

Surveys and Special Sampling



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In addition to sampling during routine Savannah River Site (SRS) Operations, special sampling is performed for pre-operational baseline monitoring prior to start-up of any new activity or facility, and for nonroutine radiological and nonradiological surveys conducted on and off site. Both short- and long-term radiological and nonradiological surveys are used to monitor the effects of SRS effluents on the site's environment and in its immediate vicinity.

Annual surveys of Creek Plantation Swamp are performed in order to determine the amount and/or distribution of radioactivity that was deposited there during the 1960s. Nonroutine occurrences unrelated to SRS Operations are characterized in order to determine the impact to the SRS Environmental Monitoring Program and the health-impact to the public. On March 11, 2011 following an earthquake and tsunami, a nuclear disaster resulting in releases of radioactive materials occurred at the Fukushima Daiichi Nuclear Power Plant in Japan. Radiation from Japan's Fukushima nuclear incident and the detection of elevated levels of radioisotopes led to the EPA establishing special monitoring protocols for sampling and testing of food, air, and water across the US. Accordingly, SRS expanded its routine environmental surveillance program to assure the public that no harmful levels had reached the immediate community surrounding SRS.

Savannah River Swamp Surveys Description of Surveillance Program

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

Comprehensive and cursory surveys of the swamp have been conducted periodically since 1974. These surveys measure radioactivity levels to determine changes in the amount and/or distribution of radioactivity in the swamp. A series of 10 sampling trails, ranging from 240 to 3,200 feet in length, was established through the swamp (figure 9-1). Fifty-four monitoring locations were designated on the trails to allow for continued monitoring at a consistent set of locations.

The 2011 survey was designated as a cursory survey, requiring limited media sampling and analysis. Cursory surveys provide assurance that conditions observed during the more detailed comprehensive surveys have not changed significantly. A comprehensive survey (requiring extensive media sampling and analyses) is performed every five years and was last conducted in 2007.

As a continuous improvement initiative, the trail markers were remapped during 2011 using rugged field Global Positioning System (GPS) units and signs were replaced on the trails markers. The data from ground soil sample results were mapped with the aerial survey measurement results. The planned 2012 comprehensive survey will include ground exposure measurements, as well as aerial survey measurements.

Surveillance Results Summary

Figure 9-2 depicts the 2011 aerial measurement footprints mapped over the 1998 aerial survey regions that are outlined with dark blue and green lines. The color schemes indicate highest to lowest concentrations—purple, red, orange, yellow, green, light blue, and dark blue. The soil sample results with GPS coordinates were also included on the map for comparison. Any



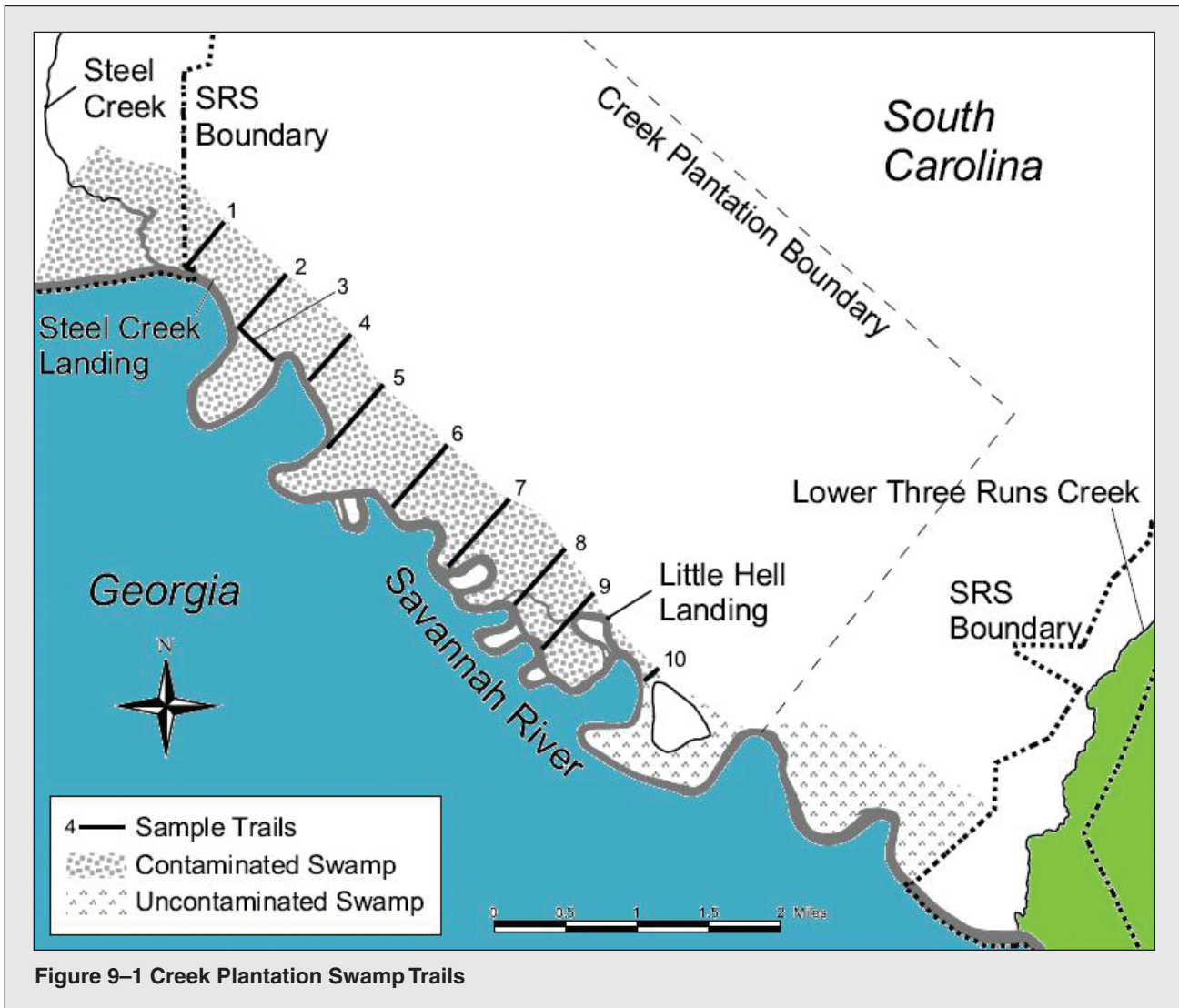
Field Sampling Team Obtains GPS Coordinates of Creek Plantation Transects during 2011 (both photos above)

differences between the sample results and gamma-overflight results are likely due to differences in averages over a region compared to point source results. The comprehensive survey of 2012 will provide a more accurate comparison with exposure measurements taken on the ground at every trail marker.

As anticipated, based on source term information and historical survey results, cesium-137 was the primary manmade radionuclide detected in the 2011 survey. Cesium-137 was detected in 41 of the 44 soil samples while no cobalt-60 was detected in any of these samples. Cesium-137 concentrations in soil varied from a minimum of below the minimum detectable concentration (MDC) to a maximum of 29.4 (+/-1.21) pCi/g. These levels are comparable with those from previous surveys (data table 9-1). The highest concentrations occurred on trails 1, 4, 5, and 9 (figure 9-3) and concentrations decreased with depth. These levels are consistent with the aerial survey measurements of higher activity regions around 1, 4, and 9 (figure 9-2). Strontium-89, 90 was detected in 6 of the 44 soil samples. The activity ranged from below the MDC to 0.248 (+/- 0.0517) pCi/g.

Cesium-137 was detected in six of the 11 vegetation samples while no cobalt-60 was detected in any of these samples. Detectable concentrations varied from a minimum below the MDC to a maximum of 4.58 (+/-0.166) pCi/g. These levels are comparable to results of previous surveys (data table 9-2). Higher concentrations generally were observed on trails 1, 5, and 9 (figure 9-3) which is consistent with what was seen in the soil results and aerial survey measurements (figure 9-2). Strontium-89, 90 was detected in 10 of the 11 vegetation samples. The activity ranged from below the MDC to 0.282 (+/-0.0325) pCi/g.

Thermoluminescent dosimeters (TLD) were placed at 32 monitoring sites in the swamp during 2011 to determine ambient gamma exposure rates, and all were retrieved. The exposure time varied from 42 to 50 days. The gamma exposure rates ranged from 0.25 to 0.66 millirem (mrem)/day, which is consistent with the ranges observed historically (data table 9-3). The highest exposure rates were measured on trails 1, 4, 8, and 9 (figure 9-4). These results confirm the aerial survey map results revealing higher levels of activity on trails 1, 4, and 9 (figure 9-2) and follows trends observed in previous surveys.

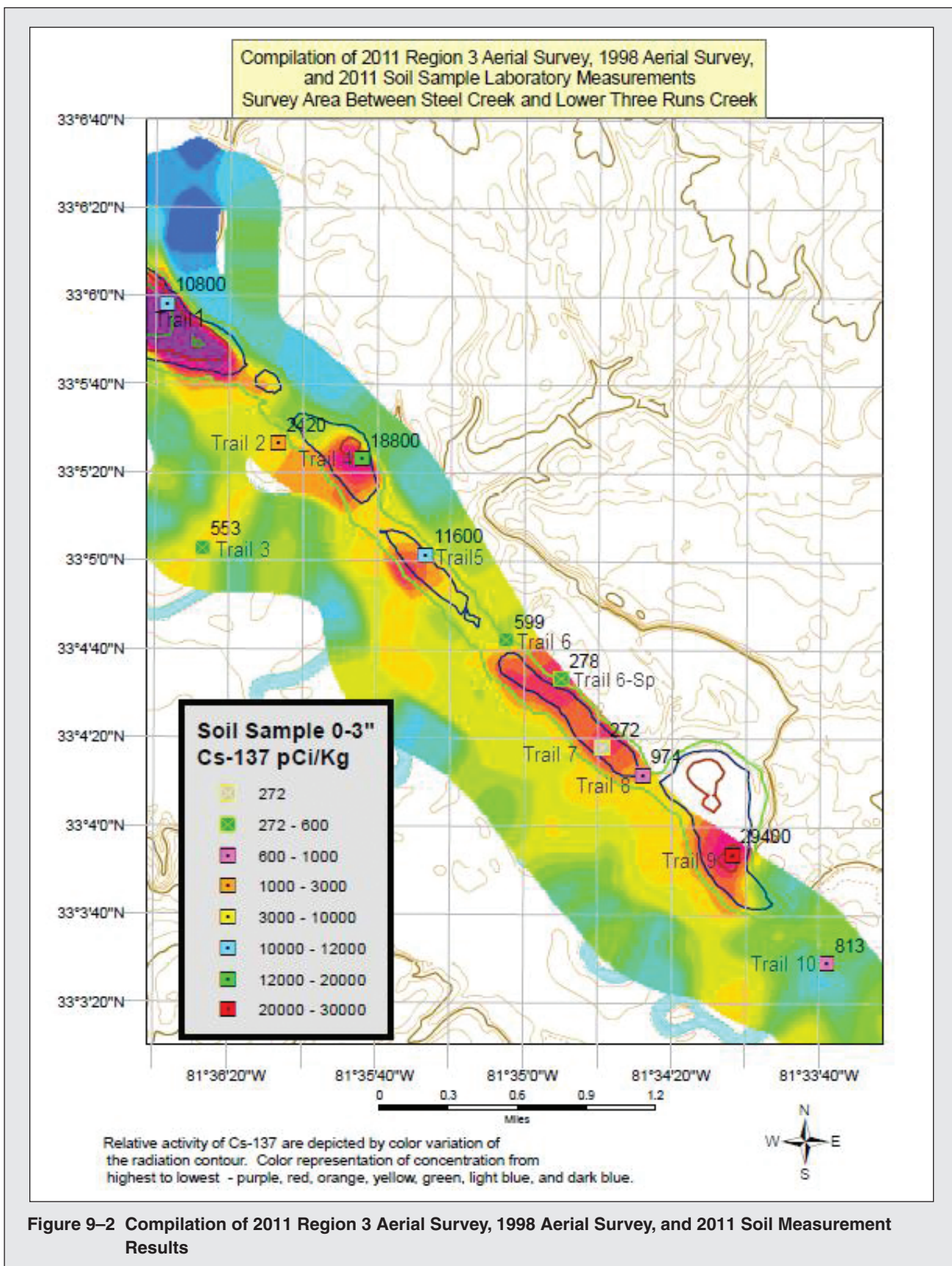


Post Japan Tsunami/Earthquake Event

On March 11, 2011 near the coast of Honshu Island, Japan a 9.0 U.S. Geological Survey (USGS) magnitude earthquake at a depth of 19.9 miles occurred triggering a destructive tsunami with waves more than 45 feet (14 meters) in height. This was the largest quake in Japan since the tracking of earthquakes began 130 years ago. The earthquake led to the automatic shutdown of 11 reactors at four sites (Onagawa, Fukushima Dai-ichi, Fukushima Dai-ni and Tokai) along the northeast coast. Diesel generators provided power until about 40 minutes later, when a tsunami appeared to have caused the loss of all power to the six Fukushima Dai-ichi reactors (www.nrc.gov).

Following the event, the radiological monitoring programs throughout the United States including SRS reported detectable levels of the radionuclides associated with the releases from Japan. To determine the dose impact and distribution of contamination in the environment, quarterly milk sampling, annual vegetation at certain air surveillance locations and edible foodstuff collection were conducted. Vegetation was collected at the Burial Ground North location, four perimeter locations, three 25-mile locations, and the Savannah location. In addition, vegetation was collected near a Georgia dairy location.

Samples were analyzed for iodine (I-131), as well as other gamma-emitting radionuclides.



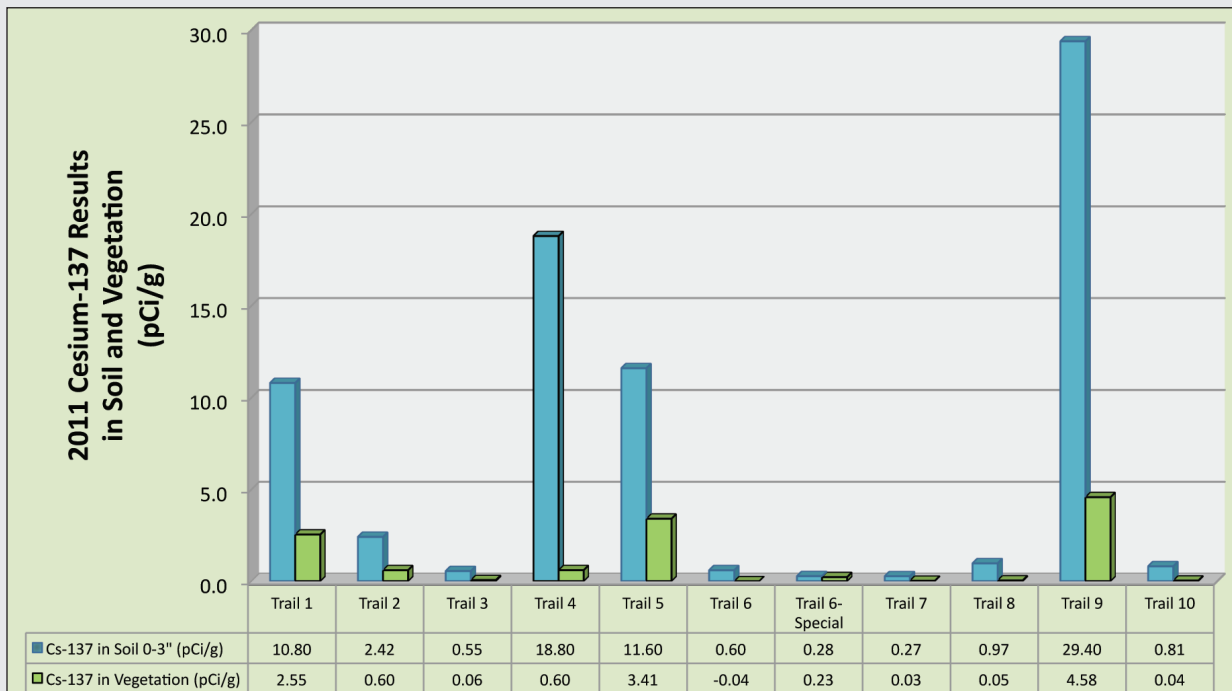


Figure 9-3 2011 Creek Plantation Cesium-137 Results in Soil and Vegetation (pCi/g)

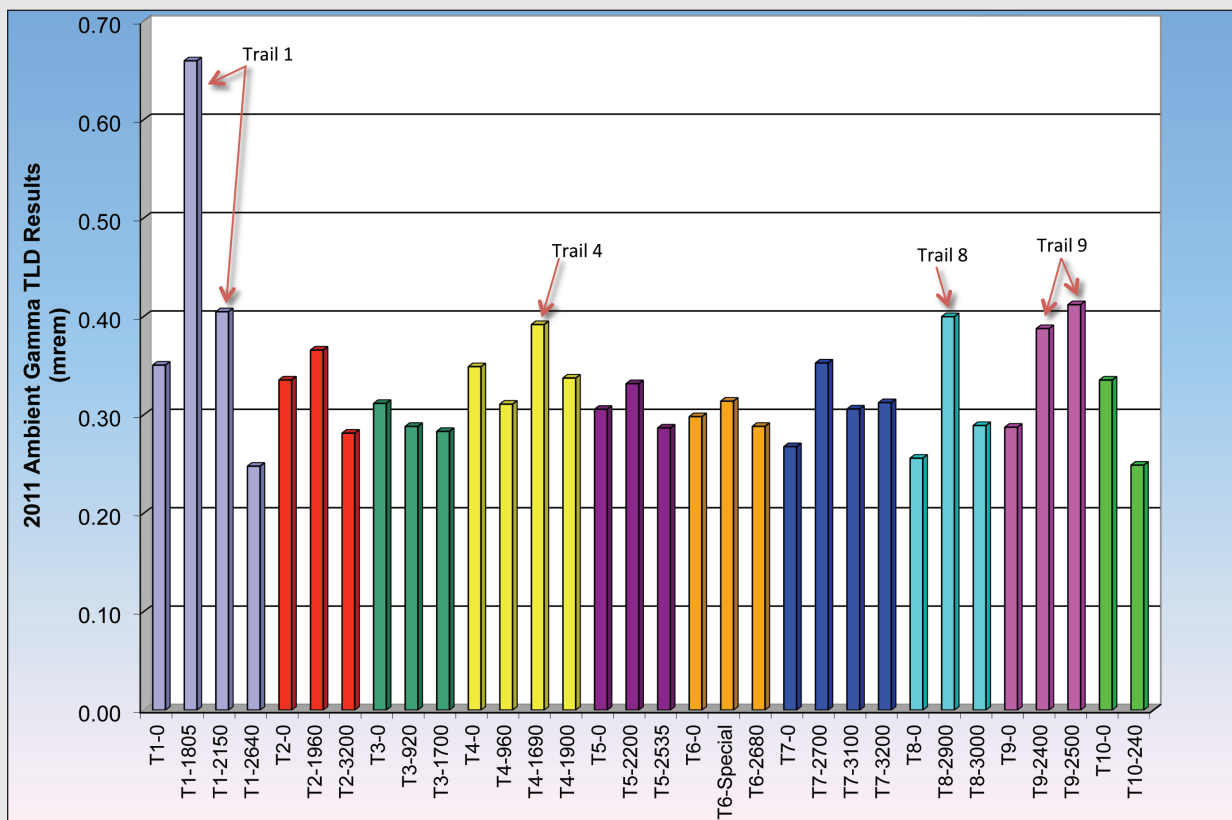


Figure 9-4 2011 Creek Plantation Ambient Gamma TLD Results in mrem/day

Surveillance Results Summary and Dose Impact

Charcoal Canister Results

During the sampling period of March 9 through April 27, 2011 a total of 29 out of 74 charcoal canister samples showed iodine-131 levels greater than the MDC. All 21 charcoal samples collected during the weeks of March 30 and April 6, 2011 were greater than the MDC for iodine-131. The iodine-131 levels fell below the MDC the week of April 6, 2011 and remained below the MDC thereafter. Results for iodine-129 and iodine-131 are summarized in table 9-1 below and are validated by other results published in the United States. Only one charcoal sample from the Talatha Gate Location had cesium-137 at $5.68\text{E-}03$ ($\pm 1.37\text{E-}03$) pCi/m³, slightly above the MDC of $5.41\text{E-}03$ pCi/m³. All of these results are included in Surveillance data table 5-2.

Particulate Filter Results

During the sampling period March 9 through April 27, 2011, two out of 55 particulate filters showed iodine-131 levels greater than the MDC. One was at the Highway 301 sampling location at $1.68\text{E-}02$ ($\pm 5.50\text{E-}03$) pCi/m³. The other sample was at the Savannah sampling location with an iodine-131 concentration at $2.29\text{E-}02$ ($\pm 6.90\text{E-}03$) pCi/m³. These results are validated by other results published in the United States. The health impact will be discussed in the dose section. There was no cesium-137 above the MDC in any of the samples. Results are included in data table 5-1.

Wet/Dry Deposition Results

Iodine-131 was detectable in 11 of the 26 deposition samples that were collection during March 9 and April 27, 2011 with a maximum of $1.52\text{E+}03$ ($\pm 1.32\text{E+}02$) pCi/m². Iodine-131 results for all the samples are summarized table 9-2 below. There were no other gamma-emitting radionuclides greater than the MDC.

Vegetation Results

Grassy vegetation was collected on April 6 and 7, 2011. For gamma spectroscopy analyses, each sample was split and half processed wet and the other half processed dry. The sample was not homogenized prior to counting due to the short half-life of iodine-131. Results are summarized in table 9-3 below. Results for wet vegetation had a maximum iodine-131 concentration of $1.19\text{E-}01$ ($\pm 9.11\text{E-}03$) pCi/g, whereas, results of dry vegetation show a maximum of $5.26\text{E-}01$ ($\pm 4.69\text{E-}02$) pCi/g. These results are validated by other results published in the United States.

Milk Results

Milk was collected at all six dairies on April 4, 2011. Gamma spectroscopy results revealed detectable levels of iodine-131 in five out of six dairies at an average of $6.99\text{E-}03$ ($\pm 2.92\text{E-}04$) pCi/mL and a maximum of $1.23\text{E-}02$ ($\pm 9.04\text{E-}04$) pCi/mL. Results are summarized in table 9-4. No other gamma emitting radionuclides were greater than the MDC.

Table 9-1 2011 Post Fukushima Event Charcoal Canister Radioiodine Results

	Average	Standard	Maximum	Standard
Location	I-131 (pCi/m ³)	Deviation	I-131 (pCi/m ³)	Deviation
Onsite	2.90E-02	4.53E-03	1.17E-01	1.21E-02
Perimeter	3.11E-02	1.91E-03	1.27E-01	1.41E-02
Offsite	3.24E-02	3.32E-03	1.09E-01	1.21E-02
	Average	Standard	Maximum	Standard
Location	I-129 (pCi/m ³)	Deviation	I-129 (pCi/m ³)	Deviation
Onsite	3.19E-03	8.55E-04	6.41E-03	1.25E-03
Perimeter	1.67E-03	2.59E-05	7.38E-03	1.55E-03
Offsite	1.64E-03	1.92E-04	4.53E-03	1.40E-03

Strawberry Results

The only local edible foodstuffs available at the time of the event were strawberries. Like the vegetation, they were split and half counted by gamma spectroscopy wet and the other half dried and counted after drying. Results for the wet strawberries showed no detectable gamma emitting radionuclides greater than the MDC for cesium-137 (MDC = 5.15E-03 pCi/g) and iodine-131 (MDC = 5.46E-03 pCi/g). Results for the dry strawberries showed no detectable gamma emitting radionuclides greater than

the MDC for iodine-131 (MDC = 1.03E-01 pCi/g) and detectable levels of cesium-137 at 4.52E-02 (+/-1.06E-02) pCi/g.

Dose Impacts to the Public

The dose impact from the radioiodine levels for the airborne pathway would equate to <0.1 mrem, far below the average natural background radiation dose of 310 mrem.

Table 9-2 2011 Post Fukushima Event Iodine-131 Results of Wet/Dry Deposition

Location	Date	Iodine-131 Conc (pCi/m ²)	Standard Deviation	MDC (pCi/m ²)	Sig
BURIAL GROUND NORTH	3/30/2011	2.21E+02	4.00E+01	7.82E+01	Y
BURIAL GROUND NORTH	4/6/2011	-8.78E-01	1.92E+01	6.69E+01	N
BURIAL GROUND NORTH	4/13/2011	2.64E+02	2.74E+01	3.98E+01	Y
BURIAL GROUND NORTH	4/20/2011	1.33E+01	1.49E+01	5.40E+01	N
BURIAL GROUND NORTH	4/27/2011	-5.81E+00	1.38E+01	4.80E+01	N
D-AREA	4/6/2011	1.52E+03	1.32E+02	1.75E+02	Y
DARKHORSE	4/13/2011	8.30E+00	1.35E+01	4.86E+01	N
DARKHORSE	4/20/2011	-1.73E+01	1.82E+01	5.19E+01	N
DARKHORSE	4/27/2011	1.29E+01	1.56E+01	5.64E+01	N
DARKHORSE	3/30/2011	2.88E+02	4.86E+01	7.97E+01	Y
DARKHORSE	4/6/2011	8.49E+02	6.00E+01	7.71E+01	Y
GREEN POND	3/30/2011	2.71E+02	3.65E+01	8.17E+01	Y
GREEN POND	4/6/2011	2.46E+02	4.44E+01	6.56E+01	Y
GREEN POND	4/13/2011	1.36E+01	1.47E+01	5.29E+01	N
GREEN POND	4/20/2011	-2.95E+01	1.54E+01	4.89E+01	N
GREEN POND	4/27/2011	-8.05E+00	1.45E+01	4.99E+01	N
HIGHWAY 301 @ STATE LINE	3/30/2011	6.91E+02	5.19E+01	6.80E+01	Y
HIGHWAY 301 @ STATE LINE	4/7/2011	1.72E+01	1.79E+01	6.52E+01	N
HIGHWAY 301 @ STATE LINE	4/13/2011	7.38E+00	1.32E+01	4.72E+01	N
HIGHWAY 301 @ STATE LINE	4/27/2011	-2.08E+01	1.90E+01	6.38E+01	N
PATTERSON MILL ROAD	3/30/2011	1.43E+03	7.91E+01	8.56E+01	Y
PATTERSON MILL ROAD	4/6/2011	1.63E+02	4.32E+01	6.47E+01	Y
PATTERSON MILL ROAD	4/13/2011	-7.91E+00	1.36E+01	4.66E+01	N
PATTERSON MILL ROAD	4/20/2011	-8.06E+00	1.38E+01	4.71E+01	N
PATTERSON MILL ROAD	4/27/2011	-2.10E+00	1.41E+01	4.94E+01	N
SAVANNAH, GA	4/7/2011	7.26E+02	7.95E+01	1.59E+02	Y
Overall Average		2.56E+02	9.00E+00		
Maximum		1.52E+03	1.32E+02		

Sig = Significance

Table 9–3 2011 Post Fukushima Event Iodine-131 Results of Grassy Vegetation

COLLECTION LOCATION	I-131 Wet (pCi/g)	Standard Deviation	MDC (pCi/g)	Sig	I-131 Dry (pCi/g)	Standard Deviation	MDC (pCi/g)	Sig
Aiken Airport	8.91E-02	1.13E-02	3.61E-02	Y	2.22E-01	3.37E-02	1.53E-01	Y
Augusta Lock And Dam 614	7.69E-02	8.79E-03	3.27E-02	Y	2.23E-01	3.25E-02	1.58E-01	Y
Burial Ground North	5.33E-02	9.34E-03	3.11E-02	Y	2.63E-01	4.16E-02	1.68E-01	Y
Darkhorse @ Williston	1.19E-01	9.11E-03	3.22E-02	Y	5.26E-01	4.69E-02	1.51E-01	Y
Dairy D	2.33E-02	5.51E-03	4.07E-02	N	2.02E-01	3.00E-02	1.92E-01	Y
Green Pond	9.84E-02	1.03E-02	2.99E-02	Y	2.79E-01	2.67E-02	1.09E-01	Y
Hwy 301	5.52E-02	9.18E-03	4.64E-02	Y	4.01E-01	2.96E-02	1.16E-01	Y
Patterson Mill Road	9.44E-02	9.93E-03	3.01E-02	Y	2.38E-01	4.05E-02	1.76E-01	Y
Savannah, Ga	8.31E-02	1.01E-02	3.68E-02	Y	1.60E-01	3.09E-02	1.66E-01	N

Table 9–4 2011 Post Fukushima Event Iodine-131 Results of Milk

COLLECTION LOCATION	I-131 (pCi/mL)	Standard Deviation	MDC (pCi/mL)	Significance
Dairy Location #1 in SC	5.95E-03	7.00E-04	2.80E-03	Y
Dairy Location #2 in SC	3.11E-03	4.29E-04	2.57E-03	Y
Dairy Location #3 in GA	1.23E-02	9.04E-04	3.50E-03	Y
Dairy Location #4 in SC	8.14E-03	8.41E-04	2.99E-03	Y
Dairy Location #5 in SC	2.02E-03	5.77E-04	3.88E-03	N
Dairy Location #6 in GA	1.04E-02	7.29E-04	2.98E-03	Y
Overall Average	6.99E-03	2.92E-04		
Maximum	1.23E-02	9.04E-04		

Sig = Significance