Appendix C: **Nonradiological Environmental Monitoring Program Supplemental Information**

Appendix Table C-1 River and Stream Water Quality Results Summary

Five river and 11 stream locations were sampled monthly in 2018, totaling 192 samples per analyte or 4,032 records. Field duplicates are not included in the generation of these tables.

DL-Detection Limit
DO-Dissolved Oxygen
TOC-Total Organic Carbon
TSS-Total Suspended Solids

Analytical methods for cadmium and lead were changed beginning in August 2018, resulting in lower detection limits. Section 8.4 *Environmental Monitoring Program QA Activities* discusses this quality improvement. The result of this change is that average values for these two analytes at some locations are greater than the maximum value.

Note: The DO value in the maximum column is a minimum value because the SC Freshwater Quality Standard is based on a minimum value.

Four River Locations (excluding control)

Analyte	SC Freshwater Quality Std. (µg/L)	Unit	Number of Results Outside Std.	Number of Results > DL	Control RM 160.0 Avg.[a]	Control RM 160.0 Max.[b]	Highest River Location Avg.[a]		Highest River Location Max.[b]	
DO [c]	min. 4.0	mg/L	0 of 60	60 of 60	8.9	7.0	RM-129.1	8.3	RM-129.1	5.4
pH [d]	6.0-8.5	SU	0 of 60	60 of 60	6.1	7.4	RM-118.8	6.1	RM-141.5	7.4
Temperature	< 5° F (2.8° C) above nat. cond. & not > 90° F (32.2° C)	° C	0 of 60	60 of 60	18	29	RM-118.8	19	RM-118.8	26
Aluminum	87 [e]	µg/L	44 of 60	52 of 60	248	1,770	RM-150.4	262	RM-150.4	1,140
Beryllium	none	µg/L	no standard	4 of 60	All < DL		RM-129.1	0.2	RM-129.1	1.2
Cadmium	0.1	µg/L	37 of 60	11 of 60	0.3	0.1	RM-129.1	0.7	RM-129.1	4.1
Chromium	11	µg/L	0 of 60	2 of 60	All < DL		RM-129.1	2	RM-129.1	4
Copper	2.9	µg/L	1 of 60	5 of 60	2.1	3.2	RM-141.5	2.1	RM-141.5	2.8
Hardness (total)	none	mg/L	no standard	58 of 60	17	18	RM-129.1	42	RM-129.1	270
Iron	1,000 [f]	µg/L	4 of 60	60 of 60	531	2,650	RM-129.1	608	RM-150.4	1,720
Lead	0.54	µg/L	38 of 60	26 of 60	6.02	1.43	RM-141.5	6	RM-141.5	10
Manganese	none	µg/L	no standard	60 of 60	78	200	RM-118.8	82	RM-150.4	167
Mercury	0.91	µg/L	0 of 60	2 of 60	0.02	0.03	RM-118.8	0.02	RM-118.8	0.02
Nickel	16	µg/L	0 of 60	4 of 60	3	3	RM-129.1	3	RM-129.1	4
Nitrate-Nitrogen	1 [g]	mg/L	0 of 60	60 of 60	0.2	0.3	RM-118.8	0.3	RM-118.8	0.5
Nitrite-Nitrogen	1 [g]	mg/L	0 of 60	54 of 60	0.01	0.01	RM-150.4	0.01	RM-150.4	0.02
Thallium	none	µg/L	no standard	1 of 60	15	19	All < DL		All < DL	
TOC	none	mg/L	no standard	60 of 60	4	7	RM-129.1	4	RM-129.1	8
Phosphorus	0.06	mg/L	49 of 60	60 of 60	0.14	0.23	RM-150.4	0.14	RM-150.4	0.26
TSS	none	mg/L	no standard	60 of 60	8	43	RM-118.8	8	RM-150.4	30
Zinc	37	µg/L	1 of 60	38 of 60	5	16	RM-141.5	8	RM-141.5	38

Nine Stream Locations (excluding two controls)

Analyte	SC Freshwater Quality Std. (µg/L)	Unit	Number of Results Outside Std.	Number of Results > DL	Control TC-1		Control U3R-0		Highest Stream Location			
					Avg.[a]	Max.[b]	Avg.[a]	Max.[b]	Avg.[a]		Max [b]	
DO [c]	min. 4.0	mg/L	6 of 132	132 of 132	8.8	6.6	8.9	7.6	FMC-2	4.7	FMC-2	1.1
pH [d]	6.0-8.5	SU	5 of 132	132 of 132	6.1	7.7	5.7	8.5	FMC-2	5.6	U3R-4	8.1
Temperature	< 5° F (2.8° C) above nat. cond. & not > 90° F (32.2° C)	° C	0 of 132	132 of 132	18	29	19	32	SC-4	20	SC-4	28
Aluminum	87 [5]	µg/L	99 of 132	117 of 132	113	240	161	477	PB-3	294	TB-5	737
Beryllium	none	µg/L	no standard	16 of 132	All < DL		0.1	0.2	FMC-2	0.3	FMC-2	1.7
Cadmium	0.1	µg/L	80 of 132	16 of 132	All < DL		0.3	0.6	FMC-2	0.8	FMC-2	5.8
Chromium	11	µg/L	0 of 132	4 of 132	2	2	All < DL		FMC-2	2	FMC-2	3
Copper	2.9	µg/L	2 of 132	7 of 132	All < DL		All < DL		FMC-2	2.5	FMC-2	7.0
Hardness (total)	none	mg/L	no standard	60 of 132	6	16	All < DL		L3R-2	31	FM-2B	250
Iron	1,000[6]	µg/L	41 of 132	132 of 132	554	953	463	765	FMC-2	3,243	FMC-2	8,370
Lead	0.54	µg/L	80 of 132	56 of 132	5.97	0.48	6.00	0.67	PB at Rd A	6	PB at Rd A	12
Manganese	none	µg/L	no standard	132 of 132	25	54	9	20	FM-2B	265	FM-2B	1,020
Mercury	0.91	µg/L	0 of 132	7 of 132	0.02	0.02	All < DL		FMC-2	0.022	FMC-2	0.05
Nickel	16	µg/L	0 of 132	8 of 132	All < DL		All < DL		TB-5	4	TB-5	8
Nitrate-Nitrogen	1[g]	mg/L	2 of 132	132 of 132	0.1	0.3	0.4	0.6	FM-6	0.8	FM-6	1.1
Nitrite-Nitrogen	1[g]	mg/L	0 of 132	55 of 132	0.003	0.005	0.003	0.0034	FM-6	0.01	FM-6	0.03
Thallium	none	µg/L	no standard	0 of 132	All < DL		All < DL		All < DL		All < DL	
TOC	none	mg/L	no standard	132 of 132	6	11	3	11	FMC-2	8	FMC-2	14
Phosphorus	0.06	mg/L	106 of 132	130 of 132	0.16	0.32	0.08	0.20	FM-6	0.16	PB at Rd A	0.34

Analyte	SC Freshwater Quality Std. (µg/L)	Unit	Number of Results Outside Std.	Number of Results > DL	Control TC-1		Control U3R-0		Highest Stream Location			
					Avg.[a]	Max.[b]	Avg.[a]	Max.[b]	Avg.[a]		Max [b]	
TSS	none	mg/L	no standard	129 of 132	6	17	11	57	TB-5	14	PB-3	72
Zinc	37	µg/L	4 of 132	106 of 132	8	34	6	13	FMC-2	15	L3R-2	73

Note:
The following pesticides, herbicides and PCBs were sampled quarterly in 2018: Aldrin, Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (Lindane), Chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin aldehyde, Heptachlor, Heptachlor epoxide, Toxaphene, 2,4-D and 2,4,5-TP (Silvex). 1,728 analytical records were reviewed. All results were < DL except three Lindane and one beta-BHC.

[a] When results fell below the detection limit, the detection limit value was used to determine average
[b] Maximum detected value
[c] Min. (versus Max.) value reported
[d] Min. (versus Avg.) value reported
[e] EPA Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft, 2015
[f] EPA National Recommended Water Quality Criteria - Aquatic Life
[g] Per DHEC Environmental Surveillance and Oversight Program 2017 Data Report (CR-004111 2/19) and Oversight Program

Appendix Table C-2 Summary of Nonradiological Results for Sediments Collected from the Savannah River, SRS Streams, and Stormwater Basins

SRS collected annual sediment samples at 25 locations in 2018—8 Savannah River, 14 stream, and 3 stormwater basins, totaling 476 analytes. Locations sampled are as follows: Savannah River locations (BDC RM, RM 118.7, RM 129, RM 150.2, RM 150.4 [Vogtle discharge], RM 157.2, RM 160.0, and SC RM), SRS Stream locations (BDC, FMC @ Rd A, L3R-2, L3R-3, McQB below Z-Basin, McQB @ MO, Meyers Branch, PB @ Rd A, SC-4, TC-1, U3R-0, U3R-4, U3R off Rd 4, and U3R @USFS Rd 2-1), and SRS Stormwater Basin locations (E-001, E-002, and E-003). The control location for the river samples was changed from RM 160.0 to RM 161.0 mid-year 2018 as documented in chapter 8, *Quality Assurance*. The control location for the stream and stormwater basin sediment samples is Upper Three Runs U3R-0 (U3R-0_SED).

The table compares all results to EPA Region 4 Refinement Screening Values (RSV) for Sediment and shows the maximum value of each analyte for the river, stream, and stormwater basin samples. Locations exceeding RSVs are shown in red text.

The field duplicate samples are included in the data evaluations performed when generating the tables.

River Sediment Results

8 River Locations (including control) + 1 Field Duplicate @ RM 157.2

Analyte	Number of Detected Results		Control RM 160 (mg/kg)	Location of Maximum Result	Maximum Conc (mg/kg)	EPA Region 4 Refinement Screening Value (RSV) for Sediment (mg/kg)	Number of Results > RSV
Aluminum	9 of 9		6,900	RM 150.4 (Vogtle discharge)	22,000	58,000	0
Arsenic	5 of 9	<	1.1	RM-150.2 & RM 150.4 (Vogtle discharge)	2.0	33	0
Barium	9 of 9		56	RM-150.2	160	60	8*
Chromium	9 of 9		11	RM-150.2	25.0	111	0
Copper	9 of 9		7.9	RM 150.4 (Vogtle discharge)	15.0	149	0
Iron	9 of 9		8,800	RM-150.2	21,000	40,000	0
Lead	9 of 9		4	RM-150.2 & RM 150.4 (Vogtle discharge)	11.0	128	0
Magnesium	9 of 9		770	RM-150.2	2,500	NA	NA
Manganese	9 of 9		640	RM-150.2	1,600	1,100	1
Nickel	9 of 9		4.8	RM-150.2	12	48.6	0
Zinc	9 of 9		76	RM-150.2 & RM 150.4 (Vogtle discharge)	55	459	0

Note: Cadmium, cyanide, mercury, selenium, silver, and uranium were nondetects.

* Two results greater than the RSV are the original and duplicate sample from one location.

Stream Sediment Results

14 Stream Locations (including control) and 2 Field Duplicates (L3R-3 and U3R@USFS Rd 2-1)

Analyte	Number of Detected Results		Control U3R-0 (mg/kg)	Location of Maximum Result	Maximum Conc (mg/kg)	EPA Region 4 Refinement Screening Value (RSV) for Sediment (mg/kg)	Number of Results > RSV
Aluminum	16 of 16		8,800	PB-Road A	15,000	58,000	0
Arsenic	7 of 16	<	3.2	U3R-USFS-RD2-1	3.3	33	0
Barium	16 of 16		94	L3R-3	104	60	6*
Chromium	16 of 16		13	L3R-3	29.9	111	0
Copper	15 of 16		7.1	L3R-3	8.4	149	0
Cyanide	3 of 16	<	2.3	U3R-Road 4	2.0	NA	NA
Iron	16 of 16		4,800	BDC & PB-Road A	12,000	40,000	0
Lead	16 of 16		19	L3R-3	12.5	128	0
Magnesium	6 of 16	<	1100	U3R-USFS-RD2-1	630	NA	NA
Manganese	16 of 16		18	L3R-3	897	1,100	0
Mercury	4 of 16	<	0.37	L3R-3	0.08	1.1	0
Nickel	9 of 16	<	8.5	BDC	12.0	48.6	0
Selenium	3 of 16	<	4.3	L3R-3	5.2	2.9	2*
Zinc	16 of 16		17	PB-Road A	45	459	0

Note:
Cadmium, silver, and uranium were nondetects.
* Two results greater than the RSV are the original and duplicate sample from one location.

Stormwater Basin Sediment Results

4 Locations (3 basins and the control)

Analyte	Number of Detected Results		Control U3R-0 (mg/kg)	Location of Maximum Result	Maximum Conc (mg/kg)	EPA Region 4 Refinement Screening Value (RSV) for Sediment (mg/kg)	Number of Results > RSV
Aluminum	4 of 4		8,800	E-001	17,000	58,000	0
Arsenic	2 of 4	<	3.2	E-001	3.0	33	0
Barium	4 of 4		94	E-002	45	60	0
Chromium	4 of 4		13	E-001	20	111	0
Copper	4 of 4		7.1	E-002	9.2	149	0
Iron	4 of 4		4,800	E-001	14,000	40,000	0
Lead	4 of 4		19	E-002	9.1	128	0
Magnesium	2 of 4	<	1100	E-002	1200	NA	NA
Manganese	4 of 4		18	E-002	80	1,100	0
Nickel	3 of 4	<	8.5	E-002	5.6	48.6	0
Zinc	4 of 4		17	E-002	71	459	0

Note:
Cadmium, cyanide, mercury, selenium, silver, and uranium were nondetects.

Appendix Table C-3 Summary of Detected Metal Results for Freshwater Fish Tissue Collected from the Savannah River

Analyte	Number of Detected Values (above the MDC)	Number of Estimated Values (above the MDC, below the SQL)	Maximum Concentration (µg/g)	SQL (µg/g)	MDC (µg/g)	Fish Type with Maximum Concentration	Location of Maximum Concentration
Mercury	124	64	1.84	0.2	0.02	Bass	Lower Three Runs Creek Mouth
Arsenic	20	20	1.51	7.34	0.734	Panfish	Augusta Lock and Dam (also known as New Savannah Bluff Lock and Dam)
Cadmium	4	4	0.728	0.769	0.077	Catfish	Hwy 301 Bridge
Chromium	116	114	0.851	0.527	0.053	Catfish	Upper Three Runs Creek Mouth
Copper	97	95	3.38	1.57	0.157	Catfish	Hwy 301 Bridge
Lead	1	1	0.808	7.03	0.703	Panfish	Hwy 301 Bridge
Manganese	93	92	3.39	0.750	0.075	Panfish	Fourmile Creek Mouth
Nickel	34	34	0.365	1.54	0.154	Panfish	Hwy 301 Bridge
Zinc	126	0	15.8	1.12	0.112	Bass	Upper Three Runs Creek Mouth

Note:

126 freshwater tissue samples were collected and analyzed for metals and mercury.

Appendix Table C-4 Summary of Detected Metal Results for Saltwater Fish Tissue Collected from the Savannah River between River Miles 0–8, Near Savannah, Georgia

All Results are for Mullet

Analyte	Number of Detected Values (above the MDC)	Number of Estimated Values (above the MDC, below the SQL)	Maximum Concentration (µg/g)	SQL (µg/g)	MDC (µg/g)
Chromium	7	7	0.22	0.693	0.069
Copper	4	4	0.159	1.40	0.140
Manganese	6	6	0.152	0.693	0.069
Zinc	7	0	3.68	1.39	0.139

Note:
Seven saltwater tissue samples were collected and analyzed for metals and mercury.

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source

All values under the "Calculated" column through "Totals" column are reported in curies.[a]

In the Calculated column, blanks indicate the radionuclide is not present. In the facility (Reactors, Separations, SRNL) columns, a blank indicates the radionuclide was not analyzed. A 0.00E+00 in the facility columns indicates the result was not significant.

Radionuclide	Half-Life [b]		Calculated [c]	Reactors	Separations [d]	SRNL	Total
Gases and Vapors							
H-3 (oxide)	12.3	y	1.42E+04	9.79E+02	2.27E+04		**3.78E+04**
H-3 (elemental)	12.3	y			1.49E+03		**1.49E+03**
H-3 Total	12.3	y	1.42E+04	9.79E+02	2.41E+04		**3.93E+04**
C-14	5700	y	5.34E-08		5.00E-02		**5.00E-02**
Hg-203	46.6	d	5.48E-10				**5.48E-10**
Kr-85	10.8	y			1.03E+04		**1.03E+04**
I-129	1.57E+07	y	7.66E-05		3.68E-03	1.42E-06	**3.76E-03**
I-131	8.02	d	1.13E-09				**1.13E-09**
Particles							
Ag-110m	250	d	1.48E-11				**1.48E-11**
Am-241	432	y	1.13E-05	2.44E-11	8.72E-06		**2.00E-05**
Am-243	7370	y	4.11E-09				**4.11E-09**
Ba-133	10.5	y	8.03E-07				**8.03E-07**
Cd-109	461	d	1.18E-08				**1.18E-08**
Ce-139	138	d	5.20E-10				**5.20E-10**
Ce-141	32.5	d	4.94E-11				**4.94E-11**
Ce-144	285	d	2.00E-08				**2.00E-08**
Cm-243	29.1	y	2.77E-09				**2.77E-09**
Cm-244	18.1	y	2.75E-07	0.00E+00	1.63E-07		**4.38E-07**
Co-57	272	d	4.76E-10				**4.76E-10**
Co-58	70.9	d			0.00E+00		**0.00E+00**
Co-60	5.27	y	6.40E-07	0.00E+00	2.31E-07	0.00E+00	**8.71E-07**
Cr-51	27.7	d			0.00E+00		**0.00E+00**
Cs-134	2.06	y	4.31E-07				**4.31E-07**
Cs-137	30.2	y	4.26E-03	0.00E+00	8.86E-03	0.00E+00	**1.31E-02**
Eu-152	13.5	y	1. 39E-09				**1.39E-09**
Eu-154	8.59	y	3.56E-07				**3.56E-07**
Eu-155	4.76	y	1.18E-07				**1.18E-07**
F-18	110	m	2.00E-02				**2.00E-02**
Fe-55	2.74	y	5.69E-09				**5.69E-09**
Mn-54	312	d	4.46E-10				**4.46E-10**
Nb-94	2.03E+04	y	2.42E-07				**2.42E-07**

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source (continued)

Radionuclide	Half-Life [b]		Calculated [c]	Reactors	Separations [d]	SRNL	Total
Particles							
Nb-95	35.0	d	3.63E-07				**3.63E-07**
Ni-59	1.01E+05	y	5.76E-11				**5.76E-11**
Ni-63	100	y	5.05E-09				**5.05E-09**
Np-237	2.14E+06	y	1.54E-06	0.00E+00	1.81E-07		**1.72E-06**
Pa-233	27.0	d	1.42E-06				**1.42E-06**
Pb-212	10.6	h	8.43E-07				**8.43E-07**
Pm-147	2.62	y	2.89E-06				**2.89E-06**
Pm-148m	41.3	d	1.90E-12				**1.90E-12**
Pr-144	17.3	m	2.00E-08				**2.00E-08**
Pu-236	2.86	y	5.28E-10				**5.28E-10**
Pu-238	87.7	y	3.14E-05	9.50E-11	9.11E-06		**4.05E-05**
Pu-239	2.41E+04	y	6.67E-05	6.75E-10	1.18E-04		**1.85E-04**
Pu-240	6560	y	7.68E-06				**7.68E-06**
Pu-241	14.4	y	2.07E-04				**2.07E-04**
Pu-242	3.75E+05	y	3.11E-06				**3.11E-06**
Ra-226	1600	y	1.21E-06				**1.21E-06**
Ra-228	5.75	y	1.19E-06	0.00E+00	0.00E+00		**1.19E-06**
Rh-106 [e]	29.8	s	3.04E-06				**3.04E-06**
Ru-103	39.3	d	5.11E-10				**5.11E-10**
Ru-106	374	d	3.04E-06		0.00E+00		**3.04E-06**
Sb-125	2.76	y	1.18E-06				**1.18E-06**
Sb-126 [e]	12.4	d	1.70E-07				**1.70E-07**
Se-75	120	d			0.00E+00		**0.00E+00**
Se-79	2.95E+05	y	4.90E-09				**4.90E-09**
Sm-151	90	y	2.89E-06				**2.89E-06**
Sn-113	115	d	6.47E-10				**6.47E-10**
Sn-123	129	d	6.66E-12				**6.66E-12**
Sn-126	2.30E+05	y	1.70E-07				**1.70E-07**
Sr-85	64.8	d	6.24E-10				**6.24E-10**
Sr-89	50.5	d	5.10E-10				**5.10E-10**
Sr-90	28.8	y	3.28E-03	0.00E+00	6.73E-05		**3.35E-03**
Tc-99	2.11E+05	y	5.08E-05				**5.08E-05**
Te-127	9.35	h	1.04E-11				**1.04E-11**
Te-129	69.6	m	1.05E-12				**1.05E-12**
Th-228	1.91	y	1.36E-08	1.71E-09			**1.53E-08**
Th-229	7340	y	1.31E-09				**1.31E-09**
Th-230	7.54E+04	y	9.94E-11	5.14E-09			**5.24E-09**
Th-231	25.5	h	2.12E-04				**2.12E-04**
Th-232	1.41E+10	y	3.97E-12	2.38E-09			**2.38E-09**

Appendix Table D-1 Summary of Radioactive Atmospheric Releases by Source (continued)

Radionuclide	Half-Life[b]		Calculated[c]	Reactors	Separations[d]	SRNL	Total
Particles							
Tl-208	3.05	m	1.41E-06				**1.41E-06**
U-232	68.9	y	5.65E-09				**5.65E-09**
U-233	1.59E+05	y	3.36E-09				**3.36E-09**
U-234	2.46E+05	y	4.21E-07	2.27E-09	4.02E-05		**4.06E-05**
U-235	7.04E+08	y	1.37E-08	1.72E-10	2.53E-06		**2.54E-06**
U-236	2.34E+07	y	3.01E-08				**3.01E-08**
U-238	4.47E+09	y	2.75E-07	1.92E-09	6.18E-05		**6.20E-05**
Y-88	107	d	4.34E-10				**4.34E-10**
Y-90[e]	64.1	h	3.28E-03	0.00E+00	6.73E-05		**3.35E-03**
Y-91	58.5	d	7.98E-10				**7.98E-10**
Zn-65	244	d	9.02E-10				**9.02E-10**
Zr-95	64.0	d	1.22E-07				**1.22E-07**
Unidentified alpha	N/A		1.41E-04	5.17E-06	1.35E-07	0.00E+00	**1.46E-04**
Unidentified beta	N/A		1.47E-03	7.56E-05	2.80E-04	1.39E-06	**1.83E-03**
TOTAL	N/A		1.42E+04	9.79E+02	3.45E+04	2.81E-06	**4.96E+04**

[a] One curie equals 3.7E+10 becquerels

[b] ICRP 107, *Nuclear Decay Data for Dosimetric Calculations* (2008)

[c] Estimated releases from unmonitored sources. Beginning in 2016, individual isotope annual releases below 1E-12 Ci (1 pCi) are no longer reported in this table and, therefore, not used in the dose calculations.

[d] Includes separations, waste management, and tritium facilities

[e] Daughter products (Sb-126, Rh-106, & Y-90) in secular equilibrium with source terms (Sn-126, Ru-106, & Sr-90, respectively). In MAXDOSE/POPDOSE, they are included in the source term and their ingrowth is included in their parents' source term.

Appendix Table D-2 Summary of Air Effluent DOE DCS Sum of Fractions

Facility (Sampling Location)	Radionuclides Included in the DCS Sum of Fractions	DCS Sum of Fractions	DCS Sum of Fractions Excluding Tritium
A Area (791-A Sandfilter Discharge)	I-129	1.42E-04	1.42E-04
C Area (C-Area Main Stack [148'])	H-3 (oxide)	1.76E+00	0.00E+00
F Area (235-F Sandfilter Discharge)	Sr-89/90, U-234, U-238, Pu-238, Pu-239, Am-241	3.66E-03	3.66E-03
F Area (291-F Stack Isokinetic)	Sr-89/90, I-129, Cs-137, U-234, U-235, Np-237, U-238, Pu-238, Pu-239, Am-241, Cm-244	3.19E+00	3.19E+00
F Area (772-4F Stack)	U-234, U-238, Pu-238, Pu-239, Am-241	1.46E-03	1.46E-03
H Area (291-H Stack Isokinetic)	H-3 (oxide), C-14, Kr-85, Sr-89/90, I-129, Cs-137, U-234, U-235, Np-237, U-238, Pu-238, Pu-239, Am-241, Cm-244	9.49E-01	8.33E-01
K Area (K-Area Main Stack)	H-3 (oxide)	1.72E+00	0.00E+00
L Area (L-Area Disassembly)	H-3 (oxide)	1.75E+00	0.00E+00
L Area (L-Area Main Stack)	H-3 (oxide)	1.90E+00	0.00E+00
Tritium (232-H)	H-3 (elemental), H-3 (oxide)	1.80E+01	0.00E+00
Tritium (233-H)	H-3 (elemental), H-3 (oxide)	7.21E+01	0.00E+00
Tritium (234-H)	H-3 (elemental), H-3 (oxide)	4.83E+00	0.00E+00
Tritium (238-H)	H-3 (oxide)	1.53E+00	0.00E+00
Tritium (264-H)	H-3 (elemental), H-3 (oxide), Co-60	1.00E+01	1.13E-05

Note:
DOE-STD-1196-2011, Derived Concentration Technical Standard

Appendix Table D-3 Summary of Tritium in Environmental Air

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

Location	Number of Detected Results	Mean Conc. (pCi/m^3)	Minimum Conc. (pCi/m^3)	Maximum Conc. (pCi/m^3)
Onsite				
Burial Ground North	27 of 27	2.61E+02	**5.32E+01**	**2.14E+03**
Site Perimeter				
Allendale Gate	3 of 27	1.11E+01	-2.70E+00	**1.81E+02**
Barnwell Gate	5 of 27	1.27E+01	-2.56E+00	**1.99E+02**
D Area	5 of 27	1.33E+01	-3.86E+00	**2.16E+02**
Darkhorse @ Williston Gate	11 of 27	1.31E+01	-2.97E+00	**8.97E+01**
East Talatha	6 of 27	1.77E+01	-5.00E+00	**1.88E+02**
Green Pond	6 of 27	3.71E+01	-2.08E+00	**7.54E+02**
Highway 21/167	4 of 27	1.69E+01	-2.89E+00	**2.97E+02**
Jackson	5 of 27	3.16E+01	-1.46E+00	**5.03E+02**
Patterson Mill Road	3 of 26	5.04E+00	-3.73E+00	**1.68E+01**
Talatha Gate	10 of 27	4.35E+01	-2.26E+00	**7.19E+02**
25-Mile Radius				
Aiken Airport	6 of 28	1.78E+01	-3.14E+00	**2.16E+02**
Augusta Lock and Dam 614	2 of 26	7.52E+00	-4.49E+00	**8.73E+01**
Highway 301 at State Line (control location)	3 of 27	1.32E+01	-3.27E+00	**2.47E+02**

Appendix Table D-4 Summary of Tritium in Rainwater

Samples were collected approximately every 4 weeks at each of 14 locations. Typically, 13 samples are collected from each location. This was the case in 2018, except for the Barnwell Gate and Darkhorse at Williston Gate sample locations where 12 samples were collected at each. Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. The results at the following locations were all not detected: Site Perimeter (Allendale Gate, Barnwell Gate, and Highway 21/167) and 25-Mile Radius (Augusta Lock and Dam 614 and Highway 301 @ State Line). The Highway 301 @ State Line location is the control location.

Location	# of Detected Results	Mean Conc. (pCi/L)	Minimum Conc. (pCi/L)	Maximum Conc. (pCi/L)
Onsite				
Burial Ground North	12 of 13	5.92E+03	2.78E+02	**2.73E+04**
Site Perimeter				
D Area	2 of 13	2.23E+01	-2.95E+02	**6.11E+02**
Darkhorse @ Williston Gate	1 of 12	1.03E+01	-1.78E+02	**3.57E+02**
East Talatha	2 of 13	6.53E+02	-2.12E+02	**6.97E+03**
Green Pond	3 of 13	7.58E+02	-2.36E+02	**7.78E+03**
Jackson	3 of 13	3.54E+02	-2.14E+02	**2.37E+03**
Patterson Mill Road	1 of 13	2.80E+00	-2.41E+02	**5.43E+02**
Talatha Gate	2 of 13	3.00E+02	-1.28E+02	**2.33E+03**
25-Mile Radius				
Aiken Airport	1 of 13	5.73E+01	-2.70E+02	**9.14E+02**

Appendix Table D-5 Summary of Gamma Surveillance

Samples were collected approximately every quarter (12 weeks) at each of 50 locations. Typically five samples are collected from each location. This was the case in 2018, except for SRS site perimeter location, PP_57D, where samples were not retrieved during the first and second quarters of the calendar year.

Station Location Type	# of Stations	Quarter 1 Average mR/day	Quarter 2 Average mR/day	Quarter 3 Average mR/day	Quarter 4 Average mR/day	Annual Total Average mR/year	Annual Minimum mR/year	Annual Maximum mR/year
Population Centers	9	0.29	0.45	0.32	0.36	129	114.4	149.3
Site Perimeter	9	0.23	0.51	0.27	0.28	116	97.5	140.8
Air Surveillance Stations	14	0.24	0.41	0.29	0.30	113	91.8	159.0
Plant Vogtle Vicinity	18	0.22	0.36	0.26	0.29	103	84.5	135.7

Appendix D-6 Summary of Radionuclides in Soil

Samples are collected annually from 22 locations. Bolded values are detected results. Values not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

The following locations are sampled: Creek Plantation Trail 1 (1175 ft), Creek Plantation Trail 1 (1600 ft), Creek Plantation Trail 1 (1805 ft), Creek Plantation Trail 6 (2000 ft), F Area (2000 feet West), H Area (2000 ft East), Z Area (#3), Burial Ground Locations (643-26E-2 and Burial Ground North), Plant Perimeter Locations (Allendale Gate, Barnwell Gate, D Area, Darkhorse @ Williston Gate, East Talatha, Green Pond, Highway 21/167, Jackson, Patterson Mill Road, and Talatha Gate) and 25-Mile Radius Locations (Aiken Airport, Augusta Lock and Dam 614, and Highway 301 @ State Line). The Highway 301 @ State Line is the control location.

All Co-60 and Sr-89/90 results were not detected; thus, they were not reported in this table.

Radionuclide	# of Detected Results	Control – Hwy 301 Conc. (pCi/g)	Location of Minimum Conc.	Minimum Conc. (pCi/g)	Location of Maximum Conc.	Maximum Conc. (pCi/g)
Cs-137	21 of 23	**1.52E-01**	Burial Ground (643-26E-2)	-1.41E-02	Creek Plantation Trail 1 (1805 ft)	**2.73E+01**
U-234	19 of 19	**1.57E+00**	Allendale Gate	**4.08E-01**	Augusta Lock and Dam 614	**1.36E+00**
U-235	18 of 19	**8.89E-02**	Aiken Airport	1.31E-02	Augusta Lock and Dam 614	**6.68E-02**
Np-237	1 of 18	1.11E-03	H Area (2000 feet east)	-5.05E-04	East Talatha	**2.46E-03**
U-238	19 of 19	**1.62E+00**	Allendale Gate	**4.24E-01**	Augusta Lock and Dam 614	**1.23E+00**
Pu-238	5 of 18	**5.70E-03**	Barnwell Gate	-2.84E-04	F Area (2000 feet west)	**2.68E-02**
Pu-239	16 of 18	**1.10E-02**	Burial Ground (643-26E-2)	4.46E-04	F Area (2000 feet west)	**4.27E-02**
Am-241	10 of 16	**6.03E-03**	Patterson Mill Road	2.09E-04	Burial Ground (643-26E-2)	**3.54E-02**
Cm-244	3 of 16	6.86E-04	H Area (2000 feet east)	-3.05E-04	Burial Ground (643-26E-2)	**6.95E-03**
Gross Beta	16 of 19	**6.24E+00**	Highway 21/167	1.40E+00	Burial Ground North	**2.73E+01**
Gross Alpha	19 of 19	**1.05E+01**	Patterson Mill Road	**2.73E+00**	Burial Ground North	**1.14E+01**

Appendix Table D-7 Summary of Radionuclides in Grassy Vegetation

Samples are collected annually from 14 locations. In 2018, 22 samples were collected from 14 locations. Bolded values are detected results. Values not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All results for Co-60, Np-237, Pu-238, Am-241, Cm-244, and gross alpha were not detected; thus, not reported in this table.

The following locations are sampled: Control (Highway 301 at the SC/GA State line), Onsite location (Burial Ground North), Site Perimeter locations (Allendale Gate, Barnwell Gate, D Area, Darkhorse @ Williston Gate, East Talatha, Green Pond, Highway 21/167, Jackson, Patterson Mill Road, Talatha Gate), and 25-Mile Radius Locations (Aiken Airport and the Augusta Lock and Dam 614).

Radionuclide	# of Detected Results	Control (Highway 301) Conc. (pCi/g)	Location of Minimum Conc.	Minimum Conc. (pCi/g)	Location of Maximum Conc.	Maximum Conc. (pCi/g)
H-3	11 of 22	-8.59E-03	Patterson Mill Road	-1.04E-02	Burial Ground North	**9.49E+00**
Cs-137	4 of 15	1.55E-03	Burial Ground North	-2.45E-02	Highway 21/167	**3.70E-01**
Sr-89/90	15 of 15	**9.81E-02**	Talatha Gate	**9.05E-02**	East Talatha	**5.35E-01**
U-234	15 of 15	**2.32E-03**	Highway 21/167	**6.78E-04**	Burial Ground North	**4.14E-02**
U-235	3 of 15	1.42E-04	Allendale Gate	-3.86E-05	Burial Ground North	**2.19E-03**
U-238	14 of 15	**9.97E-04**	Highway 21/167	3.16E-05	Burial Ground North	**4.00E-02**
Pu-239	1 of 15	3.46E-05	Aiken Airport	-1.49E-04	Burial Ground North	**1.03E-03**
Tc-99	13 of 15	**3.32E-01**	Allendale Gate	7.81E-02	Burial Ground North	**9.46E-01**
Gross Beta	15 of 15	**7.22E+00**	Allendale Gate	**5.86E+00**	Green Pond	**1.54E+01**

Appendix Table D-8 Summary of Radionuclides in Foodstuffs

Samples of five foodstuffs are collected annually from five regions surrounding SRS. Beef, greens, and fruit are collected each year. There are six foodstuffs that are collected on a rotating three-year cycle. Corn and pecans were the rotational crop samples collected in 2018.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

Food Type	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/g)	Minimum Sample Conc. (pCi/g)	Maximum Sample Conc. (pCi/g)
Beef	H-3	5	1	5.65E-02	2.87E-02	**1.06E-01**
	U-234	5	4	6.63E-05	**4.54E-05**	**1.14E-04**
	U-238	5	5	1.02E-04	**5.19E-05**	**1.35E-04**
	Gross Beta	5	5	1.90E+00	**1.35E+00**	**2.16E+00**
	Cs-137, Co-60, Tc-99, Np-237, Pu-238, Pu-239, Am-241, Cm-244, Sr-89,90, U-235, and gross alpha were not detected in beef.					
Greens	Cs-137	5	3	1.88E-02	6.16E-03	**3.19E-02**
	Sr-89,90	5	5	1.77E-01	**2.81E-02**	**3.38E-01**
	U-234	5	5	4.98E-03	**1.88E-03**	**6.51E-03**
	U-235	5	1	5.00E-04	-6.62E-06	**1.51E-03**
	U-238	5	5	5.00E-03	**2.61E-03**	**7.76E-03**
	Tc-99	5	5	5.04E-01	**3.05E-01**	**1.13E+00**
	Cm-244	5	1	3.39E-05	-1.16E-04	**3.43E-04**
	Gross Beta	5	5	2.14E+01	**1.61E+01**	**2.70E+01**
	Gross Alpha	5	1	5.94E-01	-4.08E-02	**1.70E+00**
	H-3, Co-60, Np-237, Pu-238, Pu-239, and Am-241 were not detected in greens					
Fruit (watermelon)	H-3	5	4	5.71E-02	-1.61E-03	**1.29E-01**
	Sr-89,90	5	1	2.82E-03	2.00E-03	**5.62E-03**
	Tc-99	5	4	3.45E-02	2.28E-02	**3.92E-02**
	Gross Beta	5	5	2.91E-01	**1.45E-01**	**4.46E-01**
	Cs-137, Co-60, Np-237, Pu-238, Pu-239, Am-241, Cm-244, U-234, U-235, U-238, and gross alpha were not detected in fruit.					
Corn	H-3	5	4	7.39E-02	-2.28E-02	**2.20E-01**
	Cs-137	5	1	3.47E-03	-2.56E-04	**1.13E-02**
	Sr-89,90	5	1	1.99E-02	-6.92E-03	**4.51E-02**
	Gross Beta	5	5	7.49E+00	**5.43E+00**	**1.04E+01**
	Co-60, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, Cm-244, Np-237, Sr-89,90, Tc-99, and gross alpha were not detected in corn.					
Pecans	Gross Beta	5	5	3.94E+00	**2.64E+00**	**4.41E+00**
	Gross Alpha	5	2	1.53E-01	3.05E-03	**2.72E-01**
	H-3, Cs-137, Co-60, U-234, U-235, U-238, Am-241, Cm-244, Np-237, Pu-238, Pu-239, Sr-89,90, and Tc-99 were not detected in pecans.					

Appendix Table D-9 Summary of Radionuclides in Dairy

SRS collects cow's and goat's milk samples from dairies located in communities surrounding the Site. The number listed in parentheses after the state in which the dairies are located, indicates the number of dairies that provide samples to SRS from that state.

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All Co-60 results were not detected, thus, not reported in this table.

Location	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/L)	Minimum Sample Conc. (pCi/L)	Maximum Sample Conc. (pCi/L)
SC-Dairies (5) – cow milk	H-3	16	2	6.95E+01	-1.32E+02	**7.85E+02**
SC-Dairies (2) – goat milk	H-3	4	2	8.01E+02	4.30E+01	**1.80E+03**
GA-Dairies (4)	H-3	15	0			
SC-Dairies (4) – cow milk	Cs-137	14	2	1.46E+00	-5.11E-01	**3.81E+00**
SC-Dairies (1) – goat milk	Cs-137	2	1	4.27E+00	1.32E+00	**7.22E+00**
GA-Dairies (4)	Cs-137	15	0			
SC-Dairies (4) – cow milk	Sr-90	14	2	5.48E-01	-5.51E-01	3.35E+00*
SC-Dairies (1) – goat milk	Sr-90	2	1	1.74E+00	4.70E-01	**3.00E+00**
GA-Dairies (4)	Sr-90	15	0			

Note:
* Due to large uncertainties this value is considered not significant although the value is greater than the analytical method detection limit.

Appendix Table D-10 Radiation in Liquid Release Sources

All values under the three Areas columns and the "Totals" column are reported in curies.

Tritium is the main contributing radionuclide in Liquid Sources releases. Although the remaining radionuclides are contributors, their contributions in liquid source releases are minimal.

In the facility (Reactor, Separations, SRNL) columns, a blank indicates the radionuclide was not analyzed. A 0.00E+00 in the facility columns indicates the result was not significant.

All Co-60 results were not detected; thus, they were not reported in this table.

Radionuclide	Half-Life		Reactors (Ci)	Separations [a] (Ci)	SRNL (Ci)	Totals (Ci)
H-3 [b]	12.3	y	1.75E+02	3.56E+02	5.27E-02	5.31E+02
C-14	5700	y		6.22E-04	0.00E+00	6.22E-04
Sr-90	28.8	y	0.00E+00	3.18E-02		3.18E-02
Tc-99	2.11E+05	y		2.79E-02	5.07E-04	2.84E-02
I-129	1.57E+07	y		1.66E-02	0.00E+00	1.66E-02
Cs-137 [c]	30.2	y	0.00E+00	8.06E-03	0.00E+00	8.06E-03
Ra-226	1600	y		1.03E-03		1.03E-03
U-234	2.46E+05	y		2.95E-02	5.33E-05	2.95E-02
U-235	7.04E+08	y		5.71E-04	3.07E-06	5.74E-04
U-238	4.47E-09	y		3.22E-02	4.48E-05	3.22E-02
Np-237	2.14E+06	y		1.82E-06		1.82E-06
Pu-238	87.7	y		4.91E-05	4.40E-06	5.35E-05
Pu-239	2.41E+04	y		5.45E-06	0.00E+00	5.45E-06
Am-241	432	y		1.36E-04		1.36E-04
Cm-244	18.1	y		6.81E-05		6.81E-05
Alpha [d]	N/A		1.79E-03	1.00E-03	4.17E-04	3.21E-03
Beta-Gamma [e]	N/A		4.18E-02	2.47E-03	8.00E-04	4.51E-02
					Sum	**5.31E+02**

[a] Includes separations, waste management, and tritium processing facilities.

[b] The tritium release total, which includes direct + migration releases, is used in the dose calculations for SRS impacts.

[c] Depending on which value is higher, the Cs-137 release total is based on concentrations measured in Steel Creek mouth fish near RM 141.5 or on the actual measured effluent release total from the Site. Refer to chapter 6 (Dose) for more information.

[d,e] For dose calculations, unidentified alpha and beta/gamma releases are assumed to be Pu-239 and Sr-90, respectively.

Appendix Table D-11 Summary of Liquid Effluent DOE DCS Sum of Fractions by Facility

Facility (sampling location)	Radionuclides Included in the Sum of Fractions	DCS Sum of Fractions	DCS Sum of Fractions Excluding Tritium
A Area (TB-2 Outfall at Road 1A)	H-3, U-234, U-235, U-238, Pu-238, Tc-99	1.58E-03	1.47E-03
F Area (F-013 200-F Cooling Basin)	H-3, Cs-137, U-234, U-238, Pu-238, Pu-239, Tc-99	3.51E-03	2.09E-03
F Area (F-05)	H-3, Sr-89/90, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, Cm-244, Tc-99	1.33E-02	1.22E-02
F Area (FM-3 F-Area Effluent)	H-3, I-129, U-234, U-235, U-238, Pu-238, Pu-239, Am-241, Cm-244, Tc-99	2.95E-03	2.02E-03
F-Tank Farm (F-012 281-8F Retention Basin)	H-3, Sr-89/90, Cs-137, U-234, U-238, Pu-238, Tc-99	6.83E-03	5.35E-03
H Area (FM-1C H-Area Effluent)	H-3, Sr-89/90, U-234, U-235, Np-237, U-238, Pu-238, Pu-239, Am-241, Cm-244	6.44E-03	2.97E-03
H Area (H-004)	H-3, U-234, U-235, U-238, Pu-238	6.59E-03	1.84E-03
H-ETP (U3R-2A ETP Outfall at Road C)	H-3, C-14, Sr-89/90, U-234, U-238	9.96E-01	1.17E-03
H-Tank Farm (H-017 281-8H Retention Basin)	H-3, Sr-89/90, I-129, Cs-137, U-234, U-238, Pu-238, Pu-239, Am-241, Tc-99	1.77E-02	1.45E-02
H-Tank Farm (HP-52 H-Area Tank Farm)	H-3, Cs-137, U-234, U-235, U-238, Pu-238, Pu-239, Am-241	3.92E-03	2.08E-03
K Area (K Canal)	H-3	5.98E-04	4.75E-04
L Area (L-07)	H-3	7.12E-04	6.31E-04
S Area (S-004)	H-3, Sr-89/90, Cs-137, U-234, U-238, Pu-238	1.15E-02	3.22E-03
Tritium (HP-15 Tritium Facility Outfall)	H-3	6.98E-02	4.72E-05

Appendix Table D-12 Summary of Radionuclides in Sediments

SRS collected annual sediment samples at 40 locations in 2018—11 Savannah River, 21 stream, and 8 stormwater basins, totaling 478 analytes. Locations sampled are as follows: Savannah River locations (mouths of Beaver Dam Creek [BDC] and Steel Creek [SC], River Miles [RM] 118.7, 129, 134.0, 150.2, 150.4, 151, 157.2, 160.0, and 160.5), SRS Stream locations (downstream of R-1, FM-2, FM-3A, FM-A7, FM-A7A, FMC @ Rd A, FMC Swamp, L3R-1A , L3R-2, L3R-3, McQB below Z-Basin, Meyers Branch, PB Swamp, SC-2A, SC-4, TB-5, TC-1, U3R @USFS Rd 2-1, U3R off Rd 4, U3R-0, and U3R-4), and SRS Stormwater Basin locations (E-001, E-002, E-003, E-004, E-05, E-06, Pond 400, and Z-Area Basin).

Bolded concentration results were reported as detected. Concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

The streams and stormwater basins have the same control location, U3R-0. The river control location is RM 160.5.

The field duplicate samples are included in the data evaluations performed when generating the tables.

For the river and basin sediment analyses, all results for Co-60, Np-237, and Sr-90 were below the detection limit. For the stream sediment, all results for Co-60 were below the detection limit. Therefore, these results are not presented in the sediment tables below.

River Sediment Results

11 River Locations (including control) + 1 Field Duplicate @ RM 157.2

Analyte	# > MDA	Control RM 160.5 (pCi/g)	Location of Maximum Result	Maximum Conc (pCi/g)
Americium-241	6 of 10	**1.06E-03**	RM 157.2	**2.07E-02**
Cesium -137	9 of 12	4.67E-02	SC RM	**9.63E-01**
Curium-243/244	2 of 10	3.66E-04	RM 118.7	**8.10E-03**
Gross Alpha	12 of 12	**1.21E+01**	RM 157.2	**3.13E+01**
Nonvolatile Beta	12 of 12	**2.32E+01**	RM 157.2	**2.88E+01**
Plutonium-238	3 of 10	4.76E-04	RM 118.7	**3.55E-03**
Plutonium-239/240	2 of 10	5.28E-04	RM 157.2	**5.84E-03**
Uranium-233/234	10 of 10	**9.67E-01**	RM 160.0	**1.71E+00**
Uranium-235	10 of 10	**3.95E-02**	RM 160.0	**8.16E-02**
Uranium-238	10 of 10	**9.81E-01**	RM 160.0	**1.71E+00**

Stream Sediment Results

21 Stream Locations (including control) and 2 Field Duplicates (L3R-3 and U3R@USFS Rd 2-1)

Analyte	# >MDA	Control U3R-0 (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	12 of 16	**4.39E-03**	FM-A7	**1.34E-01**
Cesium-137	18 of 23	7.75E-02	Downstream of R-1	**1.51E+01**
Curium-243/244	6 of 16	4.20E-04	FM-A7	**1.02E-01**
Gross Alpha	22 of 23	**3.36E+01**	SC-2A	**3.58E+01**
Neptunium-237	4 of 16	5.12E-04	FMC Swamp	**1.16E-02**
Nonvolatile Beta	23 of 23	**2.57E+01**	U3R @ USFS Rd 2-1	**3.90E+01**
Plutonium-238	10 of 16	1.20E-03	FM-2	**4.20E-01**
Plutonium-239/240	13 of 16	**4.65E-03**	FM-A7	**1.27E-01**
Strontium-90	4 of 16	1.15E-01	FM-A7	**5.95E-01**
Uranium-233/234	16 of 16	**1.70E+00**	TB-5	**4.30E+00**
Uranium-235	15 of 16	**6.49E-02**	TB-5	**2.48E-01**
Uranium-238	16 of 16	**1.84E+00**	TB-5	**4.51E+00**

Stormwater Basin Sediment Results

9 Locations (8 basins and the control)

Analyte	#>MDA	Control U3R-0 (pCi/g)	Location of Maximum Result	Maximum Result (pCi/g)
Americium-241	6 of 9	**4.39E-03**	E-002	**1.05E-01**
Cesium-137	4 of 9	7.75E-02	Z-Area Basin	**2.64E+03**
Curium-243/244	2 of 9	4.20E-04	Pond 400	**6.47E-03**
Gross Alpha	9 of 9	**3.36E+01**	Pond-400	**2.33E+01**
Nonvolatile Beta	9 of 9	**2.57E+01**	Z-Area Basin	**2.36E+03**
Plutonium-238	4 of 9	1.28E-03	Pond-400	**6.01E-02**
Plutonium-239/240	6 of 9	**4.65E-03**	Pond-400	**1.62E-01**
Uranium-233/234	9 of 9	**1.70E+00**	E-004	**1.78E+00**
Uranium-235	9 of 9	**6.49E-02**	E-004 & Pond 400	**1.12E-01**
Uranium-238	9 of 9	**1.84E+00**	E-004	**1.74E+00**

Appendix Table D-13 Summary of Radionuclides in Drinking Water

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large.

Samples at the Treatment Plants are collected monthly. These samples are analyzed for tritium, Co-60, Cs-137, gross alpha and gross beta. For the Treatment Plants samples, all results for Co-60, Cs-137, and gross alpha were below detection limits; and thus, not presented in the table below. Samples are collected at one onsite location quarterly for tritium, Co-60, Cs-137, gross beta and gross alpha analyses and collected annually for Sr-90 and actinides analyses. All other onsite locations are collected annually. For the quarterly onsite samples, all results for tritium, Co-60, and Cs-137 were below detection limits; and thus, not presented in the table below. For the onsite annual samples, all results for tritium, Co-60, Cs-137, Sr-90, U-235, Pu-238, Pu-239, and Cm-244 were below detection limits; and thus, not presented in the table below.

Treatment Plants—Finished Water Summary

Tritium					
Locations	**Number of Samples**	**Number of Detects**	**Mean Conc. (pCi/L)**	**Minimum Conc. (pCi/L)**	**Maximum Conc. (pCi/L)**
BJWSA Purrysburg WTP	12	12	3.91E+02	**1.89E+02**	**7.92E+02**
North Augusta Public Water Works	12	8	1.54E+02	4.32E+01	**2.44E+02**

Gross Beta					
Locations	**Number of Samples**	**Number of Detects**	**Mean Conc. (pCi/L)**	**Minimum Conc. (pCi/L)**	**Maximum Conc. (pCi/L)**
BJWSA Purrysburg WTP	12	12	1.87E+00	**1.49E+00**	**2.53E+00**
North Augusta Public Water Works	12	12	1.80E+00	**1.38E+00**	**2.28E+00**

Onsite Location Summary—Quarterly Samples

Gross Beta					
Location	**Number of Samples**	**Number of Detects**	**Mean Conc. (pCi/L)**	**Minimum Conc. (pCi/L)**	**Maximum Conc. (pCi/L)**
782-3A quarterly	4	4	1.35E+00	**9.24E-01**	**2.14E+00**

Gross Alpha					
Location	**Number of Samples**	**Number of Detects**	**Mean Conc. (pCi/L)**	**Minimum Conc. (pCi/L)**	**Maximum Conc. (pCi/L)**
782-3A quarterly	4	3	7.81E-01	2.66E-01	**1.49E+00**

Onsite Location Summary—Annual Samples

		U-234	**U-238**	**Am-241**	**Gross Beta**	**Gross Alpha**
Location	**Number of Samples**	**Conc. (pCi/L)**	**Conc. (pCi/L)**	**Conc. (pCi/L)**	**Conc. (pCi/L)**	**Conc. (pCi/L)**
617-G	1	**2.61E-02**	**1.91E-02**	**1.07E-02**	**9.14E-01**	2.08E-01
681-3G Dom. Water Faucet	1	3.68E-03	**1.42E-02**	3.24E-03	**3.00E+00**	**5.68E-01**
704-16G	1	9.93E-03	**1.56E-02**	**8.49E-03**	**9.41E-01**	**6.57E-01**
709-1G	1	**3.00E-02**	**1.02E-02**	**1.05E-02**	**5.57E-01**	4.32E-02
737-G	1	**1.36E-02**	**1.11E-02**	8.03E-03	**1.37E+00**	-4.30E-03
782-3A (annual)	1	**2.86E-02**	**4.38E-02**	**7.30E-03**		
905-112G Well	1	**1.82E-02**	**1.96E-02**	6.22E-03	**5.24E-01**	**6.22E-01**
905-113G Well	1	**4.41E-02**	**5.22E-02**	3.97E-03	**2.00E+00**	**1.95E+00**
905-125B	1	**6.84E-02**	**8.38E-02**	6.73E-03	**2.02E+00**	**2.35E+00**
905-67B	1	**1.68E-02**	**1.57E-02**	6.86E-03	**1.52E+00**	**1.28E+00**

Appendix Table D-14 Summary of Radionuclides in Freshwater Fish

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. Sr-89/90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples. Beginning in 2017, tritium (H-3) is no longer analyzed in fish. All Co-60, I-129, and gross alpha results were nonsignificant and thus, not reported in this table.

The analyte mean is set to zero if all composite values per fish species at a single location are less than the MDL or the uncertainty is large. Three composite samples were analyzed for each fish type from each location.

Cs-137 (Edible)									
	Bass			Catfish			Panfish		
Location	**Mean (pCi/g)**	**Min. (pCi/g)**	**Max. (pCi/g)**	**Mean (pCi/g)**	**Min. (pCi/g)**	**Max. (pCi/g)**	**Mean (pCi/g)**	**Min. (pCi/g)**	**Max. (pCi/g)**
Augusta L&D	1.96E-02	1.00E-02	**2.66E-02**	3.20E-02	**2.76E-02**	**3.84E-02**	3.63E-02	1.19E-02	**8.32E-02**
Upper Three Runs Creek River Mouth	2.85E-01	1.76E-02	**7.92E-01**	3.74E-02	**2.10E-02**	**4.81E-02**	0.00E+00	5.46E-03	1.73E-02
Four Mile Creek River Mouth	6.24E-02	**4.27E-02**	**9.32E-02**	3.90E-02	**1.72E-02**	**7.46E-02**	5.43E-02	**3.30E-02**	**6.92E-02**
Steel Creek River Mouth	1.24E-01	**8.00E-02**	**2.11E-01**	4.04E-02	**3.62E-02**	**4.62E-02**	2.56E-02	**1.92E-02**	**3.30E-02**
Lower Three Runs Creek River Mouth	3.37E-01	**4.30E-02**	**7.76E-01**	4.16E-02	**3.32E-02**	**5.05E-02**	6.61E-02	**2.20E-02**	**1.43E-01**
Hwy 301 Bridge Area	3.05E-02	**2.60E-02**	**3.68E-02**	3.74E-02	**1.50E-02**	**6.43E-02**	1.90E-02	**1.41E-02**	**2.47E-02**

Sr-89/90 (Edible)

Location	Bass			Catfish			Panfish		
	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)
Augusta L&D	2.59E-03	1.39E-03	**4.14E-03**	2.00E-03	1.26E-03	**3.27E-03**	0.00E+00	1.77E-03	2.38E-03
Upper Three Runs Creek River Mouth	1.95E-03	-3.53E-04	**5.65E-03**	0.00E+00	3.51E-04	8.65E-04	0.00E+00	7.81E-04	5.97E-03
Four Mile Creek River Mouth	2.51E-03	1.60E-03	**3.03E-03**	0.00E+00	6.46E-04	2.06E-03	4.77E-03	4.30E-03	**5.41E-03**
Steel Creek River Mouth	1.82E-03	9.11E-04	**2.86E-03**	2.93E-03	1.68E-03	**4.54E-03**	3.09E-03	-1.03E-03	**7.11E-03**
Lower Three Runs Creek River Mouth	0.00E+00	1.21E-03	4.27E-03	0.00E+00	1.88E-03	3.27E-03	0.00E+00	1.15E-03	2.78E-03
Hwy 301 Bridge Area	0.00E+00	1.58E-03	2.73E-03	2.04E-03	3.35E-04	**3.84E-03**	0.00E+00	1.13E-03	3.46E-03

Sr-89/90 (Nonedible)

Location	Bass			Catfish			Panfish		
	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)
Augusta L&D	7.34E-01	**6.51E-01**	**7.78E-01**	8.27E-01	**6.32E-01**	**9.27E-01**	9.42E-01	**8.05E-01**	**1.08E+00**
Upper Three Runs Creek River Mouth	7.33E-01	**5.62E-01**	**9.97E-01**	7.52E-01	**6.84E-01**	**8.68E-01**	8.53E-01	**5.81E-01**	**9.97E-01**
Four Mile Creek River Mouth	9.92E-01	**6.89E-01**	**1.26E+00**	7.26E-01	**6.59E-01**	**7.86E-01**	1.28E+00	**1.01E+00**	**1.55E+00**
Steel Creek River Mouth	7.73E-01	**6.22E-01**	**9.03E-01**	5.97E-01	**4.76E-01**	**8.08E-01**	9.51E-01	**9.08E-01**	**9.76E-01**
Lower Three Runs Creek River Mouth	3.62E-01	**3.30E-01**	**4.11E-01**	4.79E-01	**4.46E-01**	**5.00E-01**	4.95E-01	**4.16E-01**	**5.68E-01**
Hwy 301 Bridge Area	5.59E-01	**5.03E-01**	**6.03E-01**	5.46E-01	**4.43E-01**	**6.49E-01**	6.22E-01	**6.08E-01**	**6.35E-01**

Tc-99 (Edible)

Location	Bass			Catfish			Panfish		
	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)
Augusta L&D	0.00E+00	3.97E-02	4.92E-02	5.89E-02	**8.51E-02**	**8.46E-02**	6.64E-02	4.24E-02	**8.35E-02**
Upper Three Runs Creek River Mouth	0.00E+00	3.54E-02	4.35E-02	0.00E+00	1.14E-02	1.56E-02	0.00E+00	8.03E-03	3.89E-02
Four Mile Creek River Mouth	0.00E+00	4.76E-02	5.81E-02	0.00E+00	5.89E-02	7.27E-02	0.00E+00	4.14E-02	6.57E-02
Steel Creek River Mouth	7.85E-02	5.57E-02	**9.92E-02**	7.76E-02	6.03E-02	**1.04E-01**	5.68E-02	3.41E-02	**7.11E-02**
Lower Three Runs Creek River Mouth	0.00E+00	2.13E-02	5.38E-02	0.00E+00	1.52E-02	4.89E-02	0.00E+00	-5.27E-03	2.95E-02
Hwy 301 Bridge Area	5.58E-02	4.81E-02	**6.97E-02**	7.67E-02	**7.19E-02**	**8.51E-02**	6.06E-02	4.65E-02	**7.59E-02**

Gross Beta (Edible)

Location	Bass			Catfish			Panfish		
	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)	Mean (pCi/g)	Min. (pCi/g)	Max. (pCi/g)
Augusta L&D	1.73E+00	**1.39E+00**	**2.41E+00**	2.20E+00	**1.85E+00**	**2.41E+00**	1.64E+00	**1.53E+00**	**1.80E+00**
Upper Three Runs Creek River Mouth	2.34E+00	**1.95E+00**	**2.62E+00**	2.39E+00	**1.90E+00**	**2.81E+00**	2.06E+00	**2.00E+00**	**2.13E+00**
Four Mile Creek River Mouth	2.08E+00	**1.98E+00**	**2.24E+00**	2.32E+00	**1.94E+00**	**2.59E+00**	1.73E+00	**1.44E+00**	**2.03E+00**
Steel Creek River Mouth	1.43E+00	**1.11E+00**	**1.75E+00**	1.88E+00	**1.73E+00**	**2.02E+00**	1.51E+00	**1.32E+00**	**1.73E+00**
Lower Three Runs Creek River Mouth	2.75E+00	**2.17E+00**	**3.65E+00**	2.49E+00	**1.87E+00**	**3.00E+00**	2.06E+00	**1.87E+00**	**2.39E+00**
Hwy 301 Bridge Area	2.64E+00	**2.30E+00**	**2.86E+00**	2.70E+00	**2.55E+00**	**2.89E+00**	2.20E+00	**1.95E+00**	**2.45E+00**

Appendix Table D-15 Summary of Radionuclides in Saltwater Fish

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. Sr-89/90 is the only analysis performed in both flesh (edible) and bone (nonedible) samples. Beginning in 2018, red drum and sea trout are no longer collected. Beginning in 2017, tritium (H-3) is no longer analyzed in fish. Results of all samples for Co-60, Cs-137, I-129, Sr-89/90 (in flesh), and gross alpha were below method detection limits.

All saltwater fish are collected at the location designated as River Miles 0–8 (mouth of Savannah River).

	Marine Mullet			
Analyte	**Number of Samples**	**Mean (pCi/g)**	**Minimum (pCi/g)**	**Maximum (pCi/g)**
Tc-99	3	4.99E-02	6.11E-03	**8.41E-02**
Sr-89/90 Nonedible	3	1.67E-01	**1.29E-01**	**2.08E-01**
Gross Beta	3	1.53E+00	**1.46E+00**	**1.65E+00**

Appendix Table D-16 Summary of Radionuclides in Shellfish

Bolded minimum and maximum concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All Co-60, Cs-137, I-129, and Tc-99 results were not detected; thus, not reported in this table.

All shellfish are collected at the location designated as River Miles 0-8 (at the mouth of Savannah River).

The species of shellfish collected in 2018 were shrimp and crab.

Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Concentration (pCi/g)	Minimum Concentration (pCi/g)	Maximum Concentration (pCi/g)
Sr-89/90	2	1	2.96E-03	5.49E-04	**5.38E-03**
Gross B	2	2	1.15E+00	**5.43E-01**	**1.76E+00**
Gross A	2	1	1.46E-01	3.38E-02	**2.57E-01***

Note:

* The gross alpha maximum value is less than the trigger value of 0.951 pCi/g that SRS uses as the basis for performing analysis of alpha-emitting radionuclides. When results are less than the trigger value, no actinide analyses are performed.

Appendix Table D-17 Summary of Radionuclides in Wildlife

Bolded concentration results were reported as detected. Minimum and maximum concentrations not bolded indicate the result was less than the analytical method detection limit or the uncertainty is large. All Co-60 results were below detection limits, and thus are not reported in this table.

Sample Type	Nuclide	Number of Samples	Number of Results > Detection Limit	Mean Sample Conc. (pCi/g)	Minimum Sample Conc. (pCi/g)	Maximum Sample Conc. (pCi/g)
Deer Flesh	Cs-137	45	44	2.21E+00	3.68E-02	**7.27E+00**
Hog Flesh	Cs-137	4	4	2.35E+00	**5.03E-01**	**6.35E+00**
Deer Flesh	Sr-89/90	45	3	2.04E-03	-2.22E-03	**1.37E-02**
Hog Flesh	Sr-89/90	4	0	2.16E-03	-4.00E-04	5.41E-03
Deer Bone	Sr-89/90	45	45	3.35E+00	**7.86E-01**	**8.86E+00**
Hog Bone	Sr-89/90	4	4	2.53E+00	**1.85E+00**	**3.05E+00**

Appendix E: Groundwater Management Program Supplemental Information

Appendix Table E-1 Summary of Documents that Report Groundwater Monitoring Data

Document Title	Submittal Frequency
Data Report for the C-Area Groundwater (CAGW) Operable Unit	Annual
K-Area Burning/Rubble Pit (131-K) and Rubble Pile (631-20G) (KBRP), L-Area Burning/Rubble Pit (131-L), Gas Cylinder Disposal Facility (131-2L) and L-Area Rubble Pile (131-3L) (LBRP), and P-Area Burning/Rubble Pit (131-P) (PBRP) Operable Units Combined Groundwater Monitoring Report Sampling Summary	Annual
Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report	Annual
R-Area Groundwater Effectiveness Monitoring Report in Support of R-Area Operable Unit	Annual
2016 Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the L-Area Southern Groundwater (LASG) Operable Unit	Biennial
Five-Year Remedy Review Report for Savannah River Site Operable Units	Phased - Annual
D-Area Groundwater Operable Unit	Annual
Groundwater Mixing Zone Report for the D-Area Oil Seepage Basin	Annual
Groundwater Mixing Zone Sampling Summary Report for the R-Reactor Seepage Basin, 108-4R Overflow Basin Operable Unit	Biannual
488-4D Class Two Landfill Midyear Groundwater Monitoring Report	Biannual
632-G C&D Class Two Landfill Groundwater Monitoring Report	Biannual
N-Area Heating Oil (NHO) Plume Groundwater Monitoring Report	Annual
Z-Area Saltstone Disposal Facility Groundwater Monitoring Report	Biannual
288-F Class Two Landfill Annual Groundwater Monitoring Report	Biannual
Interim Sanitary Landfill (Class Three) Annual Groundwater Monitoring Report	Biannual
Annual M-Area and Metallurgical Laboratory Hazardous Waste Management Facilities Groundwater Monitoring and Corrective Action Report	Annual
Annual Corrective Action Report for the F-Area Hazardous Waste Management Facility, the H-Area Hazardous Waste Management Facility, and the Mixed Waste Management Facility	Annual
Performance Evaluation Report for the M-Area Inactive Process Sewer Lines (MIPSL) (081-M) Operable Unit	Annual
Performance Evaluation Report for the A-Area Burning/Rubble Pit (731-A, 731-1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A, 731-5A) Operable Unit	Annual

Appendix Table E-1 Summary of Documents that Report Groundwater Monitoring Data (continued)

Document Title	Submittal Frequency
Effectiveness Monitoring Report (EMR) for the Monitored Natural Attenuation (MNA) at the Chemicals, Metals, and Pesticides (CMP) Pits Operable Unit	Annual
Biennial Effectiveness Monitoring Report (EMR) for Monitored Natural Attenuation (MNA) at the C-Area Burning/Rubble Pit (131-C) and Old C-Area Burning/Rubble Pit (NBN) Operable Unit	Biennial
Scoping Summary for the General Separations Area Eastern Groundwater Operable Unit	Annual
Scoping Summary for the General Separations Area Western Groundwater Operable Unit	Annual
Performance Evaluation Report for the A-Area Miscellaneous Rubble Pile (731-6A) Operable Unit	Annual
SRS Environmental Report	Not applicable[a]

[a] The SRS Environmental Report is not submitted to the regulatory agencies as a regulatory requirement. The report is a publicly available document. The SRS Environmental Report summarizes information on offsite wells and onsite wells that are not included in regulatory submittals.

Appendix F: **Glossary**

A

accuracy—Closeness of the result of a measurement to the true value of the quantity.

actinide—Group of radioactive metallic elements of atomic number 89 through 103. Laboratory analysis of actinides by alpha spectrometry generally refers to the elements plutonium, americium, uranium, and curium but may also include neptunium and thorium.

activity—See radioactivity.

alpha particle—Positively charged particle emitted from the nucleus of an atom having the same charge and mass as that of a helium nucleus (two protons and two neutrons)

ambient—Existing in the surrounding area. Completely enveloping.

ambient air—Surrounding atmosphere as it exists around people, plants, and structures.

analyte—Constituent or parameter that is being analyzed.

analytical detection limit—Lowest reasonably accurate concentration of an analyte that can be detected; this value varies depending on the method, instrument, and dilution used.

aquifer—Saturated, permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients.

Area Completion Project—U.S. Department of Energy program that directs the assessment and cleanup of inactive waste units and groundwater (remediation) contaminated as a result of nuclear-related activities.

Atomic Energy Agency—Federal agency created in 1946 to manage the development, use, and control of nuclear energy for military and civilian application. It was abolished by the Energy Reorganization Act of 1974 and succeeded by the Energy Research and Development Administration. Functions of the Energy Research and Development Administration eventually were taken over by the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission.

audit—A systematic evaluation to determine the conformance to quantitative specifications of some operational function or activity.

B

Background control location—A sampling point that is not impacted by SRS operations.

background radiation—Naturally occurring radiation, fallout, and cosmic radiation. Generally, the lowest level of radiation obtainable within the scope of an analytical measurement, that is, a blank sample.

Benchmark — A standard or point of reference against which things may be compared or assessed.

Best Available Technology (BAT) —The preferred technology for treating a particular process liquid waste. BAT is not a specific level of treatment but the conclusion of a selection process that includes several treatment alternatives. The selection process looks at factors related to technology, economics, public policy, and other parameters.

best management practices—Sound engineering practices that are not required by regulation or by law.

beta particle—Negatively charged particle emitted from the nucleus of an atom. It has a mass and charge equal to those of an electron.

Biobased products—Products derived from plants and other renewable agricultural, marine, and forestry materials that provide an alternative to conventional petroleum-derived products.

Biopreferred® —A program the U.S. Department of Agriculture (USDA) manages to increase the purchase and use of biobased products. The program's purpose is to spur economic development, create new jobs and provide new markets for farm commodities. For more information, please see the USDA website.

biota—Plant and animal life.

blind sample—A subsample for analysis with a composition known to the submitter. The analyst or laboratory may know the identity of the sample, but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

C

calibration—Process of applying correction factors to equate a measurement to a known standard. Generally, a documented measurement control program of charts, graphs, and data that demonstrate that an instrument is properly calibrated.

canyon—Two facilities located at SRS where nuclear materials are chemically recovered and purified. They are called "canyons" because of their similarity to how a canyon looks, open space with high wall-like mountains on either side of a valley.

Carolina bay—Type of shallow depression commonly found on the coastal Carolina plains. Carolina bays are typically circular or oval. Some are wet or marshy, while others are dry.

categorical exclusion—Categories of actions that do not individually or cumulatively have a significant effect on the human environment and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.

Central Savannah River Area—Eighteen-county area in Georgia and South Carolina surrounding Augusta, Georgia. The Savannah River Site is included in the Central Savannah River Area. Counties are Richmond, Columbia, McDuffie, Burke, Emanuel, Glascock, Jenkins, Jefferson, Lincoln, Screven, Taliaferro, Warren, and Wilkes in Georgia and Aiken, Edgefield, Allendale, Barnwell, and McCormick in South Carolina.

chlorocarbons—Compounds of carbon and chlorine, or carbon, hydrogen, and chlorine, such as carbon tetrachloride, chloroform, tetrachloroethylene, etc. They are among the most significant and widespread environmental contaminants. Classified as hazardous wastes, chlorocarbons may have a tendency to cause detrimental effects, such as birth defects.

cleanup—Actions taken to deal with release or potential release of hazardous substances. This may mean complete removal of the substance; it also may mean stabilizing, containing, or otherwise treating the substance so that it does not affect human health or the environment.

closure—Control of a hazardous waste management facility under Resource Conservation and Recovery Act requirements.

compliance—Fulfillment of applicable requirements of a plan or schedule ordered or approved by government authority.

composite—A blend of more than one portion to be used as a sample for analysis.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)—This Act addresses the cleanup of hazardous substances and establishes a National Priority List of sites targeted for assessment and, if necessary, restoration (commonly known as “Superfund”).

concentration—Amount of a substance contained in a unit volume or mass of a sample.

conductivity—Measure of water’s capacity to convey an electric current. This property is related to the total concentration of the ionized substances in water and the temperature at which the measurement is made.

contamination—State of being made impure or unsuitable by contact or mixture with something unclean, bad, etc.

contaminant pathway—The way contaminants move and settle in the environment after release from operating facilities to the air and water.

continuous assessment—Evaluation of a program or employee carried out on a fixed interval (for example, weekly, monthly, annually)

control chart—A graph of some measurement plotted over time or sequence of sampling, together with control limit(s) and, usually, a central line and warning limit(s). Control charts provide a graphical representation of accuracy and precision, a long-term mechanism for self-evaluation of analytical data, and an assessment of analytical capability of the laboratory analyst.

control standard—A standard prepared independently of and run with the calibration. It is used to verify the accuracy of the calibration.

cool roof—A thick white rubber-type roof that lowers the temperature of standard roofs from about 150 degrees Fahrenheit to 100 degrees or less.

criteria pollutant—Six common air pollutants found all over the United States. They are particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead. The Environmental Protection Agency is required by the Clean Air Act to set National Ambient Air Quality Standards for these six pollutants.

curie—Unit of radioactivity. One curie is defined as 3.7×10^{10} (37 billion) disintegrations per second. Several fractions and multiples of the curie are commonly used:

- **kilocurie (kCi)**—10^{3} Ci, one thousand curies; 3.7×10^{13} disintegrations per second.
- **millicurie (mCi)**—10^{-3} Ci, one-thousandth of a curie; 3.7×10^{7} disintegrations per second.
- **microcurie (µCi)**—10^{-6} Ci, one-millionth of a curie; 3.7×10^{4} disintegrations per second.
- **picocurie (pCi)**—10^{-12} Ci, one-trillionth of a curie; 0.037 disintegrations per second.

D

DCS sum of fractions—The sum of the ratios of the average concentration of each radionuclide to its corresponding DCS value. (See below for definition of DCS-derived concentration standard.)

decay (radioactive)—Spontaneous transformation of one radionuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same radionuclide.

deactivation—The process of placing a facility in a stable and known condition, including the removal of hazardous and radioactive materials to ensure adequate protection of the worker, public health and safety, and the environment, thereby limiting the long-term cost of surveillance and maintenance.

decommissioning—Process that takes place after deactivation and includes surveillance and maintenance, decontamination, and dismantlement.

decontamination—The removal or reduction of residual radioactive and hazardous materials by mechanical, chemical, or other techniques to achieve a stated objective or end condition.

derived concentration standard (DCS)—Concentration of a radionuclide in air or water that, under conditions of continuous exposure for one year by one exposure mode (that is, ingestion of water, submersion in air, or inhalation), would result in either an effective dose equivalent of 0.1 rem (1 mSv). The guides for radionuclides in air and water are given in U.S. Department of Energy Derived Concentration Technical Standard (DOE-STD-1196-2011) (DOE 2011).

detection limit—See analytical detection limit, lower limit of detection, minimum detectable concentration.

detector—Material or device (instrument) that is sensitive to radiation and can produce a signal suitable for measurement or analysis.

disposal—Permanent or temporary transfer of U.S. Department of Energy control and custody of real property to a third party, which thereby acquires rights to control, use, or relinquish the property.

disposition—Those activities that follow completion of program mission including, but not limited to, surveillance and maintenance, deactivation, and decommissioning.

dissolved oxygen—Desirable indicator of satisfactory water quality in terms of low residuals of biologically available organic materials. Dissolved oxygen prevents the chemical reduction and subsequent leaching of iron and manganese from sediments.

DOECAP—A comprehensive audit program for contract laboratories with the intent of conducting consolidated audits to eliminate redundant audits previously conducted independently by DOE field element sites and to achieve standardization in audit methodology, processes, and procedures.

dose—Energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram in any medium.

- **absorbed dose**—Quantity of radiation energy absorbed by an organ, divided by the organ's mass. Absorbed dose is expressed in units of rad (or gray) (1 rad = 0.01 Gy).
- **equivalent dose**—Product of the absorbed dose (rad) in tissue and a radiation weighting factor. Equivalent dose is expressed in units of rem (or sievert) (1 rem = 0.01 sievert).
- **effective dose**—Sum of the dose equivalents received by all organs or tissues of the body after each one has been multiplied by an appropriate tissue weighting factor.
- **committed effective dose**—Is the effective dose integrated over time, usually 50-years. Committed effective dose is expressed in units of rem (or sievert).
- **collective dose**—Sum of the effective dose of all individuals in an exposed population within a 50-mile (80-km) radius, and expressed in units of person-rem (or person-sievert). The 50-mile distance is measured from a point located centrally with respect to major facilities or U.S. Department of Energy program activities.

dosimeter—Portable detection device for measuring the total accumulated exposure to ionizing radiation.

drinking water standards—Federal primary drinking water standards, both proposed and final, as set forth by the Environmental Protection Agency.

duplicate result—Result derived by taking a portion of a primary sample and performing the identical analysis on that portion as is performed on the primary sample.

E

effluent—A release of treated or untreated water or air from a pipe or a stack to the environment. Liquid effluent flows into a body of water such as a stream or lake. Airborne effluent (also called emission) discharges into the atmosphere.

effluent monitoring—Collection and analysis of samples or measurements of liquid and gaseous effluents for purpose of characterizing and quantifying the release of contaminants, assessing radiation exposures to members of the public, and demonstrating compliance with applicable standards.

emission—A release of a gas.

ENERGY STAR®—A U.S. Environmental Protection Agency program that helps businesses and individuals save money and protect the climate through energy efficiency. For more information, please visit the ENERGY STAR website.

environmental compliance—Actions taken in accordance with government laws, regulations, orders, etc., that apply to Site operations' effects on onsite and offsite natural resources and on human health; used interchangeably in this document with regulatory compliance.

environmental monitoring—Program at Savannah River Site that includes effluent monitoring and environmental surveillance with the dual purpose of 1) showing compliance with federal, state, and local regulations, as well as with U.S. Department of Energy orders, and 2) monitoring any effects of Site operations on onsite and offsite natural resources and on human health.

environmental occurrence—Any sudden or sustained deviation from a regulated or planned performance at a DOE operation that has environmental protection and compliance significance.

environmental surveillance—Collection and analysis of samples of air, water, soil, foodstuffs, biota, and other media from U.S. Department of Energy sites and their environs and the measurement of external radiation for purpose of demonstrating compliance with applicable standards, assessing radiation exposures to members of the public, and assessing effects, if any, on the local environment.

EPEAT—A product database that registers products based on the devices' ability to meet various criteria developed and agreed upon by diverse stakeholders to address the full lifecycle of an electronic product. This system ensures all products listed in the EPEAT database truly represent environmental leadership. For more information, please visit the EPEAT website.

exception (formerly "exceedance")—Term used by the Environmental Protection Agency and the South Carolina Department of Health and Environmental Control that denotes a report value is more than the guide limit. This term is found on the discharge monitoring report forms that are submitted to the Environmental Protection Agency or the South Carolina Department of Health and Environmental Control.

exclusion or exclusion device—Material or equipment used for wildlife control. These devices may be used to deter animal use of an area, to provide a method of collecting animals, or to provide a means of exit for an animal.

exposure (radiation)—Incidence of radiation on living or inanimate material by accident or intent. Background exposure is the exposure to natural background ionizing radiation. Occupational exposure is the exposure to ionizing radiation that takes place during a person's working hours. Population exposure is the exposure to the total number of persons who inhabit an area.

exposure pathway—The way that a person could be impacted from releases of radionuclides into the water and air.

F

fallout—The settling to the ground of airborne particles ejected into the atmosphere from the earth by explosions, eruptions, forest fires, etc. or from human production activities such as found at nuclear facilities.

Federal Facility Agreement (FFA)—Agreement negotiated among the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the South Carolina Department of Health and Environmental Control, specifying how the Savannah River Site will address contamination or potential contamination to meet regulatory requirements at Site waste units identified for evaluation and, if necessary, cleanup.

feral hog—Hog that has reverted to the wild state from domestication.

field duplicate—An independent sample collected as closely as possible to the same point in space and time as the original sample. The duplicate and original are two separate samples taken from the same source, stored in separate containers, and analyzed independently.

fiscal year—An established period of time when an organization's annual financial records start and end. In the federal government, this period is from October 1 to September 30.

fugitive greenhouse gas emissions—The inadvertent release of greenhouse gases to the atmosphere from various facilities or activities. Some common sources include leaks or releases from valves, pumps, compressors, flanges from refrigeration, and air conditioning systems.

G

global fallout—Radioactive debris from atmospheric weapons tests that has been deposited on the earth's surface after being airborne and cycling around the earth.

grab sample—Sample collected instantaneously with a glass or plastic bottle placed below the water surface to collect surface water samples (also called dip samples).

gross alpha and beta releases—The total alpha-emitting and beta-emitting activity determined at each effluent location.

ground shine—Exposure to gamma radiation produced by radioactive materials on the ground surface is called ground shine and it contributes to external dose.

groundwater—Water found underground in cracks and spaces in soil, sand, and rocks.

H

half-life (radiological)—Time required for half of a given number of atoms of a specific radionuclide to decay. Each nuclide has a unique half-life.

hazardous waste—Any waste that is a toxic, corrosive, reactive, or ignitable material that could affect human health or the environment.

I

International Organization for Standardization (ISO)—Creates documents that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes, and services are compatible with their purpose. For more information, please visit the ISO website.

Intralaboratory checks—Compare performance within a laboratory by analyzing duplicate and blind samples throughout the year.

isotope—Each of two or more forms of the same element that contain equal numbers of protons but different numbers of neutrons in their nuclei, and hence differ in relative atomic mass but not in chemical properties; in particular, a radioactive form of an element.

L

legacy—Anything handed down from the past; inheritance, as of nuclear waste.

low-level waste—Waste that includes protective clothing, tools, and equipment that have become contaminated with small amounts of radioactive material.

lower limit of detection—Smallest concentration or amount of an analyte that can be reliably detected in a sample at a 95% confidence level.

M

manmade radiation—Radiation from sources such as consumer products, medical procedures, and nuclear industry.

MAPEP—A laboratory comparison program that tracks performance accuracy and tests the quality of environmental data reported to DOE.

maximally exposed individual—Hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose equivalent.

maximum contaminant level—The maximum allowable concentration of a drinking water contaminant as legislated through the Safe Drinking Water Act.

mercury—Silver-white, liquid metal solidifying at -38.9°C to form a tin-white, ductile, malleable mass. It is widely distributed in the environment and biologically is a nonessential or non-beneficial element. Human poisoning due to this highly toxic element has been clinically recognized.

migration—Transfer or movement of a material through the soil or groundwater.

minimum detectable concentration (radionuclides)—Smallest amount or concentration of a radionuclide that can be distinguished in a sample by a given measurement system at a preselected counting time and at a given confidence level.

minimum detectable concentration (chemicals)—Smallest amount or concentration of a chemical that can be distinguished in a sample by a given measurement system at a given confidence level.

mixed waste—Waste that has both hazardous and radioactive components.

monitoring—Process whereby the quantity and quality of factors that can affect the environment and or human health are measured periodically to regulate and control potential impacts.

N

nonroutine radioactive release—Unplanned or nonscheduled release of radioactivity to the environment.

nuclide—Atom specified by its atomic weight, atomic number, and energy state. A radionuclide is a radioactive nuclide.

O

organic—Of, relating to, or derived from living organisms (plant or animal).

outfall—Place where treated or untreated water flows out of a pipe to mix with water from a water body, such as a stream or lake.

P

parameter—Analytical constituent; chemical compound(s) or property for which an analytical request may be submitted.

passive device—A device that does not require a source of energy for its operation.

PCB bulk product waste—Waste derived from products manufactured to contain PCBs in a non-liquid state at 50 ppm or greater. Typical examples are caulk, pain, and sealants.

performance evaluation (PE) sample—A sample, the composition of which is unknown to the analyst, that is provided to test whether the analyst or laboratory can produce analytical results within specified performance limits.

person-rem—Collective dose to a population group. For example, a dose of one rem to 10 individuals results in a collective dose of 10 person-rem.

pH—Measure of the hydrogen ion concentration in an aqueous solution (acidic solutions, pH <7; basic solutions, pH>7; and neutral solutions, pH 7).

piezometer—Instrument used to measure the potentiometric surface of the groundwater. Also, a well designed for this purpose.

plume—Volume of contaminated water originating at a waste source for example, a hazardous waste disposal site). It extends downward and outward from the waste source.

plume shine—Exposure to gamma radiation from airborne radioactive materials is called plume shine (sometimes called cloud shine or sky shine) and it contributes to external dose.

point source—Any defined source of emission to air or water such as a stack, air vent, pipe, channel, or passage to a water body.

population dose—See collective dose equivalent under dose.

potable water—Water that is safe to drink.

practical quantitation—The lowest level a laboratory can quantify with 99% confidence.

precision—A estimate of the degree to which a set of observations or measurements of the property, usually obtained under similar conditions agree. It is a data quality indicator.

process sewer—Pipe or drain, generally located underground, used to carry off either process water or waste matter, or both.

proficiency testing—An evaluation of a laboratory's performance against pre-established criteria by means of inter-laboratory comparison. It is also known as comparative testing.

purge—To remove water prior to sampling, generally by pumping or bailing.

Q

quality assurance (QA)—An integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure quality in the processes by which products are developed.

quality control (QC)—A set of activities for ensuring quality in products by identifying defects in the actual products.

R

rad—Unit of absorbed dose deposited in a volume of material.

radioactivity—Spontaneous emission of radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope.

radioisotopes—Radioactive isotopes.

radionuclide—Unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

reference person—A hypothetical age and gender averaged individual that is a combination of human (male and female) physical and physiological characteristics arrived at by international consensus to standardize radiation dose calculations.

RCRA/CERCLA Units—Units subject to the remedial action process established in the Federal Facilities Agreement.

Regional Screening Level (RSL)—The risk-based concentration derived from standardized equations combining exposure assumptions with toxicity data.

regulatory compliance—Actions taken in accordance with government laws, regulations, orders, etc., that apply to Savannah River Site operations' effects on onsite and offsite natural resources and on human health; used interchangeably in this document with environmental compliance.

release—Any discharge to the environment. Environment is broadly defined as any water, land, or ambient air.

rem—Unit of dose equivalent (absorbed dose in rads times the radiation quality factor). Dose equivalent frequently is reported in units of millirem (mrem), which is one thousandth of a rem.

remediation—Assessment and cleanup of sites contaminated with waste due to historical activities.

representative person—A hypothetical individual receiving a dose that is representative of the more highly exposed individuals in the population.

Resource Conservation and Recovery Act (RCRA)—Federal legislation that regulates the transport, treatment, and disposal of solid and hazardous wastes. This act also requires corrective action for releases of hazardous waste at inactive waste units.

retention basin—Unlined basin used for emergency, temporary storage of potentially contaminated cooling water from chemical separations activities.

routine radioactive release—Planned or scheduled release of radioactivity to the environment.

S

seepage basin—Excavation that receives wastewater. Insoluble materials settle out on the floor of the basin and soluble materials seep with the water through the soil column, where they are removed partially by ion exchange with the soil. Construction may include dikes to prevent overflow or surface runoff.

SEER—Seasonal Energy Efficiency Ratio—This is a measure of equipment energy efficiency over the cooling season. It represents the total cooling of a central air conditioner or heat pump during the normal cooling season as compared to the total electric energy input consumed during the same period.

sensitivity—Capability of methodology or instruments to discriminate between samples with differing concentrations or containing varying amounts of an analyte.

sievert—The International System of Units (SI) derived unit of dose equivalent. It attempts to reflect the biological effects of radiation as opposed to the physical aspects, which are characterized by the absorbed dose, measured in gray. One sievert is equal to 100 rem.

significant analytical result—Indicates that the result is statistically significant or is at or above the detection limit of the applicable radioanalytical method, or both.

Silvex— A herbicide and a plant growth regulator. It has been banned for use as a herbicide in the United States since 1985.

site stream—Any natural stream on the Savannah River Site. Surface drainage of the Site is via these streams to the Savannah River.

source—Point or object from which radiation or contamination emanates.

source term—Quantity of radioactivity (released in a set period of time) that is traceable to the starting point of an effluent stream or migration pathway.

spent nuclear fuel—Used fuel elements from reactors.

splits or split sample—Two or more representative portions taken from a single sample and analyzed by different analysts or laboratories. Split samples are used to replicate the measurement of the parameters of interest.

SRS Community Reuse Organization (SRSCRO)—A nonprofit organization charged with developing and implementing strategy to diversify the economy in the five South Carolina and Georgia counties surrounding the Site. For more information, please see the SRSCRO website.

stable—Not radioactive or not easily decomposed or otherwise modified chemically.

stack—Vertical pipe or flue designed to exhaust airborne gases and suspended particulate matter.

standard deviation—Indication of the dispersion of a set of results around their average.

statistical data evaluation—A collection of methods used to process large amounts of data and report overall trends.

stormwater runoff—Surface streams that appear after precipitation.

Superfund—See Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

surface water—Water that has not penetrated below the surface of the ground.

T

tank farm—Interconnected underground tanks used for storage of high-level radioactive liquid wastes.

temperature—Thermal state of a body, considered with its ability to communicate heat to other bodies.

terrestrial—Living on or growing from the land.

thermoluminescent dosimeter (TLD)—A passive device that measures the exposure from ionizing radiation.

total dissolved solids—Dissolved solids and total dissolved solids are terms generally associated with freshwater systems; they consist of inorganic salts, small amounts of organic matter, and dissolved materials.

total phosphorus—May occasionally stimulate excessive or nuisance growths of algae and other aquatic plants when concentrations exceed 25 mg/L at the time of the spring turnover on a volume- weighted basis in lakes or reservoirs.

total suspended particulates—Refers to the concentration of particulates in suspension in the air, regardless of the nature, source, or size of the particulates.

translocation—The deliberate movement of organisms from one site for release in another. It must be intended to yield a measurable conservation benefit at the levels of a population, species or ecosystem, and not only provide benefit to translocated individuals.

transport pathway—Pathway by which a released contaminant is transported physically from its point of discharge to a point of potential exposure to humans. Typical transport pathways include the atmosphere, surface water, and groundwater.

transuranic waste—Solid radioactive waste containing primarily alpha-emitting elements heavier than uranium.

trend—General drift, tendency, or pattern of a set of data plotted over time.

tritium—Elemental form of the radioactive isotope of hydrogen and occurs as a gas.

tritium oxide—Water in which the tritium isotope has replaced a hydrogen atom. Stack releases of tritium oxide typically occur as water vapor.

turbidity—Measure of the concentration of sediment or suspended particles in solution.

U

unidentified alpha and beta releases—The unspecified alpha and beta releases that are conservatively determined at each effluent location by subtracting the sum of the individually measured alpha-emitting (for example, plutonium-239 and uranium-235) and beta- emitting (for example, cesium-137 and strontium-90) radionuclides from the measured gross alpha and beta values, respectively. Unidentified

alpha and beta releases also include naturally occurring radionuclides, such as uranium, thorium, radon progeny, and potassium-40.

utility water—Once-through noncontact cooling water, recirculated non-contact cooling water, boiler blowdown, steam condensate, air conditioning condensate, and other uncontaminated heating, ventilation and air conditioning or compressor condensates.

V

volatile organic compounds—Broad range of organic compounds, commonly halogenated, that vaporize at ambient, or relatively low, temperatures (for example, acetone, benzene, chloroform, methyl alcohol).

W

waste management—The U.S. Department of Energy uses this term to refer to the safe, effective management of various kinds of nonhazardous, hazardous, and radioactive waste generated at DOE facilities.

waste unit—A particular area that is or may be posing a threat to human health or the environment. Waste units range in size from a few square feet to tens of acres and include basins, pits, piles, burial grounds, landfills, tank farms, disposal facilities, process facilities, and groundwater contamination.

waste stream—Waste material generated from a single process or from an activity that is similar in material, physical form, isotopic makeup, and hazardous constituents.

WaterSense®—A U.S. Environmental Protection Agency partnership that offers ways to increase water efficiency through products and services. For more information, please visit the U.S. EPA website.

water table—Planar, underground surface beneath which earth materials, such as soil or rock, are saturated with water.

Waters of the State—Surface or underground water within the jurisdiction of the state, as defined in the South Carolina Pollution Control Act.

weighting factor—Value used to calculate dose equivalents. It is tissue specific and represents the fraction of the total health risk resulting from uniform, whole-body irradiation that could be attributed to that particular tissue. The weighting factors used in this report are recommended by the International Commission on Radiological Protection (Publication 26).

wetland—Lowland area, such as a marsh, swamp, bog, Carolina bay, floodplain bottom, where land is covered by shallow water at least part of the year and is characterized by somewhat mucky soil.

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Appendix G: **References**

Aucott et al. 2017. Aucott, T.J., A.D. Brand, D.P. DiPrete, T.S. Whiteside. "Improvements to the Hunter Dose Tracking System," SRNL-STI-2017-00091, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Carlton et al. 1994. Carlton, W.H., C.E. Murphy, Jr., and A.G. Evans. "Radiocesium in the Savannah River Site Environment," *Health Physics*, Volume 67, Number 3, Williams & Wilkins, Baltimore, MD

Cherry 2006. Cherry, G.S. "Simulation and Particle Tracking Analysis of Ground-Water Flow near the Savannah River Site, Georgia and South Carolina, 2002, and for Selected Ground-Water Management Scenarios, 2002 and 2020," Scientific Investigations Report, 2006-5195, U.S. Geological Survey, Reston, VA

Denham 1995. Denham, M.E. "SRS Geology/Hydrogeology Environmental Information Document," WSRC-TR-95-0046, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

DOE 2002. U.S. Department of Energy. "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota," DOE Standard, DOE-STD-1153-2002, July 2002, Washington, DC

DOE 2011. U.S. Department of Energy. "DOE Derived Concentration Technical Standard," DOE-STD-1196-2011, Washington, DC

DOE 2013. U.S. Department of Energy. "Radiation Protection of the Public and the Environment," DOE Order 458.1, Change 3; 2013, Washington, DC

DOE 2015. U.S. Department of Energy. "Environmental Radiological Effluent Monitoring and Environmental Surveillance," DOE Handbook, DOE-HDBK-1216-2015, Washington, DC

EPA 1999. U.S. Environmental Protection Agency. "Cancer Risk Coefficients for Environmental Exposure to Radionuclides," Federal Guidance Report No.13, USEPA 402-R-99-001, Sept. 1999, Washington, DC

EPA 2000. U.S. Environmental Protection Agency. "National Primary Drinking Water Regulations," Title 40 Code of Federal Regulations, Part 141, December 2000, Washington, DC

EPA 2002. U.S. Environmental Protection Agency. "National Emission Standards for Hazardous Air Pollutants," Title 40 Code of Federal Regulations, Part 61, Subpart H, July 2002, Washington, DC

EPA 2011. U.S. Environmental Protection Agency. "Exposure Factor Handbook," National Center for Environmental Assessment, Office of Research and Development, September 2011, Washington, DC

FFA 1993. "Federal Facility Agreement for the Savannah River Site," Administrative Docket Number 89-05-FF, WSRC-OS-94-42, Effective Date: August 16, 1993, Savannah River Site, Aiken, SC

ICRP 2002. International Commission on Radiation Protection, "Basic Anatomical and Physiological Data for Use in Radiological Protection Reference Values," Annals of the ICRP 32, Publication 89, Elmsford, NY

Jannik 2017. Jannik, G.T. "Environmental Dose Assessment Manual," SRNL-TR-2010-00274 Revision 2, October 25, 2017, Savannah River National Laboratory, Savannah River Site, Aiken SC

Jannik, Stagich, and Dixon 2019. Jannik, G.T., B. Stagich, and K.L. Dixon. "Radiological Impact of 2018 Operations at the Savannah River Site," SRNL-STI-2019-00321, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Jannik and Stagich 2017. Jannik, G.T., B. Stagich. "Land and Water Use Characteristics and Human Health Input Parameters for Use in Environmental Dosimetry and Risk Assessments at the Savannah River Site—2017 Update," SRNL-STI-2016-00456, Revision 1, May 2017, Savannah River National Laboratory, Savannah River Site, Aiken, SC

Minter et al 2018. Minter, K.M., G.T. Jannik, B.H. Stagich, K.L. Dixon, and J.R. Newton. "Comparison of the Current Center of the Site Annual NESHAP Dose Modeling at the Savannah River Site with Other Assessment Methods," Health Physics Society, Health-Physics.com, 408-413

Morrison et al 2019. Morrison, C., S. Hitchens, T. Edwards, J. Mayer, and K. Minter. "Determining CS-137 Background Bodyburdens for Wild Pigs at Savannah River Site," SRNL-TR-2019-00193, Savannah River National Laboratory, Savannah River Site, Aiken, SC

NCRP 2009. National Council on Radiation Protection and Measurements, "Ionizing Radiation Exposure of the Population of the United States." NCRP Report 160, Bethesda, MD

NRC 1977. U.S. Nuclear Regulatory Commission. "Regulatory Guide 1.109 - Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I," Revision 1, Washington, DC

SCDHEC 2014. South Carolina Department of Health and Environmental Control. "Water Classifications and Standards," South Carolina Code of Regulations, R.61-68, Columbia, SC

SRNS 2017. Savannah River Nuclear Solutions, LLC. "Annual Corrective Action Report for the F-Area Hazardous Waste Management Facility, the H-Area Hazardous Waste Management Facility, and the Mixed Waste Management Facility (U)," SRNS-RP-2017-00134, Revision 0, Savannah River Site, Aiken, SC

SRNS 2018. Savannah River Nuclear Solutions, LLC. "Environmental Report for 2017," SRNS-RP-2018-00470, Savannah River Site, Aiken, SC

SRS EDAM 2017. Savannah River National Laboratory. "Environmental Dose Assessment Manual," SRNL-TR-2010-00274, Revision 2, October 2017, Savannah River National Laboratory, Aiken, SC

SRS EM Plan 2017. Savannah River Nuclear Solutions, LLC, "Savannah River Site Environmental Monitoring Program Management Plan," SRS Manual 3Q1-101, Revision 9, Savannah River Site, Aiken, SC

Stone and Jannik 2013. Stone, D.K. and G.T. Jannik. "Site Specific Reference Person Parameters and Derived Concentration Standards for the Savannah River Site," SRNL-STI-2013-00115, Savannah River National Laboratory, Aiken, SC

Viner 2013. Viner, B.J., "Summary of Data and Steps for Processing the 2007-2011 SRS Meteorological Database," SRNL-STI-2013-00268, Savannah River Laboratory, Aiken, SC, July, 2013

WSRC 2007. Washington Savannah River Company. "Soil and Groundwater Closure Projects Technology Descriptions," WSRC-RP-99-4015, Revision 7.1, Savannah River Site, Aiken, SC

Yu et al. 2001. C. Yu, A.J. Zielen, J.J. Cheng, D.J. LePoire, E. Gnanapragasam, S. Kamboj, Amish, A. Wallo III, W.A. Williams, and H. Peterson, "User's Manual for RESRAD," Version 6, Environmental Assessment Division, Argonne National Laboratory, Argonne, IL, July 2001

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Appendix H: **Units of Measure**

Symbol	Name	Symbol	Name
Temperature		***Concentration***	
°C	degrees Celsius	ppb	parts per billion
°F	degrees Fahrenheit	ppm	parts per million
Time		***Rate***	
d	day	cfs	cubic feet per second
h	hour	gpm	gallons per minute
y	year	***Conductivity***	
Length		µmho	micromho
cm	centimeter	***Radioactivity***	
ft	foot	Ci	curie
in	inch	cpm	counts per minute
km	kilometer	mCi	millicurie
m	meter	µCi	microcurie
mm	millimeter	pCi	picocurie
µm	micrometer	Bq	becquerel
Mass		***Radiation Dose***	
g	gram	mrad	millirad
kg	kilogram	mrem	millirem
mg	milligram	Sv	sievert
µg	microgram	mSv	millisievert
Area		µSv	microsievert
mi²	square mile	R	roentgen
ft²	square foot	mR	milliroentgen
Volume		µR	microroentgen
gal	gallon	Gy	gray
L	liter		
mL	milliliter		

Fractions and Multiples of Units

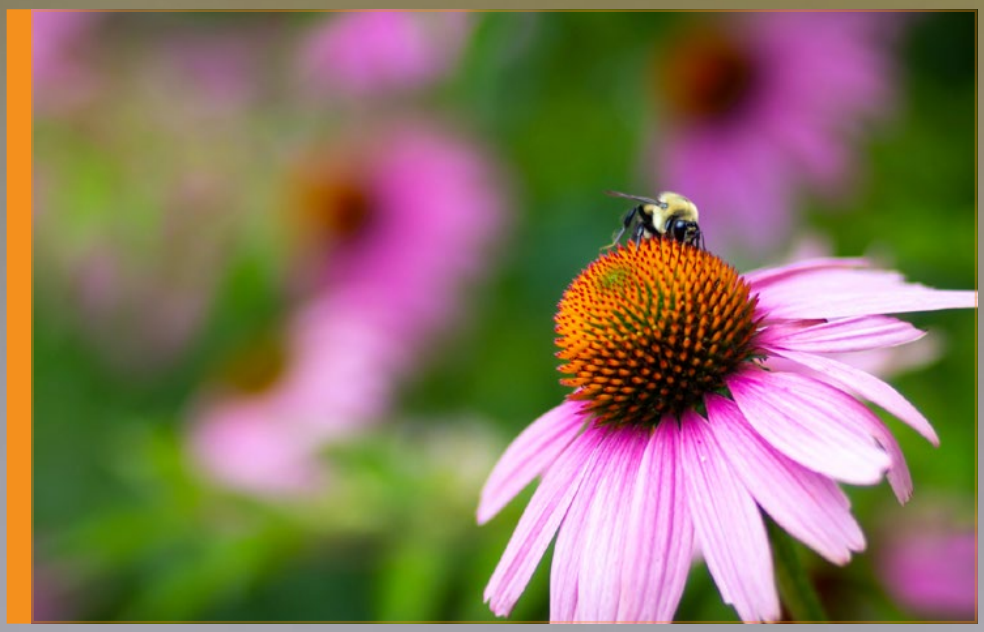
Multiple	Decimal Equivalent	Prefix	Symbol	Report Format
10^{6}	1,000,000	mega-	M	E+06
10^{3}	1,000	kilo-	k	E+03
10^{2}	100	hecto-	h	E+02
10	10	deka-	da	E+01
10^{-1}	0.1	deci-	d	E-01
10^{-2}	0.01	centi-	c	E-02
10^{-3}	0.001	milli-	m	E-03
10^{-6}	0.000001	micro-	µ	E-06
10^{-9}	0.000000001	nano-	n	E-09
10^{-12}	0.000000000001	pico-	p	E-12
10^{-15}	0.000000000000001	femto-	f	E-15
10^{-18}	0.000000000000000001	atto-	a	E-18

Conversion Table (Units of Radiation Measure)

Current System	*Systeme International*	Conversion
curie (Ci)	becquerel (Bq)	1 Ci = $3.7x10^{10}$ Bq
rad (radiation absorbed dose)	gray (Gy)	1 rad = 0.01 Gy
rem (roentgen equivalent man)	sievert (Sv)	1 rem = 0.01 Sv

Conversion Table

Multiply	By	To Obtain	Multiply	By	To Obtain
in	2.54	cm	cm	0.394	in
ft	0.305	m	m	3.28	ft
mi	1.61	km	km	0.621	mi
lb	0.4536	kg	kg	2.205	lb
liq qt-US	0.945	L	L	1.057	liq qt-US
ft^2	0.093	m^2	m^2	10.764	ft^2
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.31	ft^3
d/m	0.450	pCi	pCi	2.22	d/m
pCi	10^{-6}	µCi	µCi	10^{6}	pCi
pCi/L (water)	10^{-9}	µCi/mL (water)	µCi/mL (water)	10^{9}	pCi/L (water)
pCi/m^3 (air)	10^{-12}	µCi/mL (air)	µCi/mL (air)	10^{12}	pCi/m^3 (air)



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