0.12%, and air dose was near zero in 2005 (Table 1, MEI). The total dose that included possible NORM above background changed the ingestion dose to 81.75%, inhalation to 16.07%, and direct exposure to 2.18% (Table 1 NORM). This local NORM above the South Carolina background may be part of the 300-mrem NORM average for the United States.

The Savannah River ESOP 2005 MEI (survivalist-sportsman) clearly received the greatest dose in 2005 (Table 1) and over the last seven years (section 6.1.4) due primarily to the game consumed. The various dose scenario percentages were primarily different due to inclusion of the maximum single hunter dose, the average deer dose, or a particular drinking water dose criteria per scenario. The ESOP MEI (section 6.1.4,MEI media) game hunter received the maximum dose from deer and hogs from 1999 to 2005 (84.29%) followed by soil and sediment (6.71%), fish (4.97%), DNR groundwater wells that represent added NORM (1.97%), boat landing surface water (0.52%), milk (0.49%), public water supply wells (0.33%) ambient beta-gamma (0.34%), public water supply river water (0.31%), air, edible vegetation, and rainwater (0.03% each). The critical pathway MEI comparison in 2005 (Table 1) indicated that ingestion was 99.88% of the MEI dose excluding possible NORM, direct exposure was 0.12%, and air inhalation dose was near zero.

Because background radiation levels were subtracted from the ESOP data, it was conservatively assumed that the reported doses were a result of SRS operations. A comparison of similar media in the 2005 ESOP detected Survivalist-Sportsman MEI to the DOE-SR Maximum Potential All-Pathway and Sportsman Doses resulted in total media averages that were within one standard deviation of each other (Table 2). Compare the ESOP Table 2 average of 2.64 mrem (±3.89 mrem standard deviation) to the DOE-SR average of 2.24 mrem (±2.71 mrem standard deviation). The similarity of the evaluated data statistics appeared to confirm that both environmental programs were detecting similar magnitudes of dose that were within regulatory standards.

The ESOP Dose Calculation Project will continue to monitor the MEI dose trends. The survivalist-sportsman MEI scenario should include all potential dose as a worst-case scenario. SCDHEC has expanded the ESOP environmental program by collecting more random SRS perimeter and South Carolina background data for statistical analysis in future studies. ESOP has increased sampling near the perimeter of SRS and in closer proximity to SRS storage tanks, basins and seepage areas to insure an early warning for any contaminant making its way to the SRS streams.

6.1.2 Tables and Figures
(Return to TOC)
Radiological Dose Calculation

Table 1. 2005 ESOP Dose (mrem1) Estimates for Exposure Routes, Pathways, and Media

Exposure Routes	**Pathways**		**Media**	**MEI Dose (mrem)**	**+NORM[2]**
MEI Inhalation	Air		Air	**0.00**	
0.00% of Dose	Resuspended Soil[4]			**0.00**	1.92
	Resuspended Sediment			**0.00**	
	Total Dose - Air Inhalation (16.07% of Dose)			**0.00**	
MEI Ingestion	Food		Fish	**0.62**	
99.88% of Dose			Deer avg (0.00-mrem)	**7.64**	
			Hog		
			Vegetable	**0.00**	
			Milk	**0.00**	
	Soil		Soil	**0.02**	0.03
	Sediment		Sediment	**0.00**	
	Total Dose - Food Ingestion (69.54% of Dose)			**8.28**	
	Water	Potable	PWS River Water	0.06	
			PWS Wells	0.04	
			DNR Wells[5]	0.01	1.40
		Nonpotable	Swamp/RW[3]	**0.06**	
			Rainwater	0.02	
MEI	**Total Dose-DW Ingestion (12.21% of Dose)**			**0.06**	
Direct Exposure	Air	Cloud	Submersion		
0.12% of Dose		Skin	Absorption		
	Water	Swimming	Immersion	**0.00**	
		Skin	Absorption	**0.00**	
	Soil	Ground	Shine[6]	**0.01**	0.25
		TLD	Absorption	**0.00**	
	Sediment	Shoreline	Shine	**0.00**	
	All Direct Total Exposure (2.18% of Dose)			**0.01**	
Total MEI Offsite Dose - Food, Water, and Air Pathways				**8.35**	3.60
Notes:				MEI Grand Total Dose	11.95

1. All abbreviations are defined in the glossary and data in bold represents the MEI.
2. Probable NORM dose detections are considered separately from SRS perimeter dose.
3. Only one drinking water source assignable per scenario except for the MEI (includes well water NORM).
4. Resuspended soil alpha from six inch average depth was not backed up by air filter detections.
5. Most of the dose was from Ra-226 (U-238 natural decay series), and upgradient of SRS.
6. Most of the dose was from Ac-228 (Th-232 natural decay series), and upgradient of SRS.
7. MEI dose% are based on 8.36-mrem detection column and Total Dose% are based on 11.96-mrem column.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

Table 2. ESOP and DOE-SR Dose Results for Survivalist-Sportsman MEI

Environmental Monitors - 2005		SCDHEC			DOE-SR (1)			
Pathways by Media (below)	**Air**	**Liquid**	**Soil**	**Food**	**Air**	**Liquid**	**Soil**	**Food**
Water		0.06				0.08		
Inhalation* (7)	0.00				0.05			
Combined Soil* (3,8)			2.23				3.18	
Swimming		0.00				0.00		
Boating		0.00				0.00		
Milk				0.00				0.01
Edible Vegetation				0.00				0.02
Creek Mouth Fish				0.62				0.24
Offsite Deer				7.64				5.40
Totals	0.00	0.06	2.23	8.26	0.05	0.08	3.18	5.67
2003 MEI Comparison	**Pathways**				**Summary Statistics**			
Totals	**Air**	**Liquid**	**Soil**	**Food**	**Totals**	**Avg.**(4)	**sd** (5)	**Median**
SCDHEC	0.00	0.06	2.23	8.26	10.55	**2.64**	3.89	1.15
DOE-SR	0.05	0.08	3.18	5.67	8.98	**2.24**	2.71	1.63
Averages per column	**0.03**	**0.07**	**2.71**	**6.96**	**9.76**	**2.44**	**3.30**	**1.39**
Standard Deviation	0.04	0.01	0.67	1.83	1.11	0.28	0.83	0.34
% of standard (6)	**0.30**	**1.75**						

Notes:
1. The DOE-SR estimates of dose to the MEI come from the Savannah River Site Environmental Report for 2005, WSRC-TR-2006-00007.
2. All dose results not shown were well below the significant figure standard.
3. The combined soil reflects dose from swamp and creek bank soil plus possible NORM.
4. Avg is average.
5. sd is standard deviation.
6. % is percent of EPA and DOE air (10-mrem) and liquid (4-mrem) standards.
7. Inhalation from resuspended soil was included in the SCDHEC soil category, since inhalation of resuspended soil was not likely in flood plain soil.
8. The SCDHEC combined soil category included ingestion, direct exposure, and resuspension inhalation of soil and direct exposure detected by TLD.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

Table 3. ESOP Potential Dose Scenarios

	2005	1999-2005		
		Average	Standard Deviation	Median
MEI [1]	11.95	10.41	7.91	6.66
Public Criteria Dose [2]	0.06	0.14	0.16	0.08
Farmer [3]	3.63	1.02	1.63	0.14
Average Sportsman [4]	4.25	1.96	1.71	1.16

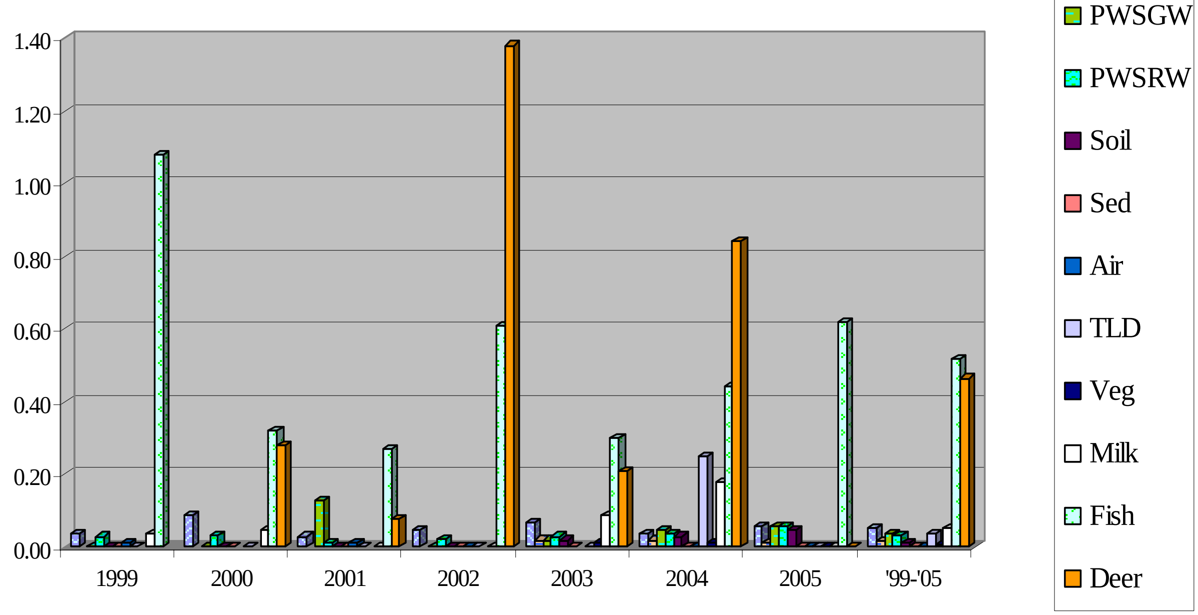
Notes:

1. The maximum exposed individual (MEI) is the worst-case scenario for a single hunter.
2. The non-sportsman public dose deletes sports food, sediments, and soil.
3. The farmer scenario adds the sediments, soil, and maximum well water dose to #2.
4. The average sportsman replaces the MEI deer dose with average deer dose.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

Figure 1. SRS 50-Mile Perimeter Media Dose 1999-2005 Excluding Probable NORM



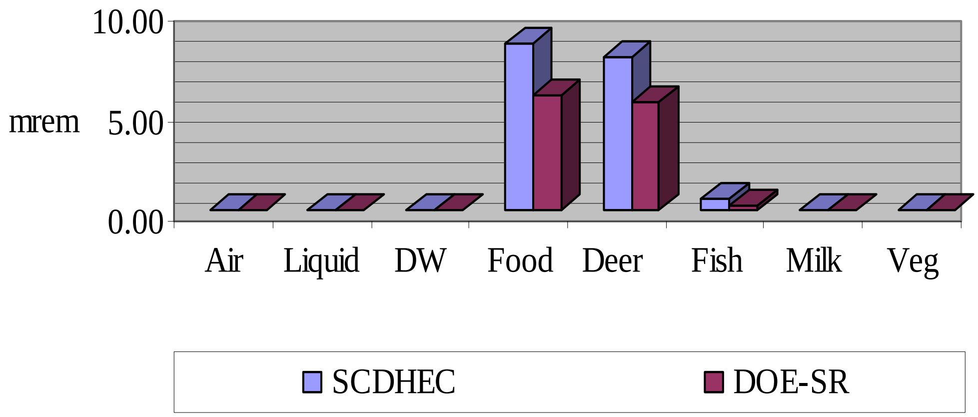
Notes: The Figure 1 data are in millirem per year and based on data in Appendix C.
1. "RW" is public water systems using river water.
2. "GW" is public water systems using groundwater.
3. "SWBL" is surface water at boat landings.
4. "DNR" is the Department of Natural Resources monitoring wells.
5. "Sed" is sediment.
6. "Veg" is vegetation.
7. TLD is the direct exposure above background detected by thermoluminescent dosimeters.
8. The deer results in Figure 1 were based on an overall average dose minus an average background dose, whereas the MEI deer results in Figure 2 were based on a maximum deer dose being consumed by one individual.
9. The '99-05' is the average dose for that media for the period 1999-2005. Consult Appendix B for the average media dose by species or radionuclide.

A carry over error occurred in the 2004 soil data that is corrected in this chart.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

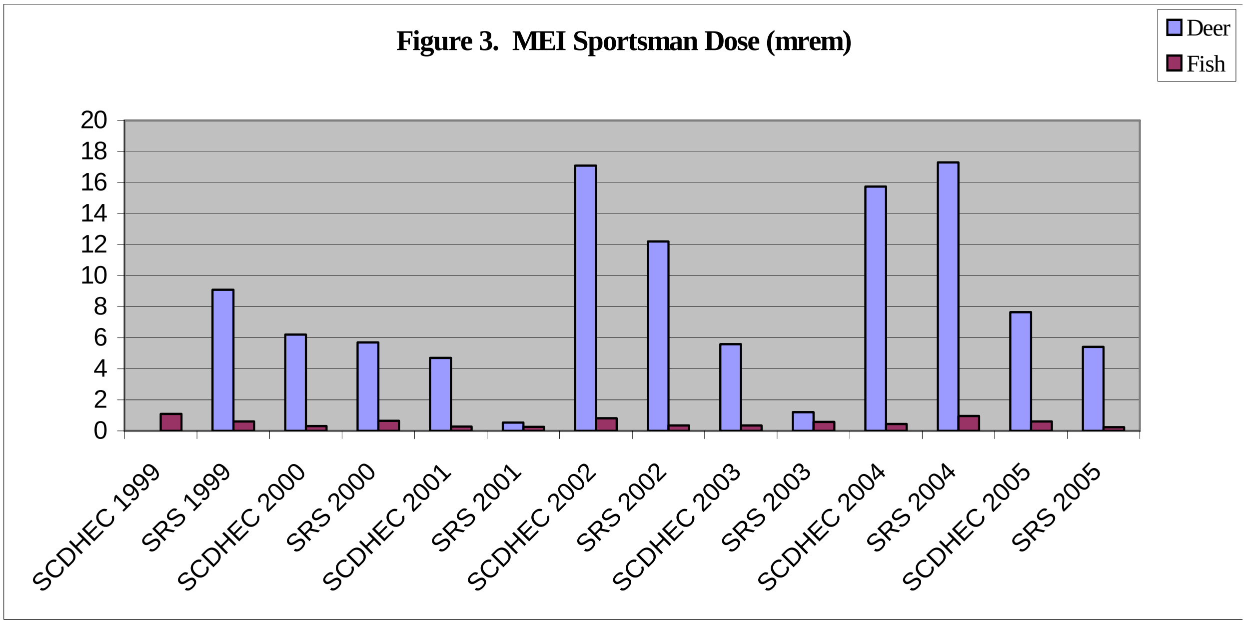
Figure 2. Comparison of the 2005 MEI Media Pathway Dose for the SRS Perimeter



Notes:
1. The air pathway refers to MEI soil, air, and TLD.
2. The liquid pathway refers to the maximally exposed individual at the SRS boundary whereas DW refers to the MEI drinking water exposure.
3. The food pathway (deer, fish, milk, veg) may be influenced by both air and liquid pathway sources.
4. The Figure 2 MEI deer results were based on a single maximum dose for one hunter, whereas the deer results in Figure 1 were based on an overall average dose above background for deer.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

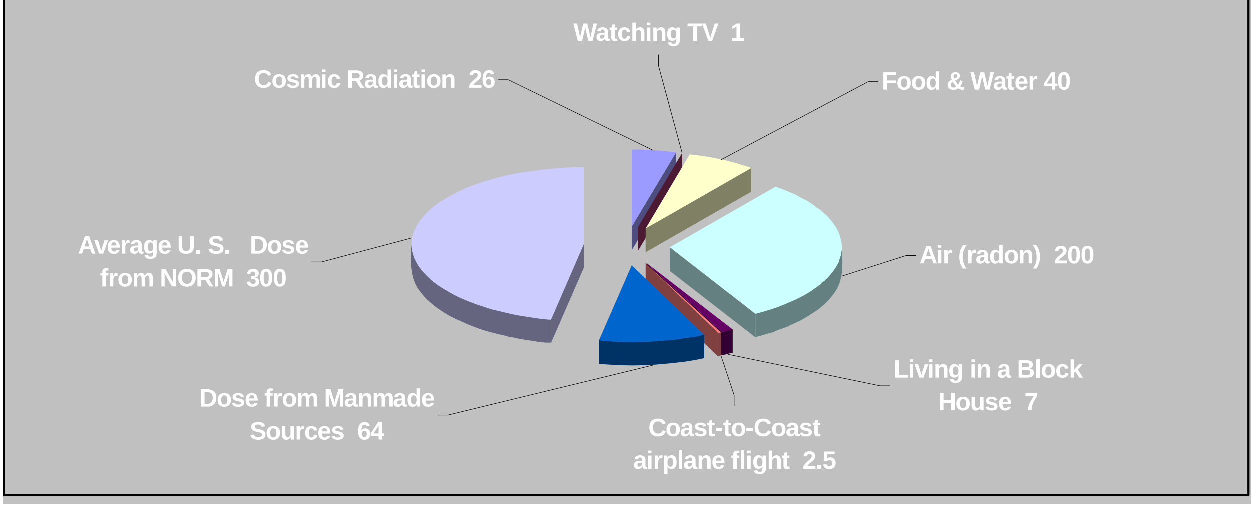


Notes:
1. When DOE-SR (SRS) showed a trend change, ESOP did also.
2. Three trends are illustrated, two decreasing from initial high doses in 1999 and 2002, and one new high dose in 2004.
3. "Mrem" is milliroentgen equivalent man dose unit.
4. "MEI" is the maximally exposed individual who consumed fish and deer.
5. Reference WSRC reports and data from 1999 through 2005.

Tables and Figures
Radiological Dose Calculation

(Return to TOC)

Figure 4. Comparison of Dose Levels (mrem/yr)



Notes:

1. Composite of dose levels established by the ESOP (2006) and the SRS Environmental Report for 2001(a). These pie sections represent relative dose levels only. The average NORM illustrated by the left pie section is exploded into its' component NORM on the right (cosmic, food & water, radon). Other pie sections represent typical non-NORM sources.

6.1.3 Data

(Return to TOC)

Radiological Dose Calculation Data

(Return to TOC)

Dose Calculation Equation Examples

Unit Conversions

1. (100rem/Sv) x (1000mrem/rem) = (1E5 mrem/Sv).
2. (pCi/g) x (1000g/kg) = (pCi/kg).
3. (pCi/L) x (1L/1000ml) x (1ml/g) = (pCi/g) or (pCi/L x 0.001 L/g).

The applicable dose conversion factors are found in the EPA Federal Guidance Reports 11 and 12. Use effective dose for inhalation and ingestion calculations, and skin dose for direct exposure. 1E5 means 1 times 10 to the 5th power.

1.

Basic Equation

Dose = (Average Activity) x (Maximum Consumption Rate) x (Effective Dose Conversion Factor)
The general equations below are applicable when the proper unit conversions, consumption rates, and effective or skin dose conversion factors from EPA FGR 11 and 12 are applied. See Table 2 and Appendix C, 2005 Dose Table, for the reference intake values needed when calculating ingestion, inhalation, or direct exposure to a particular media.

Ingestion (e. g. fish)

(pCi/kg) x (1 Bq/27 pCi) x (48.2 kg/yr) x (Sv/Bq) x (1E5 mrem/Sv) = (mrem/yr).
Ingestion (deer) – refer to sections 7.4 and 4.1 for MEI method applied to deer.

Air Inhalation (e. g. particulates)
(pCi/m^3) x (1 Bq/27 pCi) x (8000 m^3/yr) x (Sv/Bq) x (1E5 mrem/Sv) = (mrem/yr).
Air Plume (e. g. argon or iodine)

Ground Direct Exposure (e. g. soil)
Ground Surface or Shine exposure assumes 50% outdoor exposure for the swamp dweller, 15 cm mixing depth, and soil density of 1.6 g/cm^3.
The calculation of (pCi/g) x (1 Bq/27 pCi) x (4380 hrs/yr) x (3600 sec/hr) x (1.6g/cm^3) x (Sv/Bq-sec/m^3) x (1E6 cm^3/m^3) x (1E5 mrem/Sv) = (mrem/yr),

Modify the result by a ground roughness reduction factor of 0.5, and shielding factor for photons of 0.7. Electrons are shielded by soil and clothing near feet.

Sediment Shine at Shoreline (same equation as ground shine except for the addition of a shore width reduction factor of 0.2, and near river exposure of 365 hrs/yr).

Swimming dose includes 91 hrs./yr in water, inadvertent ingestion of water of 0.1 L/hr, and water immersion dose to skin.

Water Immersion
Multiply (pCi/kg) x (1 Bq/27 pCi) x (91 hrs/yr) x (Sv/Bq-sec/m^3) x (10^3kg/m^3) x (3600 sec/hr) x (1E5 mrem/Sv) = (mrem/yr).

Boating Exposure of 4380hrs/yr (swamp house or houseboat), and dose reduction factor of 0.5 for photons. Boat dweller exposure from water is calculated as skin exposure.

(Return to TOC)

Radiological Dose Calculation Data

1999 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	**mrem**	mrem	**1.08**
Ingestion	H-3	4.97	0.00	4.97	48.2	**0.015**	1.075	
	Cs-137	0.44	0.00	0.44	48.2	**1.060**		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	**mrem**	mrem	**0.04**
Ingestion	H-3	3.850E-02	0.00	3.850E-02	230	**0.001**	0.043	
	Cs-137	3.670E-03	0.00	3.670E-03	230	**0.042**		
	Sr-90	7.200E-04	2.270E-03	0.00	230	**-0.004**		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	**mrem**	mrem	*
RW Ingestion	H-3	933.67	258	675.67	730	**0.032**	0.032	
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	**mrem**	mrem	**0.01**
Inhalation	H-3	0.000	4.350	-4.35	8000	**-0.002**	0.010	
	Alpha	0.000	0.004	0.00	8000	**-9.379**		
	Beta	0.000	0.020	-0.02	8000	**-0.208**		
	Sr-89,90	0.001	0.000	0.00	8000	**0.009**		
	U-234	0.000	0.000	0.00	8000	**0.000**		
	U-238	0.000	0.000	0.00	8000	**0.001**		
TLD		mrem	mrem	mrem	hrs/day	**mrem**	mrem	**0.00**
Direct Exposure		0.182	0.198	0.00	24	**0.000**	0.000	
Soil		pCi/g	pCi/g	pCi/g	mg/day	**mrem**	mrem	**0.00**
Ingestion	Cs-137	0.73	0.19	0.54	100	**0.001**	0.001	
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	**mrem**	mrem	**0.04**
Swimming Ingestion &	H-3	1054	238	816.00	27	**0.000**	0.038	
Exposure	Alpha	0.45	1.59	0.00	27	**0.000**		
	Beta	0.00	2.86	0.00	27	**0.000**		
	Cs-137	0.00			27	**0.000**		
Boating Exposure	H-3	1054	238	816.00	63	**0.000**	0.000	
	Alpha	0.45	1.59	0.00	63	**0.000**		
	Beta	0.00	2.86	0.00	63	**0.000**		
	Cs-137	0.00			63	**0.000**		
		pCi/L	pCi/L	pCi/L	L/yr	**mrem**		
Ingestion	H-3	1054	238	816.00	730	**0.038**		
(MEI Drinking Water)	Alpha	0.45	1.59	0.00	730	**0.000**		
	Beta	0.00	2.86	0.00	730	**0.000**		
	Cs-137	0.00			730	**0.000**		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	**mrem**	mrem	**0.00**
Shoreline	Cs-137	0.54	0.035	0.51	67	**0.000**	0.000	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	**mrem**	mrem	**0.00**
	H-3	305	363	0.00	730	**0.000**	0.000	
	Alpha	0.00	4.88	0.00	730	**0.000**		
	Beta	0.00	8.46	0.00	730	**0.000**		
					Total Radiation Dose		**1.199**	
					MEI Radiation Dose			**1.17**

Notes: see the glossary section for radionuclide information.
*Alpha data will be calculated as Pu-239
*Beta data will be calculated as Sr-90
*MEI dose includes surface water instead of drinking water.

(Return to TOC)

Radiological Dose Calculation Data

2000 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.32**
Ingestion	H-3	2.51	0.00	2.51	48.2	0.0078	0.320	
	Cs-137	0.13	0.00	0.13	48.2	0.313		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.05**
Ingestion	H-3	3.820E-02	0.00	3.820E-02	230	0.001	0.054	
	Cs-137	4.600E-03	0.00	4.600E-03	230	0.053		
	Sr-90		2.270E-03	0.00	230	0.000		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	*
Ingestion	H-3	918	258	660.00	730	0.031	0.031	
	Alpha	2.76	3.50	0.00	730	0.000		
	Beta	0.000	2.84	0.00	730	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**LE**
Inhalation	H-3	0.000	4.350	-4.35	8000	-0.002	**LE**	
	Alpha	0.000	0.004	0.00	8000	-9.379		
	Beta	0.001	0.020	-0.02	8000	-0.198		
	Sr-89,90	0.000	0.000	0.00	8000	0.000		
	U-234	0.000	0.000	0.00	8000	0.000		
	U-238	1.070E-05	0.000E+00	0.00	8000	0.010		
TLD		mrem	mrem	mrem	hrs/day	mrem	mrem	**0.00**
Direct Exposure		0.181	0.198	0.00	24	0.000	0.000	
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	
Ingestion	Pu-239/240	0.05	0.02	0.03	100	0.001	0.001	**0.00**
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.09**
Swimming Ingestion &	H-3	995.54	238	757.54	27	0.000	0.091	
Exposure	Alpha	2.78	1.59	1.19	27	0.003		
	Beta	3.74	2.86	0.88	27	0.000		
	Cs-137	0.00			27	0.000		
Boating Exposure	H-3	995.54	238	757.54	63	0.000		
	Alpha	2.78	1.59	1.19	63	0.000		
	Beta	3.74	2.86	0.88	63	0.000		
	Cs-137	0.00			63	0.000		
		pCi/g	pCi/g	pCi/g	L/yr	mrem		
Ingestion	H-3	995.54	238	757.54	730	0.035		
(MEI Drinking Water)	Alpha	2.78	1.59	1.19	730	0.045		
	Beta	3.74	2.86	0.88	730	0.008		
	Cs-137	0.00			730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0.00**
Shoreline	Cs-137	0.275	0.035	0.24	67	0.000	0.000	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	*
Ingestion	H-3	390	363	27.0	730	0.001	0.001	
	Alpha	0.00	4.88	0.00	730	0.000		
	Beta	0.00	8.46	0.00	730	0.000		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	1.01		0.73		0.280	0.280	
MEI Deer Ingestion	Cs-137	**Maximum Single Hunter Consumption**						**6.20**
					Total Average Radiation Dose		**0.778**	
					MEI Radiation Dose			**6.66**

Notes: see the glossary section for radionuclide information.

*Alpha data will be calculated as Pu-239

*Beta data will be calculated as Sr-90

*MEI dose includes surface water instead of drinking water.

(Return to TOC)

Radiological Dose Calculation Data

2001 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.27**
Ingestion	H-3	0.78	0.00	0.78	48.2	0.0024	0.267	
	Cs-137	0.11	0.00	0.11	48.2	0.265		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0**
Ingestion	H-3	0.000	0.00	0.00	230	0.000	0.000	
	Cs-137	0.000	0.00	0.00	230	0.000		
	Sr-90	0.000	2.270E-03	0.00	230	-0.006		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	*
Ingestion	H-3	539	258	281.00	730	0.013	0.013	
	Alpha	0.000	3.50	0.00	730	0.000		
	Beta	0.000	2.84	0.00	730	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**0.01**
Inhalation	H-3	0.19	4.350	-4.16	8000	-0.002	0.006	
	Alpha	0.002	0.004	0.00	8000	-4.443		
	Beta	0.000	0.020	-0.02	8000	-0.208		
	U-234	0.000	0.000	0.00	8000	0.000		
	U-238	2.130E-06	0.000E+00	0.00	8000	0.002		
	Am-243	3.100E-06	0.000E+00	0.00	8000	0.003		
TLD		mrem	mrem	mrem	hrs/day	mrem	Perimeter TLD	**0**
Direct Exposure		40.480	46.700	-6.22	24	0.000		
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	**0**
Ingestion	Pu-238	1.840E-02	0.00	1.840E-02	100	0.001	0.002	
	Pu-239/240	3.840E-02	2.000E-02	1.840E-02	100	0.001		
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.03**
Swimming Ingestion &	H-3	934.4	238	696.40	27	0.000	0.033	
Exposure	Alpha	0.54	1.59	0.00	27	0.000		
	Beta	0.88	2.86	0.00	27	0.000		
Boating Exposure	H-3	934.4	238	696.40	63	0.000		
	Alpha	0.54	1.59	0.00	63	0.000		
	Beta	0.88	2.86	0.00	63	0.000		
	pCi/L	pCi/L	pCi/L	pCi/L	L/yr	mrem		
Ingestion	H-3	934.4	238	696.40	730	0.033		
(MEI Drinking Water)	Alpha	0.54	1.59	0.00	730	0.000		
	Beta	0.88	2.86	0.00	730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0**
Shoreline	Alpha	9.15	9.48	0.00	67	0.000	0.000	
	Beta	4.83	25.8	0.00	67	0.000		
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	*
Ingestion	H-3	0.00	363	0.00	730	0.000	0.013	
	Alpha	8.32	4.88	3.44	730	0.013		
	Beta	2.08	8.46	0.00	730	0.000		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	1.25		1.17		0.080	0.080	
MEI Ingestion	Cs-137	**Maximum Single Hunter Consumption**				0.000		**4.7**
					Total MEI Radiation Dose		**0.414**	
					MEI Radiation Dose			**5.01**

Notes: see the glossary section for radionuclide information.
*Alpha data will be calculated as Pu-239
*Beta data will be calculated as Sr-90
*MEI dose includes surface water instead of drinking water.

(Return to TOC)

Radiological Dose Calculation Data

2002 MEI Radiation Dose

Project	Isotope	Average Activity	Background Activity	Net Activity	Max Consump. Rate	Average Act w/ Max Consump.	Subtotal Radiation Dose	MEI Dose
Fish		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.61**
Bass Ingestion	H-3	1.04	0.00	1.04	48.2	0.003	0.606	
	Cs-137	0.25	0.00	0.25	48.2	0.603		
Catfish Ingestion	H-3	0.41	0.00	0.41	48.2	0.001	Species Average	
	Cs-137	0.08	0.00	0.08	48.2	0.193	**0.202**	
Bowfin Ingestion	H-3	0.29	0.00	0.29	48.2	0.001		
Milk		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.00**
Ingestion	H-3	0.0123	0.0000	0.0123	230	0.000	0.000	
	Cs-137	0.0000	0.0000	0.0000	230	0.000		
	Sr-90	0.0000	0.0023	0.0000	230	0.000		
Drinking Water		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	*
Ingestion	H-3	706	258	448.00	730	0.021	0.021	
	Alpha	0.00	3.50	0.00	730	0.000		
	Beta	0.00	2.84	0.00	730	0.000		
Edible Vegetation		pCi/g	pCi/g	pCi/g	kg/yr	mrem	mrem	**0.00**
Ingestion	H-3	0.137	0.379	0.00	73	0.000	0.000	
	Cs-137	0.00	1.11	0.00	73	0.000		
Air		pCi/m^3	pCi/m^3	pCi/m^3	m3/yr	mrem	mrem	**0.00**
Inhalation	H-3	1.48	4.350	0.00	8000	0.000	0.000	
	Alpha	0.001	0.004	0.00	8000	-6.911		
	Beta	0.001	0.020	0.00	8000	0.000		
TLD		mrem	mrem	mrem	hrs/day	mrem	mrem	**0.00**
Direct Exposure		45.710	56.090	0.00	24	0.000	**0.000**	
Soil		pCi/g	pCi/g	pCi/g	mg/day	mrem	mrem	**0.00**
Ingestion	Sr-89	0.00	0.00	0.00	100	0.000	**0.000**	
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem	mrem	**0.05**
Swimming Ingestion &	H-3	810	238	572.00	27	0.000	**0.050**	
Exposure	Alpha	2.16	1.59	0.57	27	0.001		
	Beta	0.00	2.86	0.00	27	0.000		
Boating Exposure	H-3	810	238	572.00	63	0.000		
	Alpha	2.55	1.59	0.96	63	0.000		
	Beta	0.00	2.86	0.00	63	0.000		
Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem		
(MEI Drinking Water)	H-3	810	238	572.00	730	0.027		
	Alpha	2.16	1.59	0.57	730	0.022		
	Beta	0.00	2.86	0.00	730	0.000		
Sediment		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	mrem	**0.00**
Shoreline	Cs-137	1.225	0.035	1.19	67	0.000	**0.000**	
Groundwater		pCi/L	pCi/L	pCi/L	L/yr	mrem	mrem	
Ingestion	H-3	0.00	363	-363.00	730	-0.017	**0.000**	**0.00**
	Alpha	2.45	4.88	-2.43	730	-0.092		
	Beta	2.42	8.46	-6.04	730	-0.053		
	Ra-226	0.959	4.88	-3.92	730	-3.795		
		Average Dose/Animal		**Average Background Dose/Animal**			**Subtotal Radiation Dose**	
Game Animal		mrem		mrem		mrem	mrem	
Average Deer Ingestion	Cs-137	2.43		1.05		1.380	**1.380**	
Average Hog Ingestion	Cs-137	4.77		0.00		4.770	**4.770**	
MEI Deer Ingestion	Cs-137	**Maximum Single Hunter Consumption**						**17.10**
					Total Radiation Dose		**7.029**	
					MEI Radiation Dose			**17.76**

Notes: see the glossary section for radionuclide information.

*Alpha data will be calculated as Pu-239

*Beta data will be calculated as Sr-90

*MEI includes surface water instead of drinking water.

(Return to TOC)

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only in Food Sources

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Food Sources							Average Dose	Total mrem/species	
Fish Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Fish mrem avg/rad	Bass	0.30
Bass	H-3	0.911	0.000	0.911	48.2	0.003	tritium avg dose	0.300	
	Cs-137	0.1233	0.0000	0.1233	48.2	0.297	0.002	Catfish	
				Bass	Avg	0.150		0.164	
Catfish	H-3	0.446	0.000	0.446	48.2	0.001	Cs-137 avg dose	Spotted Sucker	
	Cs-137	0.0675	0.0000	0.0675	48.2	0.163	0.218	0.195	
				Catfish	Avg	0.082		Fish Total Detect Dose	
Spotted Sucker	H-3	0.586	0.000	0.586	48.2	0.002		0.659	
	Cs-137	0.0801	0.0000	0.0801	48.2	0.193		Fish Average Dose	
				Sucker	Avg	0.097		0.220	
		Average Radionuclide Dose					0.110		
Milk Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Milk mrem avg/rad	Milk Maximum Dose—	0.09
Cow	H-3	0.327	0.000	0.327	230	0.005	tritium	Total mrem/species	
	Sr-90	0.001	0.000	0.001	230	0.003	0.005	Cow	
				Cow	Avg	0.004	cesium-137	0.008	
Goat		pCi/g	pCi/g	pCi/g	kg/yr	mrem	0.069	Goat	
	H-3	0.301	0.000	0.301	230	0.004	strontium-89	0.087	
	Cs-137	0.006	0.000	0.006	230	0.069	0.014	Milk Total Dose	
	Sr-89	0.006	0.000	0.006	230	0.014	strontium-90	0.095	
				Goat	Avg	0.029	0.003	Milk Average Dose	
		Average Radionuclide Dose					0.023	0.048	
Game Animal		Average		Average Bkg					
Ingestion		Dose/Animal		Dose/Animal					
		mrem		mrem		mrem	Deer Avg Dose	Average Ingested Dose	
Average Deer	Cs-137	1.59		1.38		0.21	0.21	0.21	
MEI Deer	Cs-137	Maximum Single Hunter Consumption							5.60
Edible Vegetation		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Veg Avg Dose	Edible Veg Total Dose	
Vegetable Fruit	H-3	0.446	0.000	0.446	287.0	0.008	0.008	0.01	0.01
						MEI Food Dose			6.00

Notes: see the glossary section for radionuclide information.

(Return to TOC)

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only in Water Sources

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose
Water Sources							Average Dose	Total Dose (mrem)	
PWS RW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	DW mrem avg/rad	River Water PWS Supply	0.03
Potable	H-3	573	277	296	730	0.014	Tritium (H-3)	0.029	
	Alpha	1.60	1.57	0.0	730	0.001	0.015		
	Beta	6.08	4.47	1.61	730	0.014	Alpha		
	PWS River Water Average Dose				Avg	0.010	0.001		
PWS GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Beta	Groundwater PWS Wells	0.02
Potable	H-3	357	4	353	730	0.017	0.007	0.017	
	Alpha	4.24	4.88	-0.64	730	0.000			
	Beta	2.03	6.47	-4.44	730	0.000	DW Avg Dose	PWS Total Dose	
	PWS Well Water Average Dose				Avg	0.006	0.008	0.046	
	Used Aiken State Park C-3 wells as background.							PWS Avg Dose	
	Used tritium natural isotopic ratio as background.							0.023	
DNR GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	All GW - Tritium Avg	DNRGW NORM Ttl Dose	0.02
Potable	H-3	335	4	331	730	0.015	0.016	1.181	
	Alpha	3.04	4.88	-2	730	0.000			
	Beta	3.13	6.47	-3	730	0.000			
	U-238	0.484	0.217	0.2670	730	0.005	NORM	DNR MEI Dose (H-3)	
	Ra-226	1.132	0.000	1.1320	730	1.096	NORM	0.016	
	Ra-228	1.867	1.790	0.0766	730	0.080	NORM	Total Potable Plus NORM	
	DNR Wells Average Dose				Avg	0.199		1.242	
GW & DNR	Groundwater Average Dose				Avg	0.102		Avg Potable with NORM	
Potable Water Dose Average						0.072		0.414	
Water Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Nonpotable	Surface Water Near SRS	
SR Boat	H-3	1718	313	1405	730	0.066	Average Dose		
Landings	Alpha	1.659	1.625	0.034	730	0.001	0.017	Nonpotable Ttl. MEI Dose	0.07
Nonpotable	Beta	2.552	2.334	0.218	730	0.002		0.068	
Rainwater	H-3	182.000	197.000	-15.000	730	-0.001			
Nonpotable Surface Water Average Dose					Avg	0.017		Drinking Water Sources	
							Averge MEI Water Dose		0.04
							MEI Drinking Water Dose (Highest)		0.07
Cannot add doses from more than one DW source unless consumption rate of each is modified.									
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Ingestion	0.00
Ingestion	H-3	1718	313	1405	91	0.0008		0.001	
while swimming	Alpha	1.66	1.63	0.03	91	0.0000			
	Beta	2.56	2.33	0.00	91	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Immersion	0.00
Immersion	H-3	1718	313	1405	91	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	91	0.0000			
	Beta	2.56	2.33	0.00	91	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Houseboat Exposure	0.00
Boating	H-3	1718	313	1405	192	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	192	0.0000			
	Beta	2.56	2.33	0.00	192	0.0000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swamp House Exposure	0.00
Swamp Dweller	H-3	1718	313	1405	4380	0.0000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.66	1.63	0.03	4380	0.0000			
	Beta	2.56	2.33	0.00	4380	0.0000			
							MEI Radiation Dose	Total - All Water	0.00

Notes: See the glossary section for radionuclide information.

*Alpha data calculated as Pu-239.

*Beta data calculated as Sr-90.

*MEI includes only the highest water dose.

(Return to TOC)

Radiological Dose Calculation Data

2003 MEI Radiation Dose - Detects Only For Soil, Air, and Surface Water

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Surface Soil Ingestion		pCi/g	pCi/g	pCi/g	mg/day	mrem	Total Soil Ingestion		0.00
Th-232 series	Pb-212	0.6010	0.5840	0.0170	100	0.0000	Gamma Avg Dose	Gamma Total Dose	
	Mn-54	0.0160	0.0000	0.0160	100	0.0000	0.0002	0.0008	
	Cs-137	0.1800	0.1740	0.0060	100	0.0000	Beta Avg Dose	Beta Total Dose	
	Ce-144	0.2650	0.0000	0.2650	100	0.0002	0.0003	0.0003	
Sediment	Cs-137	0.3070	0.0294	0.2776	100	0.0005	NORM Avg Dose	0.000	
	Tc-99	5.1600	0.0000	5.1600	100	0.0003	NORM Total Dose	0.000	
	Surface Soil Ingestion Average Dose				Avg	0.0002			
urface Soil Exposure		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	Total Soil Direct Exposure		0.02
Direct Exposure	Pb-212	0.6010	0.5840	0.0170	4380	0.0023	Gamma Avg Dose	Gamma Total Dose	
	Mn-54	0.0160	0.0000	0.0160	4380	0.0144	0.0041	0.0207	
	Cs-137	0.1800	0.1740	0.0060	4380	0.0000	Beta Avg Dose	Beta Total Dose	
	Ce-144	0.2650	0.0000	0.2650	4380	0.0038	0.0002	0.000	
Sediment	Cs-137	0.3070	0.0294	0.2776	4380	0.0002	NORM Avg Dose	0.002	
	Tc-99	5.1600	0.0000	5.1600	4380	0.0002	NORM Total Dose	0.002	
Shoreline	Direct Ground Exposure Average Dose - All Rads					0.0041			
rface Soil Resuspension		pCi/g	pCi/g	pCi/g	m3/yr	mrem	Total Soil Resuspension		0.00
and inhalation	Pb-212	0.6010	0.5840	0.0170	8000	0.0000	Gamma Avg Dose	Gamma Total Dose	
	Mn-54	0.0160	0.0000	0.0160	8000	0.0000	0.0000	0.0001	
	Cs-137	0.1800	0.1740	0.0060	8000	0.0000	Beta Avg Dose	Beta Total Dose	
	Ce-144	0.2650	0.0000	0.2650	8000	0.0001	0.0000	0.000	
Sediment	Cs-137	0.3070	0.0294	0.2776	8000	0.0000	NORM Avg Dose	0.000	
	Tc-99	5.1600	0.0000	5.1600	8000	0.0000	NORM Total Dose	0.000	
	Surface Soil Direct Ground Exposure Average Dose				All rads	0.0000			
Air Inhalation		pCi/m3	pCi/m3	pCi/m3	m3/yr	mrem	Total Inhalation (LE)		
Inhalation	H-3	5.7080	3.9750	1.7330	8000	0.0009			
	Alpha	0.0040	0.0039	0.00015	8000	0.3702	LE		
	Beta	0.0202	0.0191	0.0011	8000	0.0114			
Inhalation Average Dose					Avg	0.1275			
TLD		mrem	mrem	mrem	hrs/day	mrem		Ttl Absorbed Dose	
Direct Exposure	Direct	82.66	85.97	-3.31	24.0	0.0000	Offsite	0.00 offsite	0.00

Notes: see the glossary section for radionuclide information.

1. The U-234 samples greater than background occurred in flood plain areas downstream from saprolitic NORM.
2. A lab error in the gross alpha determination took place due to delayed analysis time.

(Return to TOC)

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only in Food Sources

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Food Sources							Average Dose	Total mrem/species	
Fish Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Fish mrem avg/rad	Bass	0.44
Bass	H-3	1.8970	0.0000	1.8970	48.2	0.006	H-3 avg dose	0.435	
	Cs-137	0.1780	0.0000	0.1780	48.2	0.429	0.004	Catfish	
				Bass	Avg	0.217		0.403	
Catfish	H-3	1.0430	0.0000	1.0430	48.2	0.003	Cs-137 avg dose	Shad	
	Cs-137	0.1660	0.0000	0.1660	48.2	0.400	0.415	0.001	
				Catfish	Avg	0.202		Mullett	
Shad	H-3	0.2850	0.0000	0.2850	48.2	0.001		0.004	
Mullett	H-3	1.4500	0.0000	1.4500	48.2	0.004		Fish Total Detect Dose	
				Sucker	Avg	0.003		0.843	
		Average Radioisotope Dose					0.209	Fish Average Dose	
								0.211	
Milk Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Milk mrem avg/rad	Milk Maximum Dose---	0.18
Cow	H-3	0.0000	0.0000	0.0000	230	0.000	H-3 or tritium	Cow Milk avg dose	
	Sr-90	0.0020	0.0015	0.0005	230	0.006	0.000	0.002	
	Cs-137	0.0042	0.0038	0.0004	230	0.001	Cs-137 avg dose	Cow Milk total dose	
milk solids	Sr-89	0.1407	0.0612	0.0795	230	0.169	0.001	0.007	
Goat	Sr-90	0.0030	0.0027	0.0003	230	0.003	Sr-89 avg dose	Goat Milk avg dose	
							0.169	0.003	
							SR-90 avg dose	Goat Milk total dose	
					Avg	0.003	0.004	0.003	
		Average Radionuclide Dose					#VALUE!		
Game Animal		Average		Average Bkg					
Ingestion		Dose/Animal		Dose/Animal					
		mrem		mrem		mrem	Deer Avg Dose	Average Ingested Dose	
Average Deer	Cs-137	1.8900		1.05		0.84	0.84	0.84	
MEI Deer	Cs-137	Maximum Single Hunter Consumption							15.75
Edible Vegetation		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Veg Avg Dose	Edible Veg Total Dose	
Vegetable Fruit	H-3	0.5970	0.0000	0.5970	287.0	0.011	0.011	0.011	0.01
						MEI Food Dose			16.38

Notes: see the glossary section for radionuclide information.

(Return to TOC)

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only in Water Sources

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose
Water Sources							Average Dose	Total Dose (mrem)	
PWS RW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	DW mrem avg/rad	River Water PWS Supply	0.01
Potable	H-3	489.500	245.000	244.500	730.000	0.011	Tritium (H-3)	0.012	
	Alpha	2.970	0.000	0.030	730.000	0.001	0.013		
							Alpha		
	PWS River Water Average Dose				Avg	0.006	0.021		
PWS GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Beta	Groundwater PWS Wells	0.05
Potable	H-3	299.600	4.000	295.600	730.000	0.014	0.000	0.054	
	Alpha	3.718	2.656	1.061	730.000	0.040			
SC Alpha background-average of 128 well samples in 2004.							DW Avg Dose	PWS Total Dose	
	PWS Well Water Average Dose				Avg	0.027	0.011	0.066	
	Used Aiken State Park C-3 wells as background.							PWS Avg Dose	
	Used tritium natural isotopic ratio as background.							0.033	
DNR GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	DNR wells Alpha	DNRGW Ttl Dose	0.05
Potable	Alpha	1.303	0.600	0.703	730.000	0.027	0.027	0.046	
	Beta	3.880	1.700	2.180	730.000	0.019	DNR wells Beta		
Beta background is average of 3 wells upgradient of SRS.							0.019		
	DNR Wells Average Dose				Avg	0.023		0.124	
GW & DNR	Groundwater Average Dose				Avg	0.025		Avg Potable with NORM	
Potable Water Dose Average						0.019		0.041	
Water Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Nonpotable	Surface Water Near SRS	
SR Boat	H-3	838.000	201.000	637.000	730.000	0.030			
Landings	Alpha	1.560	2.120	-0.560	730.000	-0.021		Nonpotable Ttl. MEI Dose	0.04
Nonpotable	Beta	3.170	5.300	-2.130	730.000	-0.019		0.044	
Rainwater	H-3	293.300	0.000	293.300	730.000	0.014		Drinking Water Sources	
Nonpotable Surface Water Average Dose					Avg	0.001		Avg MEI Water Dose	
								0.04	
							MEI Drinking Water Dose (Highest)		0.05
							Average MEI Water Dose		0.04
Cannot add doses from more than one DW source unless consumption rate of each is modified.									
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Ingestion	
Ingestion	H-3	883	244	639	91	0.000		0.000	0.00
while swimming	Alpha	1.76	2.12	-0.37	91	0.000			
	Beta	3.25	5.30	-2.05	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Immersion	
Immersion	H-3	883	244	639	91	0.000	No H-3 exposure DF	0.000	0.00
Exposure	Alpha	1.88	2.12	-0.25	91	0.000			
	Beta	3.25	5.30	-2.05	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Houseboat Exposure	
Boating	H-3	883	244	639	192	0.000	No H-3 exposure DF	0.000	0.00
Exposure	Alpha	1.88	2.12	-0.25	192	0.000			
	Beta	3.25	5.30	-2.05	192	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swamp House Exposure	
Swamp Dweller	H-3	883	244	639	4380	0.000	No H-3 exposure DF	-0.001	0.00
Exposure	Alpha	1.88	2.12	-0.25	4380	0.000			
	Beta	3.25	5.30	-2.05	4380	-0.001			

Avg All Water Dose	0.000
MEI DW Highest Dose	0.05
Add NORM dose detections	0.00
Total Dose	0.05

Notes: see the glossary section for radionuclide information.
DNR wells make up most of the ambient groundwater monitoring project (AGMP) or network (AGMN).
Unk in general refers to nonspeciation of specific radionuclides producing the measured radiation.
Rainwater cistern dose is based on air station monitoring of rainwater collected locally outside of SRS.
Savannah River boat landings (Steel Creek Landing, Little Hell Landing, and Brunson's Ferry) are subject to the use of boiled water by sportsmen.

(Return to TOC)

Radiological Dose Calculation Data

2004 MEI Radiation Dose - Detects Only For Soil, Air, and Surface Water

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
Surface Soil Ingestion		**pCi/g**	**pCi/g**	**pCi/g**	**mg/day**	**mrem**	**Total Soil Ingestion Dose**		**0.02**
Th-232 series	Pb-212	**0.8100**	0.5500	0.2600	100	**0.000**	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**0.9400**	0.7600	0.1800	100	**0.000**	**0.001**	**0.005**	
Th-232 series	Ac-228	**1.1500**	1.0500	0.1000	100	**0.000**	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**1.9300**	1.8500	0.0800	100	**0.004**	**0.006**	**0.019**	
Alpha	U-234	**1.988**	0.6023	1.3857	100	**0.001**	*Ingestion Dose Uses Effective Factors*		
Alpha	U-238	**0.3837**	0.3303	0.0534	100	**0.000**	**Avg NORM dose……**	**0.001**	
Sediment	**Cs-137**	**0.2000**	0.0000	0.2000	100	**0.000**	**Ttl NORM dose…..**	**0.006**	
Alpha	**as Pu-239**	**19.5000**	10.3000	9.2000	100	**0.017**	*NORM dose not included in MEI.*		
	Surface Soil Ingestion Average Dose				**Avg**	**0.003**			
urface Soil Exposure		**pCi/g**	**pCi/g**	**pCi/g**	**hrs/yr**	**mrem**	**Total Surface Direct Exposure Dose**		**0.00**
Th-232 series	Pb-212	**0.8100**	0.5500	0.2600	4380	**0.035**	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**0.9400**	0.7600	0.1800	4380	**0.046**	**0.038**	**0.192**	
Th-232 series	Ac-228	**1.1500**	1.0500	0.1000	4380	**0.109**	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**1.9300**	1.8500	0.0800	4380	**0.000**	**0.000**	**0.001**	
Alpha	U-234	**1.9880**	0.6023	1.3857	4380	**0.000**	*Direct Exposure Dose Uses Skin Factors*		
Alpha	U-238	**0.3837**	0.3303	0.0534	4380	**0.000**	**Avg NORM dose……**	**0.032**	
Sediment	**Cs-137**	**0.2000**	0.0000	0.2000	4380	**0.001**	**Ttl NORM dose…..**	**0.191**	
Alpha	**as Pu-239**	**19.5000**	10.3000	9.2000	4380	**0.001**	*NORM dose not included in MEI.*		
	Direct Ground Exposure Average Dose				**Avg**	**0.024**			
face Soil Resuspension		**pCi/g**	**pCi/g**	**pCi/g**	**m3/yr**	**mrem**	**Total Soil Resuspension Dose**		**0.00**
Th-232 series	Pb-212	**0.8100**	0.5500	0.1290	8000	**0.000**	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**0.9400**	0.7600	0.1035	8000	**0.000**	**0.000**	**0.001**	
Th-232 series	Ac-228	**1.1500**	1.0500	0.0140	8000	**0.000**	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**1.9300**	1.8500	0.0800	8000	**0.001**	**0.808**	**2.423**	
Alpha	U-234	**1.9880**	0.6023	1.3857	8000	**0.147**	*Resuspended Soil Inhalation Dose Uses Effective Factors*		
Alpha	U-238	**0.3837**	0.3303	0.0534	8000	**0.005**	Resuspension of 6 inch average soil depth unlikely except		
Sediment	**Cs-137**	**0.2000**	0.0000	0.2000	8000	**0.000**	in farming and air filters failed to confirm this resuspension.		
Alpha	**as Pu-239**	**19.5000**	10.3000	9.2000	8000	**2.271**	Total Soil Resuspension Dose not confirmed by Air Inhalation Dose		
							Avg NORM dose……	**0.346**	
	Soil Resuspension Exposure Avg Dose				**Avg**	**0.022**	**Ttl NORM dose…..**	**2.423**	
Air Inhalation		**pCi/m3**	**pCi/m3**	**pCi/m3**	**m3/yr**	**mrem**		**Total Air Inhalation**	**0.00**
Inhalation	**H-3**	**6.0550**	3.0800	2.9750	8000	**0.002**			
	Alpha	**0.0030**	0.0030	0.0000	8000	**0.000**			
	Beta	**0.0228**	0.0230	-0.0002	8000	**-0.002**			
Inhalation Average Dose					**Avg**	**0.000**			
TLD		**mrem**	**mrem**	**mrem**	**hrs/day**	**mrem**			
Direct Exposure	**Direct**	93.45	93.20	0.25	24.0	**0.250**	**Offsite**	**Ttl Absorbed Dose**	**0.25**
						Totals	**MEI Radiation Dose**	**Soil and Air**	**0.27**
							Additional NORM Dose Detected		**2.62**
								Total NORM and MEI	**2.89**

Notes: see the glossary section for radionuclide information.

1. The U-234 samples greater than background occurred in flood plain areas downstream from saprolitic NORM.

Errata in Cs-137 ingestion and alpha as Pu-239 resuspension inhalation dose for 2004 was corrected.

2. The unknown soil alpha from a mixed cubic foot of soil are not known to be from SRS influence and may only represent NORM, since air filtration did not detect this soil resuspension. This additional NORM is not considered part of the MEI dose,

(Return to TOC)

Radiological Dose Calculation Data

2005 MEI Radiation Dose - Detects Only in Food Sources

Project	Isotope	Avg	Bkg	Net	MCR	Dose	Exposure	Subtotals for	MEI
		Activity	Activity	Activity		mrem	per Radionuclide	Radiation Dose	Dose
		Food Sources					Average Dose	Total mrem/species	
Fish Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Fish mrem avg/rad	Bass	0.62
Bass	H-3	1.017	0.000	1.017	48.200	0.003	H-3 avg dose	0.622	
	Cs-137	0.201	0.000	0.201	48.200	0.484	0.003	Catfish	
	Sr-89/90	0.360	0.127	0.233	48.200	0.134		0.341	
				Bass	Avg	0.207		Sunfish	
Catfish	H-3	0.457	0.000	0.457	48.200	0.001	Cs-137 avg dose	0.366	
	Cs-137	0.141	0.000	0.141	48.200	0.340	0.363		
	Sr-89/90	0.266	0.426	-0.160	48.200	0.000		All Fish Total Dose	
				Catfish	Avg	0.114	Sr-89/90 avg dose	1.329	
Sunfish	H-3	1.200	0.000	1.200	48.200	0.004	0.077	All Fish Avg Dose	
	Cs-137	0.110	0.000	0.110	48.200	0.265		0.443	
	Sr-89/90	0.255	0.087	0.168	48.200	0.097			
				Sunfish	Avg	0.122	Avg Fish Radioisotope Dose		
							0.148		
Milk Ingestion		pCi/g	pCi/g	pCi/g	kg/yr	mrem	Milk mrem avg/rad	Milk Maximum Dose---	0.00
Cow	H-3	0.000	0.000	0.000	230.000	0.000	H-3 or tritium	Cow Milk avg dose	
	Sr-90	0.000	0.000	0.000	230.000	0.000	0.000	0.000	
	Sr-89	0.001	0.000	0.001	230.000	0.002	Cs-137 avg dose	Cow Milk total dose	
	Cs-137	0.000	0.000	0.000	230.000	0.000	0.000	0.002	
				Cow Milk	Avg	0.002	Sr-89 avg dose		
							0.002		
					Avg	0.001	SR-90 avg dose		
		Average Radionuclide Dose					0.000		
		Average		Average Bkg					
Game Animal		Dose/Animal		Dose/Animal					
Ingestion		mrem		mrem		mrem			
Average Deer	Cs-137	1.010		1.110		-0.100	Deer Avg Dose	Average Ingested Dose	
	Maximally Exposed Individual Hunter								
MEI Deer	Cs-137	8.75		1.11		7.64	0.00	0	
		pCi/g	pCi/g	pCi/g	kg/yr	mrem			7.64
Edible Veg (leafy)	H-3	0.207	0.000	0.207	73.000	0.001	Veg Avg Dose	Edible Veg Total Dose	
Edible Veg (fruits)	H-3	0.307	0.253	0.054	276.000	0.001	0.001	0.002	0.00
							MEI Food Dose		8.26

(Return to TOC)

Radiological Dose Calculation Data

2005 MEI Radiation Dose - Detects Only in Water Sources

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose
Water Sources							Average Dose		
PWS RW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	DW mrem avg/rad	Dose (mrem)	
Potable	H-3	413.000	374.000	39.000	730.000	0.002	Tritium (H-3)	Ttl RW PWS Supply	0.06
	Unk Alpha	1.475	0.000	1.475	730.000	0.056	0.001	0.059	
	Unk Beta	3.303	3.185	0.118	730.000	0.001	Alpha	Avg RW PWS Dose	
	PWS River Water Average Dose				Avg	0.020	0.047	0.020	
PWS GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Beta	Ttl GW PWS Wells	0.04
Potable	H-3	231.000	278.000	-47.000	730.000	0.000	0.001	0.040	
	Unk Alpha	5.910	4.880	1.030	730.000	0.039		Avg GW PWS Dose	
	Unk Beta	3.530	3.380	0.150	730.000	0.001		0.013	
							DW Avg Dose	PWS Total Dose	
	PWS Ground Water Average Dose				Avg	0.013	0.016	0.099	
	Used Aiken State Park C-3 wells as background.							PWS Avg Dose	
	Used tritium natural isotopic ratio as background.							0.049	
DNR GW Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	DNR wells Alpha		0.01
Potable	Unk Alpha	4.510	4.880	-0.370	730.000	0.000	0.000		
	Unk Beta	4.425	3.384	1.041	730.000	0.009	DNR wells Beta		
	H-3	278.40	278.00	0.40	730.00	0.00	0.005		
U238 series	Ttl U	0.12	0.26	-0.14	730.00	0.00	Other NORM	DNR GW Ttl Dose + NORM	
U238 series	Ra-226	1.99	0.55	1.44	730.00	1.39	1.390	1.399	
Th232 series	Ra-228	1.19	1.45	-0.26	730.00	0.00	All wells sampled were upgradient of SRS streams.		
All GW alpha background is average of 3 wells outside of the 50-mile SRS perimeter.							Thus, any DNR upgradient wells are local background.		
All GW beta background is average of 5 wells outside the 50-mile SRS perimeter.							The upgradient NORM dose comes from the saprolitic		
							granite in the groundwater recharge area.		
Used DNR well G02259 (outside of GW study area) as Ttl U, Ra-226, Ra-228 backgrounds.									
	DNR (AGMP) Wells Average Dose				Avg	0.233			
GW & DNR	Groundwater Average Dose				Avg	0.123			
Potable Water (PWS) Dose Average						0.016			
Nonpotable Water Ingestion		pCi/L	pCi/L	pCi/L	L/yr	mrem	Nonpotable	Sportsman Dose	0.06
SR Boat	H-3	1151.000	270.000	881.000	730.000	0.041			
Landings	Unk Alpha	1.980	3.140	-1.160	730.000	0.000		Nonpotable Ttl. Dose	
	Unk Beta	2.420	3.140	-0.720	730.000	0.000		0.056	
Rainwater	H-3	323.000	0.000	323.000	730.000	0.015	……Cistern dose		0.02
Nonpotable Surface Water Average Dose					Avg	0.014			
	Boat landing tritium, alpha, and beta backgrounds are from Jackson's Landing.								
							MEI Drinking Water Dose (Highest)		0.06
								Avg MEI DW Dose	0.04
Cannot add doses from more than one DW source unless consumption rate of each is modified.									
Total Surface Water MEI									0.00
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Ingestion	
Ingestion	H-3	1151.00	270.00	881.00	91	0.001		0.001	
while swimming	Alpha	1.98	3.14	0.00	91	0.000			
	Beta	2.42	3.14	0.00	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swimming Immersion	
Immersion	H-3	1151.00	270.00	881.00	91	0.000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.98	3.14	0.00	91	0.000			
	Beta	2.42	3.14	0.00	91	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Houseboat Exposure	
Boating	H-3	1151.00	270.00	881.00	192	0.000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.98	3.14	0.00	192	0.000			
	Beta	2.42	3.14	0.00	192	0.000			
Surface Water		pCi/L	pCi/L	pCi/L	hrs/yr	mrem		Swamp House Exposure	
Swamp Dweller	H-3	1151.00	270.00	881.00	4380	0.000	No H-3 exposure DF	0.000	
Exposure	Alpha	1.98	3.14	0.00	4380	0.000			
	Beta	2.42	3.14	0.00	4380	0.000		Avg All Water Dose	0.004

MEI DW Highest Dose	0.06
Add NORM dose	1.40
Total Dose	1.46

Notes: see the glossary section for radionuclide information.
DNR wells make up most of the ambient groundwater monitoring project (AGMP) or network (AGMN).
Unk in general refers to nonspeciation of specific radionuclides producing the measured radiation.
Rainwater cistern dose is based on air station monitoring of rainwater collected locally outside of SRS.
Savannah River boat landings (Steel Creek Landing, Little Hell Landing, and Brunson's Ferry) are subject to the use of boiled water by sportsmen.

(Return to TOC)

Radiological Dose Calculation Data

2005 MEI Radiation Dose - Detects Only For Soil and Air

Project	Isotope	Avg Activity	Bkg Activity	Net Activity	MCR	Dose mrem	Exposure per Radionuclide	Subtotals for Radiation Dose	MEI Dose Total
				Soil & Sediment					
Surface Soil Ingestion		pCi/g	pCi/g	pCi/g	mg/day	mrem	**Total Soil Ingestion Dose**		**0.02**
Th-232 series	Pb-212	**1.18**	**1.41**	0.00	100	0.000	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**1.06**	**0.69**	**0.38**	100	0.000	**0.005**	**0.034**	
Th-232 series	Ac-228	**1.11**	**0.98**	**0.13**	100	0.000	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**2.30**	**1.63**	**0.66**	100	**0.032**	**0.004**	**0.015**	
alpha	U-234	**0.19**	**0.29**	0.00	100	0.000			
alpha	U-235[1]	**0.07**	0.00	**0.07**	100	0.000	*Ingestion Dose Uses Effective Factors*		
alpha	U-238	**0.19**	**0.33**	0.00	100	0.000			
	Eu-155	**0.55**	**0.38**	**0.18**	100	0.000			
Soil	**Cs-137**	**0.20**	**0.17**	**0.04**	100	0.000	*NORM dose not included in MEI.*		
Sediment	**Cs-137**	**0.73**	**0.00**	**0.73**	100	**0.001**	Avg NORM dose…..	**0.005**	
Unknown Alpha	**as Pu-239**	**15.38**	**7.65**	**7.74**	100	**0.015**	Ttl NORM dose ……..	**0.032**	
See note*	**Soil Ingestion Average Dose**				**Avg**	0.004			
Surface Soil Exposure		pCi/g	pCi/g	pCi/g	hrs/yr	mrem	**Total Direct Exposure Dose**		**0.01**
Th-232 series	Pb-212	**1.18**	**1.41**	0.00	4380	0.000	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**1.06**	**0.69**	**0.38**	4380	**0.096**	**0.031**	**0.250**	
Th-232 series	Ac-228	**1.11**	**0.98**	**0.13**	4380	**0.141**	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**2.30**	**1.63**	**0.61**	4380	**0.004**	**0.003**	**0.011**	
alpha	U-234	**0.19**	**0.29**	0.00	4380	0.000			
alpha	U-235[1]	**0.07**	0.00	**0.07**	4380	**0.010**			
alpha	U-238	**0.19**	**0.33**	0.00	4380	0.000	*Direct Exposure Dose Uses Skin Factors*		
	Eu-155	**0.55**	**0.38**	**0.18**	4380	**0.007**	**EQC Building control**	**104-mrem**	
Soil	**Cs-137**	**0.20**	**0.17**	**0.04**	4380	0.000	*NORM dose not included in MEI.*		
Sediment	**Cs-137**	**0.73**	**0.00**	**0.73**	4380	**0.002**			
TLD	**beta-gamma**	**92.00**	**92.18**	**-0.18**	**mrem**	0.000	Avg NORM dose…..	**0.036**	
Unknown Alpha	**as Pu-239**	**15.38**	**7.65**	**7.74**	4380	**0.001**	Ttl NORM dose……	**0.251**	
See note*	**Direct Ground Exposure Avg Dose**				**Avg**	0.022			
Surface Soil Resuspension		pCi/g	pCi/g	pCi/g	m3/yr	mrem	**Total Soil Resuspension Dose[1,2]**		**0.00**
Th-232 series	Pb-212	**1.18**	**1.41**	0.00	8000	0.000	**Gamma Avg Dose**	**Gamma Total Dose**	
U-238 series	Pb-214	**1.06**	**0.69**	**0.38**	8000	0.000	**0.001**	**0.005**	
Th-232 series	Ac-228	**1.11**	**0.98**	**0.13**	8000	0.000	**Alpha Avg Dose**	**Alpha Total Dose**	
U-238 series	Ra-226	**2.30**	**1.63**	**0.67**	8000	0.005	**0.479**	**1.916**	
alpha	U-234	**0.19**	**0.29**	0.00	8000	0.000	*Resuspended Soil Inhalation Dose Uses Effective Factors*		
alpha	U-235[1]	**0.07**	0.00	**0.07**	8000	**0.007**	*NORM dose not included in MEI.*		
alpha	U-238	**0.19**	**0.33**	0.00	8000	0.000	Avg NORM dose…..	**0.240**	
	Eu-155	**0.55**	**0.38**	**0.18**	8000	0.000	Ttl NORM dose……	**1.921**	
Soil	**Cs-137**	**0.20**	**0.17**	**0.04**	8000	0.000			
Sediment	**Cs-137**	**0.73**	**0.00**	**0.73**	8000	0.000			
Unknown Alpha	**as Pu-239[2]**	**15.38**	**7.65**	**7.74**	8000	**1.909**	Resuspension of 6 inch average soil depth unlikely except		
See note*	**Surface Soil Resuspended Avg Dose**				**Avg**	0.175	in farming and air filters failed to confirm this resuspension.		
							Total Soil Resuspension Dose not confirmed by Air Inhalation Dose		
Total Air Inhalation MEI									**0.00**
Air Inhalation		pCi/m3	pCi/m3	pCi/m3	m3/yr	mrem			
Inhalation	**H-3**	**4.60**	**0.00**	**4.60**	8000	**0.002**	**Air monitors did not pick up the large**		
	Alpha	**0.00**	**0.00**	**0.00**	8000	0.000	**unknown alpha theoretical resuspension**		
	Beta	**0.02**	**0.02**	0.00	8000	0.000	**based on Pu-239.**		
Air Inhalation Average Dose					**Avg**	**0.001**			
MEI Radiation Dose - Soil and Air									**0.028**
Notes: see the glossary section for radionuclide information.							Additional NORM Dose Detected		**2.204**
								Total NORM and MEI	**2.23**

1. The U-235 sample greater than background occurred near the North Fork of the Edisto River in a flood plain area downstream from saprolitic NORM.

2. The unknown soil alpha from a mixed cubic foot of soil are not known to be from SRS influence and may only represent NORM since air filtration did not detect the soil resuspension.

6.1.4 Summary Statistics Radiological Dose Calculation

(Return to TOC)

1999-2005 SCDHEC Detected Dose (Millirem) Within 50 Miles of the SRS

	Year							7 Yr.	% of ALL[8] Media		Statistics		
Media	1999	2000	2001	2002	2003	2004	2005	Totals	Avg	MEI	Avg.	SD	Median
Surface Water	0.04	0.09	0.03	0.05	0.07	0.04	0.06	0.38	2.66	0.52	0.05	0.02	0.05
DNRGW					0.02	0.02	1.40	1.44	10.07	1.97	0.48	0.80	0.02
PWSGW	0.00	0.00	0.13	0.00	0.02	0.05	0.06	0.26	1.82	0.35	0.04	0.05	0.02
PWSRW	0.03	0.03	0.01	0.02	0.03	0.04	0.06	0.23	1.59	0.31	0.03	0.02	0.03
Soil	0.00	0.00	0.00	0.00	0.02	2.64	2.23	4.89	34.20	6.67	0.70	1.19	0.00
Sediment	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.18	0.04	0.00	0.01	0.00
Air	0.01		0.01	0.00		0.00	0.00	0.02	0.14	0.03	0.00	0.01	0.00
TLD	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.25	1.75	0.34	0.04	0.09	0.00
Vegetables					0.01	0.01	0.00	0.02	0.14	0.03	0.01	0.01	0.01
Milk	0.04	0.05	0.00	0.00	0.09	0.18	0.00	0.36	2.52	0.49	0.05	0.07	0.04
Fish	1.08	0.32	0.27	0.61	0.30	0.44	0.62	3.64	25.45	4.97	0.52	0.29	0.44
Avg Deer[2]		0.28	0.08	1.38	0.21	0.84	0.00	2.79	19.51	3.81	0.47	0.54	0.25
MEI Deer[2]		6.20	4.70	17.10	5.60	15.75	7.64	56.99		77.78	9.50	5.47	6.92
MEI Hog				4.77				4.77		6.51	4.77		4.77
Sportsman Food[3]	1.08	6.52	4.97	22.48	5.90	16.19	8.26	65.40	Totals, mrem and %		9.34	7.39	6.52
Ttl Food MEI[3]	1.12	6.57	4.97	22.48	6.00	16.38	8.26	65.78	14.30	73.27	9.40	7.40	6.57
MEI[4]	1.17	6.66	5.11	22.53	6.09	19.35	11.95	72.86	100	100	10.41	7.91	6.66
Public Dose[5]	0.08	0.08	0.14	0.02	0.13	0.49	0.06	1.01			0.14	0.16	0.08
Farmer[6]	0.05	0.05	0.14	0.00	0.14	3.16	3.63	7.17			1.02	1.63	0.14
Avg Sportsman[7]	1.16	0.68	0.49	2.01	0.66	4.44	4.25	13.69			1.96	1.71	1.16

Notes:

1. All abbreviations are in the glossary.
2. Avg (average) deer hunter dose is contrasted with the single hunter (MEI) dose.
3. Sportsman food is contrasted with the addition of all food media.
4. The MEI (maximum expected dose) in the worst-case scenario.
5. The public dose deletes sports food & swamp soil, & adds max drinking water .
6. The farmer scenario adds the swamp soil plus maximum well water dose.
7. Avg sportsman replaces MEI deer with avg deer dose and adds the max dw dose.

Scenario totals include only one DW source versus all DW in total media sums.

8. % of all media means all drinking water dose sources are added together.

Summary Statistics
Radiological Dose Calculation

(Return to TOC)

Comparison of the 2005 Dose (mrem) to the Seven Year Average

1999-05	Ttl mrem	% of Dose	2005	Ttl mrem	% of Dose
Cs-137	12.74	55.19	Pu-239	1.93	37.31
Pu-239	4.21	18.26	Ra-226	1.43	27.73
Ra-226	2.53	10.97	**Cs-137**	1.09	21.16
alpha	1.50	6.48	**Sr-89/90**	0.23	4.48
H-3	0.51	2.22	Ac-228	0.14	2.73
b-gamma	0.25	1.08	alpha	0.11	2.15
Ac-228	0.25	1.08	Pb-214	0.10	1.86
Sr-89/90	0.24	1.04	**H-3**	0.09	1.67
Sr-89	0.19	0.80	U-235	0.03	0.52
U-234	0.15	0.64	beta	0.01	0.21
Pb-214	0.14	0.62	**Eu-155**	0.01	0.14
Eu-155	0.12	0.52	**Sr-89**	0.00	0.04
Ra-228	0.08	0.35	**Sr-90**	0.00	0.00
beta	0.06	0.27	U-234	0.00	0.00
Pb-212	0.04	0.15	U-238	0.00	0.00
U-235	0.03	0.12	Ra-228	0.00	0.00
U-238	0.02	0.10	b-gamma	0.00	0.00
Sr-90	0.01	0.05	**Pu-239/240**	0.00	0.00
Ce-144	0.00	0.02	Am-243	0.00	0.00
Am-243	0.00	0.01	**Pu-238**	0.00	0.00
Pu-239/240	0.00	0.01	**Ce-144**	0.00	0.00
Pu-238	0.00	0.00	**Tc-99**	0.00	0.00
Tc-99	0.00	0.00	Pb-212	0.00	0.00
GrandSum	23.08	100.00	Grand Sum	5.16	100.00

Notes:

1. This table uses the average game animal dose (not the MEI dose).

2. The recent inclusion of questionable NORM and unknown alpha and beta may result in distortion of the possible contributions to dose by SRS.

3. The highlighted (bold) radionuclides represent probable SRS contributions, and the rest represent NORM above the South Carolina background or unknown alpha/beta assigned as Pu-239/Sr-90 respectively.

4. Adjustment for possible NORM contributions and unknown radionuclides (alpha, beta) would change the seven year average order to Cs-137, tritium, Sr-89/90, Eu-155, Ce-144, Pu-239/240, Pu-238, and Tc-99.

References

(Return to TOC)

Agency for Toxic Substances and Disease Registry (ATSDR), April 2004 http://www.atsdr.cdc.gov/tfacts159.html, Toxfaqs for Strontium.

Bond, V.P., T.M. Fliedner, and J.O. Archambeau, 1965 Mammalian Radiation Lethality. Academic Press, New York, p. 340.

Botsch, Romantschuk, Beltz, Handl, and Michel, 2000 Investigation of the Radiation Exposure of Inhabitants of Contaminated Areas in Northern Ukraine, Center for Radiation Protection and Radioecology, University of Hannover, Hannover, Germany.

Brisbin, I.Lehr, Jr., and M.H. Smith, 1975 Radiocesium Concentrations in Whole-Body Homogenates and several Body Compartments of Naturally Contaminated White-tailed Deer. In Mineral Cycling in the Southeastern Ecsystems, ERDA Symposium Series, CONF-740513, National Technical Information Service, Springfield, Virginia, p. 542.

Centers for Disease Control and Prevention (CDC), 2004 "Draft for Public Comment" of Phase III Savannah River Site (SRS) Dose Reconstruction Project for the SRS Health Effects Subcommittee (SRSHES). Radiation Studies Branch, National Center for Environmental Health, Centers for Disease Control and Prevention of the U. S. Department of Health and Human Services.

Colquohoun, Woolen, Van Nieuwenhuise, Padgett, Oldham, Bolan, Bishop, and Howell, 1983 Surface and Subsurface Stratigraphy, Structure and Aquifers of the South Carolina Coastal Plain, University of South Carolina, Department of Geology.

Davis, J.J, 1963 Cesium and its Relationships to Potassium in Ecology, in Radioecology. Colorado State University, Fort Collins, Colorado, pp. 539-556.

Duke Cogema Stone & Webster, 1998 Mixed Oxide Fuel Fabrication Facility Environmental Report. Charlotte, NC. Docket Number 070-03098.

Du Pont, 1983 Environmental Monitoring in the Vicinity of the Savannah River Plant. E. I. du Pont de Nemours and Company, Savannah River Plant, Aiken, SC. DPSPU 84-30-1.

Du Pont, 1984 United States Department of Energy, Savannah River Plant Environmental Report For 1984, E.I. du Pont de Nemours and Company, Savannah River Plant, Aiken, South Carolina.

Haselow, L.A., 1991 The Relationship of Radiocesium and Potassium In The Nutritional Ecology of White-tailed Deer From the Savannah River Site. Masters Thesis, Purdue University, p. 1.

Hurst, R. W., n.d Isotopic Tracers in Groundwater Hydrology. Retrieved from http://www.swhydro.arizona.edu/archive/V2_N1/featurette2.pdf#search=%22preatomic%20tritium%20levels%22.

References

Kalac, P., 2001 A Review of Edible Mushroom Radioactivity, University of Southern Bohemia, Czeck Republic.

Kathren, R.L., 1984 *Radioactivity in the Environment: Sources, Distribution, and Surveillance.* Gordon and Breach Publishing Group, Newark, New Jersey.

Michigan, 2002 *DEQ Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria.* Michigan Department of Environmental Quality Remediation and Redevelopment Division.

Old Radioactive Waste Burial Ground Focus Group (ORWBG FG), 2001 Long Range Analysis of the need for Cleanup and Closure of the Old Radioactive Waste Burial Ground – Human Health Risk Analysis, Prepared for the Savannah River Site Citizen's Advisory Board, Aiken, SC.

Pacific Northwest Laboratory (PNL), 1997 Site Annual Environmental Report, UCRL-50027-97, Oakland, California.

Radiological Assessments Corporation (RAC), 1999 Savannah River Site Environmental Dose Reconstruction Project. Phase II: Source Term Calculation and Ingestion Pathway Data Retrieval Evaluation of Materials Released from the Savannah River Site. RAC Report No. 1-CDC-SRS-1999-Final.

RADNET, 2006 Information about source points of anthropogenic radioactivity, A Freedom of Nuclear Information Resource, http://www.davistownmuseum.org/cbm/, Chernobyl Plume, Country-by-Country.

Rosson, R., S. Klima, B. Kahn, and P. Fledderman, 2000 "Correcting Tritium Concentrations in Water Vapor Monitored with Silica Gel," Health Physics, Volume 78, Number 1, pp.68-73, Williams & Wilkins, Baltimore, Md.

Seel, J.F., Whicker, F.W., Adriano, D. C., 1995 Uptake of Cs-137 in Vegetable Crops Grown on a Contaminated Lakebed, 1995 Health Physics Society manuscript.

South Carolina Department of Health and Environmental Control (SCDHEC), 1998 Summary of Selected Water Quality Parameter Concentrations in South Carolina Waters and Sediments January 1, 1993 - December 31, 1997, Technical Report No. 004-98, Bureau of Water Pollution Control, Division of Water Quality Assessment and Enforcement, Columbia, South Carolina.

SCDHEC, 2000a 1998 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, Aiken, SC.

SCDHEC, 2000b 1999 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, Aiken, SC.

References

SCDHEC, 2001 2000 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, Aiken, SC.

SCDHEC, 2002 2001 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, Aiken, SC.

SCDHEC, 2003 2002 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, SC.

SCDHEC, 2004 2003 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, SC.

SCDHEC, 2005a Water Classifications and Standards (Regulation 61-68), Bureau of Water, Water Pollution Control, Division of Water Quality Assessment and Enforcement, Columbia, South Carolina.

SCDHEC, 2005b. 2004 Environmental Data Report, Bureau of Environmental Services, Environmental Surveillance and Oversight Program, SC.

SCDHEC, 2005c 2005 Surface Soil Monitoring Adjacent to Savannah River Site Report, Bureau of Environmental Services-Environmental Surveillance and Oversight Program, Aiken, South Carolina

SCDHEC, 2005d 2005 Radiological Dose Calculation Report for the Savannah River Site Perimeter, Bureau of Environmental Services-Environmental Surveillance and Oversight Program, Aiken, South Carolina

SCDHEC 2006a 2005 South Carolina Fish Consumption Advisories. Division of Health Hasard Evaluation. Columbia, South Carolina.

SCDHEC, 2006b 2005 Surface Soil Monitoring Adjacent to the Savannah River Site, Bureau of Environmental Services-Environmental Surveillance and Oversight Program, Aiken, South Carolina.

SCDHEC, 2006 Internet site. http://www.scdhec.net/eqc/water/html/radium.html.

South Carolina Department of Natural Resources (SCDNR), 2005 Lake and Stream Data, Savannah River Near Clyo, Georgia (02198500), www.dnr.state.sc.us/hydro/owa/river.

United States Geological Survey (USGS) 2000 Water Quality in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-98: U.S. Geological Survey Circular 1206, 32p., http://pubs.water.usgs.gov/circ1206/.

United States Environmental Protection Agency (USEPA) website, n.d. Tritium, retrieved July 26, 2006 from http://www.epa/gov/radiation/radionuclides/tritium.htm.

References

USEPA, 1992 Guidance for Performing Site Inspections Under CERCLA, EPA-540-R-92-021.

USEPA, 1996 National Primary Drinking Water Standards, EPA-822-B-96-002. Office of Water, Washington DC.

USEPA, 2000a Practical Methods for Data Analysis, Guidance for Data Quality Assessment, EPA QA/G-9, QA00 Update.

USEPA, 2000b Guidance For Assessing Chemical Contaminant Data for use in Fish Advisories, Vol. 1. (November 2000).

USEPA, 2002a National Primary Drinking Water Regulations.

USEPA, 2002b List of Drinking Water Contaminants and MCLs, EPA 816-F-02-013 (July 2002)

USEPA, 2004a Office of Radiation and Indoor Air, Environmental Radiation Data, Report 91 July - September, Montgomery, AL.

USEPA, 2004b Preliminary Remediation Goals, Direct Contact Exposure Pathways, Residential Soil.

U.S. Geological Survey (USGS), 2000 Water Quality in the Santee River Basin and Coastal Drainages, North and South Carolina, 1995-98: U.S. Geological Survey Circular 1206, 32p., http://pubs.water.usgs.gov/circ1206/

Walter, A. E., 1995 America the Powerless, Facing our Nuclear Energy dilemma, Library of Congress Card Number: 95-080187.

Westinghouse Savannah River Company (WSRC), Jannik, G.T., 1997 Assessment of SRS Radiological Liquid and Airborne Contaminants and Pathways, WSRC-TR-970152, Westinghouse Savannah River Company, Aiken, SC.

WSRC, 1994a SRS Environmental Report for 1993. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-94-075.

WSRC, 1994b SRS Environmental Data for 1993. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-94-077.

WSRC, 1995a SRS Environmental Report for 1994. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-95-075.

References

WSRC, 1995b SRS Environmental Data for 1994. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-95-077.

WSRC, 1996a SRS Environmental Report for 1995. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-96-075.

WSRC, 1996b SRS Environmental Data for 1995. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-96-077.

WSRC, 1997a SRS Environmental Report for 1996. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-97-171.

WSRC, 1997b SRS Environmental Data for 1996. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-97-077.

WSRC, 1998a SRS Environmental Report for 1997. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-97-0032.

WSRC, 1998b SRS Environmental Data for 1997. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-97-00324.

WSRC, 1998c Assessment of Radionuclides In the Savannah River Site Environmental Summary. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-98-00162.

WSRC. 1999a SRS Environmental Report for 1998. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-98-00312.

WSRC, 1999b SRS Environmental Data for 1998. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-98-00314.

WSRC, 1999c Radionuclides in the Savannah River Site Environment. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-MS-99-00667.

References

WSRC, 2000a SRS Environmental Report for 1999. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-99-00299.

WSRC, 2000c Savannah River/Swamp Integrator Operable Unit Scoping Summary. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-RP-2000-4026.

WSRC, 2000d SRS Environmental Data for 1999. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-99-00301.

WSRC, 2001a SRS Environmental Report for 2000. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2000-00328.

WSRC, 2001b SRS Environmental Data for 2000. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2000-00329.

WSRC, 2002a SRS Environmental Report for 2001 Summary. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2001-00476.

WSRC, 2002b SRS Environmental Data for 2001. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2002.

WSRC, 2003a Site Evaluation Report for the Early Construction and Operational Disposal Site (ECODS) G-5 (NBN) (U), WSRC-RP-2003-4169.

WSRC, 2003b SRS Environmental Report for 2002. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2003-00026.

WSRC, 2004 SRS Environmental Report for 2003. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2004-00015.

WSRC, 2005 SRS Environmental Report for 2004. Environmental Monitoring Section, Environmental Protection Department. Westinghouse Savannah River Company, Savannah River Site, Aiken, SC. WSRC-TR-2005-00005.

Washington Savannah River Company (WSRC), 2006 SRS Environmental Report for 2005, WSRC-TR-2006-00007, Environmental Monitoring & Analysis, Environmental Services Section, Aiken, SC

List of Radionuclides

(Return to TOC)

Radionuclides and Associated Half-Lives

Ac-228	Actinium-228	6.1 hours (h)
Am-241	Americium-241	432 years (y)
Ar-41	Argon-41	1.83 h
C-14	Carbon-14	5730 y
Ce-144	Cerium-144	284 days (d)
Cs-134	Cesium-134	2.06 y
Cs-137	Cesium-137	30.1 y
Cm-242	Curium-242	163 d
Cm-243	Curium-243	28.5 y
Cm-244	Curium-244	18.1 y
Cm-245	Curium-245	8.5E3 y
Cm-246	Curium-246	4.75E3 y
Co-57	Cobalt-57	271 d
Co-60	Cobalt-60	5.27 y
Eu-154	Europium-154	8.8 y
Eu-155	Europium-155	4.96 y
H-3	Hydrogen-3 (tritium)	12.3 y
I-129	Iodine-129	1.57E7 y
I-131	Iodine-131	8.04 d
I-133	Iodine-133	20.9 h
K	Potassium-40	1.27E9 y
Kr-85	Krypton-85	10.7 y
Mg-54	Magnesium-54	312.5 d
Na-22	Sodium-22	2.6 y
Nb-95	Niobium-95	35.0 d
Ni-63	Nickel-63	100y
Np-237	Neptunium-237	2.14E6 y
Pb-212	Lead-212	10.64 h
Pb-214	Lead-214	27 m
P-32	Phosphorus-32	14.3 d
Pm-146	Promethium-146	5.5 y
Pu-238	Plutonium-328	87.7 y
Pu-239	Plutonium-329	2.4E4 y
Pu-240	Plutonium-240	6.5E3 y
Ra-226	Radium-226	14.8 d
Ra-228	Radium-228	5.75 y
Ru-103	Ruthenium-103	39 d
Ru-106	Ruthenium-106	1.00 y
S-35	Sulfur-35	87.4 d
Se-79	Selenium-79	6.5E4 y
Sb-125	Antimony-125	2.77 y
Sn-113	Tin-113	115 d
Sn-126	Tin-126	1.0E5 y
Sr-89	Strontium-89	50.6 d

List of Radionuclides

Sr-90	**Strontium-90**	**28.8 y**
Tc-99	**Technetium-99**	**2.13E5 y**
Th-228	**Thorium-228**	**1.9 y**
Th-230	**Thorium-230**	**7.7E4 y**
Th-232	**Thorium-232**	**1.41E4 y**
Th-234	**Thorium-234**	**24.1 d**
Tl-208	**Thallium-208**	**3.05 minutes**
U-233	**Uranium-233**	**1.59E5 y**
U-234	**Uranium-234**	**2.44E5 y**
U-235	**Uranium-235**	**7.03E8 y**
U-238	**Uranium-238**	**4.47E9 y**
Y-91	**Yttrium-91**	**58 d**
Zn-65	**Zinc-65**	**244 d**
Zr-95	**Zirconium-95**	**64.0 d**